

The role of NGOs in Mexican small-scale fisheries: From environmental conservation to multi-scale governance

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Abstract:

Multi-scale governance has been widely recommended for effective marine resource management. This approach suggests critical collective decision-making and actions, coupling governance and ecological scales, co-production of knowledge, among other elements. Here, we examine what elements of multi-scale governance are present in Mexican fisheries management and the contribution of NGOs in promoting and implementing this scaling approach to small-scale fisheries management (SSF). We selected three ongoing SSF management processes for our analysis: 1) the establishment of fishing refugia in the Punta San Cosme to Punta Coyote Corridor; 2) implementation of catch shares in the Gulf curvina fishery; and 3) the development of the Fisheries Management Plan (FMP) for the swimming crab fishery. Through case study analysis we show that NGOs in the Gulf of California have moved beyond an environmental agenda and can significantly contribute to fisheries management processes by promoting and improving institutional scales representation, collective and cooperative management, co-production of knowledge, information sharing, social learning as well as by fortifying the linkages between governance and ecological scales. We observed in all case studies that successful stakeholder collaboration for multi-scale governance will be more feasible to achieve when shared visions and clear procedures are present in management processes. Finally, this work provides a framework to evaluate attributes of multi-scale governance, which can be applied to management processes elsewhere.

Keywords: NGOs, multi-scale governance, small-scale fisheries, Gulf of California, Mexico

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1. INTRODUCTION

Small-scale fisheries (SSF) are the backbone of the majority of the coastal communities around the world, and especially in developing countries they represent the main source of income, food and development (FAO 2012a). But they are also significantly important in terms of employment and production, as it is estimated that 50 of the 51 millions world's fishers work in this sector, catching 50% of the total fish production (FAO 2012b). SSF represent ways of living, traditions and cultures (FAO 2012a). Because of the proliferation of coastal communities, and as it is difficult and costly to exclude others from harvesting the resource, there has been an ever increasing growth in the number of fishers, causing SSF's to exhibit the same problems shared by other common pool resources (McBay 1987, Feeny et al 1990, Ostrom et al 1999). Further, sustainable management of SSF's to ensure the permanence of fishing culture, fisheries production and local livelihoods is particularly complex due to several characteristics, including complexities due to multiple users, multiple species and multiple gear types (Salas et al 2007, Seijo et al 2009). Also, SSF's tend to be data-poor, lack monitoring, and due to their isolation and complexity have reduced compliance (FAO 2012b). These challenges have led to sequential overexploitation of the resources that SSF's depend on around the world.

Fisheries governance has been defined as a key element of sustainable fisheries management (FAO 2012b). New systems of governance have emerged, and have been proposed to improve the management of SSF. These emerging governance structures include self-organized communities (Ostrom 2009), co-management (Sen and Nielsen 1996), and polycentric management. In addition, multi-scale governance has been defined as an essential element for effective fisheries management because it fortifies collaboration between users and managers, strengthens linkages across vertical and horizontal levels, and provides the framework for institutions to match social and ecological scales (Berkes 2010). Particularly with SSF, NGOs have contributed to build local capacity for communities to self-organize, create institutions, and participate in co-management (see FAO 2013, Berkes 2010, Seijo et al 2009). Although these efforts have expanded, they have been poorly documented.

By comparing across management processes in the Gulf of California Mexico, we analyzed multi-scale governance in small-scale fisheries. Further, because of the extensive presence and work of non-governmental organizations (NGO's) in the Gulf of California eco-region, we also analyzed the role that NGO's have played in fortifying multi-scale governance. For our analysis, we selected three ongoing fisheries management processes in which NGOs have actively participated, including: 1) the establishment of fishing refugia in the Punta San Cosme to Punta Coyote Corridor; 2) implementation of catch shares in the Gulf curvina fishery; and 3) the development of the Fisheries Management Plan (FMP) for the swimming crab fishery.

