Developing the Gulf of California's Regional System of Marine Protected Areas

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Gulf of California Overview

The Gulf's Biological Richness.

The Gulf of California in northwest Mexico covers an area of 283,000 square kilometers (Brusca et al. 2004). Fourteen of the world's 32 marine phyla are represented in the Gulf (Brusca et al. in press) An estimated half of its faunal diversity is comprised of nearly 6,000 known macrofaunal species. The Gulf is home to 907 fish species (more than 55% of which are species from marine families), 240 sea and shore birds, 35 marine mammals (82% of all marine mammals found in the northeastern Pacific), and 4,818 known marine macroinvertebrates. (Findley et al. in press). Some authors estimate that more than 4,000 invertebrate species remains undescribed in this extraordinarily rich environment. Of all these species, 770 are endemic to the region, including the totoaba *Totoaba macdonaldi* , a giant corvina, and the vaquita *Phocoena sinus,* the Gulf of California's unique harbor porpoise (Findley et al. in press).

Cetacean species richness in the Gulf is outstanding. This sea has three of the world's four families of baleen whales (Urban et al. in press). Furthermore, its seafloor, together with 6,000 square km of coastal lagoons and 2,560 square km of mangrove forests, serve as reproductive, nesting and nursing sites for hundreds of resident and migratory species (Carvajal et al. 2004). The complex archipelago of the Gulf's islands — containing 922 islands and smaller islets — harbors 90 endemic species, five of which are critically endangered, and 60 of which are reptilian (Case et al. 2002). Such endemism significantly contributes in putting Mexico in global terms, as the second country with the highest reptile biodiversity (Mittermeier et al. 1998).

The Gulf's high biodiversity, biological productivity, presence of 770 endemic species and its 39 marine species listed on the IUCN Red List as threatened or vulnerable (Conservation International, 2004), make this one of the large coastal ecosystem conservation priorities on the planet (Roberts et al. 2002).

Socioeconomic Aspects and Challenges for Conservation

The Gulf of California region is not only one of Mexico's richest in terms of natural resources; it also holds one of Mexico's fastest growing regional economies. With some 26% of Mexico's land area and 8.8% of its population in the year 2000, the States surrounding the Gulf of California produced 9.1% of the country's gross domestic product (GDP). The Gulf is a large, still sparsely-populated area with human densities of only one-third the national average. It is also a relatively wealthy region within Mexico: the *per capita* contribution of Gulf inhabitants to the country's GDP is 5% above the national average. This productive advantage is even higher in the Baja California Peninsula and the State of Sonora, where the *per capita* income is about 22% higher than the national average. In particular, the region is a major contributor to the national fisheries sector, producing approximately 50% of the landings and 70% of the value of national fisheries in Mexico. The coastal plains of Sonora and Sinaloa are also major agricultural producers. Approximately

40% of the national agricultural production comes from this region, mainly supported by high-technology irrigation (Carvajal et al. 2004).

The *maquiladora* industry (meaning corporations with special foreign investment and import/export privileges) in Baja California and Sonora estates, the high-input crops and associated agro-industries in the agricultural valleys and the booming regional tourism industry are all powerful driving forces in economic and demographic growth (Ezcurra, 1998).

These economic indicators highlight some of the most pressing environmental problems of the region. On the one hand, open-access fisheries seem to have reached a limit, and little can be expected from this sector for future development. On the other hand, the rapid growth of the manufacturing and services sectors is putting an additional strain on the regional resources. It is extremely difficult to keep supplying services such as running water and sewage to cities that double in size every ten years. Rapid demographic growth means, almost by definition, an increasing pressure on the regional resources, both through an increase in demand for these resources, especially water, which is scarce in the peninsula. It also means an increase in pollutants that result from the uncontrolled urban growth and from the growing pressures on the deficient sanitary infrastructure, including poor drainage and lack of water-treatment facilities. Thus, the rapid expansion of the population linked to the more successful sectors of the regional economy is mostly done at the expense of depleting underground aquifers and destroying the natural ecosystems and watersheds that surround the largest urban conglomerates (Carvajal et al. 2004).

