Prospective of the natural protected areas of the south of the Baja California peninsula

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Abstract

Natural Protected Areas (NPA's) constitute fundamental instruments in the enforcement of environmental policies and are considered essential to preserve biodiversity. NPA's are also perceived as an important engine for sustainable development. Mexico is one of the countries with the highest levels of biodiversity in the world, ranking as high as fourth in the global biodiversity scale by country but also some of the most threatened and with highest erosion rate. Within this scenario, the Mexican government is currently promoting NPA's as mechanisms to protect and encourage the sustainable development of many regions of environmental importance over the nation. Among these, the Peninsula of Baja California is a privileged geographical area with a high natural, historical and cultural value, which importance has been recognized not only by the Mexican government, but on an international scale. A great percentage of the peninsula's territory (42%) is currently under protection. Baja California Sur is the Mexican state with the longest coastal line, and both the highest annual population growth rate with a huge pressure from tourist development. It is also the Mexican state with the highest proportion of NPA's in its territory. In this context, this study presents the description of these NPA's, and elaborates on their importance, their major perceived challenges, and finally, as a result of two workshops and Delphi method development, the main threats and some recommendations for the sustainable development of the NPA's in the state of Baja California Sur.
Keywords: Baja California, natural protected areas, NPA.

1 Introduction

The NPAs are strategic planning tools in areas where different natural resources are preserved and can become generators of multiple socio-economic and cultural

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benefits. The NPAs help to maintain key habitats, to provide shelter, and to enable migration and movements of species, ensuring the maintenance of natural resources. They are the main source of drinking water for more than a third of the largest cities in the world, and are important protectors of the safety of the food sources of the planet. According to Kettunen *et al.* [1] globally, it is estimated that the value of the benefits provided by protected natural areas exceed by far the costs of their conservation.

Mexico has begun to establish specific actions for the protection of NPAs. These actions focus in the generation of strategies designed to contribute to increase the resilience of ecosystems and to absorb the shock of extreme weather events (e.g. cyclones, storms, droughts); or lessen the impacts and risks associated with these phenomena, in order to reduce the vulnerability of population systems within the NPAs. According to the UNESCO [2] Baja California Sur is the state of greater coastal extension and the greatest diversity of marine resources in Mexico. Its natural resources have a great importance in different economic activities at national and international levels: business and tourism, fisheries, aquaculture, recreation. This has provided the ideal scenario to create protected areas, in order to preserve natural resources but at the same time respecting, instructing and supporting socio-economic activities of localities, fig. 1.

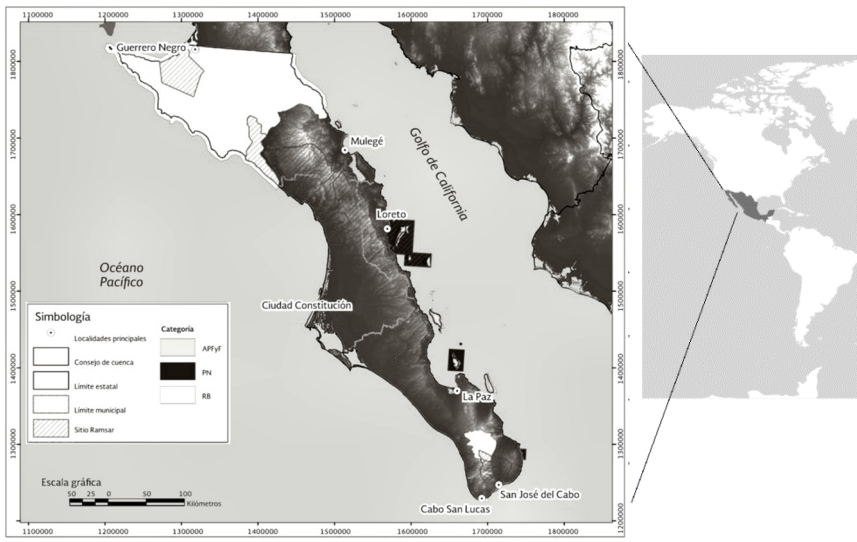

Figure 1: Baja California South natural protected areas.

In this context, this paper seeks to integrate economic, social and environmental information of the NPAs in the state, along with a brief description of the relevant issues that can contribute both to improve environmental health, and provide elements to improve the quality of life of local populations.

