

Governance for the sustainability of fisheries targeting species with different degrees of mobility

La gobernanza para la sostenibilidad de pesquerías dirigidas a especies con distintos grados de movilidad

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Abstract

Sustainability has been the overarching goal for fisheries management over the last few decades. To achieve this goal, the State and non-state actors have constituted different governance configurations, to overcome the increasing overexploitation of fish marine resources. This study uses the case of Mexico to investigate the institutional settings (fishing rights, formal and informal rules) developed and implemented by the State and non-state actors to achieve the sustainability of fisheries. It particularly contributes to the work of Caddy & Seijo (2005) on institutions for fisheries targeting species with different degrees of mobility. Results show that most fishing rights granted for Mexican fisheries are not exclusive and are difficult to enforce because they are granted for large areas due to species migratory patterns. Managers, therefore, apply management tools, mainly five (*i.e.*, gear types, seasonal closures, no-take areas, size limits, and quotas), which are developed based on species inherent characteristics (including mobility patterns) to ensure fisheries sustainability. Non-state actors, participating in fisheries improvements and certifications processes, often implement additional rules and participate in data collection, assessments, and enforcement efforts to contribute to fisheries sustainability. Such contributions inform best practices to improve fisheries institutions and management considering species mobility.

Keywords: institutions, governance, fishing rights, formal rules, informal rules, resource mobility.

Resumen

La sostenibilidad ha sido la meta del manejo pesquero en las últimas décadas. Para alcanzar esta meta, el Estado y actores no estatales han constituido diferentes configuraciones de gobernanza para contrarrestar la creciente sobreexplotación de recursos marinos pesqueros. Este estudio utiliza el caso de México para investigar los enfoques institucionales (derechos de pesca y reglas formales e informales) desarrolladas e instrumentadas por el Estado y actores no estatales para alcanzar la sostenibilidad pesquera. Particularmente, este estudio contribuye al trabajo de Caddy y Seijo (2005) sobre instituciones y pesquerías que capturan especies con distintos grados de movilidad. Los resultados muestran que los derechos de pesca asignados para las pesquerías mexicanas, generalmente no son exclusivos y son costosos de vigilar, ya que incluyen áreas extensas dados los patrones de migración de las especies. Por lo tanto, los responsables del manejo de las pesquerías, aplican herramientas de manejo, principalmente cinco (*i.e.*, restricciones en los artes de pesca, vedas, zonas de no pesca, tallas mínimas, y cuotas de pesca) basadas en las características inherentes de las especies (incluidos patrones de movilidad), para asegurar la sostenibilidad. Los actores no estatales, participando en proyectos de mejora pesquera y procesos de certificación, generalmente instrumentan reglas informales adicionales y participan en la colección de datos, en las evaluaciones y la vigilancia del cumplimiento para contribuir a la sostenibilidad. Estas contribuciones informan acerca de buenas prácticas para mejorar las instituciones y el manejo de especies considerando su movilidad.

Palabras clave: gobernanza, instituciones, derechos de pesca, reglas formales, reglas informales, movilidad de recursos marinos.

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Introduction

Sustainability has been the desired outcome from fisheries management and governance over the last few decades, due to the mandates of the United Nations Convention on the Law of the Sea (UNCLOS) and the increasing overexploitation of fish marine resources (FAO 2020).¹ By 1982, when the UNCLOS was endorsed by coastal states, fisheries sustainability mainly referred to reaching the Maximum Sustainable Yield (MSY) of target commercial species (UN 1982).² However, over the last three decades, sustainability has included social, economic, and governance aspects of fisheries (Caddy & Seijo 2005, FAO 1995, 2015).

This analysis focuses on fisheries governance and its relationship with species mobility. Fisheries governance refers to actors' interactions (Kooiman *et al.* 2005), institutions (fishing rights, formal and informal rules) and the enforcement systems that sanction those that violate the compliance of such institutions (Cochrane 2018: 8). To achieve fisheries sustainability, governance systems need to account for the inherent characteristics of marine species associated to their mobility and the uncertainties of abundance and distribution over space and time (Hilborn & Peterman 1996). In fisheries, the State is generally the actor that establishes the formal institutions under which, actors interact and extract resources. Other actors often create rules and mechanisms that are informal and complement those of the State to contribute to management and sustainability. As an example, private and social actors implementing market-based mechanisms (*e.g.*, ecolabelling, certification processes, and fishery improvement projects (FIPs)), whom are bounded by national regulations, are developing additional rules, auditing processes, and verification systems to increase information generation and institutions compliance (Cochrane 2018). This analysis explains the institutional settings, both formal and informal, established for resources with different degrees of mobility, to pursuing fisheries sustainability.

Analytical Approach

This analysis uses and contributes to the framework developed by Caddy & Seijo (2005) and adapted by Seijo *et al.* (2010) for Latin American and the Caribbean (LAC) fisheries, which suggests institutional approaches to share exclusion, information, and enforcement costs related to fisheries targeting species with different degrees of mobility (resource types hereinafter) (See Table 1):

As observed in *Table 1*, Caddy & Seijo (2005) suggest three types of resources: sedentary-low mobility, straddling, and highly migratory stocks that live in the exclusive economic zone (EEZ), within more than one EEZ, and beyond the EEZ (in the high seas), respectively. As part of the contributions to the framework, this study adds the *mobile resources within an EEZ*, as a new category, given the relevance of this type of resources in coastal states with wide littorals.³ It also analyses the institutional settings developed for the sustainability of fisheries targeting these four types of resources.

Institutional settings for fisheries sustainability

Institutions refer to fishing rights and rules. Fishing rights are those that influence the opportunities of users and their power to have access to resource use. They require to be clearly specified, exclusive, transferable, and effectively enforced for the optimal allocation of fish resources (Scott 1955, Randall 1981, Schmid 1987, Seijo *et al.* 1998). *Rules* refer to formal (*i.e.*, state regulations) and informal (*e.g.*, community or industry-based) institutions that are applied to specific fisheries (*i.e.*, input and output controls) and for governance aspects (*e.g.*, monitoring, and enforcement). As shown in *Table 1*, different institutions are adequate to mitigate the effects of high exclusion, information, and enforcement costs associated with marine fisheries. Such costs are generally shared by actors, usually when having compatible objectives.

This study analyses the institutional settings (fishing rights, formal and informal rules) developed for the sustainable extraction of the four

1. Overfished stocks increased from 10% in 1974 to 34% in 2017, particularly in developing countries (FAO 2020).
2. UN. 1982. United Nations Convention on the Law of the Sea. United Nations. EEUU. 202p.

3. Countries with the longest coastlines: 1. Canada, 2. Norway, 3. Indonesia, 4. Russia, 5. Philippines, 6. Japan, 7. Australia, 8. United States, 9. Antarctica, 10. New Zealand, 11. China, 12. Greece, 13. United Kingdom, 14. Mexico (World Atlas 2018).

resource types. Generally, the State is the actor that creates the formal institutions to guide the actions of autonomous actors towards goals of public interest such as sustainability. Non-state actors, often establish complementary (informal) institutions and share the costs derived from the

governing of fisheries. By analysing both formal and informal institutions, this study contributes to the work of Caddy & Seijo (2005). By doing so, it contributes to the understanding of different realities that constitute the governance of marine fisheries, which are under public trust.

Table 1.