2. BACKGROUND INFORMATION AND CASE STUDY DESCRIPTION

2.1 Overview of Mexican SSF

Mexico is a mega diverse country with 11,122 km of coastline with a surface of 231,813 km² of territorial waters (CONEVAL 2010), with 41% (47,344,698 people) of its population living along 150 coastal municipalities (CIMARES 2010). SSF provide direct employment to 350,000 fishers, which capture 40% of the total national catch (Botello et al. 2010), which for the past 20 years has fluctuated around 1.2 million metric tons per year, representing 1% of the world's fisheries production (FAO, 2010). Around 65% of this catch is for domestic consumption (Botello et al. 2010), and a great percentage is non-reported or illegal (Cisneros-Montemayor et al 2013). Since the 1920's access to Mexican fisheries has been controlled through the permit and concessions system (Basurto et al. 2012). In the 1990's, seasonal closures and official bylaws (Normas Oficiales Mexicanas, NOMs), which include specific regulations for each fishery, began to be broadly implemented. Albeit these rules, in practice Mexican SSF, as in other countries, are considered *de facto* open access fisheries (OCDE 2009).

Fisheries in Mexico are federally managed, (OCDE 2009), however centralized management institutions do have elements conducive to implement multi-scale governance. The National Commission for Fisheries and Aquaculture (CONAPESCA) is the centralized institution in charge of administration, regulation and enforcement of fisheries. Although its offices are centralized in one of the most important fishing ports (Mazatlan, Sinaloa) there are regional and local offices of this institution (OCDE 2009). The National Fisheries Research Institute (INAPESCA), which is the scientific and technical arm of CONAPESCA, also has centralized headquarters with several regional offices. There are also decentralization initiatives that give more attributions to states, as well as legal mechanisms that promote structures for stakeholder participation in decision-making processes (Espinoza-Tenorio et al. 2011), both of which have been explicitly established in legal instruments (see DOF 2011, 2007, 2006). The new structures include the: 1) National Council for Responsible Fishing—conformed by different Ministries and representatives of industrial and small-scale fisheries—to revise and approve new regulations; 2) National and State Committees of fisheries stakeholders focused on bolstering the value chain; and 3) State Councils to address fisheries and aquaculture issues such as revising objectives of management plans, giving recommendations on permit and concessions issuing and distribution and promoting fishers' participation (see DOF 2007). Most NOMs and seasonal closures developed by CONAPESCA with the participation of multiple stakeholders have a match with ecological scales.

Mexican fishers have diverse, elaborate and scaled organizations. At the local level, fishing cooperatives are very common in Mexico, as well successful examples of self-organized small-scale fishers to better manage their resources (e.g. Sanchez-Bajo and Roelants 2011, Basurto et al. 2012). Cooperatives are joined at the regional level into federations (group of cooperatives), or unions (group of cooperatives and other stakeholders involved in the fishery). Finally, there is a national Confederation that represents small-scale fishing cooperatives. In total, the Confederation is currently conformed by 32 federations representing 2,685 cooperatives and ~180,000 fishers, and has gained political power and a place in the National Committee of

Fisheries and Aquaculture and the National Council. In some places, fishers have also formed the cooperative business structures to access benefits and subsidies. Finally, organized small-scale fishermen in Mexico have been successful in implementing novel management instruments such as fishing refugia (no-take zones); catch shares for lobster, abalone and different bivalve species; and the Marine Stewardship Council (MSC) certification for lobster fishery in Baja California Peninsula and Mesoamerican Reef.

2.2 Role of NGOs in Mexico

NGOs have played a key role in this transition to new forms of fisheries governance in Mexico, especially in the Gulf of California region. Given the very important diversity of species in the Gulf of California, NGO's have had a strong presence for several decades. Up until the 1990's NGOs was mostly focused on environmental issues such as endangered species, habitat protection, and natural protected areas (OCDE 2009). However, in the last couple of decades, NGOs have shifted their objectives and now are playing a key role in working with fishermen to improve the sustainable management of fisheries and the habitats. This has included key work on promoting increased scientific information (e.g. Basurto et al. 2012, Moreno-Baez et al. 2012, Cinti et al. 2010), building local capacities, supporting the development of management plans, promoting information sharing across different levels, and fortifying fishermen organization and participative processes (Basurto et al. 2000, Herman 2004). The work of NGOs has included work across all governance scales (local, regional, national and international) (Herman 2004) and has been slowly recognized since their support to the certification of the lobster fishery in Baja California (Cisneros-Mata *pers. comm.*).

