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Evolution of environmental policy instruments implemented for the protection of totoaba and the vaquita porpoise in the Upper Gulf of California

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ABSTRACT

We retrospectively analyzed environmental policy instruments decreed by the Mexican federal government for the protection of marine species and ecosystems in the Upper Gulf of California. Totoaba (*Totoaba macdonaldii*) and the vaquita porpoise (*Phocoena sinus*) are two priority species in the national and international agendas for marine protection. We observe that while the measures taken by the State, since 1949, show a growing commitment to sustainable management of the region, there are limitations in the design and implementation of concrete actions for their protection. Some possible reasons the tools have proven to be ineffective are: there has been no consistency between the goals of fisheries and conservation sectors; the decrees are not clear on how they will achieve success; the fishers have not been sufficiently or appropriately informed about the harm done by their work practices and they only respond to their needs and interests; there is not enough honest inspection and surveillance, so illegal and improper practices occur. The case of totoaba has been handled in a way that is clearly ineffective, because the instruments have focused on the protection of adults without regard to juveniles. This is possibly because the decrees have tried not to interfere with shrimp fishing at sea.

1. Introduction

The need for mitigation actions and strategies to remedy environmental damage to marine ecosystems in Mexico has forced the enactment of environmental policy instruments without prior testing, evaluation, or full projection of its potential consequences. This is no unusual, since internationally environmental regulations have evolved rapidly in a fashion dominated by learning by doing and are in permanent state of flux (O'Briena et al., 2007). For example, contemporary species protection regulations originated from natural resources laws intended to protect valuable fisheries. New knowledge and changing societal priorities are one of the most

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important drivers of policy change. For instance, protection of biodiversity is substantially different than protection of commercial fisheries because the causes of species and ecosystem losses are extremely diffuse in nature and involve many difficult sectors (Gunningham and Young, 1997). Environmental policies have been explained thoroughly in textbooks (Ayres and Braithwaite, 1992; Gunningham and Grabosky, 1998) and several papers since the 1990s (Sinclair, 1997; Innes et al., 1998; Wilcove and Lee, 2003; Gunningham and Sinclair, 2005; Chappin et al., 2009). ''An environmental regulation'' is any legal restriction that is enacted to control the way people interacts with the environment in order to reduce the negative effects of human interaction with nature. Nevertheless, according to Gunningham and Young (1997), despite decades of policy experimentation, the efficient, effective and equitable environmental regulation has continued to elude policy-makers and regulatory theorists. They also address underlying causes of threats to biodiversity which if removed or countered by a compensating mechanism make further administrative action rarely necessary.

In developed countries, a new approach to regulatory quality, based on a more balanced approach compared to costs and benefits of regulation is called smart regulation (Howlett and Rayner, 2004). The central argument is multiple use rather than single policy instruments, and a broader range of regulatory actors intending to produce better regulation. Further, this will allow the implementation of complementary combinations of instruments and participants tailored to meet the imperatives of specific environmental issues. By implication, this means a far more imaginative, flexible, and pluralistic approach to environmental regulation than has so far been adopted in most jurisdictions (Gunningham and Grabosky, 1998). Other regulation is known as responsive, promoting voluntary compliance with taxation laws by tailoring the administrative treatment of taxpayers in accordance with the individual taxpayer's tax compliance posture. Requires regulators to be responsive to the conduct of those they seek to regulate in deciding whether a more or less interventionist response is required (Ayres and Braithwaite, 1992). The trend to more smart or responsive regulation is already investigated in marine policy in developed countries (Howlett and Rayner, 2004; Van Gossum et al., 2009), but not in emergent countries like Mexico. México has used different instruments for a single problem, which could be argued as ''smart regulation''. However, different strategies use does not mean intelligent focusing; rather it means no planning, assessment neither projection of the used instruments. At present, none of the instruments have worked thoroughly. Experimenting new instruments seems a permanent activity in each governmental period, instead of evaluating and correcting or adapting the older ones. The Mexican marine policy is an interesting theme because the existence of a tug-of-war between rational use and conservation (Espinoza-Tenorio et al., 2011). These authors did a general analysis in the fisheries evolution and environmental policies in Mexico, in this paper the same was done but focused in a special marine area detailing policies evolution for two flag species, which are important for conservation on an international scale.

The Gulf of California is the only inland sea in the eastern Pacific, the most important fishing region in Mexico and one of the marine systems most closely watched by the worldwide conservation sector (Lluch-Cota et al., 2007). The Upper Gulf of California is one the most productive and diverse marine ecosystems in the world (Marinone and Ulloa, 2008) and a natural refuge area for species breeding and rearing (Álvarez-Borrego, 2001).

