A MARINE RESERVE NETWORK FOR THE GULF OF CALIFORNIA

THE NEXT STEP IN CONSERVING 'THE WORLD'S AQUARIUM'

GREENPEACE

Contents

OCTAVIO ABURTO OROPEZA AND CATALINA LÓPEZ SAGÁSTEGUI
UNIVERSIDAD AUTÓNOMA DE BAJA CALIFORNIA SUR.
DEPARTAMENTO DE BIOLOGÍA MARINA.
CARRETERA AL SUR KM 5.5. LA PAZ, B.C.S.,
23081. EMAIL: MABURTO@UABCS.MX

A REPORT PREPARED FOR GREENPEACE

PUBLICADO POR GREENPEACE MÉXICO
JOSÉ MA. VERTIZ 646
COL. NARVARTE
C.P. 03010
MÉXICO D.F.
WWW.GREENPEACE.ORG.MX
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Prologue

Life abounds in the Gulf of California. This wonderful sea shelters some of the richest fisheries in the world, contains more than thirty species of marine mammals, and sustains the northernmost coral reefs in the American Continent. Immense coastal surges bring nutrients from the depths of the Gulf to the surface, and fertilize some of the richest oceanic waters in the world. The estuaries bring nutrients from land to sea, and join the ecological processes of ocean and land.

Few places on earth represent such dramatic environmental contrasts as can be found in this region. For the past six million years the Sea of Cortez has maintained this long and arid peninsula of Baja California separate from the rest of the Mexican territory, which at the same time has kept the Sea of Cortez locked in within its own depths and apart from the Pacific Ocean.

All around, the central theme is the evolutionary isolation that generates unique and extraordinary species, and the insularities that harbor astonishing forms. In this scenery, where land and sea embrace each other, isolation and biological evolution are the cause and engine of this immense natural richness. Islands and bays, sea mountains and estuaries, reefs and lagoons, they all keep the genetic secrets of its founding life forms in its isolated landscapes, and the evolutionary memories of the species that provided their origins.

For six million years these plants and these animals evolved without the presence of modern human beings until they formed a spectacular collection of biological species. Since the peninsula's separation from continental Mexico, this collection of living beings has remained there, evolving and surviving, with adaptations ever more incredible and wonderful, with a rich diversity of forms. The Gulf and the deserts surrounding it regulate the climate, maintain the fisheries, feed our richest agricultural valleys, and with their spectacular beauty, feed and nourish our dreams and culture as well. If we left them alone, the desert and sea would survive without us, but we would not survive without them.

In this study, Octavio Aburto Oropeza and Catalina López Sagástegui present a detailed, comparative analysis of the different efforts carried out in the Gulf of California aiming to establish conservation priorities. With profound knowledge of the region, they discuss the alternatives set forth to establish a network of marine reserves in the Gulf of California, and with a broad, inclusive spirit, they search for consensus and solutions, finding accords, similarities in the focus points, and congruence in the different perspectives. In their excellent compilation of the efforts to establish conservation priorities in the great ecosystem of the Gulf of California, the authors also do a brilliant job at joining and adding to these efforts. Even though the methods differ, the results of the different groups point to the same direction, identify areas in common, propose similar actions, and underline the same priorities.

Product of an opportune initiative from Greenpeace, this work is above all a manifest of unity and consensus. We must protect this environment for our own well-being and that of everyone else, and we should respect it for no other reason than its own singularity. The protection of the Gulf of California is the most important task in favor of our own survival, for many generations. It is a task that will last many, many years. That is why it is so urgent.

1 :: The Gulf of California

The Gulf of California, also known as the Sea of Cortez, harbors great biological richness with highly productive waters. It is among the five most productive and biologically diverse marine ecosystems of the world. It is approximately 1,000 Km long and 150 Km wide (Álvarez-Borrego, 1983) and covers an area of 278,000 Km^2. Five states surround this sea: Sonora, Sinaloa, Nayarit, Baja California, and Baja California Sur (Morgan et al., 2005) (Fig. 1).

The coastline of the gulf is irregular and includes a great number of coastal bays and lagoons. The northern portion is dominated by the Colorado River delta, resulting in a unique ecosystem. The eastern coast of the gulf has a series of rivers that originate in the chain of mountains running through Sonora and Sinaloa. These rivers deliver water and sediments to the enclosed sea, however there are no rivers on the peninsula side due to the dry conditions of the region. The sea floor is characterized by underwater canyons and depressions that, in some places, are over 3 kilometers deep. These underwater canyons form a series of depressions that increase in depth towards the mouth of the gulf.

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Fig. 1. Map of the area of the study

1.1 Biological richness and diversity

The Gulf of California region is recognized worldwide for its biological richness, high number of unique species, productive waters and scenic beauty. This region includes 23 priority areas for marine biodiversity, 42 areas of priority for terrestrial biodiversity and 62 priority areas for the conservation of birds, all described and identified by National Commission on knowledge and use of biodiversity (CONABIO for its initials in Spanish) (Enríquez-Andrade et al., 2005). This high biodiversity can be explained through two phenomena: (i) the wide variety of habitats including mangrove forests, coastal lagoons, rocky and coral reefs, hydrothermal vents and other shallow and deep marine habitats; and (ii) the geology and oceanographic conditions of the region (Ezcurra, 1998; Carvajal el at., 2004). There are 887 species of plants and animals living on the 922 islands of the gulf, including 90 endemic species. Sixty of these are reptiles, placing Mexico second in the world in terms of the number of endemic reptiles (CSGC, 2004).

Marine invertebrates are the largest group represented by 4,800 identified species. Some authors believe that there is an equal number of unidentified species waiting to be discovered (Ezcurra, 1998). Of the total number of species, 740 of them are endemic (Enríquez-Andrade et al., 2005).

There are 665 species of algae, 580 of them are macroalgae. Puerto Peñasco possesses the highest species diversity of microalgae in the gulf, while the coast of Baja California in the area of the midriff islands is where the highest biomass of commercially important algae can be found (CSGC, 2004).

The Gulf of California region is home to between 870 and 890 species of fish and 77 are endemic (CSGC, 2004; Enríquez-Andrade et al., 2005). Of the 271 reef species known in the Sea of Cortez, 52 are endemic (Ezcurra, 1998). The Totoaba *(Cynoscion macdonaldi)* is endemic to the upper gulf and is endangered. Five of the eight species of sea turtles can be found in the region, and all five species are categorized as endangered on the IUCN red list. The Gulf of California is considered a very important area for the feeding, reproduction and migration of these species (CSGC, 2004). The five species of sea turtles found here are: the loggerhead *(Caretta caretta)*, the Pacific green *(Chelonia mydas agassizi)*, the leatherback *(Dermochelys coriacea)*, the hawksbill *(Eretmochelys imbricada)*, and the olive ridley *(Lepidochelys olivacea)*.

In the case of the Pacific green turtle, it uses the coastal lagoons and bays of Baja California, Sinaloa and Sonora as feeding grounds and can be commonly found around the Midriff Islands. The leatherback is considered to be critically endangered and has several nesting grounds in the southern portion of Baja California Sur. The loggerhead and hawksbill turtles feed in waters off this state, and the olive ridley nests in the southern portion of the peninsula (CSGC, 2004; Morgan et al., 2005).

At least 17 species of seabirds use the islands located in the Gulf of California as breeding grounds: 11 are migratory, six are resident, and six are quasi-endemic - 95% of the world population nests on one island (CSGC, 2004; Enríquez-Andrade et al., 2005). Heermann's gull *(Larus heermanni)* and the royal tern *(Sterna maxima)* are examples of two species that reproduce on these islands. The wetlands of the region are used by ducks and geese, such as the brent goose *(Branta bernicla)*, as resting or feeding grounds during their migration (Morgan et al., 2005). Some endemic species and sub-species like the yellow-footed gull *(Larus livens)* and the Yuma clapper rail *(Rallus longirostris yumanensis)* are disappearing or are threatened by the rapid loss of habitat (Ezcurra, 1998).

The Gulf of California is also considered a very important area for its diversity of cetacean species, since 40% (33 species) of the world's species are found here. The upper gulf is the only place in the entire world where the vaquita *(Phocoena sinus)* can be found, it is the only endemic marine mammal in Mexico and has the most restricted distribution of any marine mammal in the world (Ezcurra, 1998; Enríquez-Andrade et al., 2005; Morgan et al., 2005). There are also around 40 colonies of California sea lions *(Zalophus californianus)* forming a population of approximately 30,000 individuals (Enríquez-Andrade et al., 2005). The blue whale *(Balaenoptera musculus)*, listed as endangered by the IUCN, arrives to the gulf from Alaska after the feeding season; while the humpback whale *(Megaptera novaeangliae)* uses the area as reproduction grounds (Morgan et al., 2005).