Of particularly concern are the agricultural runoffs fueling the marine systems. A recent study, shows for example, that some of the Gulf of California phytoplankton blooms are associated to Yaqui Valley' runoffs of Nitrogen associated fertilizers to the area (Beman et al. 2005). This study suggest that up to 22% of the annual phytoplankton blooms in their study area in the central Gulf of California are related to the nitrogen spilled by agricultural fields neighboring the Gulf. This study also predicts that these runoffs might increase by 2050 in a range of 27-50%, disrupting the oceanographic conditions and changing in turn the dynamics of all trophic levels in this vulnerable enclosed sea (Beman et al. 2005). Since this is not the only agricultural area under high rates of development, these results are of high relevance for the entire Gulf.

A Regional System of Marine Protected Areas

Complex human dynamics present within the region and the global conservation importance of the Gulf of California requires a long-term vision and strategy that will necessarily include two basic and apparently mutually exclusive goals. That is, to achieve conservation of the unique biodiversity present within the Gulf, while at the same time providing for the social and economic regional development needs.

One available tool for the protection and sustainable use of the Gulf's rich biodiversity is the establishment of protected areas (PAs). While Mexican law contemplates other environmental policy tools that can also be used to achieve the same objectives such as marine refuges, marine environmental zoning and fisheries concessions, these tools should be used in conjunction with a backbone of Marine Protected Areas (MPAs) that include by themselves a wide range of protection policies, zoning and management schemes. Sixteen coastal and marine PAs currently under legal status have been established within the region. Seven of them protect insular, terrestrial and coastal habitats including Isla Isabel National Park, Islas del Golfo de California, Valle de los Cirios and Meseta de Cacaxtla flora & fauna protection areas, Playa Ceuta and Playa Verde Camacho sanctuaries for marine turtles and El Pinacate y Gran Desierto de Altar Biosphere Reserve. Although coastal and insular areas serve as refugee for several important or endangered marine species such as marine birds or, sea turtles, no truly marine habitats are included within their boundaries. Other nine protected areas do include marine habitats (see Table 1 and Figure 1) and currently cover a total of 1,492,592 hectares of the Gulf of California's marine ecosystems within their borders.

A quantum leap on marine conservation was achieved over the last decade in the Gulf of California when seven out of the existing nine marine areas were created and management capacity was established for most of them. Professional personnel was assigned to these areas, participatory bodies to assist on their management were established, management plans were defined, legislation was updated and the budget assigned for managing most of these protected areas grew exponentially. The National Protected Area Commission (CONANP), which reports directly to the Environmental Minister (now SEMARNAT) was also created during this period (Bezaury 2004). Currently seven of the Gulf's marine protected areas are being managed by the National Protected Area Commission. Islas Marías Biosphere Reserve, still falls within the Jurisdiction of the Department of Interior (Secretaría de Gobernación - SEGOB) with a Federal penitentiary status that guarantees impacts from external factors. Only the recently established Islas Marietas National Park is still lacking a management structure.

Table 1. Institutional indicators and marine surface area, for marine protected areas in the Gulf of California.

Marine Protected Area	Established	Management Structure	Management Plan	Social Participatory Body	Total Marine Surface Area (Hectares)	Marine Core Zone Surface Area
CABO SAN LUCAS Flora & Fauna Protection Area	1973	2004			3,785	0
EL VIZCAINO Biosphere Reserve	1998	1993	2000	1997	49,451	0
ALTO GOLFO DE CAL Y DELTA DEL RIO COLORADO Biosphere Reserve	1993	1996	1995	1998	541,636	88,252
CABO PULMO Nacional Park	1995	2004		1998	7,111	0
BAHIA DE LORETO Nacional Park	1996	1996	2000	1999	183,711	0
ISLAS MARIAS Biosphere Reserve	2000	SEGOB			617,257	0
ISLA SAN PEDRO MARTIR Biosphere Reserve	2002	1999	Included with Islas del Golfo de California FFPA	Included with Islas del Golfo de California FFPA	29,887	822
ARCHIPÍELAGO SAN LORENZO National Park	2005	1999	Included with Islas del Golfo de California FFPA	Included with Islas del Golfo de California FFPA	58,443	8,806
ISLAS MARIETAS National Park	2005				1,311	7
TOTAL (Hectares)					1,492,592	97,887

Updated from Bezaury, 2004.