Different strategies have been implemented, being the biosphere reserve Upper Gulf of California and Colorado River Delta (UGCCRD) the most important, initially targeting species in need of urgent protection, and later for protection of the whole ecosystem (DOF, 2007). Coastal human communities are highly dependent on fishing (Morales-Zarate et al., 2004; De-la-Cruz-González, 2002) an activity shaping regional human–environment interactions and driving the UGCCRD ecosystem's health. Since the mid-twentieth century the Mexican federal government has led efforts for conservation and sustainable management in the UGCCRD (INE, 1995). Mexican policies, and regulatory measures have created a complex and evolving institutional framework (Cudney-Bueno et al., 2009) which has been rarely scrutinized. Despite decades of protective measures, commercial fish populations are deficient and threatened or endangered species still declining (Pedrín-Osuna et al., 2001). Existing policies and programs need to be evaluated to identify strength and weaknesses and develop new generation strategies to protect the UGCCRD. This paper analyzes environmental policy instruments established by the Mexican federal government for the UGCCRD protection, and in particular for totoaba (*Totoaba macdonaldii*) and the Gulf of California harbor porpoise or vaquita (*Phocoena sinus*).

2. Methodology

Federal decrees (DOF, 1955a,b, 1986, 1988a,b, 1994a, 2009) were searched in the National Federal Library, Mexican Federal Government libraries and websites. Results were chronologically organized and compared considering their objectives. The instruments were contextualized according to the historical, political and social events in which they were generated. The geographic area covered by each instrument was mapped according to the coordinates referred therein. When necessary, informal interviews were made to key actors, referencing their answers as personal communications in the text.

3. Political strategies for the Upper Gulf of California

The UGCCRD has been the field for experimenting with different strategies for environmental protection and natural resource management, based on both direct and regulatory instruments as well as economic incentives (Lercari and Chávez, 2007; INE-WWF, 2007). Regulatory instruments focus on modifying human behavior codes with relation to marine resources (Wiman, 1991). Each instrument addressed the same problem with two different goals, to improve or at least sustain fishing yields, and to protect the environment.

More or less scattered throughout the twentieth century, Mexico presents multiple evaluation attempts, in 2001 important efforts for processes systematization through

external evaluation started (Cardozo-Brum, 2006). Several other isolated evaluations have been done to specific programs and projects, interesting is an *ex ante* evaluation for PACE-vaquita (Arellano, 2008). Evaluation of Secretariats plans is common up to date, but still it is missing their real impact assessment.

A historical breaking point was the decree of the UGCCRD as a Biosphere Reserve in order to ensure the protection of their ecosystems and provide advice to its inhabitants for the rational and sustainable resources use (DOF, 1993). In addition, the federal government has issued legal instruments for specific problems, such as protection of the vaquita and totoaba (DOF, 1994a) or their ecosystems (DOF, 2002). Recently, a financial economic instrument was implemented to persuade local fishermen to convert their activities to other productive activities or the modification of fishing gear to other less harmful to the environment (Table 1). This has been supported through an inspection and surveillance operation (INE-WWF, 2007).

Both fishing and conservation instruments seek the protection of breeding areas for fish species, and the conservation of two endangered species (vaquita and totoaba). The development of public policy was organized chronological into four periods (Fig. 1).

3.1. *Flagship species*

3.1.1. *Totoaba*

Totoaba is endemic to the Gulf of California (GC). In early 1900s, the totoaba was abundant and reached its maximum catch ratio during the 1940s, then the fishery collapsed (Berdegué, 1955) when about 2300 metric tons were caught (Lercari and Chávez, 2007). In 1949 a decree temporarily forbade the shark fishery because totoaba was in its bycatch (DOF, 1949). In 1955 the whole GC was closed for totoaba and other commercial fish (cabaicucho) (DOF, 1955a). In 1975 the fishery was completely and indefinitely banned for the whole GC (DOF, 1975) (Fig. 2). However, illegal fishing has hampered the abundance monitoring, its growth patterns, and its mortality (Pedrín-Osuna et al., 2001).