2.3 Case Study: Establishment of fishing refugia in the Punta San Cosme -Punta Coyote Corridor

The Punta San Cosme to Punta Coyote Corridor (the Corridor) spans more than 150 kilometers of the remote eastern coastline of the state of Baja California Sur, and includes several diverse and highly productive marine and coastal habitats. It is the fishing grounds for all of the 11 coastal and island communities, home to a total of 170 fishers (90 skiffs) of ~500 residents in the region. Although this is a multi-species fishery in which up to 46 species are landed, the main species of economic importance include snappers, groupers, yellowtail jack, tilefish, sharks and chocolate clams. Because of the relative isolation of all the communities, fishing is the main source of income (DOF 2012). Although the residents of the Corridor principally fish this region, during different seasons fishers from the north (Loreto municipality) and south (La Paz municipality) also fish this region.

As with any fishery in Mexico, fisheries in the Corridor are managed by CONAPESCA, which require all fishers to have a permit to fish legally. Besides permits, there are no other regionally specific fishery regulations. All of the communities are in one state, which has a state level fisheries ministry, as well as delegations of federal entities. Further, the Corridor lies between

two previously established marine protected areas: Loreto Bay National Park (est. 1996) to the north and the Espiritu Santo Archipelago National Park (est. 2010) to the south (see in Figure 1). Although NGO presence in the Corridor began in 2003, the process analyzed herein began in 2008 when NGOs, researchers, and federal authorities gathered to talk about how to implement fishing refugia for sustainable fisheries management in Mexico, the first time this process was to be undertaken under the new revision of the Fisheries Law. As a result of this meeting, federal fisheries authority (CONAPESCA) made a commitment to use this tool with the primary input of fishers and INAPESCA. In 2009, NGOs began to work with all the 11 communities of the Corridor region to generate the necessary information to understand the fishery management needs of the region. In the beginning of 2010, a visit from an official from CONAPESCA to this remote region was truly a turning point for this process. In this visit, the authority invited the fishers to present a proposal for fishing refugia in the Corridor, and committed to support a process to regulate unlicensed fishers. Following this visit an intensive nine-month process began, facilitated by NGO's, culminating in a proposal from resident fishers to the authorities for a network of fishing refugia. Concurrently, over the period of a year, the process of permitting unlicensed fishers was completed.

In 2012, the community proposal was signed into law, establishing the first fishing refugia network in Mexico (DOF 2012). A total of 11 distinct zones were established as no-take for a period of five years. Previous to the permitting process, less than 50% of the fishers from the area had permits. As a result of the process 97% of resident fishers have permits. Currently, resident fishers are actively working to develop an Operational Plan for the fishing refugia that includes enforcement plan, monitoring and evaluation protocols and the establishment of the Regional Coordination Committee, to allow for the continued participation and dialogue of fishers and authorities.

Due to the remoteness of the communities, NGOs played a key role by creating opportunity and providing structure for communities to have dialogue amongst themselves, as well as guidance on how to reach agreements and build proposals together. Also, the NGO's served as advisors and facilitators through the entire permitting process, being a communication bridge between authorities and the remote communities which have no electricity, cell phone or land line communication. The NGOs were critical in maintaining continuity in the process, transparency and information sharing which was critical for agreements to be met. Finally, NGOs provided key information, including scientific, legal and social data that was critical to the process.

2.4 Case Study: Establishment of catch shares for the gulf curvina fishery

The gulf curvina is large endemic croaker (*Cynoscion othonopterus*) that aggregates to spawn in the northernmost reaches of the Upper Gulf of California and Colorado River Delta Biosphere Reserve in Northwestern Mexico (Erisman et al 2012). It is one of the most important fishery resources shared between four distinct fishing communities that span two states: Sonora and Baja California. El Golfo de Santa Clara is the most important curvina fishing community, landing

80% of the total volume and having the largest fleet (408 curvina skiffs, in 84 cooperatives, grouped into seven federations). The Cucapá are an indigenous group who were historically river fishers, but began to fish gulf curvina in the Delta as a means of survival once other freshwater and estuarine fishing grounds were no longer available due to the decreased flow from the Colorado River (Alvarez Williams 1997, Muehlmann 2009). For the three main Cucapá fishing cooperatives, as well as the four cooperatives of the Bajo Rio community who fish alongside the Cucapá, the gulf curvina is their main source of income. Although San Felipe is the largest fishing community of all four, few fishers depend on the aggregation as a main source of income, as they have access to a large diversity of other species (Erisman et al. 2011, Moreno-Báez et al. 2012).