Institutional setting for resource types with different degrees of mobility to cope with high exclusion, information, monitoring, and enforcement costs, according to Caddy & Seijo (2005) and Seijo *et al.* (2010)

Resource type	Exclusion costs	Information costs	Enforcement costs
Sedentary: Low mobility resources such as invertebrates (bivalves)	Individually Transferable Quotas (ITQs) Individual transferable grounds or leases among community members (for small-scale fisheries)	Share among those deriving rent and the State	Self-policing Community-managed monitoring control and surveillance (MSC) Co-management
Straddling stocks: Resources that move in waters of multiple neighbour nations EEZs	Limited entry agreed bilaterally or multilaterally, allocation of shared TACS	Bilateral/multilateral cooperation (binding and non-binding) and standardized data collection and stock assessments	Bilateral/multilateral cooperation, harmonised regulations
Highly migratory (high seas): Resources that move beyond the EEZs	Harvest quotas, negotiated allocations and entry rules established by the Commission Members of the commission arrange negotiations on resource allocations, and establish harvest rules for the fishery	Data collection and stock assessment organized by the Commission	Shared costs proportional to annual harvest by individual countries

Material and methods

Mexico is the case study selected to investigate the governance of marine fisheries. Mexican fisheries include the four resource types (*i.e.*, sedentary, mobile within an EEZ, straddling, and highly migratory stocks) and a variety of institutional settings to rule and ensure a sustainable extraction. Since the enactment of the Fisheries law in 2007, sustainability has been the end goal for fisheries management (DOF 2007a). The Maximum Sustainable Yield (MSY) is the reference point used to achieve fisheries sustainability, according to the National Fisheries Charter (NFC) in align-

ment to UNCLOS and other international binding agreements. It is important to note, that this reference point may not be the most adequate given the risks and uncertainties associated to marine species assessment and exogenous dynamic environmental factors. As it only accounts for target species, it does not consider the broader dimensions of sustainability (*e.g.*, impacts on ecosystems, governance aspects).

To analyse the institutional settings developed for the four types of resources (mentioned above), this study includes two data sources: 1) NFC, and 2) third-party assessments conducted for FIPs and certified fisheries using the Marine Stewardship Council (MSC) fisheries standard.

The NFC is the official document published by the Mexican State, which includes the stocktaking of commercial species as well as the information on fishing rights, regulations, and stock status based on assessments developed by the State. For comparison purposes, this analysis includes the publications from every six years (2000, 2006, 2012, 2018), and the fisheries that were consistently reported in the four publications: 12 fisheries involving 31 species. Species were categorised in the four resource types presented in *Table 1* (*i.e.*, sedentary, mobile, straddling, and highly migratory) and fleet types: small-scale and industrial. The small-scale fleet is characterized by multiple users, multi-specific fisheries, as well as diverse gear types, organizational systems, and markets (Salas *et al.* 2007, 2015, Seijo *et al.* 2010). An industrial fleet is represented by high investment, intensive use of technology, high levels of organization, and political power in regulatory and management matters (Altamirano-Jiménez 2017, Bennett 2017). These fleets for some fisheries interact to harvest different components of the population structure, also called “sequential fisheries”⁴ (*e.g.*, shrimp, red groupers).

The *institutional settings* for the four types of resources include fishing rights as well as the formal and informal regulations. *Formal regulations* are those developed by the State that include input and output controls, applicable to resource types and fleets. Input regulations include fishing licence limits, seasonal and area closures, gear types, species excluding devices, among others. Output regulations include total allowable quotas (TACs), minimum and maximum size limits, prohibition of harvesting berried or gravid females, etc grounds (Jentoft 1989). For straddling stocks and highly migratory species, this analysis accounts for international arrangements adopted in domestic regulations. *Informal institutions* are those developed by non-state actors. In this study, are those institutions developed by non-state actors that are part of FIPs and MSC certification processes. FIPs

and certification processes show non-state actors’ contributions to institutional settings for sharing exclusivity, information, and enforcement costs with the State. FIPs and MSC certification processes have used the MSC fisheries standard to assess fisheries sustainability (see Fernández-Rivera *et al.* 2018), which is based on FAO’s guidelines for ecolabelling of marine capture fisheries (See FAO 2009). The standard includes 28 indicators of stock health, ecosystem impacts, and management effectiveness. The description of these indicators is public and can be found on the MSC website.⁵ The standard uses a traffic light system for the assessment of the indicators (Caddy 2000). Scores of 80 or above (green colour) indicate that the requirements for each indicator are met. The information for indicators related to institutional settings (both formal and informal) were accounted for this analysis.

The two sources of data (NFC and third-party assessments) supported the triangulation of information as well as the understanding of state institutions and the underlying informal rules developed by private and social actors, to achieve fisheries sustainability.

Results

The Mexican State grants fishing rights and regulates the fisheries targeting the four types of resources (*i.e.*, sedentary, mobile, straddling, and highly migratory). Most fishing rights in practice are not exclusive and difficult to enforce because they are granted for large areas and in some cases for multiple species (*e.g.*, finfish fisheries). Through regulations the State applies mainly five types of management tools, although the fisheries law includes 22 tools. The five management tools correspond to input controls (*i.e.*, gear types, seasonal closures, no-take areas) and output controls (*i.e.*, size limits, TACs).

4. Sequential fisheries. Two fleets of spatially segregated fisheries (*e.g.*, coastal artisanal and industrial) affect different age components of the population structure of one or more species (*e.g.*, shrimps in Willmann & García 1985). Thus, sequential competition between different resource users is expected.

5. https://www.msc.org/docs/default-source/default-document-library/for-business/program-documents/fisheries-program-documents/msc-fisheries-standard-v2-01.pdf?sfvrsn=8ecb3272_11_

According to assessments developed and published by the State, the status of 12 fisheries (including 31 species) selected for this study are as follows. In 2000, 74% of the species were reported to be at MSY, 3% with potential for development, and 23% overexploited (DOF 2000). By 2018, 81% of the species were reported at MSY and 19% overexploited (DOF 2018). These results confirm the trend of the State to reach the MSY in Mexican fisheries.

From the 31 studied species, ten species were reported as overexploited during the period 2000-2018.

These overexploited species correspond to three different resource types, which move within the EEZ: sedentary (queen conch-*Lobatus gigas*), mobile within the Mexican EEZ (shrimps-*Farfantepenaeus californiensis* and *Litopenaeus vannamei*, groupers-*Epinephelus morio* and *Mycteroperca bonaci*), and straddling stocks (mulletts-*Mugil cephalus* and *Mugil curema*, snappers-*Lutjanus campechanus*, *Lutjanus buccanella*, and *Lutjanus vivanus*). Six of these species (*i.e.*, queen conch, groupers, and snappers) continue in this status (Table 2).