3.1.2. *Vaquita*

Is the best known flagship species of the region, considered the most critically endangered marine mammal species in the world (Rojas-Bracho and Jaramillo-Legorreta, 2009). Rojas-Bracho et al. (2006) compiled all vaquita legislation; it is classified in the most critical conservation category by International Union for the Conservation of Nature (CCA, 2008; IUCN, 1996, 2007) and in 1979 in the Convention on International Trade in the Endangered Species of Wild Fauna and Flora. In 1985, was listed by the US Government as an endangered species under the US Endangered Species Act. The Mexican government was to recognize explicitly that vaquita is a species in danger of extinction in 1994 (DOF, 1994a,b) and at the same time to place it on the priority list of species subject to special protection and conservation. It was included in the ecological criteria that determine rare, threatened, or endangered species or those subjected to special protection in Mexico (DOF, 1991) and the Mexican Wild Species List (DOF,

Table 1 – Instruments in the UGCCRD.

Year	Instrument	Specific objective
1949	Temporary ban on shark fishing which is related to bycatch of *Totoaba macdonaldi*.	Reduce bycatch of totoaba.
1955	Ban and refuge area for protection of nursery grounds of all fish species in the Upper Gulf of California.	Protect species of fishing importance such as shrimp, totoaba, grouper and others.
1955	Ban and fishing regulations of species with common names totoaba and cabaicucho, and specifications for shark fishing nets in the Gulf of California.	Conserve fisheries of totoaba and cabaicucho to obtain a maximum sustained production, and rehabilitate the area.
1974	Reserve area for nursery grounds and increment of stocks of all fish species.	Increment the stocks of commercial species such as shrimp, totoaba, grouper, and others.
1975	Total and permanent ban of totoaba from the mouth of the Colorado River to the Fuerte River in the state of Sinaloa, on the east coast and from the mouth of the Colorado River to Bahia Concepcion, Baja California, on the west coast.	Preserve the totoaba for the benefit of fishermen cooperatives.
1993	Biosphere reserve in the Upper Gulf of California and Colorado River Delta.	Protection of the region's ecosystems, sustainable development of riparian communities, and rational and sustainable use of resources.
1993	Mexican Official Norm 012-PESC-1993, which establishes measures for the protection of the totoaba and the vaquita.	Reduce mortality of the vaquita porpoise; establish a regulatory framework that ensures maximum protection of the vaquita and totoaba.
1994	Mexican Official Norm NOM-059-ECOL-1994, which determines the species and subspecies of terrestrial and aquatic wildlife endangered, threatened, rare and specially protected, and establishes specifications for their protection.	The vaquita and the totoaba are listed as endemic species of the Gulf of California in danger of becoming extinct.
2002	Emergency Mexican Official Norm NOM-EM-139-ECOL-2002, which establishes protection measures of marine and coastal ecosystems, and of species subjected to special protection in Biosphere Reserve waters of the UGCCRD.	Protection of marine and coastal ecosystems, as well as species that inhabit them, such as the vaquita and totoaba.
2005–2009	Economic compensation fund for fishing with gill nets and the promotion of alternatives to fishing in the Upper Gulf of California	Cessation of gill net fishing, and to convert fishermen into other economic activities.