2 Characterization and diagnostic

A key aspect in environmental planning is not only environmental characterization, but the definition of the economic and social areas of interest, as well as the delimitation of the different micro regions that compose them, in order to facilitate their comprehensive and specific evaluation. To obtain our first base of information a compilation and analysis of available databases environmental, economic and social in each NPA was performed. This paper summarizes the different NPAs of Baja California Sur, their extension, and type of protection – from the federal to the municipal levels, and if they possess an international status of protection, such as those established by UNESCO and Ramsar. In order to corroborate the information and establish a uniform system of analysis, the Regional Directorate of the CONANP, which defines the most relevant NPAs based on population centres, was used.

A program that included both sampling and surveys was conducted in the Natural Protected Areas to verify, among other things, the coverage area and its location in relation to the sources of human impact, tourism activities and other possible sources of stress provoked by the human population of the area. The intention was to locate the most important problems in the areas for further evaluation of their vulnerability. The information was integrated to a Geographic Information System (GIS) generated in its thematic maps at a 1:250,000 scale was used for the elaboration of the GIS. Subsequently, a base map for each NPA map was generated. Once each Bounded Environmental Functional Unit (or micro-region) was delimited, thematic layers were determined to begin the process of intersection (micro-watersheds, physiography-reliefs and edaphology), offering an overview of the distribution and patterns of the different areas that compose each micro-region. The first integration of the three thematic layers resulted in the conformation of the Environmental Units (EU) without a specific hierarchy. Consecutively for each of these micro-regions, three thematic layers (micro-watersheds, physiography and edaphology) from different sources were integrated. As a final step each of the micro-regions was described, and their most important features were highlighted. In this last stage six micro-regions that include the NPAs of four municipalities in the state (Mulege, Loreto, La Paz and Los Cabos) were obtained.

In 2014, two workshops were held, with a separation of 6 months. These workshops included key members, managers, population and experts of the NPAs (Delphi Method). These workshops were seen as a fundamental element of analysis regarding the matters relevant to the community and the possible threats to the NPAs. This assessment can also serve to shape proposals for improving the operation of each NPA. The most relevant aspects of each NPA are described and referenced below.

2.1 El Vizcaino Biosphere Reserve

The Biosphere Reserve El Vizcaino (REBIVI), is located in the central portion of the Baja California peninsula with an area of 2,546,790 Ha and is the largest NPA

in the state. It is surrounded by the Pacific Ocean and the Gulf of California and includes coastal environments, plains, steep mountains, hills, plains and wetlands (Álvarez-Castañeda *et al.* [3]). Overall, its climate is very dry. In the ground portion of the reserve there have been found 463 plant species, 37 of which are endemic, all belonging to xeric vegetation. Regarding marine vegetation, the west coast has a larger abundance of species than the Gulf of California, as seasonal upwelling and a feedback of nutrients from the California current helps sustain the major fisheries and mangrove populations (Morgan *et al*. [4]).

The REBIVI has ecological, scientific, historical, cultural and recreational importance, and on this basis in 1993 the World Heritage Committee of the Organization of the United Nations Educational, Scientific and Cultural Organization (UNESCO) awarded the title of *World Heritage* to the Cave Paintings of the *Sierra de San Francisco*, as well as the *Ojo de Liebre* and *San Ignacio* lagoons, as they host exceptionally valuable ecosystems. Also in 2004, theses lagoons became Ramsar sites, and are also Bird Conservation Importance Areas (AICA). According to Arizpe *et al.* [5] Ecosystem services provided by the reserve include a sanctuary for migratory birds and wildlife of great importance, both nationally and internationally. The main threat, not only for this NPA, but for the entire Baja Peninsula is the mining industry. The first stage of the mining company project Arc-Minera Mexico has been recently authorized; it is estimated that this project will generate a high environmental impact, leading to the decline of the zone and a significant reduction of the aquifer mantles.

2.2 Sierra La Laguna Biosphere Reserve

The area known as Sierra La Laguna was declared a Biosphere Reserve in 1994, and has an area of 112,437 ha. It is located in the southern part of the state of Baja California Sur (Schmidt and Ortega [6]). As a direct result of its isolation and other geological processes, the region presents a high endemism. The NPA has great environmental relevance, as it contains unique ecosystems and has a great value as a recharge site for a significant number of aquifers. The particularity of physical factors and the environment in this area helps the development of different types of vegetation: scrub, tropical deciduous forest vegetation or gallery forest, oak forest, pine-oak forest and grassland (CONANP [7]).