1.2 Cultural importance

The historical and cultural importance of the peninsula of Baja California has been recognized by specialists around the world. Even though studies of the indigenous cultures of the peninsula began in the late 19th century, the last 70 years have seen the most scientific activity focused on the region (Reygadas-Dahl, 2003). There are a great number of cave paintings, encompassing a variety of styles, on the peninsula. The most famous of these are the great mural style paintings found in the central region of the peninsula on the San Borja, San Juan, San Francisco, and Guadalupe Sierras (Hambleton, 2003). It is also worth mentioning that many archaeological remains have been found belonging to ancient communities of hunter-gatherers that inhabited the area long ago. These findings have helped us to understand the lifestyle and culture of these isolated communities and the ways in which ancient cultures, such as the Pericues, Gaicuras, Cochimies and Cucapas, thrived in this hostile land (León-Portilla, 2003).

The arrival of the Jesuits and the founding of the missions along the peninsula are also important elements in the history of the

region. They were among the very few who were able to survive the harsh conditions of the peninsula. Their success was partly due to the relationships they were able to establish with the natives living around the missions. The exchange of knowledge between natives and missionaries resulted in a fusion of two cultures that in turn resulted in lifestyles that can still be found in local communities. The indigenous groups on the mainland side of the gulf region, such as the Seri, Yaqui and Cucapa, also developed lifestyles that allowed them to take advantage of marine and terrestrial resources.

1.3 Socioeconomic importance

There are approximately 8.6 million people living in the Gulf of California region, and this number is expected to rise to 10.4 million by the year 2010. Population density is considered to be low now; however this entire region is attracting people from different places at a fast rate. This can be seen through the population growth rates which are higher than the average national growth rate (CSGC, 2004). Between 1990 and 2000 Mexico had an annual population growth rate of 1.9%, while the gulf region had a growth rate of 2.4%. Baja California, Baja California Sur, and Sonora have growth rates higher than the national rate, but Sinaloa's and Nayarit's are lower. The biggest population growth can be observed in coastal municipalities, and it is those municipalities where the pressure on resources is highest (CSGC, 2004).

The abundant natural resources and the economic activity have created new investment opportunities that encourage regional economic growth. The cities and ports of the region have become specialized in the primary and tertiary sectors, transforming the Gulf of California region into one of the regions with the highest per capita incomes in Mexico. The region is important for the production and export of primary products (agriculture, cattle, fishing and mining). In total the Gulf of California is responsible for 10% of the total gross national product (GNP). The fishing and agricultural sectors contribute 17%, with Sonora and Sinaloa as the main producers (CSGC, 2004)

Almost 50% of the national fishery products come from this region, and 90% of shrimp farms are located here producing 40% of the national product. The shrimp, sardine, tuna and squid fisheries yield around 500,000 tones of products with an estimated value of 300 million dollars (this represents 70% of the total national value). Artisanal fisheries, mostly conducted in bays and costal lagoons and estuaries, target 70 species and produce 200,000 tons annually (Robadue, 2002; CSGC, 2004; Enríquez-Andrade et al., 2005).

The fishing industries create employment for more than 50,000 people and have resulted in the construction of around 250 processing plants. There are nearly 26,000 boats dedicated to fishing in the Gulf of California. Among them are 72% of the national tuna fishing fleet, and almost all of them fish sardine as well. Also, 52% of the total number of boats dedicated to shrimp fishing in the country work in this region as well.

Sonora, Sinaloa and Nayarit produce 40% of the national agricultural products (Enríquez-Andrade et al., 2005). These four states dedicate 1.5 million hectares of land (40% of the total national agricultural land) to agricultural production (CSGC, 2004).

Tourism is also an important sector for the economy of the region, generating high incomes annually that represent between 9-10% of the national income. The Sea of Cortez holds many natural attractions considered among the most beautiful in the country. It is estimated that 4.8 million tourists (8% of the national total) visit this region annually and spend approximately 2 billion dollars. Sport fishing and adventure tourism are among the most popular activities (Robadue, 2002; CSGC, 2004; Enríquez-Andrade et al., 2005).

2 :: Threats in the Gulf of California

The natural ecosystems in the Gulf of California region have been affected by factors like fishing, decrease in freshwater input, sedimentation and pollution. Some economic activities have resulted in a decrease of productivity of ecosystems. This can potentially have negative impacts on local communities because they depend directly on the availability of natural resources for their wellbeing.

2.1 Overfishing and aquaculture

For many years, the artisanal fisheries in the region were sustainable. As fish populations have decreased, fishermen have changed fishing techniques in search of those that maximize their efforts. High extraction rates and the use of gill nets, trawling techniques and longlines have all played a role in the rapid reduction of fish populations, therefore risking the sustainability of this activity (Ezcurra, 1998; Morgan et al., 2005).

As fish populations decrease the community structure begins to change because as one species disappears or becomes rare, others take their place in the community (Morgan et al., 2005). Studies have demonstrated that the abundance and density of some species of commercial value have decreased in the last 30 years as a result of the increase in fishing effort (Sala et al., 2004; COBI, 2005). However, this phenomenon is not easy to detect with the types of data used by the state and federal governments because these group various species into broad multi-species categories such as "groupers" or "sharks". When these data are separated by species, then the effects of overfishing become apparent. The disappearance of large predatory species (sharks and large groupers) is evident, as is the substitution of these species by species of smaller size from lower down in the food chain (herbivores).

An example of a collapsed fishery in the Gulf of California is that of the Totoaba *(Cynoscion macdonaldi)*, a species that today has almost disappeared. Populations of other species like the Gulf grouper *(Mycteroperca jordani)* and the Leopard grouper *(Mycteroperca rosacea)* show signs of over exploitation (Sala et al., 2004; COBI, 2005). In the southern portion of the gulf, fish catch composition has undergone major changes - large predatory species like sharks, groupers and snappers were abundant in the 1970's, but were considered rare by the year 2000 (Sala et al., 2004). Large predators and migratory species (e.g. marlin, tuna, fin fish) have also decreased in abundance in other regions of the gulf.

The shrimp fishery also poses a major threat to the ecology of the region because 90% of total catch is discarded as bycatch (Excurra, 1998; Morgan et al., 2005). In the Gulf of California shrimp fishery bycatch is made up of more than 100 fish species and between 85 and 114 species of invertebrates. Among the non-target species is the Totoaba, who is especially vulnerable during its juvenile stage when it is caught during trawling (García-Caudillo et al., 2000). It is estimated that every year 200,000 tons of bycatch are returned to the sea, while only 30,000 tons of shrimp are caught (Carvajal et al., 2004).

Agriculture no longer expands towards the large inland valleys but, through aquaculture, it expands to occupy salt marshes, coastal lagoons, and estuaries. It mostly is dedicated to shrimp farming, and the construction of these farms has resulted in coastal modifications. This modification has resulted in a loss of habitat that affects many species, not only the species that live permanently on these habitats. Many marine species, like fish, use these habitats as nursery grounds or during other stages in their life cycle. Aquaculture also creates conflicts with agriculture because it needs great amounts of water; and with conservationists because it affects water quality and the state of coastal habitats located near and around the farms (Robles et al., 1980).

2.2 Pollution

Urban water discharge causes environmental damage to coastal areas. Guaymas is a shocking example of a coastal city where pollution problems in the bay have reached extreme levels (Ortiz-Lozano et al., 2005). These residual waters provide sources of nutrients for marine organisms including microalgae that exploit the situation and form large blooms. This increase in phytoplankton biomass causes dissolved oxygen concentrations to decrease. In some cases, these blooms kill almost all organisms in the area, if not all of them.

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Agricultural runoff has also become a major source of pollution in the Gulf of California region. Pollutants are carried toward the gulf from the United States and from Sonora and Sinaloa. The coasts of Sonora and Sinaloa are among the most productive in terms of agriculture in Mexico. This activity is causing damage to marine and coastal ecosystems because of the chemicals used. By the 1950's this type of pollution had already impacted the pelican population on the islands of Salsipuedes, Las Animas and San Lorenzo.

Shrimp farms are also sources of pollution because their residual waters are often discharged directly into the natural environment. Around 70% of the aquaculture infrastructure of the entire country is located in the state of Sinaloa, which means that its coastal areas, in particular lagoons, are constantly receiving large amounts of water enriched with nutrients (Ortiz-Lozano et al., 2005). This can cause the lagoons to become eutrophic zones where algal blooms are frequent and the possibility of the formation of dead zones is high.

2.3 Loss of habitat

The coastline is a narrow fringe where the ocean and land interact, and where drastic modifications take place as a result of human activities. These changes begin from the moment human activity begins and changes in the natural environment start to happen. The Gulf of California is not exempt from this phenomenon, and there are plenty of examples of cases where economic activities are in conflict with the well being of marine and coastal ecosystems.

Estuary and coastal lagoon ecosystems are threatened by the construction of industries and tourist developments. The deterioration of these types of habitats affects a great number of marine species including shrimp, mollusks and fish. These developments are also likely to have negative impacts on the migratory bird species that use them as feeding or resting areas during their migration (Ezcurra, 1998). Los Cabos and Mazatlan, considered two of the most important tourist destinations in the country, are also among the places that have suffered severe disturbance (Ortiz-Lozano et al., 2005) as a result of the development that has taken place in order to satisfy the demands of the tourist industry.