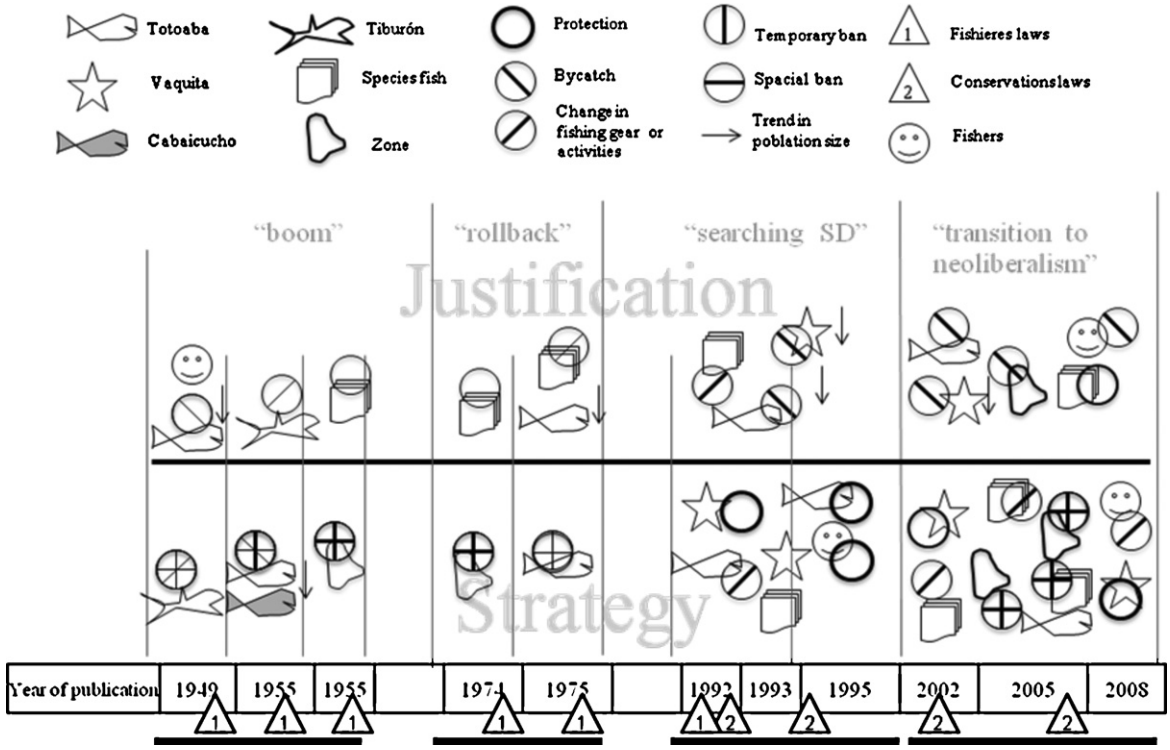

Fig. 1 – Decrees evolution in the area. Agglomeration represents how chaotic the situation has become. Triangles, laws supporting decrees implementation. Arrows, totoaba and vaquita populations decrease.

1994a,b). The main risk factor for vaquita survival is bycatch in fishing operations. Gill nets for fish and shrimp cause very high rates of vaquitas entanglement.

Estimates of bycatch rates are from D'Agrosa et al. (2000) from 1993 to 1994 and refer to one of three main fishing ports: 39 per year (95% CI 14–93) using combined data from observers and fishermen interviews. Boats from other ports may experience similar rates, and the total is probably well above what would be sustainable (Rojas-Bracho and Taylor, 1999; Rojas-Bracho et al., 2006). In 2008 the Mexican Government launched the recovery program for vaquita: Action Program for the Conservation of Species-vaquita (PACE-vaquita; http://www.conanp.gob.mx/pdf_especies/PACEvaquita.pdf) (SEMARNAT, 2008).

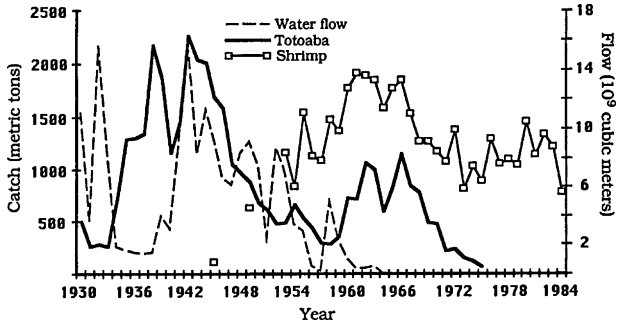

Fig. 2 – Annual catch of adult totoaba (Rosales-Juarez and Ramirez-González, 1987), shrimp (Magallón-Barajas, 1987) and flow of the Colorado River (CR) (Flanagan and Hendrickson, 1976) (Cisneros-Mata et al., 1995).

Silber (1990) addressed the problem of the vaquita through fishermen interviews reporting incidental captures while fishing totoaba, stating their awareness of prohibiting fishing totoaba, and saying that "we fish it despite this measure". Such testimonies highlight the decrees implementation inadequacy.

4. Periodization

In Mexico, the development of a consolidated regulatory system to encourage sustainable fisheries management has been inhibited by inconsistent, and sometimes contradictory, policy directions (Espinoza-Tenorio et al., 2011). The first strategies, in the fifties, stage called "the boom" (Fig. 1), the GC was viewed as the main source of the country's food supply (Alcalá, 2003). The second period, in the seventies, called "rollback" because previous ordinances of the fifties (DOF, 1974) were rethought and repealed with the same strategies but without a significant contribution (Castañeda, 1995). The third period, in the nineties, is characterized by "searching sustainable development", when countries invest efforts to incorporate environmental issues in government agendas (Caddy and Cochrane, 2001).

The most recent period is called "transition to neoliberalism" because an economic instrument was implemented for the first time in a marine protected area. The Mexican government and international organizations invested $53 million USD for conservation purposes (INE-WWF, 2007). This latter instrument differs from previous ones because it seeks

to compensate the regional fishing industry to end fishing activities. Always, from the first decrees the main motivation was fisheries decline in the area (DOF, 1955a,b, 1986, 1988a,b, 1994a, 2009).