Currently the estimated population of Biosphere Reserve Sierra la Laguna (REBISLA) is of 371 inhabitants, and the major threats to its safety are: illegal logging, poaching, unplanned exploitation of forest resources (timber and non-timber), ranching, erosion and soil degradation, and mining (CONANP [8]).

2.3 Loreto Bay National Park

Loreto Bay was declared a National Marine Park in 1996, and its total area is of 206,580 ha. In 2004 it was designated as a Ramsar site, and in 2005 as a World Heritage site by UNESCO (Breceda *et al.* [9], DOF [10, 11]). The Bay of Loreto National Park (PNBL) has a variety of marine coastal environments with rocky, sandy bottoms, beaches, canyons, submarine canyons and submarine terraces. The ecosystem services of the Park have significant recreational components for its

unique scenic beauty, biodiversity and whale watching areas, where blue, grey, humpback, sperm and killer whales can be found. The Park also provides habitat and ecological support for about 30 species of marine mammals. The insular environment is characterized by high species endemism in plants, insects, reptiles and mammals (Hernández *et al.* [12]).

The main threats identified in the area are associated with the impact of the traditional 'sun and beach' tourism. In Mexico the parastatal entity known as FONATUR, was established since 1974. Shortly after its foundation, they began promoting mega touristic developments that do not take into account environment or sustainability. As a result of this, and in meetings held with the population Arizpe-Vicencio *et al.* [13] observe that the citizens of Loreto have repeatedly expressed their concern over the great risk of depletion of the main aquifer in the region (San Juan Londo), unplanned settlement of desalination and the deterioration of the coastal zone. At a meeting held in February 2015, the community expressed a new concern: the arrival of mining projects to the municipality of Loreto.

2.4 Cabo Pulmo National Park

The only coral reef in the Gulf of California was declared a Protected Natural Area in 1995, and a World Heritage Site (UNESCO [2], DOF [14]) by UNESCO in 2005. The Cabo Pulmo National Park (PNCP) has an area of 7,111 ha. Cabo Pulmo is also the northernmost coral reef in the Eastern Pacific and represents a particular types of habitats, biological communities and physiographic features; situation that gives it not only a considerable regional significance, but great environmental importance. The Park is home to eleven of the fourteen species of hermatypic corals recorded for the Gulf. Even after 20 years of its establishment as NPA, Cabo Pulmo can be seen as a world example that conservation can generate benefits for both the environment and the local communities (Arizpe *et al.* [5]).

A possible threat to the Park is represented by two adjoining projects located within the northern and southern boundaries of its territory. The Golden Cape development, in particular, as it aims to establish approximately 30,000 hotel rooms in a small area, is marked by most evaluations as a negative influence on the NPA due to its proximity. Other possible threats for the Park are the destruction of coastal dunes and non-regulated commercial and sport fishing in the vicinity of the Park.

2.5 National Park Archipiélago de Espíritu Santo

The Park was declared as a part of Gulf of California Island Reserve in 1978. In 2007 the decree declaring it as a Protected Area, with the category of Marine National Park was published by the Official Journal of the Federation. The Espiritu Santo Islands have a total area of 48,654 ha. These islands are almost aligned on a north-south axis of nearly 20 km in length and possess a maximum width of 8 km in the central portion of the largest Espiritu Santo Island (CONANP [16]).

Amongst the main characteristics of the Park we can include: a high biodiversity, a significant number of terrestrial and marine species, of which many

are endemic, it being an important habitat of threatened and endangered species and also many other which possess commercial, cultural or recreational value. Furthermore, mangroves in the Park are important sites of breeding, nesting and feeding of various species of birds and marine species, both endemic and migratory, including several of commercial interest. They also serve as buffer from possible storm damage; serve as nitrogen fixators and capture carbon and as stabilizers of costs and drivers erosion. As the Park is only an hour away from the capital city, and one of the main population centres of the state, La Paz, the main identified threats for the Park are associated with an increment in the loitering and a saturation of its visiting areas. There has also been an increment in the number of providers of tourist services, and in the damage generated to the endemic flora of the area by the introduction of animals as goats and cats.

2.6 Protection areas of flora and fauna in the Gulf of California Islands

These areas were established in 1978, creating a conservation area and refuge for migratory birds and wildlife on the islands of the Gulf of California (IGC). From 2000, these areas were considered within the category of Protection Areas of Flora and Fauna in the Gulf of California Islands. In 2005 these areas were declared World Heritage Site by UNESCO [2], DOF [17].