The delta of the Colorado River is another example where there have been significant habitat changes caused by the reduction in the amount of fresh water reaching the gulf and resulting in an increase in salinity levels in the water and the disappearance of wetland vegetation. In the last 100 years the river's water has been used to irrigate agricultural land and for other human uses. Wetland areas have varied between 5,800 and 63,000 hectares from 1973 to1993 (Glenn et al., 1996). This wetland habitat is important for threatened species like the desert pupfish *(Cyprinodon macularis)* and the Yuma clapper rail *(Rallus longirostris yumanensis)*. The decrease in the amount of water reaching the gulf has also caused a change in the natural conditions in what used to be an estuary-like habitat important for fish reproduction (Morgan et al., 2005). Changes in salinity attributed to the water quality of the Colorado River have been recorded on the northern portion of the gulf (INE, 1994) the area where the Totoaba and Vaquita, both endangered, can be found.

Mangroves are disappearing at a rate of 2.5% annually on a national level (INE, 2005). The cause for this degradation varies depending on the area where the mangrove is, but sedimentation, eutrophication, deforestation and changes in local hydrology may have negative impacts on the mangrove forests. In many cases, mangrove forests are cut down in order to clear space to build shrimp farms or tourism developments. Water flow is very important for the development and health of mangrove forests, and it changes when coastal areas are modified by the construction of shrimp farms, marinas and channels (Conservation International, www.conservation.org.mx).

2.4 Tourism

Tourism can also have a negative impact on the natural resources on which it depends. Infrastructure built to satisfy the needs of national and international tourists causes environmental damage through the modification and destruction of natural habitats, water consumption, and sewer discharges. Highly developed areas like Quintana Roo have attracted the attention of conservationists and the community as a whole due to the severe ecosystem destruction that is tourism-related. In the Gulf of California, tourism destinations like Mazatlan and Cabo San Lucas are described as places where "extreme" changes of the natural environment have taken place (Ortiz-Lozano et al., 2005).

Ecotourism has also had its impacts on some ecosystems, especially those located on and around islands which are considered to be the most vulnerable and fragile of all. Due to its isolation, evolutionary processes have transformed the islands of the Gulf of California into ecosystems that are highly vulnerable to the ecological impacts caused by the introduction of exotic species, habitat deterioration, hunting and fishing. Studies done in the last years have shown that introduced species, like rats, cats and goats, can cause devastating damage to native plant, bird and reptile populations (Ezcurra, 1998).

3 :: Marine Reserves, a special type of Natural Protected Area

Marine Protected Area (MPA), is a term that is becoming increasingly common in the context of biodiversity conservation, habitat protection and fisheries management. The term covers a wide range of protection measures, with an equally wide variation in the benefits conferred by this status. MPAs can be created for many purposes, ranging from the protection of a species to a whole habitat or ecosystem, to the protection of certain interests, such as small scale or recreational fishing. Marine reserves are the type of MPA that offer the highest level of protection and are closed to all extractive and disposal activities.

In the last decade, marine reserves have become a favored conservation tool of many conservationists and of the scientific community (Allison et al., 1998). This is because reserves offer new and stricter ways to protect ecosystems that cannot be implemented otherwise, such as providing full protection for critical habitats and the species that live in those habitats. In addition to protecting the ecosystem in its entirety, marine reserves can also bring benefits to the fisheries in the surrounding waters and thus help to avoid overfishing.

In Mexico, a natural protected area (NPA) is an area of ocean or land representative of a particular ecosystem and its associated biodiversity, which has not suffered any significant changes caused by humans and where special protection, conservation, restoration and development regimes are implemented (SEMARNAT, 2000). Mexican NPAs used to be created based on laws that applied to the logging, fishing and hunting sectors. On January 28, 1988, a new law, the General Act for Ecological Balance and the Protection of the Environment (LGEEPA for its initials in Spanish), was established and since then NPAs are created under a different set of laws. On November 30, 2000, the federal government published a set of regulations that allowed the creation and implementation of specific conservation measures in protected areas. One such example is the prohibition of fishing activities when the volume of bycatch is larger than the volume of the target species (Bezaury-Creel, 2004).

In order to adequately protect the wide range of marine species and habitats found in Mexican waters, Mexico must further develop its NPA system, with a network of fully-protected marine reserves providing the backbone.

3.1 Benefits of Marine Reserves

Marine reserves are a conservation tool that can bring benefits to the fishing industry, recreational activities and other activities that use, directly or indirectly, marine resources (Allison et al., 1998; Gell and Roberts, 2003). Recent studies show that reserves can help increase biomass, abundance, and diversity of species that live in them. Average biomass can be more than four times greater inside a reserve than in an area that is not protected. Density and species richness can be double within a reserve than outside one; and average size of individuals can also be larger (Gell and Roberts, 2003; PISCO, 2002).

These changes have been observed in species that are commercially important as well as on those that are not. Protection from fishing activity allows organisms to live longer and thus, reach larger sizes. Furthermore, degraded habitats located inside a reserve will be allowed to recover and become able to support a higher number of organisms. This results in more species that will serve as prey for more species that are predators, until the complexity of the food chain is restored. Marine reserves are the only conservation tool used today that yields a cascading series of events that promote the entire ecosystem's wellbeing (PISCO, 2002).

Marine reserves not only bring benefits to populations living inside them, but also can affect populations of species living around them. This overflow of individuals can help maintain and restore populations outside of the reserves. In the case of fish, some individuals will leave the reserves to find places with lower densities and, therefore, less competition for resources. The overflow rate of larvae, juvenile and adults increases as time passes resulting in population growth. There are some cases in which species only spend a stage of their life cycle in the reserve, and then move to other place to occupy other habitats (PISCO, 2002).

The benefits resulting from a reserve are easier to see on species that spend their entire lives inside them. However, marine reserves can also help protect migratory species (such as tuna, marlin, cetaceans, birds) if they are designed adequately (PISCO, 2002). Despite the long range of movements that these species have, entire populations are highly vulnerable to fishing or other human activities when they aggregate in specific areas to reproduce or feed, or in migratory corridors, or in areas suitable as nursery

grounds. In the case of many fish species, these aggregations take place in the same areas every year making it easier for fishermen to capture them, and thus harvest a large portion of the population in a short period of time (Sala et al., 2003).

If a reserve is established in a critical or key area it can help protect a migratory species of special interest during a stage in which it is vulnerable. For example, protecting nursery habitats of commercially important species can result in an increase of the adult population, which in many cases live in other areas (PISCO, 2002).

3.2 Principles for designing marine reserves

If a marine reserve's main objective is to restore and protect biodiversity of an area while promoting sustainable fishing practices, then there are several criteria that can be used to analyze different areas and thus come up with a several scenarios for a marine reserve network (Table I). There are models that can be used to help analyze these criteria and the different options, and they hold the benefit of being flexible enough to satisfy every community's needs (PISCO, 2002).

There is a wide variety of habitats in the ocean, and each one supports communities of plants and other organisms. The importance of protecting different habitats lies in that there is connectivity among all habitats. For example, estuaries and lagoons are nursery habitats for many species of fish. These are places with high productivity, and so the organic matter produced here works as a natural fertilizer on other coastal environments when it is carried out by currents and the tide. Also, these habitats trap sediments carried by runoff and prevent it from covering other habitats like rocky and coral reefs.

As mentioned above, many species use different habitats during their lifetime. In the Gulf of California there are many fish species that as adults live on rocky reefs, but the larvae travel with the currents and the juvenile forms are found in coastal lagoons or mangrove forests. As these juveniles grow, they move away from coastal habitats until they reach the rocky reefs once they reach their adult stage. The ocean is filled with species with very different needs, and this is why all types of habitats are important. In order to support and protect this biodiversity, it is necessary to protect parts of each habitat present in a region (Sala et al., 2002).

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Table I. Scientific criteria used for evaluating potential sites during the process of marine reserve design

Scientific Criteria	Definition	Application
Biogeographic representation	The inclusion of different regions characterized by particular sets of habitats, environmental conditions, and species	Protecting all biogeographic regions can help protect the biological communities associated with each region
Habitat representation	The inclusion of different types of habitats (e.g., estuary, rocky shore, kelp forest, sandy bottom)	Protecting a variety of habitants can help protect the various sepecies in those habitats, and allow them to complete their life cycles
Vulnerable habitats	Rar or threatened habitats susceptible to stresses	Marine reserves offer additional protection to vulnerable habitats
Vulnerable life stages	Important life stages, such as breeding, juvenile, or migration periods	Protecting habitats where these vulnerable stages live can help increase abundance, size, and population growth rates
Species or populations of special concern	Species that are of economic or recreational value, are globally rare, or live in small geographic ranges	Protecting habitats where these species live can help increase abundance, size, and population growth rates
Reserve size	The area convered by a single reserve or a network of reserves	The choice of reserve size depends on the objectives for reserves. Larger reserves produce proportionately greater effects. A network of several smaller reserves may be a good compromise
Ecosystem likages (Connectivity)	The exchange of nutrients, plants, and animals that connects many ecosystems	Identifying important linkages among ecosystems can help locate potential reserves sites
Reserve networks	A system of reserves in critical habitats that are linked by movement of animals and plant propagules	A network of marine reserves protects critical habitats that are used by plants and animals during differents stages of their life cycle
Ecosystem services	Beneficial services that people use directly (e.g., removal of pollutants from the water, climate control)	Reserves should include critical habitats tha sustain ecological services
Human Threats	Human actions that endanger an ecosystem and cannot be prevented or reversed by establishing a reserve (e.g., pollution and habitat loss)	Sites affected by human threats, such as pollution and coastal develpment, are not likely to be effective marine reserves. Other types of management may be necessary to control these
Natural catastrophes	Events like large storms, harmful algal blooms, disease epidemics, and climate change	Sites subjected to frequent catastrophes are unlikely to be effective marine reserves. Multiple reserves in different locations can reduce the overall risk from natural catastrophes
Social and economic criteria	Social and economic values expressed by community members affected by ocean management	Social and economic criteria should be incorporated into reserve design in order to maximize benefits and minimize cost.