Table 2.
Species reported as overexploited in the NFC during (2000-2018)

NFC 2000	NFC 2006	NFC 2012	NFC 2018
Queen conch fishery (<i>Lobatus gigas</i>)	Queen conch fishery (<i>Lobatus gigas</i>)	Queen conch fishery (<i>Lobatus gigas</i>)	Queen conch fishery (<i>Lobatus gigas</i>)
Grouper fishery (<i>Epinephelus morio</i> , <i>Mycteroperca bonaci</i>)	Grouper fishery (<i>Epinephelus morio</i> , <i>Mycteroperca bonaci</i>)	Grouper fishery (<i>Epinephelus morio</i> , <i>Mycteroperca bonaci</i>)	Grouper fishery (<i>Epinephelus morio</i> , <i>Mycteroperca bonaci</i>)
Shrimp fishery (<i>Farfantepenaeus californiensis</i> and <i>Litopenaeus vannamei</i>)	Shrimp fishery (<i>Farfantepenaeus californiensis</i> and <i>Litopenaeus vannamei</i>)	Snapper fishery (<i>Lutjanus campechanus</i> , <i>Lutjanus buccanella</i> , <i>Lutjanus vivanus</i>)	Snapper fishery (<i>Lutjanus campechanus</i> , <i>Lutjanus buccanella</i> , <i>Lutjanus vivanus</i>)
Mullet fishery (<i>Mugil cephalus</i> and <i>Mugil curema</i>)	Mullet fishery (<i>Mugil cephalus</i>)		
	Snapper fishery (<i>Lutjanus campechanus</i> , <i>Lutjanus buccanella</i> , <i>Lutjanus vivanus</i>)		

Actors participating in FIPs and MSC certification processes have contributed with additional rules which are nested within the institutional setting developed by the State. In some cases, particularly in small-scale fisheries, implementers of FIPs and certifications develop these rules for the implementation of complementary management tools, for data collection, and for enforcement. This contribution is relevant for the sustainability of non-regulated fisheries, in sites where the State is absent, and in data-poor fisheries.

Resource types

Of the 31 species, 10% are sedentary, 32% are mobile within the Mexican EEZ, 55% are straddling stocks, and 3% are highly migratory stocks. The new category, *Mobile species within the EEZ*, include native species (*e.g.*, red grouper-*Epinephelus morio*) and cosmopolitan species with local populations (*e.g.*, common octopus-*Octopus vulgaris*). In total, 52% of the species are caught by a small-scale fleet, 3% by an industrial fleet, and 45% are sequential fisheries –extracted by the two

fleets. The composition of species in this analysis shows: *i*) the dominance of small-scale fisheries, often characterized by complexity and heterogeneity (multiple users, gear types, and target species) (Salas *et al.* 2007, Seijo *et al.* 2010), and *ii*) the presence of stocks under the State jurisdiction (42%), *iii*) the presence of shared stocks (straddling and highly migratory) (58%), for which domestic institutional settings require harmonization with international agreements negotiated with coastal states extracting these stocks. Most species are mobile (90%), which represent greater costs for ensuring sustainability, due to the exclusivity, information, and enforcement costs. These varieties of marine fisheries and fleets also reflect the need for different layers of governance for adequate management.

Institutional settings

Fishing rights. The State through its Executive branch grants the fishing rights. According to the Mexican Constitution, the State is the owner of fish resources living within territorial waters and has jurisdiction on species living within the EEZ. The State cannot transfer the ownership of these resources to citizens or corporations, only their use (DOF 1917). Since 1992, the State has granted fishing rights through permits and concessions issued per vessel, fishing effort unit, specific or groups of species, and areas (DOF 1992a). Fishing permits for commercial purposes are issued for two to five years, and concessions from five up to 20 years (DOF 2007a). Concessions are issued for longer periods in situations when the fishing investment is high and requires longer periods to recover it. The granting of concessions and permits is subject to the following criteria: the public interest, the abundance and availability of the natural stocks, equity principles, and the use of the best scientific information available (DOF 2007a). Permits and concessions specify fishing gears, seasons, landing sites, and applicable management tools. Permits and concessions, in some cases, allocate exclusive exploitation areas to a specific fishing organization, which constitute another form of right called territorial use rights in fisheries (TURFs). In addition, the law of 2007 allows for the granting of quotas –an additional type of right for fisheries–.

Permits are granted for all 31 species included in this analysis, and therefore to the four resource types. Concessions are only granted for six species, which are sedentary (turban star shell-*Megastraea turbanica*, turban snails-*Megastraea undosa*) and mobile species within the EEZ (four-eyed octopus-*Octopus maya*, common octopus-*Octopus vulgaris*, yellowleg shrimp-*Farfantepenaeus californiensis*, and Pacific white shrimp-*Litopenaeus vannamei*). Individual quotas are recorded for two sedentary species of snails (turban star shell-*Megastraea turbanica* and turban snail-*Megastraea undosa*), which were first assigned to vessel (DOF 2000) and later to fishing grounds (DOF 2006).

As shown in *figure 1*, fishing rights (*i.e.*, permits, concessions, individual quotas) that are site-specific (*i.e.*, TURFs, Campeche Bank, Chinchorro Bank, Cozumel Bank), especially if they are allocated to specific fishing organizations and include multiple species, are exclusive and less costly to enforce than those rights granted for large areas. Fishing rights (*i.e.*, permits, concessions) for large areas (*e.g.*, Gulf of Mexico, Pacific) are granted for mobile species (within the EEZ, straddling, and highly migratory species). These types of rights are less exclusive and in practice, the costs of enforcement are higher than those related to site-specific fishing rights. The least exclusive rights are those granted for large areas and multiple species. An example of this type of fishing right are the permits granted for the finfish fishery, which include large areas and multiple fish species. As shown in *Figure 1*, most fishing rights granted by the State for species included in this analysis, are those allocated for large areas which provide a lower exclusivity and lower enforceability than those allocated for specific areas to specific fishing organizations (*Fig. 2*). It is important to note, that according to the fisheries law, rights transferability is not allowed, except in cases of the right holder death.

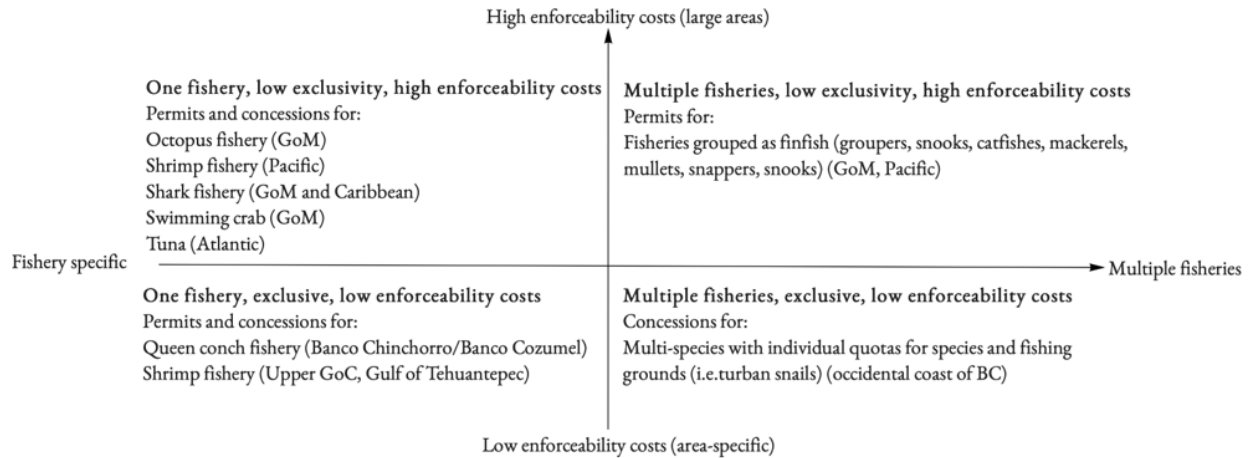


Fig. 1. Types of fishing rights in Mexico. Source: Own elaboration based on the National Fisheries Charter (NFC) (DOF 2000, 2006, 2012, 2018). GoC refer to Gulf of California, GoT refers to Gulf of Tehuantepec, GoM to Gulf of Mexico. See figure 2 for geographical reference.