Despite the fact that the creation of these protected areas represents an important achievement for conservation, their geographic coverage is still not wide enough to adequately protect marine environments within a regional approach. The Gulf of California has an overall surface area of 283,000 square kilometers (Brusca et al. 2004). At the moment these protected areas represent only 4 % of the Gulf's surface area (14,925 sq km), a fraction that is still far from adequate for achieving significant conservation results. Only a small portion of these protected areas (979 sq km, representing 6.6 % of the Gulf´s MPAs surface area, or 0.26% of the Gulf's total surface area) have been zoned for full protection as Core Zones. Smaller areas have been subzoned as no-take zones in Bahía de Loreto National Park and Isla San Pedro Mártir Biosphere Reserve, through community agreements thus establishing local networks of community-based fully protected marine reserves within the protected areas system.

Halpern (2003) has suggested, that from 20 to 40% of the marine environment should be fully protected (this means excluding all extractive human activities), to achieve both conservation and sustainability of economic activities (e.g. fishing). Certainly this goal would be far too high and unrealistic to start up a concerted and socially inclusive conservation effort. Nevertheless, it is a guide that quantifies how much of the oceans should be protected over the long term. A specific target goal for the Gulf of California should be actively developed in the near future, through consistent monitoring and evaluations of regional conservation outcomes derived from the establishment and management of protected areas and the implementation of differentiated management regimes within or outside their borders, either as multiple use zones or as fully protected marine reserves.

Existing protected areas also still do not provide a good geographic representation of the Gulf of California's rich regional ecosystem diversity and are also still too scattered to provide for adequate connectivity between them. Using as an analytical framework, the Marine Ecological Regions of North America by the Commission for Environmental Cooperation [1](Wilkinson *et al.* In Preparation), all existing marine protected areas are included within the Gulf of California Level I Region, four Level II Regions out of six currently include marine protected areas and five Level III Regions out of nine currently include marine protected areas. Thus, the existing marine protected areas system, needs to be expanded to adequately cover the high diversity of marine regions within the Gulf of California and also to foster their biological interconnectivity.

A Scientific Participatory Approach for Designing a Regional MPA System

In order to identify and evaluate conservation priorities in the region, the Gulf of California Sustainability Coalition assembled a diverse group of local, national and international conservation NGOs, academic institutions and government conservation agencies, On 2001, "The Coalition" convened over 180 regional, national and international experts to a workshop in Mazatlán, Sianaloa, assigning them the task of identifying, analyzing and defining, those places of importance in the Gulf due to their biodiversity and the threats that jeopardize their existence (Coalición 2001a,

[1] **Level I** captures ecosystem differences at the largest scale, defining large water masses and currents, large enclosed seas, and regions of coherent sea surface temperature. **Level II** captures the break between neritic (near shore) and oceanic areas and is determined by large-scale physiography (continental shelf, slope, and abyssal plain, as well as areas of oceanic islands and major trenches, ridges and straits). **Level III** captures the differences within the neritic realm and is based on more locally significant variables (local characteristics of the water mass, regional landforms, as well as biological community type). Levels I and II extend from the coastline to the outer edge of the EEZ. Level III covers an area from the coastline to the shelf edge or the 200 meter isobath on oceanic islands.

2001b). A methodology was designed to achieve broad consensus by means of a highly participatory process that involved the following: (1) the independent, but coordinated, work of experts in task groups to integrate all available information on the key ecological and socioeconomic processes, as well as to generate updated inventories of species; (2) a workshop to identify (based mainly on the information gathered during the first stage) the biologically important areas, and to spatially analyze the anthropogenic pressure on biodiversity, as well as the potentiality for social conflicts; and, (3) the integration and spatial analysis of the results by means of a geographical information system. The analysis is rooted in a set of databases compiled by a selected group of 29 specialists and taxonomists prior to the workshop; represent the most updated inventories of species available, with more than 12,000 species recorded. From the analysis of these inventories, the conservation targets (defined prior to the workshop), the biological important areas and the socioeconomic human stress factors (Haro and Parra, 2000) were incorporated into a set of integrated biologically important areas, representing valuable results obtained through consensus of all workshop participants (Enriquez-Andrade et al. 2005). Other important outcomes of the workshop were a Geographic Information System and spatial databases regarding with physical oceanography, social and economic data and the inventories of species obtained during the planning process, were compiled in a CD format and distributed among the researchers, education institutions and policy makers in the region (Coalición 2001a, 2001b).