Taken and modified form: Pisco, 2002

The design, number and size of marine reserves in a network will be determined by both the environmental conditions and socioeconomic factors. A species will be fully protected if it completes its entire life cycle inside the reserve. A large reserve or a group of smaller ones located in strategic places can achieve the conservation goals set. A large reserve may include a wide variety of habitats and species, but at the same time it can result in increased fishing effort in other areas. There are examples of reserves of different sizes (from <1 km^2 to >5000 km^2) that function favorably (Gell and Roberts, 2003). The key is to determine the adequate size according to the magnitude of the movements of the species we wish to protect. It is also important that conservation efforts are ecosystem based, and thus all habitats have to be represented within the reserve network.

Economic conditions in some places may not make it possible for the establishment of large marine reserves. However, a network of reserves can be designed and it can achieve its conservation objectives without compromising the economic wellbeing of local communities. This network can include reserves of different sizes guaranteeing connectivity between reserves through the movement of organisms. When reserves include different sizes and are located at different distances from each other we can ensure the protection of species with different needs and characteristics. For example, a network of marine reserves can include feeding grounds in oceanic habitats and also reproduction and/or breeding grounds in shallow or coastal habitats.

To ensure that a marine reserve or network of marine reserves meets its objectives it is absolutely crucial that all stakeholders, including resource management specialists, government agencies, biologists, sociologists, commercial and recreational fishermen, conservationists and community members are included in the planning process from its inception so as to create the optimal marine reserve network. If a reserve, or a network of reserves, is not designed properly then it will not meet its conservation objectives successfully.

Greenpeace is proposing the establishment of a global network of marine reserves that covers 40% of the world's oceans in order to ensure that the whole range of marine ecosystems and the marine life that they harbour are adequately protected and help secure ecological sustainability for the rest of the oceans. Such a network would provide the cornerstone for implementing the ecosystem approach. Greenpeace's demand is consistent with that of the World Parks Congress that said "networks should be extensive and include strictly protected areas that amount to at least 20-30% of each habitat." Meanwhile, the United Nations Millennium Project calls for 10% of the oceans to be covered by marine reserves in the short to medium term with a long term goal of 30%.

In Mexico, different exercises have already identified important conservation areas in the Gulf of California. Some areas have already been declared NPAs, while others are in the process of gaining that status. However, the majority of the identified areas are not protected in any way.

4 :: The history of the establishment of natural protected areas and areas of conservation priority in the Gulf of California

The importance of biological diversity is widely recognized not only for the Gulf of California, but also the rest of Mexico. As a result of all the pressure natural environments are being put through by the different economic activities that are practiced in the Gulf of California region, conservation efforts have been focused on trying to find ways on how to mitigate the damage (Fig. 2). Over the years, the government has tried to protect and conserve the country's biodiversity with the creation of natural protected areas of different categories such as: biosphere reserve, national park, sanctuary and area for the protection of flora and fauna, among others.

The Gulf of California region includes 29 NPAs working for the protection and conservation of regional biodiversity. Of these, 16 NPAs include marine and coastal habitats; seven protect islands and terrestrial and coastal areas, while nine include marine habitats (Table II). In the last 10 years conservation efforts aimed at this region have yielded promising results since seven of the nine NPAs were created during this time.

These conservation efforts have involved many participants, including the Mexican government, NGOs and community members. In 1996, the National Ecology Institute (INE for its initials in

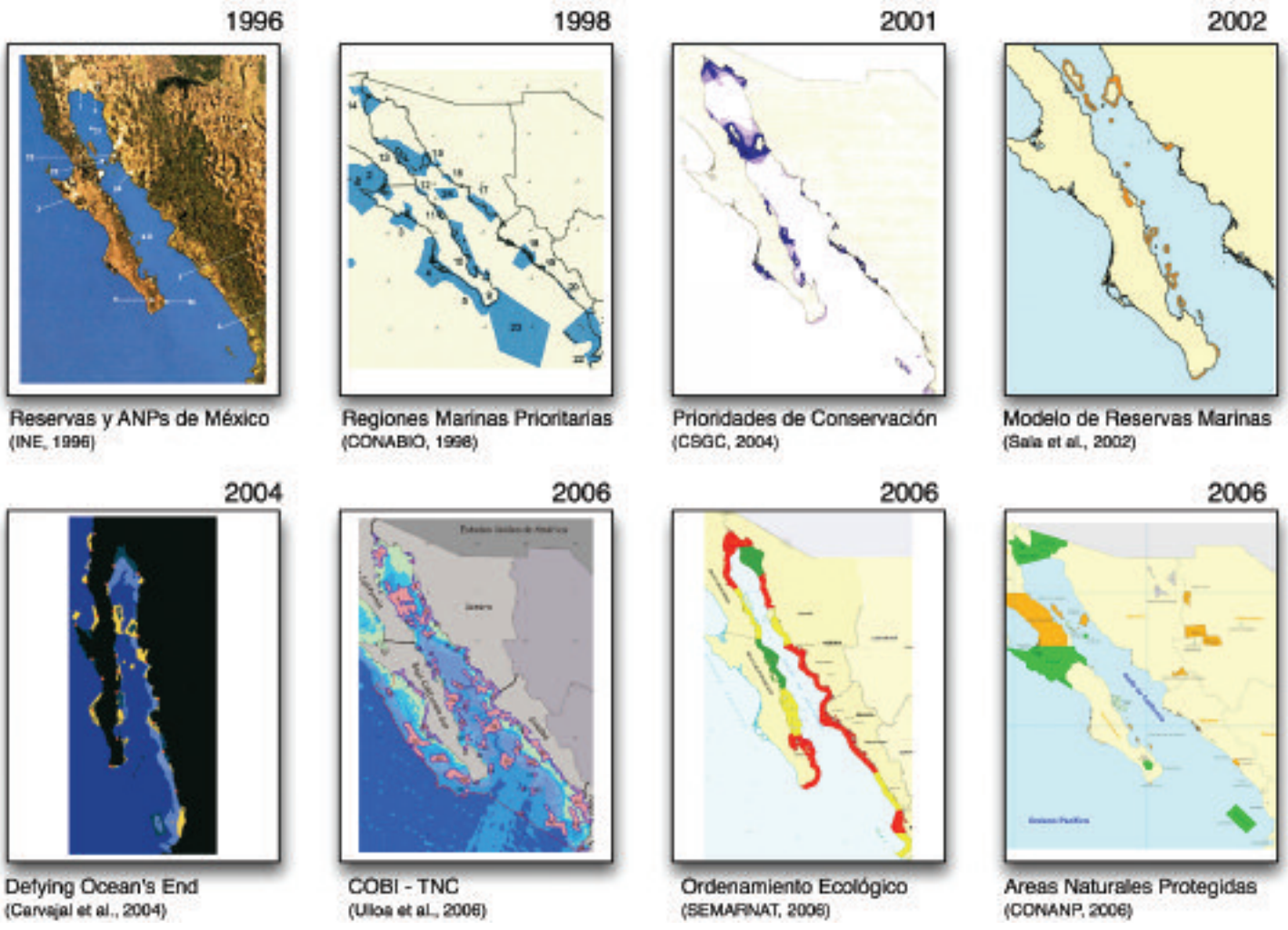


Fig. 2. Series of exercises that identify the areas of significance for conservation in the Gulf of California region

Table II. Marine protected areas in the Gulf of California that include the protection of marine and coastal habitats.

Natural Protected Areas	Date established	Marine area (hectares)
Area for the protection of Flora and Fauna Cabo San Lucas	1973	3,785
Biosphere Reserve El Vizcaíno	1998	49,451
Biosphere Reserve Alto Golfo de California y Delta del Río Colorado	1993	541,636
National Park Cabo Pulmo	1995	7,111
National Park Bahía de Loreto	1996	183,711
Biosphere Reserve Islas Marías	2000	617,257
Biosphere Reserve Isla San Pedro Martir	2002	29,887
National Park Archipiélago San Lorenzo	2005	58,443
National Park Islas Marietas	2005	1,311
TOTAL		**1,492,592**

Source: CSGC, 2004

Spanish) recognized the importance of having a national NPA network and, through the publication of a list of all NPAs in Mexico, highlighted the need for updated information regarding conservation status of the established NPAs. This analysis was the starting point of a movement that since then has worked to create a network of NPAs that works efficiently through updates, integration of new information and evaluation of established areas.