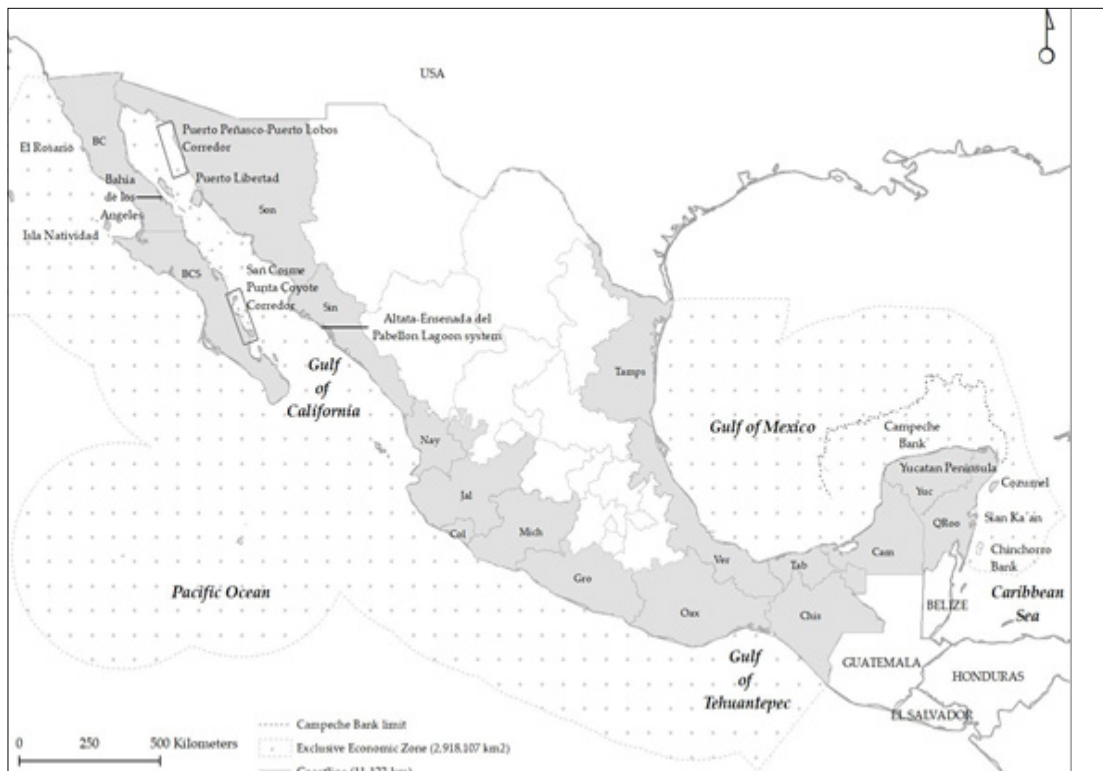


Fig. 2. Map of Mexican EEZ, coastal provinces, and relevant fishing sites. The dotted area corresponds to the EEZ, where the Mexican State has jurisdiction.

Fisheries regulations

The State applies mixes of management tools rather than single ones. Of the 22 management tools included in the fisheries law (DOF 2007a),

the State applies a set of five in most fisheries: gear-type restrictions (100% of the species), seasonal closures (65%), TACs (26%), no-take areas (55%), and size limits (48%). Gear types, seasonal closures, and no-take areas are input controls that

are applied to all resource types and to both fleets (small-scale and industrial). TACs and size limits are output controls; TACs are applied to all types of resources in different time periods, and size limits are applied to all, except for highly migratory species (e.g., tuna fishery). It is important to note that the NFC reports that the State is currently conducting research to implement this latter tool in the tuna fishery.

A set of prohibited fishing methods and techniques apply to both fleets (e.g., the use of nets and trawlers in estuaries and lagoons, the use of toxic substances for fishing purposes) (DOF 2015a). The State reported additional tools for small-scale fisheries such as a quota for domestic consumption (e.g., species of mullets) and the prohibition of harvesting berried or gravid females (e.g., swimming crabs). The State also reported additional tools applicable to the industrial fleet, which include: *i*) the use of turtle excluder devices (TEDS) (DOF 1993, 1996) and fish excluder devices (FEDS) for the shrimp vessels to meet international market requirements (e.g., exports to United States), *ii*) bycatch limits, vessel storage limits, and observer programs for the tuna fishery, to comply with international arrangements set by the Inter American Tropical Tuna Commission (IATTC) and the Agreement on the International Dolphin Conservation Programme (AIDCP) (DOF 1992b, 1999); and *iii*) the use of vessel monitoring systems (VMS) for the industrial fleet to meet the requirements of the IATTC, the International Commission for the Conservation of Atlantic Tunas (ICCAT), and the International Plan of Action to Prevent, Deter, and Eliminate Illegal, Unreported, and Unregulated Fishing (IPOA-IUU) (DOF 2015b).

Since the 1990s, the trend of the State is to update fisheries regulations (formal institutions) for management tools, rather than to adopt new ones. For the ten species reported as overexploited during the period 2000-2018, seven reported updates of regulations, and three of them did not report regulatory changes or implementation of remedial actions to recover the stocks.

For the seven species that reported institutional change, only five reported recoveries. Examples of institutional change are reported as follow. In 2000, the shrimp species reported overexploitation in the Gulf of Tehuantepec, Nayarit, Sonora, Sinaloa, and the occidental coast of Baja California Sur in

2000. The State kept updating annual seasonal closures, and the specifications of the use of TEDS (DOF 1993, 1996, 2007b), developed a new gear type (Magdalena I⁶ and Suripera)⁷ (DOF 2001), and published an official standard that establishes gear types, vessels, outboard motor requirements, fishing effort controls (prohibited areas, schedule for operations, and duration of fishing lances in the water), the use of FEDS and TEDS, and of the VMS for the industrial fleet (DOF 2013). The fishery reported recovery (to be at MSY) in 2012 (DOF 2000, 2012, 2018). In the case of two mullet species (white mullet-*Mugil curema* and great mullet-*Mugil cephalus*), which were reported as overexploited in 2000, the State updated the seasonal closures for the Veracruz and Tamaulipas coasts, published the management plan for these sites (DOF 2014), and updated the official standard to include specifications for outboard motors, gear types and fishing methods, the quotas for domestic consumption and the prohibition of fish cleaning at sea to avoid pollution (DOF 2015c). The white mullet (*M. curema*) reported recovery in 2006 (DOF 2006) and the flathead great mullet (*M. cephalus*) reported recovery in 2018 (DOF 2018).

Two species have not shown recovery despite the institutional change. These species include the queen conch (*Lobatus gigas*) (a sedentary species), for which the State granted permits for specific sites and implemented management tools such as size limits, requirements for gear and fishing methods, TACs, and no-takes (e.g., MPAs). Due to its overexploitation, the State also implemented permanent closures (e.g., Yucatan) or moratoriums applicable for some years (e.g., Cozumel bank and Chinchorro bank) for species recovery. Despite these regulatory efforts, the fisheries continue overexploited in the Yucatan and Quintana Roo coasts. Species such as the queen

6. The Magdalena I for the shrimp fishery is a typical trawl designed for towing by a smaller boat. The net has a maximum size, a construction of polyamide or polyethylene (mono and multifilament netting), with minimum mesh size in the body and wings in the codend. The net must have a Turtle Excluder Device (TED) and a bycatch reduction device (BRD) (MRAG 2010: 9).