There are about 900 IGC and they are known worldwide for their beauty, biological richness and the high productivity of the waters that surround them, which has led the Mexican government to promote the implementation of policies for their conservation; one of these actions was the establishment of the islands as a NPAs (CONANP [18]).

The islands are home to numerous breeding colonies of sea lion (*Zalophus californianus*), and they are an important resting centre of birds during their migration; some of the islands also present endemic or "type" ecosystems in a good state ecological conservation. Such is the case of Tiburón Island, quite possibly one of the most well preserved 'Sonoran Desert' type ecosystem sites.

The evaluation in this study has noted that the islands have a high degree of vulnerability, mostly due to the impacts caused by human activities. The species of the islands, which have evolved in the absence of other predators, are particularly threatened against the introduction of plants and animals foreign to their habitat, as in the case of goats, cats, fish and non-native herbivores.

2.7 Protection area of flora and fauna in Cabo San Lucas

This area is one of the oldest protected areas in the peninsula, having been designated since 1973 and has a total area of 3,996 ha, of which 208 ha is land area and 3,787 ha marine surfaces. In 2005 UNESCO designated this area as a Heritage Site (UNESCO [2]). The basis for declaring it as a NPA was because it is an area of the Baja Peninsula where a submarine canyon starts. The particular placement of the canyon and the movements of the zone produce unique sand-falls in the sea-bed. These sporadic phenomena caused this area to be declared as an underwater haven where all the uniqueness of this spectacle can be preserved (CONANP [19]).

The human settlements in the area have caused erosion problems that threaten to change the environment. The large amount of solid waste and polluted water threaten to pollute the marine systems. Despite environmental regulation, there exists a high presence of traditional tourism projects with many negative impacts on the environment. Despite the establishment of a decree that prohibits fishing within the NPA site, there is a strong conflict between sport fishing and commercial fishing. The presence of ships, both of the tourism sector and of commercial fishing, has caused considerable environmental damage. Malpractice by part of divers and tourists visiting the reefs also represent a threat; some guides and instructors handle wildlife to show it the visitor. However, different specialists and managers of the community agree that the main pressure and threat to the Area is the overfishing of species (DOF [20]).

2.8 Protection area of flora and fauna Balandra

The Balandra region was designated as a Ramsar site in 2008, with an area of 449 ha. The designated area includes two wetland areas: Balandra and El Merito. Balandra has the largest mangrove area within the Bay of La Paz, located in the Gulf of California. The roots are a substrate for various agencies and form a filter which promotes the settling of organic and inorganic material carried by currents (CONANP [21]). The flora community of this region is manly composed by *Rhizophora mangle*, *Avicennia germinans* and *Laguncularia racemosa* mangroves. The proximity of mangroves, sea-grass beds, rocky shores and a small coral spots, facilitates the trophic transfer and use of habitats by fish and invertebrates. This signals the great importance of the mangrove community in the maintenance of the abundance of several marine species [21]. Several of these species are recorded in the various lists of species of ecological, economic and cultural importance in Mexico (Balvanera and Cotler [22]). Between the perceived ecosystem services provided by the NPA we can mention a source for the existence of biodiversity, ecosystems and habitats which provide a high landscape value, tourist-recreational, economic and social values. These services also maintain the balance in the ecosystems of the region; they serve as the basis of the food chain and serve as a regulator of the insect and rodent populations, among others.

2.9 State Ecological Reserve Estero de San José del Cabo

In 1994 the Official Gazette of the State of Baja California Sur released a decree designating the "Estero de San José del Cabo" as State Ecological Reserve (REE), with an area of 487 ha. The official area delimitation has been changed 3 times to date (Reyes and Santoyo [23], GOB BCS [24]). It is also important to note that the area of the Estero San José is considered as an important Migrating Bird Area in the Peninsula (INE-CONANP [25]), and was designated as a Ramsar site in 2008.

Biogeographically, it belongs to the Cape Region and politically, to the municipality of Los Cabos. The closest and most important city located within the basin is San José del Cabo. This ecosystem holds a great importance for the region, as it contains unique plant species and contains many important wildlife corridors and refuges. One of the most important features of the site is the presence of the

oasis of San Jose and the estuary of the same name, which is one of the largest epi-continental environments.