In 1997, a multidisciplinary group of experts started working on a database of scientific data that would allow them to define the areas of conservation priority in the Gulf of California. The Coalition for the Sustainability of the Gulf of California was thus formed and its main objective was to find sustainable activities and to create a fund that would allow the creation and implementation of an action plan. The Coalition began gathering information on the biology, ecology, physical and socioeconomic aspects of the region that would be useful to define priority areas.

It was clear that marine ecosystems were poorly represented among the already established NPAs of the country. This, as well as recognizing the importance of having necessary information on biodiversity and ecosystems in general, served as a motivation for the National Commission on knowledge and use of biodiversity (CONABIO) to establish conservation priorities, and proper management and sustainable use of marine ecosystems. In 1998 CONABIO organized a workshop where marine and coastal priority areas were defined.

Through the participation of 71 experts, 70 coastal and oceanic areas were identified as priority areas for their high biodiversity, the use of the resources found in them, and for the lack of specific information of each area. Of the 70 areas, 43 are located in the Mexican Pacific, and for each one the experts identified the threats that have the most impact on them. It is important to say that this list of areas does not represent a thorough analysis; instead it is a "reflection of the knowledge, experience and preference" of the participating parties. Furthermore, these priority areas look to highlight the problems, knowledge and most current proposals regarding this matter so they represent a reference point and conservation tool for future efforts.

On May of 2001, The Coalition gathered 180 people in a workshop that took place in Mazatlan with the hope of finding a consensus on the Biologically Important Areas (BIAs). The main motivation behind this workshop was to support a Federal Government initiative that was to create a Marine Ecological Ordinance of the Gulf of California. During this workshop participants identified 22 marine BIAs and 20 terrestrial BIAs that together covered a large portion of marine, coastal and terrestrial critical habitats of the region. One aspect that makes this work particularly important is the use of socioeconomic factors in determining the areas where human-related threats are strongest. This allowed the identification of areas that need immediate attention because of the level of threats and pressure on resource exploitation. Participants also point out that there is no hierarchy among the BIAs, but that their objective was to identify these areas so that there could be a visual representation of the Areas of Special Importance for Conservation.

This work drew attention to the use of socioeconomic variables together with biological and ecological information during the process of designing natural protected areas and marine reserves. Of particular importance when designing marine reserves is taking into account the effect they will have on fishing activities and so, since this is a very important activity in the region, it is crucial to understand that socioeconomic and ecological criteria are not independent of one another.

In 2002 a proposal for a MPA network designed to protect biodiversity while assisting in fisheries management in the Gulf of California was published (Sala et al., 2002). It is important to note that although the authors use the term marine reserve they are not talking about fully-protected marine reserves or areas where fishing is not allowed but rather using the term as a synonym for NPA/MPA. This exercise used ecological data of rocky ecosystems and other important habitats. It aimed to protect 20% of representative habitats and 100% of all rare habitats as well as areas with high species richness. To maximize the conservation objectives, the authors sought for the protection of areas considered as larvae sources and nursery grounds for commercially important species. Rocky areas along the Gulf's coastline were divided into 69 planning units and using an algorithm model a network of MPAs was designed using the least number of units possible without compromising connectivity, and using only those units where conservation goals were met. Sala et al. presented two proposals: the first network maximizes protection based on biological factors; the second network minimizes social conflict by reducing overlap between reserves and fishing grounds.

On May of 2003 a meeting in Los Cabos took place and participants were divided into groups that dealt with regional and global subjects, and identified strengths and weaknesses of conservation efforts on specific case studies. The objective behind *Defying Ocean's End, An Agenda for Action* was to create a global agenda for marine conservation and in which priorities would be clearly specified. Case studies were chosen based on physical characteristics, marine components, threat levels, political and legal status, and conservation efforts dedicated to the area; one of the case studies was the Gulf of California. Most of the priority areas identified during this exercise are the same areas that during the exercise led by The Coalition had the most overlap of information (Carvajal et al., 2004). This analysis however establishes seven objectives that must be met if sustainability of the region is to be achieved: (1) improve the management of marine and coastal NPAs; (2) enlarge the marine and coastal NPAs so that at least 15% of the marine area is protected; (3) develop a comprehensive plan to manage and protect priority wetland areas; (4) reduce the shrimp trawling fleet and improve its fishing technology; (5) develop a plan that regulates the use of

land, coasts and waters; (6) redirect regional tourism activities toward a low-impact and sustainable resource use; and (7) articulate a common vision for regional development and management.

With the hopes of contributing to regional conservation efforts and to improve marine and coastal management, Comunidad y Biodiversidad (COBI) and The Nature Conservancy (TNC) teamed up to develop a new exercise to identify priority areas in the Gulf of California (Ulloa et al., 2006). Even though it is not the first to gather regional information, this exercise is important because it is entirely based on spatial information relating to the distribution and diversity of species, natural communities, and ecological systems in the region. The main outcome of this exercise is the identification of 54 priority areas, more than the number identified in other exercises - a result of using fine scale data. These priority areas cover 24% of the Gulf of California waters, exceeding the 15% proposed by Carvajal et al. (2004), and are representative of regional biodiversity and human activities. An important characteristic of this exercise is that it is the first to include deep sea habitats as priorities for conservation. Another valuable aspect is its analysis of similarities with studies already done: 49% with that of The Coalition, 43% with Defying Ocean's End, and 32% of similarity with the Marine Ecological Ordinance of the Gulf of California. It also holds almost 70% of similarity with the proposal presented by Sala et al. (2002). These percentages are evidence that there is a scientific consensus on what the regional conservation priorities should be.

The process of establishing the Marine Ecological Ordinance of the Gulf of California began on June 5, 2004. It consists of a program that will help the government and society work together in regional management by generating, implementing, and evaluating public policies that strive to achieve a balance between production activities and environmental protection. Federal and state governments (Baja California, Baja California Sur, Sonora, Sinaloa, and Nayarit) are involved in this process. An analysis of pressure and fragility was carried out to get an idea of the development tendencies in the region. Note that pressure is made up of two components: pressure from land toward the sea, and pressure generated at sea. The fragility refers to various attributes like biodiversity, presence of birds and species considered endangered or under special protection, presence of wetlands, among others. To analyze vulnerability of the different areas at state and regional levels, pressure and fragility became important factors to consider. The areas where the highest values given to those two factors overlap are to be considered of priority.

In general, this program seeks to integrate ecological sustainability criteria with economic activities. It also looks to create a set of actions directed to the protection of species, habitats and ecosystems identified as priorities in order to conserve biodiversity and at the same time ecosystem services of the region. Lastly, the program aims to create concrete management and research actions that generate the necessary elements for the design and implementation of strategies that identify and prevent environmental conflicts, so strengthening the regional decision making processes.

5 :: Proposal for establishing a marine reserve network

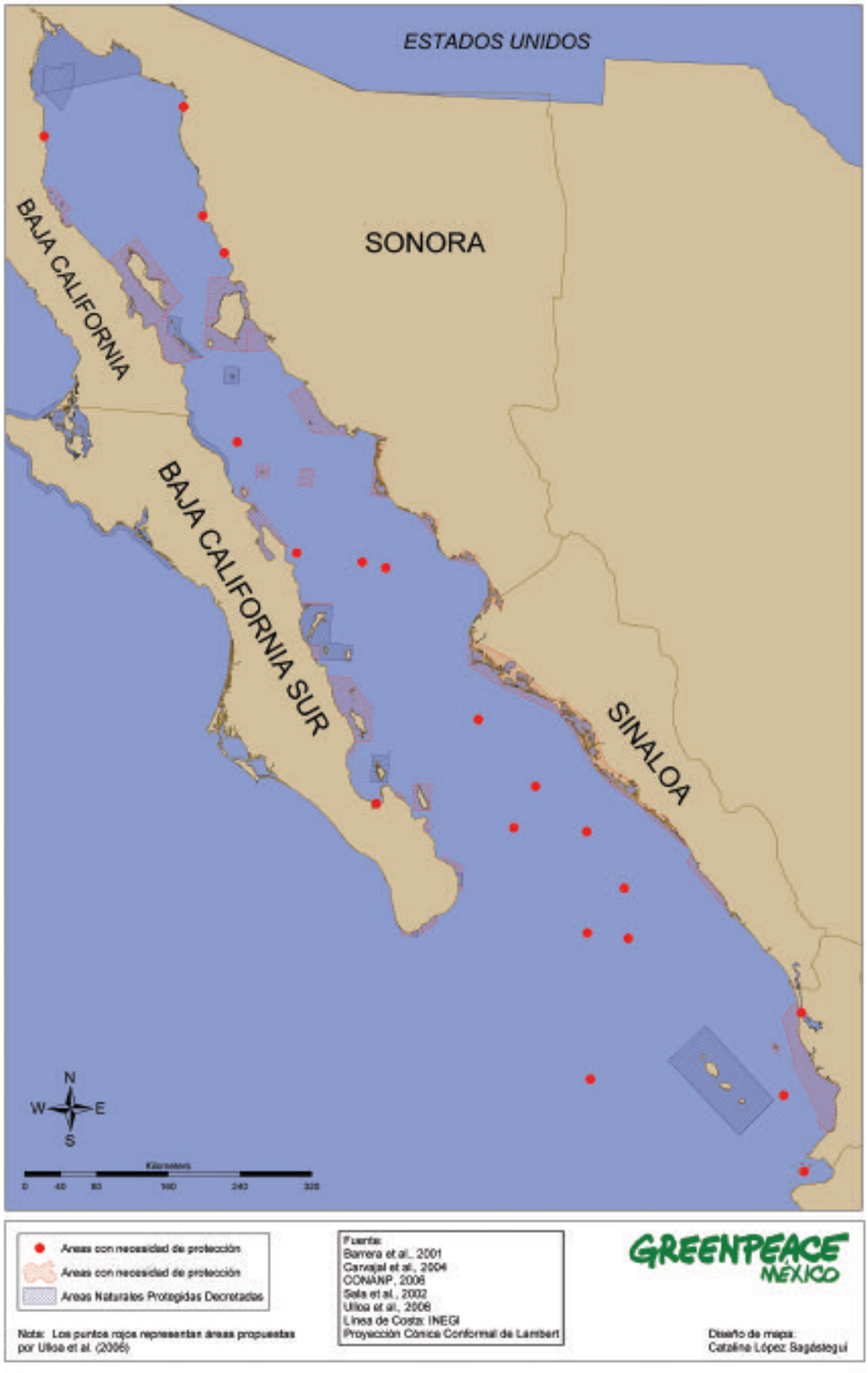
Developing a regional conservation plan for the Gulf of California is no easy task, mainly because it is a region where economic and social development is dependent on the same resources that need to be protected. This paper does not intend to promote complete protection of all the areas listed by the exercises described above. We wish to highlight the ecological importance of these ecosystems, and the value that the resources and ecosystem services hold for local communities. We propose a conservation plan based on the protection of ecosystems, important ecological processes, and of critical habitats that is compatible with human use. Our proposal aims to summarize and draw attention to the conservation efforts that have already taken place, while at the same time encourage the present administration and society to take further action.