7. The suriperas is a surface-to-bottom wall of net suspended from the surface (on floats or from the vessel) that drifts across the bottom as the vessel drifts with the current or the wind. The bottom of the net is weighted to maintain contact with the bottom (MRAG 2010: 9).

conch, which barely move, are highly vulnerable to fishers' overexploitation and illegal fishing. The second case is the grouper fishery, which despite the regulations and their corresponding updates, continue overexploited. This is a long-lived territorial species with mobility during reproduction aggregations within the Mexican EEZ. It is important to note that the NFC reports that the Cuban fleet still participates in this fishery with a catch quota. According to the Mexican fisheries law (Article 62) and UNCLOS (Article 62), coastal states should only allow foreign vessels to participate in domestic fisheries exploitation in those cases when catch surpluses exist and are not extracted by the national fleet. This is not the case.

Finally, the snapper fishery (that includes three species: *L. campechanus*, *L. buccanella*, *L. vivanus*), which is a straddling stock shared with the USA, reports overexploitation—except for the coastal province of Tabasco, where it is assumed that the fishing effort is below MSY for the species sub-stock—. Despite the signs of overexploitation, no institutional change has been observed for remedial actions to recover the fish stock since 2000.

The lack of species recovery confirms, as suggested by Caddy & Seijo (2005), that once a fishery surpasses the MSY, recovery can be slow or difficult to reach. Recovery also becomes less likely in those cases where no remedial or recovery actions are taken.

FIPs and MSC certification processes

Twenty species within the fisheries included in this analysis are part of FIPs and certified fisheries. These species sustain the highly valuable fisheries (e.g., shrimps, tunas) (CONAPESCA 2017) as well as small-scale fisheries (e.g., swimming crabs, finfish species). FIPs and certified fisheries are concentrated in the most productive region of Mexico, namely the northern Pacific, which includes the Gulf of California (82% of the species). Fewer cases are available for the Gulf of Mexico and the Caribbean (18%) and no cases for the South Pacific. Particularly for the case of FIPs, they are implemented at a local scale, rather than to the scale or mobility range of species. On the contrary, the State, regulates a wider range of fisheries and geographies due to its jurisdictional area, covering the Mexican coast and fleet types.

Different actors participate in FIPs and certifications, from assessment process (led by third parties) to enforcement. Actors include Conformity Assessment Bodies (CABS) (i.e., MRAG Americas, SCS), civil society organizations (e.g., Comunidad y Biodiversidad, Pronatura Noroeste, and Ocean Outcomes), and consultants (i.e., Intertek Fisheries Certification, Pesca Responsable y Comercio Justo). These assessments and collective action efforts include broader aspects of sustainability, beyond the status of target species (MSY), (e.g., the impact of fisheries on other species and habitats, governance aspects) and can inform best practices at sharing exclusivity, information, and enforcement costs for governing marine fisheries.

Contributions of non-state actors involved in FIPs and certified fisheries to institutional settings

Actors involved in FIPs, and certified fisheries have complemented the regulations of the State. For example, fishers in FIPs, who have been granted concessions with TURFs for multiple species (e.g., abalone, lobster, sea cucumber, red rock lobster, and snails) have implemented no-take zones for the restoration of marine fisheries (e.g., abalone in Isla Natividad, and finfish species in El Rosario). TURFs provide users with more exclusivity to implement additional institutions and cooperative management. This type of management has been investigated by Seijo (1993) in the Caribbean lobster, in which fishers distributed the TURF space among the members of the cooperative (individual transferable grounds ITG), to make fishing rights provided by the State more exclusive and more enforceable. These additional institutions and cooperative management are recognised by the State in the fisheries management plan for lobster (DOF 2014).

Other informal institutions developed by FIPs implementers holding permits for small scale fisheries, that are granted for larger and isolated areas, include fishing effort limits, the prohibition of chlorine and other substances, no-take areas, and rotating harvest (e.g., octopus's fishery in the north Pacific *O. bimaculatus* and *O. hubbsorum*). In Mexico, particularly in FIPs, fishers tend to request the State to legitimize and formalize these informal institutions to make them enforceable by the State.

For highly migratory species, the State in collaboration with the industrial fleet has implemented tools to comply with international arrangements (*i.e.*, RFMOs) and fulfill the requirements MSC fisheries standard, such as the bycatch restrictions and mitigation strategies on protected species.

The MSC fisheries standard requires evidence on the implementation of institutions (harvest strategies⁸ and control rules), but also on the evaluation of their effectiveness and responsiveness to stock status. Most species show evidence on implementation; however, little evidence is available the second two, which is something that could be addressed by the State or non-state actors.

Sharing information (collection and analysis) costs

Fisheries in FIPs and MSC certifications are assessed against the MSC standard, which requires evidence on broader dimensions of sustainability (*e.g.*, impacts on other species, habitats, governance aspects) than just the target species. The MSC standard pays attention to information quality and comprehensiveness. Although most Mexican fisheries do not meet all these criteria, participants are incentivised to improve information collection and analysis to score better in indicators.

The Mexican fisheries law and the MSC fisheries standard recognize traditional and other types of knowledge for the development of institutions for fisheries. This type of knowledge is particularly relevant in cases of data poor fisheries and has been included in FIPs. In addition, for small-scale fisheries, FIPs are reporting the implementation of community-based monitoring efforts to fulfil the MSC fisheries standard requirements (*e.g.*, Verill's two-spot octopus-*O. hubbsorum*, Hubb's octopus-*O. bimaculatus*).

Data poor fisheries in FIPs are improving and assessing the quality of stock assessments. For example, those assessments that are obsolete, which need to be updated (*e.g.*, shrimp fishery). For data-limited fisheries, the MSC standard suggests a tool called the Risk-Based Framework (RBF), to assess

the stock status, which uses information from workshops and existing data for the development of management tools and strategies. The RBF has been applied (ocean whitefish-*Caulolatilus princeps*, arched swimming crab-*Callinectes arcuatus*, yellowtail amberjack-*Seriola lalandi*, Caribbean spiny lobster-*Panulirus argus*, and giant squid-*Dosidicus gigas*) and recommended for different species (red octopus-*O. maya*, common octopus-*O. vulgaris*, and swimming crab-*Callinectes bellicosus*).

For those fisheries that report overexploitation, the MSC standard requires information on rebuilding strategies and on outcomes (stock recovery trends), to drive actors' action towards species recovery. Although, most fisheries require and are not applying these strategies, there are exemptions. For example, the shrimp fishery has implemented recovery measures based on fishing effort limits. Monitoring has been applied, unfortunately, this fishery has not shown yet evidence of stock status improvement.

The species in FIP and certifications require the information collection on other outcomes related to species (primary and secondary), habitats, and ecosystem functions with which the fisheries interact. In relation to these outcome indicators, a good percentage of species are reaching the requirements (58% species for primary species requirements, 52% for secondary species, 55% for ETP species, 61% for habitat, and 39% for ecosystems).

Those FIPs and certified fisheries targeting highly valued species, particularly those extracted by industrial fleets, are proving collaboration between the State (INAPESCA) and industry for sharing the costs monitoring (*e.g.*, blue shrimp-*Litopenaeus stylirostris*, tuna-*Katsuwonus pelamis* and *Thunnus albacares*, small pelagics-*Sardinops sagax* and *Opisthonema* spp.). In addition, highly migratory species such as tuna (*i.e.*, *K. pelamis*, *T. albacares*) show the collaborations with other states extracting these resources, through the IATTC and its regional scientific and enforcement programme, for sharing information production, stock assessments, and the corresponding costs.