The gulf curvina fishery exists under a very complex regulatory framework, including national fisheries law and a national conservation law, meaning that several federal agencies are involved in the management of the region including CONAPESCA, INAPESCA, and the National Commission of Protected Areas (CONANP). All of these federal entities also have state-level representation. Further, since the Upper Gulf Reserve is part of two states, fishery management also includes the state governments and fishing delegations of both Baja California and Sonora. In 2007, curvina specific bylaw to the federal fisheries law was published (NOM-063-PESC-2005). This regulation established the foundation for the changes in fishery management to date, including gillnet mesh size restrictions, yearly seasonal closures, no-take zones, and annual catch limits (DOF 2007b).

For this analysis, the focus was on the process of establishing rights-based management in the gulf curvina fishery, which was catalyzed in 2011 when INAPESCA established the first annual catch limit for the 2012 season. This rule had been in the NOM-063-PESC-2005 since 2007, but had not been implemented. Because the established catch limit represented less than half of historical landings, and was announced without public consultations or community involvement, it initially caused a very significant backlash. Over the months between the publication of the catch limit and the start of the season, NGOs in the region worked to turn this potentially large conflict into an opportunity to build stronger foundations for management of this fishery, including the implementation of catch shares.

Relevant for this analysis, NGOs led the establishment of a Curvina Regional Management Committee, the region's first formal structure with wide participation where all interested parties can discuss policy issues. The committee includes representatives from all four fishing communities, the federal government, the Baja California and Sonora State governments and NGOs. Although this committee has legal standing under curvina bylaw (NOM-063-PESC-2005), it had not been implemented. Moreover, the continual data and information sharing that and the inclusion of diverse stakeholders into the process was they key role of the NGOs. Of most importance is the inclusion of the Cucapá indigenous group, who had historically not been active in curvina management.

The 2012 curvina fishery's season was the first to operate with a total allowable catch (TAC), and through multi-stakeholder engagement resulted in significant progress in governance, management and compliance. Through community agreements, which were supported by the government, the town of El Golfo de Santa Clara established per skiff, per tide allocation rules in conjunction with price agreements with the main buyer. Although other factors beyond the community agreement are likely involved, from 2011 to 2012 average ex-vessel prices for curvina rose by 67% in El Golfo Santa Clara, while average market prices for curvina at the Nueva Viga market (the most important seafood market in México City) rose by 18%. This progress was the result intense and complex collaboration between the state and federal governments and, most importantly, the fishing communities, especially in Sonora. The 2013 season showed progress and continued commitment with the process, as the government legally established the per-skiff allocations in curvina specific permits.

2.5 Case Study: Development of the swimming crab fisheries management plan

Swimming crabs are one of the most important SSF in Mexico. The states of Sonora and Sinaloa in the Gulf of California produce up to 60% of the total national swimming crab landings (CONAPESCA 2011), providing direct employment to approximately 22,300 fishermen (Huato-Soberanis et al. 2010). Brown (*Calinectes bellicosus*) and blue (*C. arcuatus*) swimming crabs are the two species concentrated in the catch. *C. bellicosus* represents 57% of the catch in Sinaloa and 95% in Sonora (Huato-Soberanis et al. 2010). Permits and a fishery specific bylaw (NOM-039-PESC-2003 see DOF 2007c) establish regulations for responsible fishing of the specie (e.g., size limits, number and specifications for gear types). INAPESCA through the National Fisheries Chart has provided key recommendations to improve the long-term sustainability of this fishery such as the implementation of no-take zones and a series of studies to improve gear selectivity and to design traps with biodegradable materials (DOF 2006b).