This proposal includes priority areas located in the coastal areas, the continental shelf, as well as deep sea areas, all of which are affected by human activities and are characterized by having high biodiversity and ecological uniqueness. The final result is a graphic representation of the areas that are already under NPA status and those areas that need to be protected (Fig. 3).

Our proposal includes a network that includes both fully protected marine reserves and other marine protected areas (MPAs) where different activities take place (fishing, diving, ecotourism activities) but need to be managed in order to achieve sustainability. This network is at a suitable scale so as to encompass a variety of ecosystems. Each MPA is perceived as an area where human activity takes place but also where biodiversity conservation, including its physical, economic, cultural, demographic and political components, promotes community development (Toledo, 2005). Essential to the effectiveness of the proposed network will be the designation of marine reserves of significant size within the larger MPAs where all harmful activities are prohibited in order to allow the ecosystem to remain in a healthy state. This way, the Gulf of California will have a natural protected area network and a marine reserve network that will help in achieving conservation goals.

The final decision regarding the actual design of each of the conservation areas belongs to the affected parties, in particular the local communities that use the areas and their resources. It is important to say that the network that we present here is based on the areas already identified as conservation priorities in previous studies. These are areas that have been identified several times, and we feel it is time to take the next step and work to get unprotected areas declared as NPAs. Efforts should also be directed to identifying areas within these NPAs that should be declared marine reserves. Conservation efforts need to focus on reinforcing cooperation among stakeholders, including local communities, so that each NPA has its own management program that addresses the environmental, social, and economic problems or concerns specific to each area.

Fig. 3. Proposal for a protected area network in the Gulf of California



6 :: Community management as the basis for marine reserve management

Community management or co-management is "a regime in which two or more parties negotiate, define and guarantee a fair approach to describing responsibilities, roles, and rights regarding a specific area or natural resource" (Borrini-Feyerabend et al., 2001). In other words, natural resource management is carried out by sharing responsibilities among state institutions, local communities living in or near the NPA and that use the natural resources found there, and by social organizations. In order to achieve sustainability collective efforts need to take place, communities need to organize, suitable discussion forums need to be available, and economic and political power need to be balanced out (Andrade and Ortiz, 2004).

Community management is not a new concept; many ancient communities that had fishing and farming traditions managed their resources in a way that caused little damage and based this management in knowledge of the environment (Negrete and Bocco, 2003). Through community management it is possible to take into account wider environmental concerns beyond those relating to a single fishery which will allow the maintenance of the natural structure and function of the ecosystems and their productivity. Ecosystems are dynamic and are constantly changing so their management should be based on ongoing monitoring programs that keep track of all elements. Community management is a process that evolves and as such keeps identifying new objectives and elevating standards. As a result, community participation will also evolve to meet these goals.

Marine reserve and NPA management must be based in equality and social fairness, sustainable use of resources and initiatives proposed or led by the local community itself. In order for this management to be successful, particular values, interests and worries of every participating person or party need to be acknowledged. Transparency and equity are important and need to be present during negotiations, especially those regarding resource use. Community members need to be allowed to assume ever more important roles and responsibilities in this process. All sectors have unique skills that are valuable and useful and that complement each other if they decide to work together. It is also extremely important to clearly establish the relationship between the rights and responsibilities of each party involved in any resource's management.

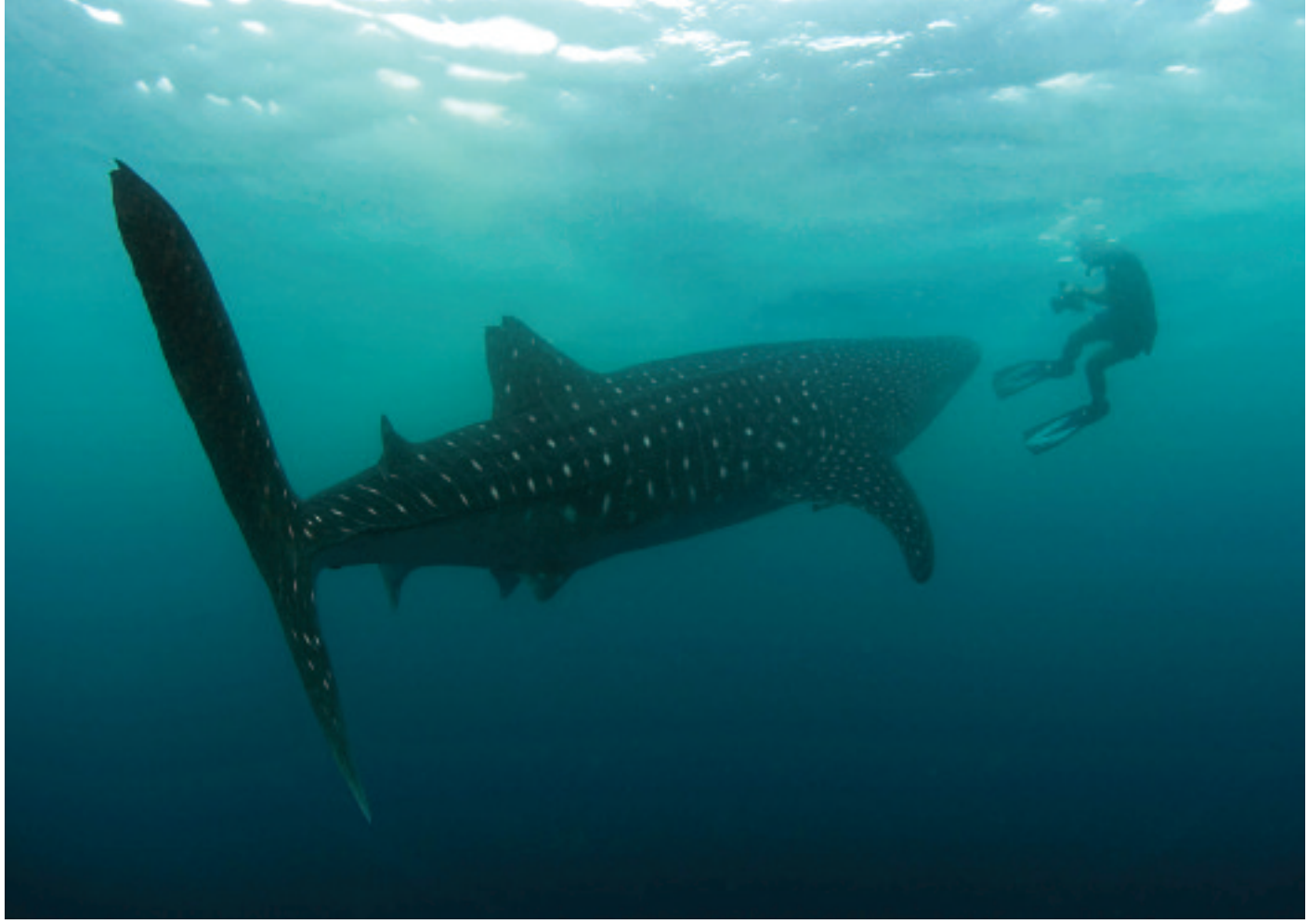
In order for the management of a marine reserve/MPA network to be successful it is important for it to meet certain criteria that allow for community management to develop. These criteria include: community property rights, identity, administrative equity, transparency and activity reports and conservation within an economic context.