Sharing enforcement costs

The MSC standard requests evidence of monitoring, control, and surveillance mechanisms to ensure management tools are complied with. FIPs

8. Management strategies are represented by one policy/management tool, or a mix of tools, adopted for a fishery. They include management objectives and are responsive to stock and ecosystem state (MSC 2018).

and certified fisheries show that these functions are mainly conducted by the State. However, few fisheries and species (9%) meet the requirements of the MSC fisheries standard. The argument presented in assessments indicate that the State administration (Comisión Nacional de Acuacultura y Pesca [CONAPESCA]) has insufficient staff, insufficient sanctions, and a lack of consistency in the application of sanctions when enforcing regulations (e.g., quotas, size limits, the use of chlorine).

Fishers who have been granted with TURFs demonstrate the implementation of effective enforceable systems, which also benefit other fisheries extracted in the same area, under different fishing rights. For example, the cooperatives extracting ocean whitefish (*C. princeps*) in Isla Natividad and El Rosario, have concessions with TURFs for diverse species with low mobility (i.e., abalone, lobster, sea cucumber, and snails) and permits for mobile species included in the finfish fishery (McCay *et al.* 2014). Thus, users' governance and enforcement systems are applied in these areas, where two types of fishing rights overlap.

In specific cases, industry and community engage in enforcement activities, due to market pressures and international binding arrangements. For example, the industrial fleet has adopted observer programs and the VMS systems to meet the MSC standard requirements. Buyers have engaged in the monitoring of fishers' compliance with legal practices (e.g., permits, authorized fishing gear, and regulations) (e.g., swimming crab-*C. bellicosus*). Cooperatives have also integrated informal rules into the cooperative by-laws for effective enforcement (e.g., El Rosario, whitefish fishery); in this case, fishers are displaying a high level of compliance and shared responsibility in enforcement activities. International factors have also made an influence for better enforcement. For example, market requirements of United States for imports, made the Mexican State adopt an enforcement programme for the Pacific blue shrimp fishery (*L. stylirostris*), which covers 100% of the fleet and implies random inspections in port and at sea. For the tuna fishery, the international binding arrangements negotiated within the IATTC, guided the Mexican State and industry to comply with the regional scientific and enforcement program, to avoid the violations of such arrangements by vessels with Mexican flag as well as the bans by international markets.

Discussion

Resource types: The analysis covered the four types of resources with different degrees of mobility, which show the need for different layers of governance. The category suggested in this analysis, *Mobile species within the EEZ*, included in this analysis, allows for the representation of mobile species that are endemic (e.g., red octopus-*O. maya*), local populations of native species (e.g., red grouper-*E. morio*) and local populations of cosmopolitan species (widely distributed in different oceans) (e.g., common octopus-*O. vulgaris*). Most fisheries in this analysis were reported as small-scale (52% of the NFC), and in some cases as sequential fisheries (45% in NFC), which also show the complexity entailed in the governing of fisheries. In addition, the presence of shared resources (straddling and highly migratory stocks) (58% in state assessments) shows the relevance of supranational levels of governance, which require coordination among coastal states extracting such resources.

Institutional settings. The State, through fishing rights and regulations, limits access to fisheries. Fishing rights granted for sedentary species (clams and snails), especially those with TURFs (site-specific exploitation areas), are exclusive and enforceable. Fishing rights for mobile species (including species moving within the Mexican EEZ, straddling, and highly migratory stocks) are granted for large areas and therefore are less exclusive and imply high costs of enforcement. Beyond the state allocation of fishing rights, the State and users develop formal and informal rules to ensure fisheries sustainability.

In terms of management tools, the State applies five of them (gear types, size limits, seasonal closures, no-take areas, and TACs) to all resource types. This is consistent with the work of Salas *et al.* (2007), which reported these tools are the most frequently applied in LAC. The implementation and monitoring of these management tools supports the fulfilment of the MSC standard requirements, although the standard includes broader dimensions of sustainability, and the State focuses on the health of the stock.

MSC certifications and FIP processes include best practices that can inform the State and derive in replication in other fisheries. However, these practices are insufficient for fisheries targeting mobile

species. In developing countries, where the State does not have the capacity to apply direct control over fisheries (*e.g.*, data collection, enforcement), the State plays a fundamental role as a meta-governor to ensure formal institutions for the responsible use of fisheries that apply to the scale of fisheries (spatial distribution). In addition, the State plays an important role at facilitating coordination among stakeholders, and with other states when applicable, to share the high information, exclusion, and enforcement costs. In this way states with limited capacity set an institutional framework and a governance setting that is conducive to fisheries sustainability. Otherwise, it is very unlikely to reach the sustainability.

Private and social actors that are part of FIPs and certification processes, develop informal institutions based on traditional knowledge for non-regulated and regulated fisheries. The Mexican fisheries law and the MSC fisheries standard acknowledge traditional knowledge and informal institutions. However, the State and third-party assessments show an implicit preference for state regulation. Auditors are scoring better fisheries with state regulations than those of fisheries that rely solely on informal institutions. In addition, the State focuses its enforcement on formal regulations. Therefore, private, and social actors often request the State the legitimization and formalization of the informal institutions in official agreements to meet the MSC requirements, improve their scores, and receive State support in terms of enforcement. Increased recognition of informal institutions and informal enforcement mechanisms are needed to incentivise more participation in management duties. This engagement can support the cost sharing that fisheries management can entail. This is particularly relevant in areas where the State does not have the capacity to govern fisheries and where other actors are ready to become competent partners. The formalization of informal institutions and the integration of private and social actors in management duties is also relevant in cases of mobile species management, for which sustainability represents a greater challenge due to the nature of fishing rights (granted for large areas, and in some cases for multiple species) and species migration patterns.

The analysis of FIPs and certification processes shows non-state actors (market, fishing organizations, communities) are strengthening assess-

ments, monitoring, and enforcement systems in fisheries. This participation is relevant in the case of Mexico, as most FIPs and certification processes reported the lack of capacity of the State to sustain data collection, fisheries assessments, regulations, and enforcement.

This analysis shows that the Mexican State adopts the institutional settings for the four types of resources to achieve MSY, which continues to be the most common reference point for fisheries sustainability. Ten fisheries surpassed this reference point during the studied period, from which, six are not yet recovered (queen conch, groupers, and snappers). In addition, three of them have not reported institutional change or recovery actions. Regulations and remedial actions for the recovery of overexploited species are necessary. In addition, in nations like Mexico, where most of the species are reported at MSY (81%) (DOF 2018), it is relevant to make sure stocks are well and periodically assessed (by the State and experts) to ensure the MSY referent point is not surpassed.

This study highlights the relevance of developing institutional settings for overexploited fisheries to pursue recovery, the integration of broader dimensions of sustainability in fisheries management (beyond the MSY reference point), as well as the integration of different actors in the governing of fisheries. There is some progress that is worth to mention. For example, the NFC already includes elements (*e.g.*, associated species to fisheries, environmental stressors for fisheries) that could be used to incorporate the ecosystem approach to fisheries. In addition, the Congress recently presented an initiative to include the definition of sustainable fisheries in the fisheries law, that includes not only the sustainable use of the stocks, but also the impacts of the fishery on the ecosystem and elements of governance. Advances in other countries can be used as a reference for Mexico.

Finally, we present contributions to the work of Caddy & Seijo (2005), by bringing a new resource type relevant for states with wide littorals, and alternative options to share the exclusion, information, and enforcement costs entailed in the governing of fisheries targeting species with different degrees of mobility (Table 3).

Table 3.