INAPESCA had been working on the fisheries management plan incorporating the information generated by several processes in the region. In order to ensure its implementation, in July 2010, INAPESCA in strong collaboration with and NGO, started a participatory process to develop a Fisheries Management Plan (FMP). The process focused on the states of Sinaloa and Sonora—where catch is concentrated—and involved the confederation of fishing cooperatives, 18 federations of cooperatives, 23 cooperatives, seven buyers and distributors, representatives of local, regional, and federal government offices, eight NGOs and four academic institutions (Cisneros-Mata et al. 2011, <http://plandemanejojaiba.blogspot.mx>).

The goal for all stakeholders was to develop the FMP and have it legally published before the presidential elections of July 2012. Although, the FMP has not been published, INAPESCA and the NGO have started to implement some of the strategies established within the plan, including research, capacity building, and stock assessments in Sinaloa and Sonora. Furthermore, INAPESCA has expanded the scope of the FMP with a participatory approach so as to include all states on the Pacific coast where swimming crab is caught.

Among other results, this process resulted in the creation of a multi-stakeholder group that has been coherent enough to work together to take on other initiatives, including the development of options for seasonal closures. Also, in terms of research, this process created a working community of researchers. Further, even though the FMP has not been officially sanctioned yet, the key objectives and management goals for the fishery are known by a broader community. Also, several sites were selected in the FMP process as pilots where no-take zones and rights-based (catch shares) management would be tested. Especially in the state of Sonora, one of the first sites started doing populations methodology fine-tuning to do finer scale scientific evaluations.

Although there are tangible impacts of the process, there are also intangible results, the most important of which are stakeholder trust in the process. The process was the first in which information generated by multi-stakeholder groups is being taken into account for the fishery management plan. Also, given that this was the first marine FMP in the region developed with a participatory approach, and that it was seen as a success for INAPESCA in terms of methodology for co-management, the process is now being replicated with several other FMP's.

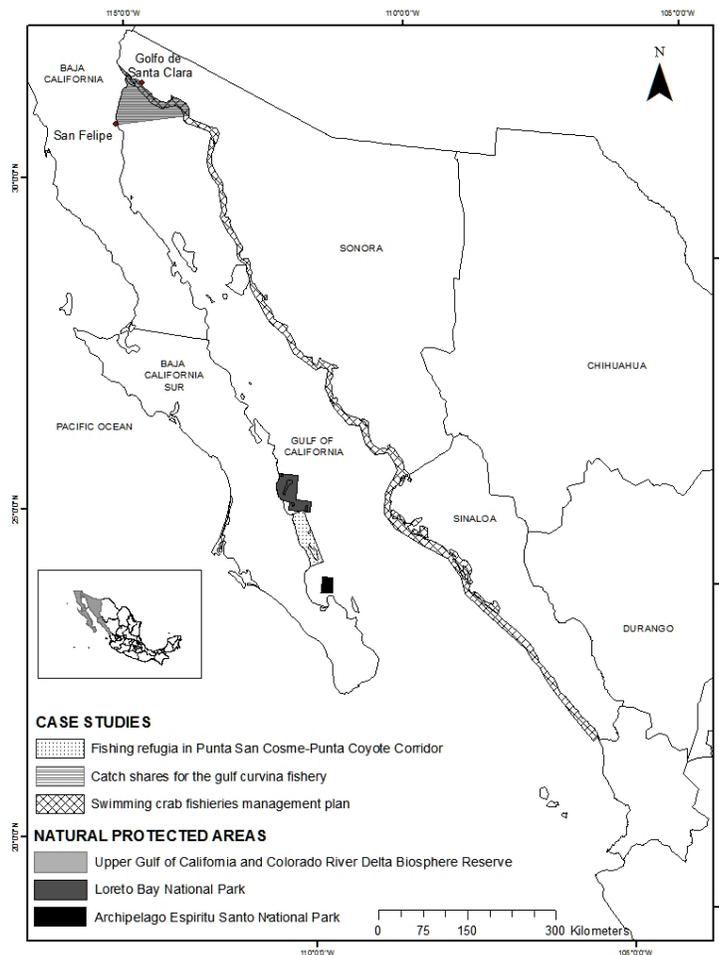


Figura 1. Small-scale fisheries management processes in which NGOs have actively participated. This map only shows the Natural Protected Areas cited in this work.