Further work was carried out after the Coalition's Mazatlan Workshop by scientists using a target based site identification methodology, in order to define the optimal distribution of areas needed to conserve the Gulf's reef fish (Sala *et al*. 2002). All this information was then analyzed in relation to shrimp trawling areas and current fisheries regulations in order to define a set of "Especially Important Areas for Coastal and Marine Biodiversity Conservation" (Bezaury *et al.* in preparation) for the Gulf of California.

Especially Important Areas for Coastal and Marine Biodiversity Conservation, represent a reduced amount of a region's territory, where a set of different protection strategies need to be implemented in order to maintain a functioning regional ecosystem. These strategies can include legal protection such as: the establishment of new protected areas, consolidation of legal protection regimes or the use of non protected area environmental policy tools for their protection, and/or social protection strategies through: private protection mechanisms or community coastal resources management schemes. Defining a specific mix of social and legal strategies that will provide optimal results for each "Especially Important Area" represents the next challenge. A challenge that requires important input from stakeholders all across the board. Nevertheless having a port-map at hand will prove to be an invaluable aid, while navigating towards the achievement of conservation and sustainable use of the Gulf of California's unique biodiversity.

The existing MPAs and specially Important Areas for Coastal and Marine Biodiversity Conservation cover approximately 15% of the Gulf's total area (Figure 1) and constitute a basic representation of the region's different habitats including: coastal wetlands, mangroves, islands, coral and rocky reef, sea grass beds, and hydrothermal vents. Currently, The Nature Conservancy (TNC) and Conservación y Biodiversidad (COBI) have undertaken an ecoregional planning exercise that will provide further information on still underrepresented deep benthic and pelagic habitats. It is our opinion that by implementing adequate management regimes over existing MPAs and by implementing successful individual protection strategies for all 38 coastal and marine areas (Figure 1), using them as a template for the establishment of new MPAs where applicable and socially viable, we will be making important strides towards insuring protection of biodiversity and regional economic sustainability, through the increase of: geographic coverage, biogeography representatively and connectivity of the resulting regional marine protected area system for the Gulf of California.