6.1 Ensuring Community Involvement

To be effective, MPAs and marine reserves should be managed by local communities rather than imposed and enforced by centralized and bureaucratic agencies. To help with this, access to resources may be assigned through permits, area concessions, quotas or, in the case of fishing, caps on catch volumes. The advantage of these types of management tools is that they identify the rights and obligations associated to the use or one or several resources. Also regulations can be devised that place obligations on communities to ensure that their activities are sustainable. This creates an incentive for communities to gain the organizational capacity and the political action that allows the development of conservation strategies.

Implementation of these kinds of scheme may run into problems due to lack of financial investment. Local users usually hold great amounts of knowledge of the area and its resources; however they have limited possibilities of investment lowering expectations of this type of conservation tool. The challenge is in designing a system that meets the community's needs, in other words, something that allows for the community's quality of life to improve over time.

Many areas within the Gulf of California are beginning to show problems caused by population growth and competition for local resources. The way in which these resources have been managed has created a sense of insecurity among local users, who often cannot compete against the advantages that foreign users have over them. Protecting coastal communities' access to marine resources as a means to help implement MPAs, will enable these communities to benefit from the resources for longer periods of time. This will create an incentive for them to strive for sustainability in the use of those resources. Economic growth and long term sustainability for all sectors affected by an MPA must be a focus point in management programs.



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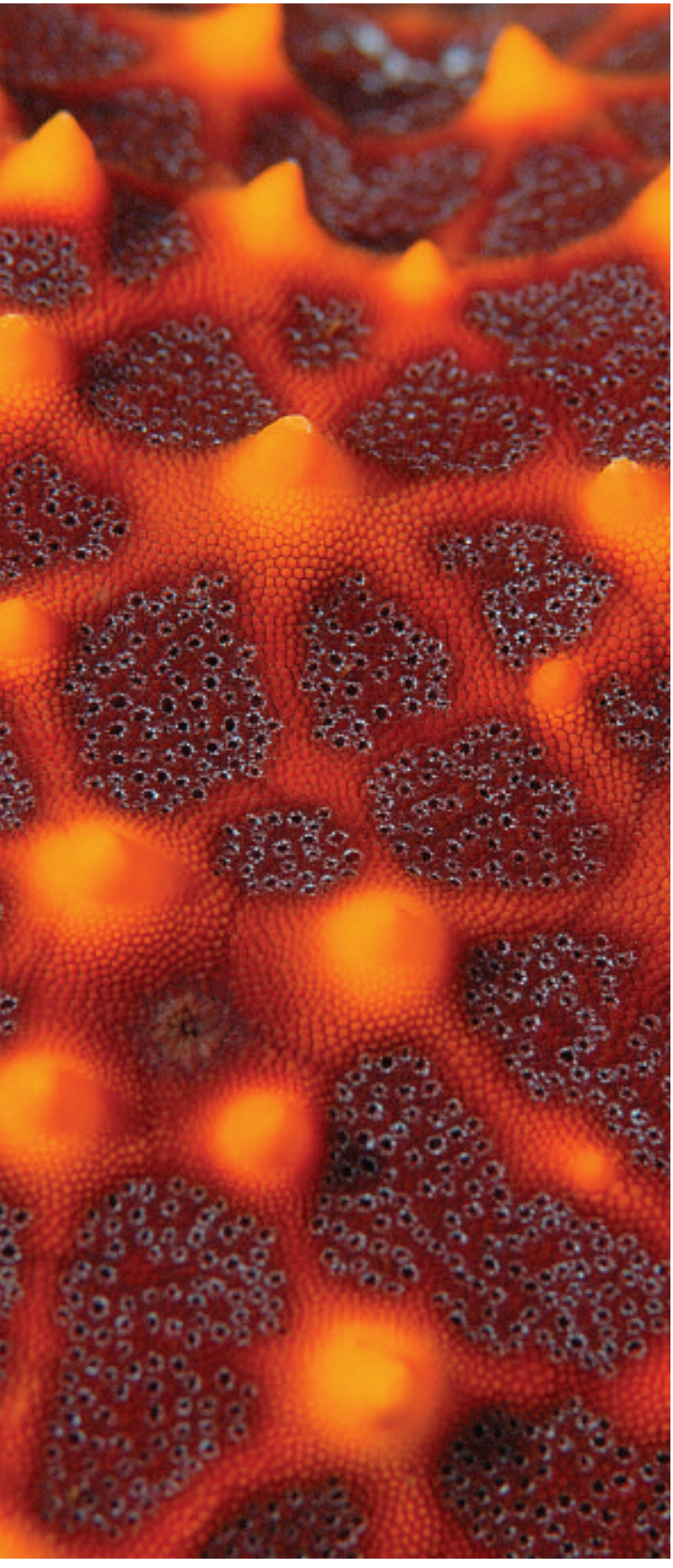
An example of this type of problem is what goes on in Bahia de Los Angeles, in Baja California, where trips to see and swim with whale sharks have become very popular (Box 1). However, the local community has not seen an improvement in their quality of life because of the lack of organization among users and economic benefits going to outsiders rather than the local community. Rodríguez-Dowdell (2004) proposes that a system where a concession on the area is given to local community members because this is the best way to maximize resource exclusivity, guarantee the welfare of the community, and develop cooperation among stakeholders in conservation efforts.

Ensuring that coastal communities have access to adjacent marine resources is a tool that can be used to implement effective marine reserves/MPAs and achieve conservation goals. Developing such systems needs to be carried out hand in hand with the management plan of the marine protected area and be specific to the community and area where the MPA is situated.

Box 1. Whale Shark Sightings in Bahia de los Angeles

- Bahia de los Angeles is one of the most productive zones in the Gulf of California.
- For ten years there have been ecotourism activities around the Whale Shark.
- The species and its habitat represent a valuable source of capital for the community. However, the quality of life of people in the area has not seen improvement.
- There exists a degree of capital flight in the area, since many external groups that offer the same activities but do not hire local people who offer the same services.
- A possible solution to this problem would be to grant certain areas to members of the local communities for their use.
- This mechanism can lead to cooperation and represents an incentive for the preservation of the resource since exclusivity would be high, and the economic benefits would be maximized.

Source: Rodriguez-Dowdell, 2004



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6.2 Identity

It is important for MPAs to be considered areas where natural resources interact with social factors resulting in an identity that includes the relationship of a community with the natural environment (Andrade and Ortiz, 2004). To achieve this it is necessary to identify all sectors affected by the establishment of an MPA. This means all individuals that directly or indirectly use the natural resources in a MPA, including individuals from the fishery or tourism sectors, as well as community members.

Individuals and entire communities use the natural resources surrounding them in different ways, and there are social, economic and cultural factors that determine the way in which these resources are perceived by these individuals. Indirectly, this causes individuals to place a value on ecosystems and species. These values can have serious implications on the way resources are managed.

The way resources are perceived usually differs among communities, and respect for nature and community solidarity are two key values that need to be kept in mind while establishing an MPA and developing its management program. If MPAs that are in the process of being established, and those that already are, do not take into account the community's perceptions, values, and interests with respect to the natural resources, then they risk failure (Cinner and Pollnac, 2004; Toledo, 2005).

The main objective is to identify the natural resources that represent the interaction of the local community with the MPA (Box 2). This means that species and ecosystems that give meaning to the relationship of individuals with the environment need to be identified, as well as the value of each one, threats and diagnosis for its immediate future. Only this way can we "value" its loss, recovery, or conservation for future generations (Fagetti and Olivera, 2003).

Furthermore, preserving local identity can result in the creation of job opportunities. Community members hold advantages over government officials for doing certain activities like enforcement and monitoring. Since local communities depend on the availability of resources, it is to their advantage to protect an area and its resources. And so, it is necessary to have economic management schemes that create incentives for the monitoring and evaluation of the health of the resources.

6.3 Equity

It is crucial to recognize that by helping the most disadvantaged groups related to an MPA we can promote their participation and thus improve their quality of life. Any development that results in the improvement in the quality of life of local communities should be considered a priority. Development programs should always place priority on the local community before any outside parties or sectors experience economic benefits (Andrade and Ortiz, 2004).

It is also important to recognize that economic, social and cultural interests are fundamental aspects of any management plan. Everybody's participation in the management process makes it more democratic because it gives everybody the right and authority to make decisions regarding the MPA. When the more disadvantaged groups get involved in the decision making process, management becomes more efficient in controlling ecosystem and resource degradation.

Many of the activities that take place in and around MPAs, such as fishing and ecotourism activities, compete against each other for the same resources. As effort or pressure from one activity increases, the resources needed by the other decrease thus jeopardizing its future. It is crucial to find a balance between interests and this can be achieved through dialogue and the use of legal mechanisms that allow fair access to resources.

Resource extraction inside marine protected areas is considered in the administration plans because it represents a source of food, jobs, recreation, and economic wellbeing to local communities and visitors. However, it is essential that resource extraction is done through responsible measures (FAO, 1995). While federal, state, and municipal fishing regulations should be followed inside MPAs, it is necessary to apply regulations regarding the next three concepts:

6.4 Creating marine reserves

Due to the overexploitation of many resources and the collapse of the fisheries that depended on those resources, it is clear that fishery regulations on their own are not enough to restore populations to sustainable levels. The creation of marine reserves, where all extractive activities are prohibited, has become a popular measure in many parts of the world in order to let target species populations recover. These no-take zones should be big enough to allow for resources to recover without compromising the wellbeing of those who depend on the extraction of the resources that are looking to be protected. These types of conservation strategies have begun to be implemented in the Gulf of California by NGO's like COBI (Box 3).