Institutional setting for fisheries targeting species with different degrees of mobility to cope with high exclusion, information, monitoring, and enforcement costs. In bold the contributions of this work

Resource type	Exclusion costs	Information costs	Enforcement costs
Sedentary: Low mobility resources such as invertebrates (bivalves)	Individually Transferable Quotas (ITQs) Individual transferable grounds or leases among community members (for small-scale fisheries) Limited entry Total Allowable Catches (TACs) Size limits Seasonal closure No-take areas Gear type restrictions	Share among those deriving rent and the State Coordination of communities, civil society organizations, academics with the State	Self-policing Community-based monitoring control and surveillance (MSC) Co-management
Mobile: Resources that move within the exclusive economic zone (EEZ) of a nation	Limited entry TACs Size limits Seasonal closure No-take areas Gear type restrictions	Coordination of communities, civil society organizations, industry, academics with the State	Coordination among communities, industry, and the State
Straddling stocks: Resources that move in waters of multiple neighbour nations EEZs	Limited entry agreed bilaterally or multilaterally, allocation of shared TACs Size limits Seasonal closure No-take areas Gear type restrictions	Bilateral/multilateral cooperation (binding and non-binding) and standardized data collection and stock assessments Coordination of communities, civil society organizations, industry, academics with the States	Bilateral/multilateral cooperation, harmonised regulations
Highly migratory (high seas): Resources that move beyond the EEZs	Harvest quotas, negotiated allocations and entry rules established by the Commission Members of the Commission arrange negotiations on resource allocations, and establish harvest rules for the fishery Seasonal closure No-take areas Gear type restrictions Policy and regulations harmonization by member states	Data collection and stock assessments organized by the Commission Data collection within the country in coordination with the industry	Shared costs proportional to annual harvest by individual countries

Source: Adapted from Caddy & Seijo (2005) and Seijo *et al.* (2010)

Concluding Remarks

- This work illustrates the institutional settings for ensuring the sustainability of fisheries targeting four types of species with different ranges of mobility. It also shows examples of how public, private, and social actors collectively share the exclusivity, information, and enforcement costs, associated to the governing of these types of marine fisheries.
- In the Mexican case, the State, given the mobility of marine species, grants fishing rights that are often not exclusive. To pursue sustainability (MSY), the State applies mainly five management tools to all resource types. Different configurations and layers of governance are taking place according to the mobility of species and non-state actors' interests, resulting in a variety of formal and informal institutions for information collection, assessments, compliance, and enforcement.
- This analysis brings new elements to the work of Caddy & Seijo (2005), based on these collective efforts, some of which, despite their site -or fleet- specific nature (e.g., FIPs and certified fisheries), provide information and practices that can be expanded to broader scales and to more fisheries targeting species with different degrees of mobility, for better governance and for sustainability.

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Annex I.

Mexican fisheries included in this analysis. Information based according to the National Fisheries Charter (NFC), Fishery Improvement Projects (FIPs) and certified fisheries with the Marine Stewardship Council (MSC)

Resource type/species	Fleet type	Area	Institutional Setting (NFC)	Additions in 2006 (NFC)	Addition in 2012 (NFC)	Additions in 2018 (NFC)	FIPs or certified fisheries	Actors involved	Institutional settings
Sedentary									
Snails									
Turban star shell <i>Megastrea turbanica</i> (Dall 1910)	SSF	Occidental coast of BC	Permits and concessions (spatial and multi-species). Individual quotas per vessel. Reference point based on catch at MSY.	Individual quotas per fishing ground.	Exploitation rate as a percentage of the spawners biomass, size limits, seasonal closure.	Exploitation rate based on the percentage (20%) of the population above the size limits.			
Turban snails <i>Megastrea undosa</i> (W. Wood 1828)									
Queen conch <i>Lobatus gigas</i> (Linnaeus 1758) (previously <i>Strombus gigas</i>)		Cozumel and Chinchorro Bank	Permits. Size limits, fishing methods, fishing gear limits (number), total allowable catch (TAC), no-take (marine protected areas-MPA) (Chinchorro bank and Cozumel bank), permanent closure in Yuc.	Specific regulations for Chinchorro bank in management plan.	Three years' closure in Cozumel bank. Seasonal closure for Chinchorro bank. Five-year seasonal closure and a seasonal closure from 2018 onwards for Chinchorro bank.	A closure from 2015 to Feb 2017 for more areas: from Punta Herrero to the North of Mahahual to Bacalar. In 2018, a seasonal closure. Size limits, fishing methods and equipment (including outboard motor) specifications.			
Mobile species within the EEZ									
Reef fish									
Red grouper <i>Epinephelus morio</i> (Valenciennes 1828)	SSF, IF		Permits for finfish for Mexico and Cuba fleet. Specify fishing seasons and gears. Cuban fishers have a quota according to the Fisheries Treaty Mexico-Cuba, which is revised annually. TAC-Reference points are based on the current, predicted, and initial biomass.	TAC-Reference point at 45 487 tons seasonal closure.	Size limits, gear types (allowed and prohibited), vessels, outboard motor characteristics, domestic consumption restrictions (3kg/day). TAC-Reference point based on the average biomass of the last 14 years. Current biomass should not be lower than this.	Update of fishing gear requirements (bigger hooks and less power for outboard motors). Increase the seasonal closure for 15days more. Vessel monitoring system (VMS) for the IF.	Location: Yucatan (FIP) Black grouper <i>M. bonaci</i> Red grouper <i>E. morio</i> Location: San Cosme-Punta Coyote, Baja California Sur (FIP) Leopard grouper <i>Mycteroperca rosacea</i> (Streets 1877) Finescale triggerfish <i>Balistes polylepis</i> Streindachner 1876	State, fishing cooperatives, buyers, and CSOs	Permits for finfish. Size limits, gear types, seasonal closure. Management plan and local fisheries committee
Black grouper <i>Mycteroperca bonaci</i> (Poey 1860)						In the Gulf of California, no-take areas.		State, fishing cooperatives, buyers, and CSOs	Permits for finfish. No-take area (fish refuge)

<p>Demersal species</p>	<p>SSF</p>	<p>Gulf of Mexico</p>	<p>Permits for finfish, fishing season and gears. Seasonal closure. Reference point based on TACs per province. No regulations for the provinces of Tabasco and Campeche.</p>	<p>Reference point for the South of Cam.</p>	<p>Reference point based on the average of catch in the last ten years. Reference points based on TACs per province increased.</p>	<p>Fish refuge in Akumal.</p>	<p>Location: Sinaloa, Marismas Nacionales (FIP) White snook <i>Centropomus viridis</i> Lockington 1877 Location: Isla Natividad and El Rosario, Baja California (2 FIPs) Ocean white fish <i>Caulolatilus princeps</i> (Jenyns 1840)</p>	<p>State, fishing cooperatives, buyer, NGO Fishing cooperatives, CSO, buyer</p>	<p>Permit for finfish. Fishing method, Ramsar site, no-take area (MPA) Permit for finfish. Overlap with concession for other species (abalone, lobster, sea cucumber and snails), fishing method. No take areas. Informal no-take area (fish refuge) in El Rosario Cooperative based monitoring and enforcement</p>
<p>Octopus Four-eyed octopus <i>Octopus maya</i> Voss & Solis 1966 Common octopus <i>Octopus vulgaris</i> Cuvier 1797</p>	<p>SSF</p>	<p>Campeche, Veracruz coasts Yucatan Peninsula and Veracruz coasts</p>	<p>Permits for finfish, fishing seasons and gears. Reference point based on TACs per province Permits and concessions. Size limits, quota per species and region, gear type prohibitions, and seasonal closure.</p>	<p>Reference point based on MSY</p>	<p>Reference point based on the catch of the last 10 years and provided for Tamaulipas and Veracruz.</p>	<p>Fishing gear requirements (mesh size). Update of the seasonal closure including the one for the Veracruz National Park. Size limits for males and female, fishing equipment and gear specifications, bat type, prohibition of use of explosives or</p>	<p>Location: Yucatan (FIP) Four-eyed octopus <i>O. maya</i> Common octopus <i>O. vulgaris</i> Location: Bahía de los Angeles, Baja California (FIP)</p>	<p>Buyers Buyers</p>	<p>Permits. TAC, size limits, seasonal closure, no-take area (MPA). Buyers' contributions to fisheries assessments Permits. Seasonal closure, no-take area (MPA), size</p>