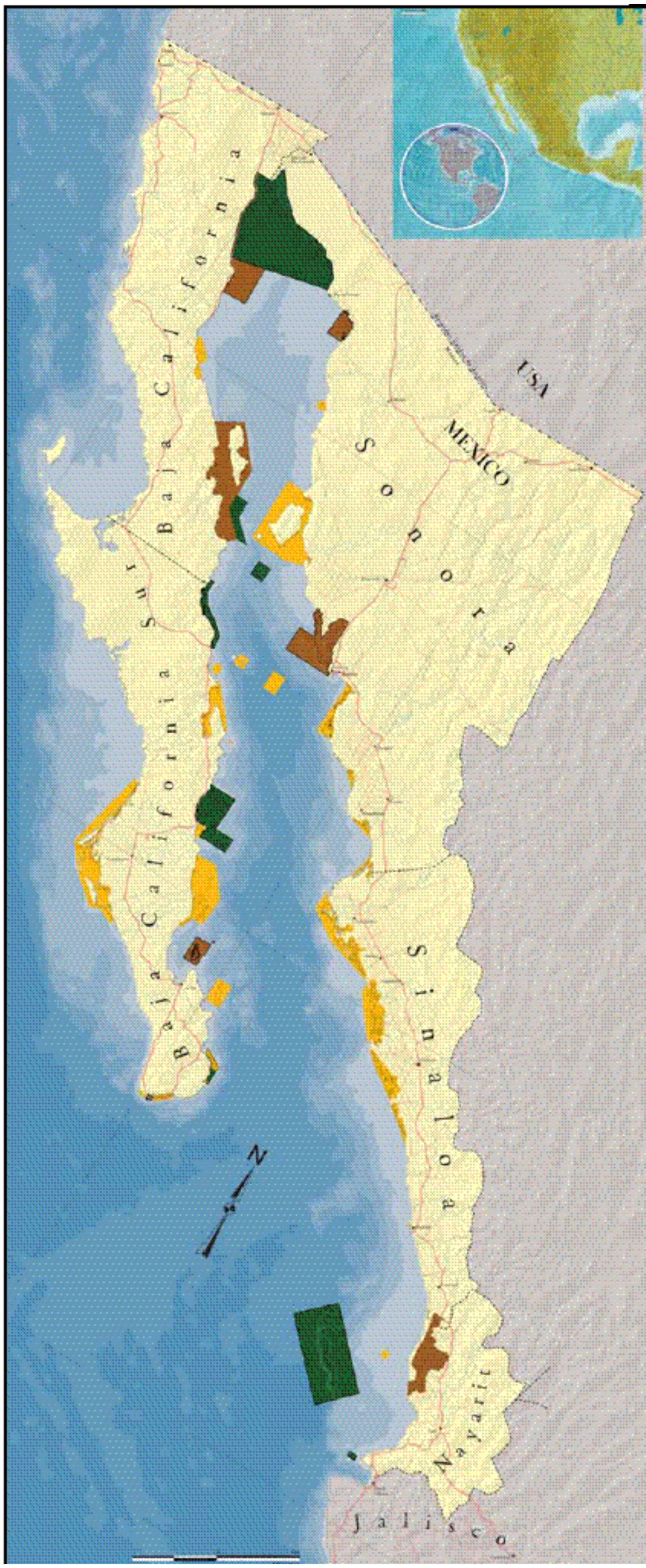

Figure 1.
Existing Marine Protected Areas and Especially Important Areas for Coastal and Marine Biodiversity Conservation in the Gulf of California

Established MPAs

Legal MPA Establishment Process

Especially Important areas for Coastal and Marine Biodiversity Conservation

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MAP DESIGN: Conservation International (CI)

Table 2. Existing marine protected areas and Especially Important Areas for Coastal and Marine Biodiversity Conservation as a blueprint for establishing a Regional MPA System for the Gulf of California, using the Marine Ecological Regions of North America as a framework.

18 Level I	**Gulf of California**	**Existing Marine Protected Areas**	**Especially Important Areas for Coastal and Marine Biodiversity Conservation**
18.1 Level II	**Cortezian Shelf**	Six Protected Areas	
18.1.1 **Level III**	Eastern Cortezian Neritic	• APFF Islas Marietas	• Arcos de Vallarta (legal update) • PN Isla Isabel (marine expansion) • APFF Islas de Mazatlán (marine expansion) **Integrated site conservation strategies which could include limited protected area implementation within their boundaries:** • Marismas Nacionales • Bahía de Ceuta • Altata / Ensenada del Pabellón, • Bahía de Santa María, • Topolobampo / Navachiste, • Laguna de Agiabampo • Yábaros / Bahia de Santa Bárbara, • Bahía del Tobári • Costa Yaqui.
18.1.2 **Level III**	Guaymean Neritic		• Guaima (El Peruano / Las Gringas / Islas de la Bahías San Francisco / Algodones) (marine expansion) • APFF Isla San Pedro Nolasco (marine expansion)
18.1.3 **Level III**	Tiburonian Neritic		• APFF Islas Tiburón and San Esteban (marine expansion)
18.1.4 **Level III**	Loboian Neritic		• Cabo Tepoca (marine)
18.1.5 **Level III**	Upper Cortezian Inner Neritic	• RB Alto Golfo de California y Delta del Río Colorado	
18.1.6 **Level III**	Upper Cortezian Outer Neritic	• RB Alto Golfo de California y Delta del Río Colorado	• APFF Islas San Jorge (marine expansion) / Estero Morúa • Vaquita Refuge
18.1.7 **Level III**	Northern Baja Californian Neritic		• PN Bahía de los Angeles (marine) • APFF Islas Encantadas / San Luis Gonzaga (marine expansion)
18.1.8 **Level III**	Southern Baja Californian Neritic	• PN Bahía de Loreto • RB Vizcaino	• APFF Isla San Marcos (marine expansion) • Bahía Concepción • APFF Isla San Ildefonso (marine expansion) • PN Bahía de Loreto Northern and Southern expansion (marine)
18.1.9 **Level III**	Cape-Cortezian Neritic	• PN Cabo Pulmo • APFF Cabo San Lucas	• PN Complejo Insular Espíritu Santo / El Bajo (marine expansion) • APFF Isla San José (marine expansion) • APFF Isla Cerralvo (marine expansion)
18.2 Level II	**Midriff Island Straits**	• RB Isla San Pedro Mártir • PN Archipiélago San Lorenzo	

18.3 Level II	**Gulf of California Slope and Basins**	• RB Islas Marías	• Hydrothermal Vents Cuenca de Guaymas (submarine protected area) • APFF Isla Tortuga (marine expansion)
18.4 Level II	**Gulf of California Plains and Seamounts**		An ongoing analysis is being executed by TNC - COBI
18.5 Level II	**East Pacific Rise**		• Hydrothermal Vents N 21° (submarine protected area)
18.6 Level II	**Mesoamerican Trench**	• RB Islas Marías	An ongoing analysis is being executed by TNC - COBI

From Bezaury *et al.,* in prep & Bezaury in prep. Underlined sites are currently under their legal establishing process.