4.1. *Proposed stages for the analysis of environmental policies*

4.1.1. *The boom (mid-1950s)*

Environmental laws did not exist as it, sectorial laws worked as environmental laws if providing control enforcements as minimum size catching, ban, or any other measure to restrict intensive use or protect a natural resource itself. In our case, fishing laws contained issues that could resemble what environmental law is understood nowadays. In 1954, Mexico hosted a FAO fisheries training on finfish waste bycaught by shrimp nets (Hernández-Fujigaki, 1988) because bycatch includes a wide variety of invertebrate and vertebrate species. Institutions providing the basis for managing GC resources had the mission to increase exploitation and fishing yield (Castañeda, 1995). Mexican specialists of the time indicated the need to promote research and formulate a business plan to increase the yields without risking fish species (Soberanes-Fernández, 1994). None of these institutions were concern in ecosystems conservation, but their measures goal was to maintain fish populations to increase yields and obtain greater economic benefits (Caddy and Cochrane, 2001), as expressed by the 1950 Law of Fisheries (DOF, 1950).

Instruments related to this period are from 1949 to 1955. The first was aimed to the shark fishery due to its intimate relationship with totoaba bycatch (DOF, 1949). The first 1955 instrument temporarily forbade totoaba and cabaicucho capture (Fig. 3a) (DOF, 1955a) and responded to the statistical decline in totoaba's catch, despite previously taken protective measures. The objectives of this decree were the preservation of totoaba to benefit the fishermen cooperatives, which by law had the exclusive right of this fishery. The second 1955 decree set a protected area (DOF, 1955b) consisting of a natural breeding ground for important fish species (Fig. 3b).

4.1.2. *Decline (1970s)*

In 1974, decrees established fish population's reserve and recovery areas. In 1975 one decree totally and indefinitely forbade totoaba fishing (Fig. 3a). These decrees repealed those of 1955. When the 1974 decree set the boundary limits of the banned area near the Colorado River mouth, there was a decrease in the geographical spread, reducing the banned polygon's area (Fig. 3b) declared in 1955. The 1970s decrees were based on the Federal Law of 1972 for the Promotion of Fisheries intended for the maximal use (not necessarily sustainable) of fish stocks (DOF, 1972) and supported by the fact that during that period, the offshore fishing fleet doubled its size and artisanal fleet and number of cooperatives tripled (Soberanes-Fernández, 1994). Likewise, the artisanal fisheries sector enjoyed easy access to credit and promotion programs. Shrimp cooperatives had access to credit and government guarantees for their fleets (Alcalá, 2003). Cardozo-Brum (2006) express, that even when programs of previous administrations have achieved the proposed objectives, they were renamed only to show a personal stamp.