<p>Shrimps Yellowleg shrimp <i>Farfantepenaeus californiensis</i> (Holmes 1900) Pacific white shrimp <i>Litopenaeus vannamei</i> (Boone 1931)</p>	<p>SSF, IF</p>	<p>Pacific including the Gulf of California and Gulf of Tehuantepec</p>	<p>Permits and concessions. Seasonal and area closures, fishing effort control, regulations for vessels and gear types, use of turtle excluder device (TED). Periodic assessments of reproduction and recruitments. Results are compared with assessments conducted by fisher advisors. Reference points based on biomass at MSY, spawners biomass at recruitment peaks, and sizes to maximize recruitment.</p>	<p>Seasonal closures updates Gear type (Magdalena I and suripera) in the Lagoon-Estuary system of Bahía Magdalena-Almejas, BCS. Specifications for SSF and IF in Sinaloa. Fishing effort limits, area of operation.</p>	<p>Seasonal closure updates. Management plan for the Upper GoC, refuge zone for vaquita marina. Specifications for DETs.</p>	<p>for medium-scale vessels include fishing trips of seven hours and maintain a density per hectare at the beginning of the fishing season.</p>	<p>toxic substances. VMS for the IF.</p>	<p>Verill's two-spot octopus <i>Octopus bimaculatus</i> Verrill 1883 Hubb's octopus <i>Octopus hubbsorum</i> S. S. Berry 1953</p>	<p>Industry, buyers, consultants</p>	<p>limits. Community-based management plan Collective action for implementation</p>
<p>Straddling stocks Coastal pelagic Atlantic Spanish mackerel <i>Scomberomorus maculatus</i> (Mitchill 1815) Flathead grey mullet <i>Mugil cephalus</i> Linnaeus 1758</p>	<p>SSF</p>	<p>Gulf of Mexico and Pacific</p>	<p>Permits for finfish. Fishing seasons and gears. Reference point based on TACS for different provinces.</p>	<p>Reference point for the region.</p>	<p>Increase the reference point for the region.</p>	<p>Management plan for Tamps. and Ver. coasts. Update</p>	<p>Rock shrimp <i>Sicyonia penicillata</i> Lockington 1878</p>	<p>Observer programme and VMS for the IF.</p>	<p>Management plan for Tamps. and Ver. coasts. Update</p>	

White mullet <i>Mugil curema</i> Valenciennes 1836	SSF		gear requirements (mesh size), seasonal closure. Reference points based TACS per province.	in Tamps. and Ver. Coasts.	of the seasonal closure in Tan and of the standard to include prohibited gear type and fishing methods. Retention of organisms to reduce discards. Prohibition of onboard fish cleaning. Limits for domestic consumption.
Northern red snapper <i>Lutjanus campechanus</i> (Poey 1860)	SSF, IF	Gulf of Mexico	Permits for finfish, with gear specifications (hooks), size limits. Reference point based on TACS, per province.	For Campeche bank, reference point on biomass (current and future with respect to initial biomass, 50% of the initial biomass), and exploitation rate.	No-take in Akumal, Quintana Roo
Blackfin snapper <i>Lutjanus buccanella</i> (Cuvier 1828)					
Silk snapper <i>Lutjanus vivanus</i> (Cuvier 1828)					
Sharks Blacknose shark <i>Carcharhinus acronotus</i> (Poey 1860)	SSF, IF	Gulf of Mexico and Caribbean	Permits. No fishing effort increase. Reference point based on reproductive rate.		Seasonal closures per province. VMS.
Spinner shark <i>Carcharhinus brevipinna</i> (Valenciennes 1839)					
Silky shark <i>Carcharhinus falciformis</i> (Bibron 1839)					
Bull shark <i>Carcharhinus leucas</i>					

Governing fisheries targeting species with different mobility patterns

1839)	Blacktip shark <i>Carcharhinus limbatus</i> (Valenciennes 1839) Swimming crabs Bocourt swimming crab <i>Callinectes bocourti</i> A. Milne-Edwards 1879	Gulf of Mexico	Permits. Size limits, fishing seasons, gear types, and landing sites.	SSF	Location: Campeche and Yucatan (2 FIPs) Blue crab <i>C. sapidus</i>	Fishing cooperative, buyers, consultant, CSO	Permits. No take areas (MPA), management plan
	Dana swimming crab <i>Callinectes danae</i> Smith 1869 Shelling crab <i>Callinectes ornatus</i> Ordway 1863 Sharptooth swimming crab <i>Callinectes rathbunae</i> Contreras 1930 Sharptooth swimming crab <i>Callinectes sapidus</i> Rathbun 1896 Blue crab <i>Callinectes similis</i> Williams 1966				Location: Puerto Peñasco-Sonora, Baja California Sur, Gulf of California (3 FIPs) Brown swimming crab <i>Callinectes bellicosus</i> (Stimpson 1859) Arched swimming crab <i>Callinectes arcuatus</i> Ordway 1863	State, fishing cooperatives, buyer, CSO	Permits. Size limits, excluder devices, fishing effort limits, seasonal closure, gravid female protection, limited effort. Management plan. These are all formal, applicable to the north pacific
Highly migratory species							
	Tuna Yellowfin tuna <i>Thunnus albacares</i> (Bonnaterre 1788)		Permits. Release of turtles, dolphins, and ETP species. Seasonal closure. Fishing gear, equipment, and vessel requirements (purse seine). Observer programme. Storage capacity limits. Annual	SSF, IF	Location: Northern Tropical Pacific Yellowfin tuna <i>T. albacares</i> Skipjack tuna <i>Katsuwonus pelamis</i> (Linnaeus 1758)	State, fishing industry	Not additional ones.
			TAC, no-take (MPA). No-retention and commercialization of oceanic sharks. Reporting of catches and dolphin mortality to the National Tuna and Dolphin Protection Programme				

			<p>(NTDPP) and/or IATTC. Prohibition of releasing waste (plastics) to the ocean. Fishing operations (use of buoys). Fishing gear requirements, including pole and line tuna fishery. Prohibition of retention of dolphin, turtles, and protected species. VMS.</p>			<p>limits of dolphin mortality according to the International Dolphin Conservation Programme (IDCP). No night fishing. Prohibition of use of explosives. Managed by InterAmerican Tropical Tuna Commission (IATTC). Specifications on commercial and sanitary information.</p>
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Source: Elaboration based on the NFC (2000, 2006, 2012, 2018). SSF means small-scale fisheries. IF means industrial fisheries. GoM means Gulf of Mexico, GoC means Gulf of California. Acronyms for coastal provinces are presented. See figure 2 for geographical reference