3. METHODS

To document the influence of NGOs in multi-scale governance in Mexican SSF, three ongoing fisheries management processes were analyzed: 1) the establishment of fishing regufia in the Punta San Cosme to Punta Coyote Corridor; 2) implementation of catch shares in the Gulf curvina fishery; and 3) the development of the FMP for the swimming crab fishery.

As a starting point, and to develop the analytical framework for this work, we began with a literature review of existing research on fisheries governance. Using the references, we defined a list of key attributes for good multi-scale fisheries governance. Further, for each attribute we developed a qualitative grading system to evaluate each fisheries management process using. In addition, the contribution of different NGOs in promoting multi-scale governance in said management processes was described. As part of the final analysis, the authors present the opportunities, challenges and lessons learned from NGOs' participation in multi-scale governance.

Given the nature of the present analysis, it is very important to state explicitly that the authors are also members of the NGOs that have been involved in the three processes described. Hence, it is appropriate to assume a level of subjectivity in the analysis.

4. RESULTS

4.1 Attributes and grading-system for multi-scale governance

The following are the key attributes of multi-scale governance that were selected based on Basurto (2013), Berkes (2010, 2011), and Armitage et al. (2007), and which were used to analyze each case study: 1) institutional scale, 2) collective decision-making, 3) cooperative management, 4) polycentric management, 5) horizontal and vertical information sharing, 6) coproduction of knowledge, 7) social learning, 8) match with ecological scale, and 9) multilevel linkages. In the following section, the attributes are defined and discussed in relation to each case study analysis. Further, the rankings across the case studies are summarized in Table 1.

4.1.1 Institutional scale (multi-layer)

Multi-scale governance requires the representation and participation of local, regional, national, and in some cases, international institutions. For this attribute the scoring was ordinal, ranking each case study as having “all”, “some”, or “none” scales represented by institutions.

The swimming crab FMP process was the only case study where all of the institutions at all relevant scales were represented. This included federal, state, local community, cooperative/federations, buyers and processing plants represented. In both the curvina and corridor case studies there were some institutions that were not represented. Specifically, in the corridor case study local/regional (municipality, state) did not have active participation, while in the curvina case study there was not effective participation of three of the communities, leading to sub-optimal rules for these sub-regions. In all cases, NGOs made sure to invite all stakeholders from different levels to participate in the processes.

4.1.2 Cooperative management

Cooperative management is defined as the process by which management planning, implementation, evaluation and adaptation incorporates the knowledge, skills, resources and perspectives of a diverse and inclusive representation of participants, and which is characterized by deliberation and accountability (Lejano and Ingram 2009 in Berkes 2011). This attribute was also ranked with an ordinal scale (high, medium, low, none), where a “high” ranking indicated that management includes diverse actors’ knowledge and perspectives, the process includes deliberation and participants are held accountable. A “none” score indicates that management implements measures unilaterally and there is little management accountability.

In all three case studies, there had been the inclusion of diverse perspectives and information into management. In the curvina case, scientific information from different sources was included during the process of establishing rights-based management, the government supported stakeholders’ agreements, and the process of evaluation led to adaptive management. In the swimming crab FMP process, management planning incorporated knowledge, skills, and the perspectives of diverse actors, but had very weak process accountability, as it is yet to be officially published and the date of its publication is unknown. In the corridor, especially given the fact that it was the first time that the specific management tool of no-take zones had been developed within the fisheries administration context, there were no clear rules on who should participate, or how to deliberate in the process of establishing the zones. Although there was a lot of deliberation and consensus building within one scale (fishers), this dialogue was lacking a more cross cutting participatory process. In all cases, NGOs role at making sure that stakeholders and their perspectives and information were included in management processes was critical.