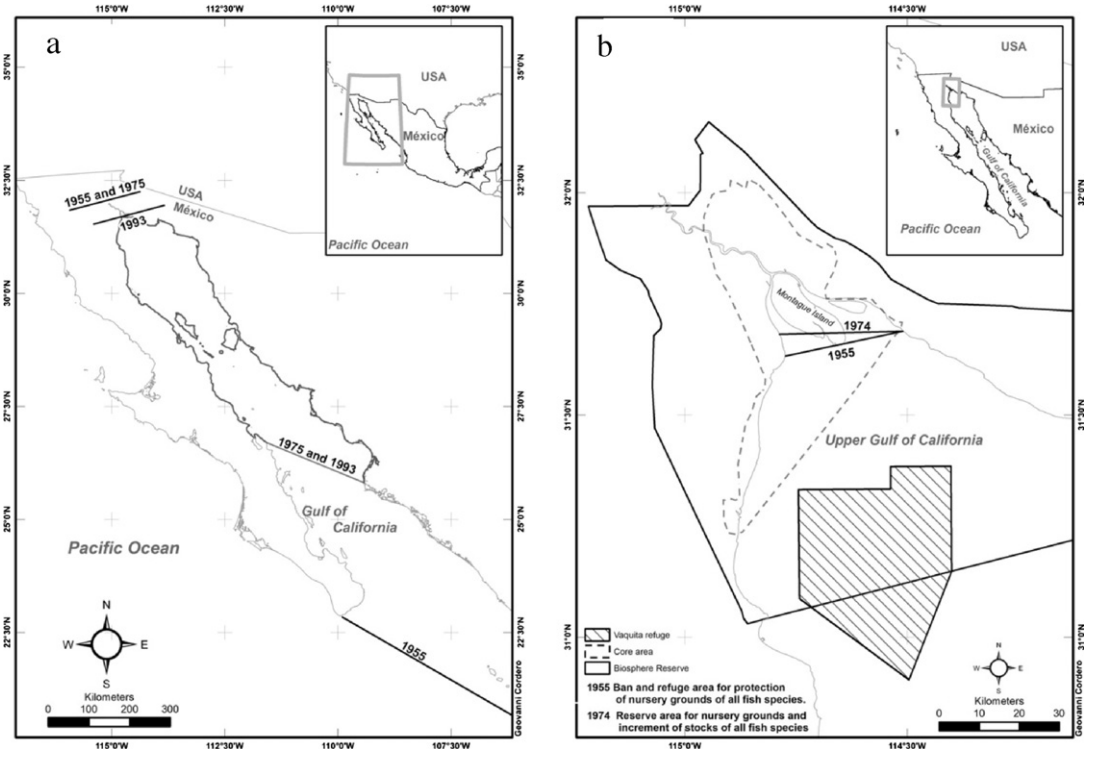

Fig. 3 – (a) Area temporarily closed to totoaba and cabaicucho fishing, 1955; area totally and indefinitely banned for the totoaba fishery, 1975; area for the totoaba and vaquita protection, 1993. (b) UGCCRD buffer and core area polygons. Shadowed is vaquita protection area, 2005.

4.1.3. *Search for sustainable development (1990s)*

A period marked by increased concern of environmental conservation and sustainability of fishery resources (Caddy and Cochrane, 2001). Mexico adopted commitments to amend international environmental policies. Natural resources were considered a key strategic reserve for national sovereignty and country's comprehensive development.

The National System of Protected Natural Areas was consolidated. This period was characterized by the Departments of the Mexican Federal Government creation and a legal environment framework. In 1995, INE presented a comprehensive study of the Mexican coast incorporating into the government's agenda a new planning and environmental policies approach (Ortiz-Lozano et al., 2005).

The highlighted strategy from the 1990s decrees is the change in fishing gear intended to allow benefitting from fisheries while taking care of natural resources (Fig. 1). These measures proposed fishing practices in order to keep fishermen's income, but also sought not to detriment marine ecosystems. The vaquita was incidentally caught in fishing nets called ''totoaberas''. The use of these nets was banned in 1993. At the same time, the UGCCRD was declared a Biosphere Reserve (Fig. 3b). The southern marine boundary considered by this decree was already in the 1975 decree that banned fishing of totoaba (Fig. 3a). This decree was amended later in 1993 in its nomenclature to become an official Mexican norm, since it ceased to be governed by the Secretariat of Fisheries. The biosphere reserve decree declared total and indefinite ban on pursuing and catching vaquita and totoaba, both in its core area as well as in the buffer area (Fig. 3b).

The UGCCRD Reserve Management plan was published in 1995 (DOF, 1995). The International Committee for the Recovery of the Vaquita (CIRVA) in 1997 declared that gillnets were the most hazardous factor for the vaquita mortality, and recommended their immediate prohibition (D'Agrosa et al., 2000; Rojas-Bracho and Jaramillo Legorreta, 2002). The most precise estimate of abundance based on a 1997 survey was 567 vaquitas (95% CI 177–1073) based on Jaramillo-Legorreta et al. (1999). In 2008, total vaquita abundance was estimated to be 245 animals (CV = 73%, 95%CI 68–884), 57% lower than the 1997 estimate (Jaramillo-Legorreta et al., 1999). This means an average rate of decline of 7.6%/year due to bycatch in gillnets (Gerrodette and Rojas-Bracho, 2011). The 2000 Mexican National Fisheries Chart reported that to prevent its extinction its incidental mortality in mesh and gillnets should be under 0.2% per annum. This is less than one vaquita killed per year or zero bycatch (Jaramillo-Legorreta et al., 1999; D'Agrosa et al., 2000; Rojas-Bracho and Taylor, 1999). More recently, Gerrodette and Rojas-Bracho (2011) estimated that only by eliminating entangling and gillnets throughout vaquitas's habitat the probability of success of the recovery plan PACE-vaquita is >0.99.

An emergency regulation (DOF, 2002) was issued to again establish measures to protect marine and coastal ecosystems, with main emphasis on species with endangered status living.