The characteristic flora community of this estuary is formed by species typical to oasis habitats like palm trees, reeds and aquatic species. It is the last resting spot for waterfowl and shorebirds that migrate to areas of southern Mexico, Central or South America.

This wetland is extremely dynamic, and the pressure of urban development and tourism in the last two decades has led to the disappearance of its original geomorphology. These problems are becoming increasingly frequent and durable, and cause an important environmental damage in the system.

3 Final discussion

While in Baja California Sur only a small percentage of the population knows what 'Natural Protected Area' means, a great portion of the community is aware of the need to protect areas that have not been affected by man and almost half of the population know of the existence of institution responsible for the supervision and protection of NPAs in Mexico. Despite this, more than half of the people living within the NPA are not familiar with the management programs, rules and regulations of the NPA in which they live, and are only aware of the permitted and prohibited activities.

This responsiveness is also reflected in the interest of the local communities to have contact with authorities and engage with them in meetings, workshops and forums to learn more about the importance of the areas where they live. This interest can be channelled to integrate the community in the efforts for the protection of the NPA. The greatest threats and challenges that the NPAs of Baja California Sur currently have to confront are:

a. A considerable increment in the rate of land use change.
b. The reduction of the coastal zone.
c. An increment in the frequency and magnitude of storms.
d. A reduction of the harvest yield due to extreme weather conditions.
e. A reduction in the live stocking.
f. Shortages in the fisheries yield.
g. Loss of biodiversity.
h. Tourism reduction due to damage in the coastal zone.

According to the information available, it is considered that the southern portion of the peninsula of Baja California is an area particularly exposed to natural hazards like tropical cyclones, sudden mudflows and river floods, landslides, earthquakes, coastal erosion, coastal sediment accumulation, tsunamis and storm surges. Of these potential hazards, hurricanes are those that have caused more damage in both human lives and material losses, so it is urgent to determine the most vulnerable areas in each micro-region, in order to issue the appropriate specific adaptation and mitigation measures.

Baja California Sur has an enormous environmental, economic and social potential in different productive sectors. However it is also highly vulnerable to the effects of climate change; which highlights the importance to implement and regulate actions that lead to strategies of adaptation. To achieve this, we must deepen the vulnerability assessment in each micro-region of the NPA state, prioritizing those that concentrate in the largest centres of population.

The integration of information and analysis of environmental regionalization of NPAs plays a decisive role in the conservation of environmental goods and services different regions, such as the recharge, discharge and storage of the aquifers, the development of flooding containment and the avoidance of the degradation of the land and other services provided by the NPAs. Moreover, these elements can be seen as a contribution for the decision-making process and the implementation of public policies, which is urgent in developing countries with a high rate of environmental degradation like Mexico.

These public policies should also aim to generate a stronger link between the different sectors, governmental and nongovernmental institutions and academic sectors engaged in the investigation of NPAs; it is also necessary to create a regulatory framework to increase the involvement of society in the decision-making processes and make them partakers of the actions taken in the NPAs. NPA's management programs consider activities that contribute to improve the quality of life of the community, as is ecotourism. Currently there exist several authorizations for ecotourism and non-consumptive uses in the NPAs in Baja California Sur, which mostly focus their activities in the coasts of the state and mainly concentrate on watching different species of whales, birds, and other types of local flora and fauna, and camping, kayaking, scientific travel and eco-tourism and other low-impact activities.

A common threat in most of the NPAs studied is the presence of opencast mining projects, which are highly toxic and forbidden and in many parts of the world. To date a model of mining development in NPA has not been created, despite its urgency due the high number of mining projects that have been presented in these areas. The absence of a solid fisheries managements program also creates a lot of conflicts and the risk of overfishing; this highlights the urgent need that the competent authorities formulate and implement its application as soon as possible in this region, which has the highest marine biodiversity in the country.

Finally, it is important to note that a mere declaration of NPAs is not the solution to the problems of environmental degradation in any region and country. This local or international declaration must be matched by an extensive consensus of the population and local authorities, management strategies derived from detailed studies of characterization and diagnosis that ideally would lead to program activities more consistent with the characteristics of each micro region of the NPA. Unfortunately in Mexico a comprehensive strategy for public participation and community involvement in the processes of conservation and management of NPAs has not been created; although in different scenarios the involving of the local communities has proved to be the one of the best approaches

to counter and reverse the alarming environmental degradation present on our planet.

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