4.1.3 Collective decision-making

Collective decision-making was defined as the ability of a diverse group to have full autonomy to craft and enforce their own rules (Ostrom 2009). For this analysis, the score for this attribute used an ordinal scale (high, medium, low, none), where a “high” score indicated that interest groups have full autonomy at the collective-choice level to craft and enforce some of their own rules, while the “none” score indicated that there is no autonomy to craft and enforce rules.

In all of the case studies, it was observed that collective decision-making across multiple levels had occurred. But, the attribute was scored as “medium” across all case studies because there had not been efficient enforcement of the rules. Also, it was noted that the autonomy given to multi-level groups to create their own rules and reach agreements was undermined when they did not feel their rules were recognized as valid by government institutions, or when certain decisions, which had been discussed collectively, were decided and hence unilaterally imposed, by the government. In all cases, the NGOs in each region were key actors, as they played a prominent role in promoting and facilitating multi-level meetings, or multi-level participation groups to provide forums for dialogue and decision-making.

4.1.4 Polycentric management

It is not sufficient for multi-scale governance for institutions at each scale to exist. It is also necessary for nested institutions to devolve decision-making power to their decentralized units (Folke et al. 2005 in Berkes, 2011). This attribute was ranked in a “yes/no” binary manner, noting with a “yes” if institutions have multiple centers or authorities, are nested, quasi-autonomous decision-making units operating at multiple scales, balancing between centralized and decentralized control, or with a “no” if institutions are highly centralized.

In all three case studies, this attribute was scored as not polycentric. In the swimming crab FMP process all of the final control of the process, and final decision-making, is at the hands of one centralized institution—INAPESCA. Similar in the curvina and corridor processes, the final decisions of management were at the hands of the centralized fisheries management agency—CONAPESCA. We found that NGOs have not been active, or effective, in promoting this attribute of multi-scale governance.

4.1.5 Match with ecological scales

Given the broad spatial range of many fisheries, matching governance to the ecological scale is often a significant challenge (Berkes 2010). For this attribute, an ordinal ranking (high, medium, low, none) was used, where a “high” match meant that there are existing institutions or management tools that match the ecological scales, or have institutional arrangements that allow for this match. A “none” score result if existing institutions or management tools or system do not match ecological scales and this creates a problem for resource management.

In these case studies, the swimming crab has the largest ecological range (California to Gulf of California, Fischer et al 1995). The attribute was scored as medium in this case. Although there are no management institutions yet that matches the ecological scale, the process started with the states of Sonora and Sinaloa, where the majority of the catch is concentrated. In addition, during the process, stakeholders suggested new structures to match the ecological scale. In the corridor, this attribute was scored as medium because the multi-species finfish fishery also does not yet have institutions that match the ecological scale, however the management goals defined for the region do match the ecological scale (spawning, aggregation, nursery and critical habitat).

Finally, this attribute was scored as high for the curvina case, mainly because management is inclusive of in the reproductive aggregation for the whole species, which is endemic to the Northern Gulf of California (Erisman et al 2012). From this process there was one emerging institution that can match the ecological scale (at least during the reproductive/fishery period), which is the Regional Subcommittee, which was created through the facilitation of participating NGOs. NGOs have helped design and facilitate the conformation of new institutions that match ecological scales. In the case of the Corridor, the NGO helped defining the idea of the “ecological corridor”.

4.1.6 Horizontal and vertical information sharing

Given the complexity of multi-scale management, and coordination between different scales, it is essential the information is adequately shared both vertically, linking higher and lower levels of government, as well as horizontally (Berkes 2010) between regions, communities, or institutions that are at the same level. This attribute considered an ordinal scale (high, medium, low, none); on the one hand, “high” information sharing means that institutions actively shared information, and explained decisions, actions and inactions to stakeholders. Further, that there were processes to define what information is needed, how and who should generate it and how it should be shared. On the other hand, a “none” score implies that institutions did not, nor were under no obligation, to provide information and explain decisions and actions or inactions to resource users.