4.1.4. *''Transition to neoliberalism'' period*

The adoption of this doctrine in Mexico began in 1987 and although it is not completely neoliberal yet, the system is reflected in the fisheries sector in the granting of rights to private entrepreneurs and fishing cooperatives, leading to over-capitalization and overfishing (Ibarra et al., 2000). In this period, it was established an economic instrument to prevent the extinction of the vaquita and other species, and promote the economic sustainability of communities through a compensation schedule for fishers, long enough to implement the cessation of fishing with gillnets and make their conversion to other economic activities (Fig. 1). There is a substantial change in the applied strategies, and the instruments are no longer only for direct regulation but complemented with economic instruments as Wilcove and Lee (2003) mention to promote wildlife conservation elsewhere. This instrument rationale was the fisheries acute crisis and overfishing impact on trophic food chains (García and Gómez-Palafox, 2005), mainly bycatch in the shrimp trawling fishery and fisheries with gillnets (Cisneros-Mata et al., 1995).

In 2005, the Economic Compensation Fund for Gillnet Fishing and the Promotion of Alternatives to the UGCCRD's Fisheries was established as a strategy to protect vaquita (INE-WWF, 2007) which was implemented through the Action Program for the Conservation of Species (PACE-vaquita), where the government seeks to support individuals and families whose welfare would be affected in the short term for not fishing (Fig. 3b). This period resembles the smart regulation model (Gunningham and Grabosky, 1998) although incomplete as shown in the following section.

A national commission for federal policies was created, making compulsory federal programs evaluation. The economic instrument design was assessed (Arellano, 2008) showing that there is congruence between objectives and success indicators. The implementation impacts of the program will be assessed in the future and will learn lessons as mentioned by Holland et al. (1999).

5. Discussion

The main finding of this research is the policies symbolic implementation which emphasizes that the rational use objectives are still prevailing over the conservation aims. This is not different from other fishing and biodiverse marine areas in the world. As Hanna (1999) mentions, governance of the world's marine fisheries is ill-adapted to sustainability. Basic requirements for healthy ocean fishery governance are not being met because the scope and structure of governance are weak. Although the particular forms of weakness vary with fisheries and with geopolitical regions, the substance of the weakness is common across all regions.

Fisheries and conservation are inextricably linked – not only through the prosecution of fisheries in oceans ecosystems, but across the continuum of international obligations, policy frameworks and standards, management institutions and tools, and science support needed to choose responsible strategies and tactics for management (Rice and Ridgeway, 2010). The three local problems between rational use and conservation of natural resources mentioned in this paper represent worldwide marine conflicts: (1) the region is an area of high fish production facing problems of population decline of by overexploitation, loss of biodiversity, by-catch of non-target species as mentioned on other areas of the world

(Ludwig et al., 1993; Hanna, 1999; Rice and Ridgeway, 2010; Gilman and Lundin, 2010); (2) it is a marine protected area where convergent goals of conservation and use occur like Salomon et al. (2011) analyze in different case studies (European Union, Artic and Kenya communities), and (3) endangered species like vaquita, are by-catch of commercial fisheries as Zhao et al. (2008) mention for Yangtze finless porpoise (*Neophocaena phocanlides asiaorientalis*) and the baiji or Chinese dolphin river *Lipotes vexillifer* (http://www.iucnredlist.org/apps/redlist/details/12119/0) in China.

The decrees analysis and environmental policy literature review show that, while explicit policies and programs indicate a growing commitment to natural resources management oriented to sustainability, limitations prevail in the design and implementation of concrete actions. The main problem of these environmental policy instruments is that they were implemented without a clear implementation structure, there was no evaluation carried (*ex ante* neither *ex post*) as is suggested at present by most public policy theory and policy makers (García-Frapolli and Toledo, 2008; Svenfelt et al., 2010).

The Mexican fisheries regime has been conducted by fisheries policies and, more recently, environmental policies (Espinoza-Tenorio et al., 2011). Worldwide, the former are relatively new and still a process under construction (O'Briena et al., 2007). We identified some possible reasons why the tools have proven to be ineffective: (1) there has been no consistency between fisheries goals and conservation sectors, Espinoza-Tenorio et al. (2011) showed that the regulatory system encouraging sustainable fisheries management has been inhibited by inconsistent and contradictory policy directions; (2) decrees, although clear in their objectives, are not clear on how they will achieve success; (3) fishers only respond to their needs and interests, also because they are accustomed to State protection (Alcalá, 2003); (4) there is not enough honest inspection and surveillance, so illegal and improper practices continue damaging ecosystems and natural resources; Pedrín-Osuna et al. (2001) suggest that despite the protective efforts in the last years, clandestine totoaba fishing during the breeding season has continued, as well as bycatch by shrimp boats, but as an illegal activity, no measuring is possible and (5) objectives and justifications from one decree to another remain unchanged, there has only been a transcription of the conservation discourse. From the above, we consider the tug-of-war between the groups with contrasting views (sustainable use and conservation) making the policy-making ineffective.