Networks of Community-based Fully Protected Marine Reserves

The failure of fisheries conventional management tools (quotas, size limits on fish, gear modifications etc) to ensure sustainable catches and preserve life in the oceans, has resulted in a global call to change from a single species management approach to a broader ecosystem perspective. Fully protected marine reserves are thus becoming the main management tool for this approach.(Agardy 1994, Dayton et al. 2000, Pauly et al. 2002, Pikitch et al. 2004, Roberts et al. 2005). Fully protected marine reserves are gaining increasing support, mainly derived from a robust body of evidence that indicates that they allow fish populations to rapid increase not only within the reserves boundaries (Halpern 2003), but also outside their boundaries (Murawski et al. 2000; Parks et al. 2001) and thus have a positive effect at enhancing fisheries (Roberts et al. 2001; Gell & Roberts 2003). Recent evidence shows that fully protected marine reserves can also potentially benefit large migratory marine megafauna, if established in areas were they are particularly vulnerable (Hooker & Gerber 2004). Fully protected reserves also provide important opportunities for direct community insight on the effects of fisheries over fished populations. Within the Bahía de Loreto National Park for example, two small fully protected reserves, that have little effect as management tools due to their size, have proved to be invaluable tools to provide artisanal fisheries living proof on how unsustainable fisheries are rapidly depleting reef fish populations outside the fully protected reserves boundaries (Sáenz-Arroyo et al. 2005).

Many approaches can be taken for the establishment of a network of fully protected marine reserves within or outside the boundaries of protected areas. What appears to always be crucial, is to fully address the social and ecological complexity while these reserves are designed (Agardy et al. 2003; Christie et al. 2003) and that a wide range of stake-holders are involved in the process through a participatory approach (Sáenz-Arroyo et al. 2005). An interesting scientific approach to design networks of fully protected reserves, is the model developed by Sala et.al (2002). This novel mathematical and spatial analysis approach, facilitates identification of areas of special concern (such as spawning aggregations or feeding grounds), that together with mapable socioeconomic variables, allows for modeling that provides for different conservation alternatives. The finer the scale in which this model is feed, the more accurate responses become. The different solutions ilustrate trade-offs among socio-economic activities and conservation goals. The model aims to maximize viability of conservation targets within the smallest possible number of sites and surface area, ensuring connectivity among the different sites selected, while minimizing regional social conflicts (Sala et al. 2002). Although this model was tested in the Gulf of California using reef fish diversity, the methodology can be applied for any other marine taxa, in any other marine region and incorporate as much social complexity as can be mapped. In the absence of hard data, other versatile methodologies, such as multicriteria analysis can be useful while designing networks of fully protected reserves, using local empirical knowledge to identify sites of particular concern (Sáenz-Arroyo et al. 2005).

Still on time

The establishment of a system of marine protected areas as outlined, together with multiple networks of community-based fully protected marine reserves within or outside their borders, could become an invaluable tool towards achieving protection for sustainable use marine biodiversity in the Gulf of California. This system would provide for better geographic coverage, biogeographic representativity and functional interconnectivity of the Gulf´s critical ecosystems. Target species such as those identified by scientists attending the Coalition's workshop, such as marine mammals, turtles, reef fish, sea birds, etc. would also be adequately covered through this MPA system. Participatory process specifically tailored for each situation should take place in each of the areas to actively involve all social groups and economic interests to establish both MPAs and local networks of fully protected reserves. These processes should include stakeholders that reflect the complex interactions between the coast and the marine environment. Furthermore it is important to realize that a standalone MPA strategy will not suffice to protect the Gulf of California's incredible wealth. Sustainable tourism coastal development,, fisheries, aquaculture, agriculture, energy ports and navigation policies and practices are urgently needed in the Gulf in order to achieve regional conservation and development goals. In this case to, MPAs could become a manageable microcosm to start experimenting on a transition towards the Gulf's sustainability.

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