In the curvina case, this attribute was scored as high because the government openly discussed information used in decision-making in multi-stakeholder forums, government decisions were shared with interested parties, there was extensive community outreach to share scientific and market information, and catch information was shared openly. The swimming crab FMP and the corridor were scored as medium. During the FMP process, especially during the participatory meetings, there was very open sharing between institutions. Still, the final FMP document has not been released and shared with all the participants; there has been no explanation of what has held the process up. In the corridor case, the NGO was critical as a liaison between different institutions, although often times it was not defined neither what information was needed nor what the process should be to share information. For this attribute, we found that NGOs played a significant role by creating and maintaining processes and mechanisms to share information, including forums, councils, meeting processes, blogs, and in general acting as key liaisons between and across levels.

4.1.7 Co-production of knowledge

The existence of multiple institutions at multiple scales results in a plurality of knowledge sources and types, which if considered in conjunction can improve systems-oriented understanding (Armitage et al. 2007). For this attribute, the score was defined in a binary fashion (yes/no), whether there were various sources of knowledge taken into account.

Across all case studies, it was observed there was co-production of knowledge. The role of the NGOs was found to be very broadly evident in this attribute. In the Gulf of California region there has been significant efforts in building capacity within fishing communities to co-generate biological, social and economic data. In all cases the NGO has played a critical role in financing information generation, promoting information sharing within and between institutions, and ensuring the participation of knowledge-holders in co-management processes. This has led to all three case studies having initiatives where local communities have been involved in generating management proposals using their empirical knowledge.

4.1.8 Social learning

Social learning implies collective development and sharing of knowledge by the participants through learning-by-doing (Armitage et al. 2007 in Berkes, 2011). For this analysis, an ordinal scale (high, medium, low, none) was used, where “high” social learning was ranked when there was collaborative development and sharing of knowledge through learning-by-doing; whereas “none” was scored when there was no collaborative development and sharing of knowledge through learning by doing.

This was the only attribute that across all case studies was ranked as “high”, and it was considered a direct effect of the multi-stakeholder processes and the collaboration between NGOs with governmental institutions. In all three cases, there was a novel participation of diverse set of stakeholders, where each was highly involved in generating the proposals, using empirical knowledge (social, economic and biological). Systematic processes facilitated by NGOs promoted data sharing, inclusion and deliberation. Although significant collaborative sharing and development of knowledge was observed, clear procedures and the involvement of the centralized government institutions are needed, as their absence in some instances can truncate the feedback loops upon which complete social learning depends in the long term.

4.1.9 Multi-level linkages

The final attribute that was ranked was multi-level linkages. A linkage was defined as “*a formal rule, strategy, or regularized action that establishes interdependencies among two distinct actors around different tasks*” (Heikkila et al., 2011 in Basurto 2013). An ordinal ranking (high, medium, low, none) was used for this attribute, where a “high” score meant that the process had formal rules, strategies or regularized arrangements that established interdependencies among the distinct actors around different tasks, while a “none” score described when these interdependencies were non-existent.

There was variability between each case study in terms of multi-level linkages. In the swimming crab FMP process there were financial, informational and institutional linkages. In the curvina process, there were institutional arrangements between regions to collaborate in advisory bodies. There was significant coordination between different federal government agencies, as well as within federal agencies that have representation at multiple scales, facilitated by NGOs. In the corridor process, the federal government coordinated with other ministers and commissions at the federal level. The state government played a hands-off role, while the local government has played close to no role in fisheries management in general. In all cases, NGOs’ work focused on providing formal and informal communication channels for all stakeholders.

Table 1. Summary of attribute score for each case study.

| Attributes of multi-scale governance | Fishing refugia in the Corridor | Catch shares for gulf curvina | Swimming crab fisheries management plan |
|---|---------------------------------|-------------------------------|---|
| Institutional scale (multi-layer) | Some | Some | All |
| Cooperative management | Medium | High | Medium |
| Collective decision-making | Medium | Medium | Medium |
| Polycentric management | No | No | No |
| Match with ecological scales | Medium | High | Medium |
| Horizontal and vertical information sharing | Medium | High | Medium |
| Co-production of knowledge | Yes | Yes | Yes |
| Social learning | High | High | High |
| Multi-level linkages | Low | Medium | Medium |

4.2 Contribution of NGOs to each case study

For each case study, we also analyzed the role of NGO's within each attribute. Results are summarized in Table 2.