Although, it is clear that substantial progress has been made in the strategies, the latest approaches to integrated management still challenge the subject of sustainability seeking social, economic and environmental equity. When dealing with protecting marine ecosystem or flagship species, like the vaquita, the federal authorities that should regulate fishers (i.e., SAGARPA) decide *to be on the side of the fishers' interests, and they induce a very hard situation of conflict with agencies like SEMARNAT, whose objectives are related to the rational management of natural resources within MPA's, and the livelihood of local communities* (Diaz-de-León, personal communication).

There are noted inconsistencies in the instruments texts between the objectives and what actually happens. In the "search for sustainable development" period, the 1993 decree that banned totoaba fishing nets to protect the vaquita leads us to inquire: why after 18 years since "the boom" period that a total ban on totoaba fishing was enacted it was not implemented and the nets used to catch them were still being used? This is another example that in Mexico the laws have often been a dead letter, and there is a strong need for effective law enforcement. Possibly, if instruments in the boom stage would have been assessed it would have not been necessary to design or implement any other one.

Measures to protect totoaba have been handled in a way that is clearly ineffective, because the instruments have focused on the protection of adults without regard to juveniles. Cisneros-Mata et al. (1995) and Pedrín-Osuna et al. (2001), suggest that adult poaching and juvenile bycatch by the shrimp fishery may contribute to the still low abundances of the totoaba stock. This is possibly because the decrees have tried not to interfere with shrimp fishing at sea. The decrease in the totoaba population has been attributed to the lack of input of fresh water from the Colorado River to the UGC (Berdegué, 1955; Lercari and Chávez, 2007). However, it has also been questioned why after more than half a century of putting into operation large dams (Hoover in 1935, and Glenn Cannyon in 1961) the species has not yet been extinguished.

The shrimp fishery was related to the decline in the population of totoaba two decades after 1940 (Cisneros-Mata et al., 1995). These authors indicated that in the mid-1980s an estimated 120,000 totoaba juveniles died each year as bycatch-in shrimp nets, and 6200 adults (average weight 26 kg) due to poaching. Valdez-Muñoz et al. (2010) reported that the catch per unit effort of juvenile totoaba (16.5–31.5 cm) did not correlate with the salinity of the UGCCRD and concluded that the reproduction of totoaba did not require brackish water.

Taking Valdez-Muñoz et al.'s (2010) capture values of juvenile totoaba and multiplying them by the UGC area, we can roughly estimate an annual mortality of ~11,000 to ~60,000 juveniles considering a single sweep of the boat per unit area. Up to four passes of shrimp nets, on average, have been reported per square meter per fishing season (Pérez-Mellado and Findley, 1985; García-Caudillo, 1999). Therefore, mortality of juvenile totoaba in the UGCCRD must be much larger than our estimate and known by fisheries authorities for more than three decades. In 1973, in the decline stage, the local university registered shrimp boats trawling catch contained 247 juveniles of totoaba measuring 7–27 cm in length among other species of fauna and recommended a permanent banned area for trawl fishing in a triangle in the UGCCRD (Guevara-Escamilla, 1973). Despite, this was not reflected in the 1975 decree, neither in subsequent years. If the former recommendation would have been followed since 1975, perhaps it would not have been necessary to implement any other instrument.

What happened to the totoaba has also affected many other species. Brusca (2010) mentions that taking advantage of the shrimp's bycatch has greatly changed over the past half century. Nowadays, life on the UGC seabed is dominated by scavengers.

Historically the legal instruments have not completely achieved their objectives because new strategies for the same

problem are still being proposed, possible this happened because there are no effective evaluations and if evaluation is provided, methodologies used for evaluating new programs is limited since it does not question the policy itself, it only looks for congruence between objectives and the strategies to reach them.

Finally, this is the first time that marine environmental (fisheries and conservation) instruments in the area are compiled and explained in a temporal scale to understand their role in the regional public policy as Espinoza-Tenorio et al. (2011) did for the whole country. General issues we recommend like the last decrees enforcement intending to protect marine resources and ecosystems of the Upper Gulf; or particular recommendations as is the protection of totoaba juveniles in the UGCCRD by banning all fishing gear catching these juveniles within the Reserve. But the assessment of these instruments to measure environmental policies success in order to make the decision if other ones need to be decreed, if existing ones need to be modified or better enforced is a process strongly needed and in starting to be appointed by the Mexican government.

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