Closing an area to a particular activity can be difficult since many people may depend on that very activity. While we do not recommend converting all marine protected areas, or those that need to be protected, into marine reserves it is important that MPAs include marine reserves (no-take zones) where no fishing is allowed. Marine reserves will therefore be a core component of wider MPA network and will work together to achieve their conservation goals.

Box 2. National Park Bahia de Loreto

- Historically the economy of Loreto has relied on fishing, however in the last few years the tertiary sector has gained importance.
- The zone was very important for the fishing of the mother pearl in the nineteenth century.
- Bahia de Loreto is a zone famous for its optimal conditions for activities like sports fishing and traditional fishing.
- In 1996, it was proclaimed a natural protected area.
- Population growth and the development of the region represent a threat to the area's natural resources.
- The fishing communities recognize the importance of conserving the fish populations since these represent their livelihood.
- Many fishermen collaborate with scientists to the best strategies for the conservation of the zone and its resources..

6.5 Protection of critical habitats

A critical habitat is a place that is used for reproduction, feeding and as nursery grounds by many species, including some of economic importance like snappers, groupers, lobsters, and shrimp. Recognizing the importance of these habitats is crucial in fishery sustainability because the survival of commercially targeted schools depends on the availability and health of these habitats. If these habitats are altered, either by pollution, natural causes or human related causes, then their productivity will decrease.

It is very important to determine the distribution of critical habitats like mangroves, seagrass beds, macroalgae beds, reefs and seamounts. Management plans for established MPAs have an inventory of species; however they lack maps detailing habitat distribution and ecosystem diversity. It is time to dedicate our efforts to generating this type of information because by providing a spatial representation of biological and physical information we will better understand the dynamics that take place at an ecosystem level (Box 4).

Each MPA, and therefore all reserves, need to have its own set of maps developed that include the species present in the area, the eco-regions where they are distributed, their critical habitats, and human related threats they are subject to. This will prove useful not only when trying to identify specific threats, but also when creating a management plan that includes regional conservation efforts as well as specific actions directed to each individual MPA. While a regional approach is necessary to guarantee sustainability of the entire region, it is equally important to have a more local vision that helps identify and tackle problems from the roots, problems that in many cases are very site specific.

Box 3. No-take Zones in the Gulf of California

- In 2001, Comunidad y Biodiversidad (COBI) leads a new project to develop a methodology for the use of No-take zones as conservation mechanisms in the Gulf of California.
- The Bahia de Loreto National Park (PNBL) is one of the areas where this methodology was implemented.
- Fishing communities have responded favorably, creating a demand for the implementation of this methodology in the areas where they work.
- The knowledge and participation of the community is key for the success of these zones.
- In the PNBL, although the no-take zones are not the right size in order to work effectively, the biodiversity and abundance of species has remained the same, while open areas have seen a reduction in these two factors.
- It is likely that the protection of these zones is allowing these ecosystems to become more stable and resistant to environmental chances (healthy ecosystems).

Source: COBI. 2005. COBI. 2005. Diseño y evaluación de reservas marinas en las islas del Golfo de California (A-1-00/24). Final Report. Comunidad y Biodiversidad A.C. 39 pp.

6.6 Coastal and reef habitat restoration

The effects that human activities have on ecosystems have compromised their recovery in the short and long term. Dredging and removal of structural species (e.g. mangroves, macroalgae, corals, and molluscs) have modified the natural environment and have had cascading effects on the entire community. When a community becomes unstable with low probability of recovering, restoration programs need to be put in place.

Historical information on these habitats needs to be gathered, and species need to be reintroduced in accordance to their natural and historical distributions. Regulation of human activities needs to be implemented and a monitoring program established to evaluate the restoration process. This information can be used not only to restore habitats, but also to identify the cause of the deterioration, as well as the modifications needed to eliminate this negative impact.

Box 4. Protection of Critical Habitats Sargazo Beds

Sargasso Beds

- The leopard grouper *(Mycteroperca rosacea)* is a commercially valuable species, both for commercial fishing and sports fishing.
- The recruitment of juveniles takes place in Sargasso beds (*Sargassum* spp.), in brown algae that forms in rocky zones along the coastal strip.
- Recruitment depends on the three-dimensional structure that the algae, like the *Sargassum*, offer.
- The intensity of the recruitment is directly related with the abundance of adequate habitat (biomass of the *Sargassum*).

Source: Aburto-Oropeza, O., E. Sala, G. Paredes, A. Mendoza and E. Ballesteros. In prep. Predictability of fish recruitment in a highly variable nursery habitat.

Wetlands

- Wetlands are being threatened by water contamination, urban development, aquaculture farms, among other factors.
- The deterioration of these habitats affects a large number of species that use these areas during one time or another of their life cycle. Some of these species are of high economic importance, like some fish, mollusks, and shrimp.
- This also affects many species of birds that use these habitats for feeding or rest during their migration route.

Source: Ezcurra, E.M. 1998. Conservation and Sustainable use of Natural Resources in Baja California: An Overview. Briefing Paper prepared for San Diego Dialogue's Forum Fronterizo series, San Diego Dialogue, San Diego, California, October 1998, 15 pp. (available at http://sandiegodialogue.org/pdfs/)

6.7 Transparency and activity reports

Marine protected areas should promote collective efforts like commissions and associations (fishermen, hotels, transportation, ecotourism, among others), as well as support the cooperation between public and private sectors. They should promote the formation of development agents that identify, organize, and help community members, and in order to achieve this, the government's political will is fundamental (Fagetti and Olivera, 2003).

For some time now, the Mexican government has implemented programs that help structure a planning process that involves society as a whole, and in which knowledge and technology can be incorporated in the search for better use of natural resources (Negrete and Bocco, 2003). Therefore, it is essential to strengthen existing groups like the Sustainable Development Councils, the Natural Protected Areas Technical Councils, and others that also work to develop society's participation like the Rural participation evaluation group (ERP), the Rapid rural diagnostic group (Negrete and Bocco, 2003). These groups are formed by representatives from the communities, academic institutions, and from the government; this allows for more transparency in the administration of natural protected areas.

These collective efforts should combine technical knowledge with traditional knowledge in order to design an information system that includes: the area's management, community administration, regionalization and its uses, and the design of evaluation, training, monitoring and investigation processes. This system should not only consider the boundaries of the MPA/marine reserve and the community, but it should work with a regional perspective of a MPA/marine reserve network.

Box 5. Habitat Restoration

- The perception of what is "natural" changes through time and every generation has a different idea of what natural is based on what they can observe around them.
- Fishermen over 55 years of age recall that there were up to five more economically important species, and four times the number of productive fishing areas that have since collapsed.
- There is also a difference between older fishermen and younger ones when recalling the size of the individual species they catch, these being larger in the past than they are now.
- There are species that were abundant before that now many of the younger fishermen have never seen in their natural habitat or spotted on rare occasions.
- Examples of these species are the *totaba Cynoscion macdonaldi*, the gulf grouper *Mycteroperca jordani*, and the *mother pearl Pinctada mazatlanica.*

Source: Sáenz-Arroyo, A., C.M. Roberts, J. Torre, M. Cariño-Olvera and R.R. Enríquez-Andrade. 2005a. Rapidly shifting environmental baselines among fishers of the Gulf of California. Proc. R. Soc. B. (272):1957-1962.

6.8 Conservation in an economic context

Mexican natural protected areas are under management schemes controlled by the state, with a hierarchical government, and highly structured markets. The people using those areas do not have any incentives to strive for the area's sustainability, and instead look to gain the most economic support possible from the public administration. This leads to the exploitation of resources at levels which are not sustainable on the long run. Overexploitation is the result of a failure to control extraction activities.

Recognizing that "biological conservation is not simply a biological matter" allows the creation of a new perspective on MPAs and marine reserves, which from a biological point of view are necessary to protect biodiversity but are certainly not enough (Toledo, 2005). To make MPAs economically feasible we must perceive them as productive units that generate vital benefits to society that need to be recognized and valued, and that their management is subject to investments that cover its operational costs (INE, 1995).

The Gulf of California has great potential for local development based on its natural and cultural resources. This development can be achieved through the legal framework of marine protected areas and marine reserves, using them as conservation tools to protect natural resources, but also as attractors and market opportunities. Regulated development of small-scale fisheries in the waters surrounding a marine reserve or inside an MPA and the use of commercially efficient marketing methods with certified labeling are also conservation tools that promote sustainable development. These strategies can link the revival of traditions and customs with the development of new roles that are not well known such as tourist guides, environmental educators, or park rangers (Fagetti and Olivera, 2003).

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7 :: Conclusions

- The Gulf of California is a biologically diverse and culturally rich region. The great number of unique species and the variety of habitats make it a region of great conservation importance.
- Local communities have a close relationship with natural resources and the region's development is based on the availability of those resources. It is crucial that the region has management and conservation plans that ensure sustainability while promoting economic development.
- Conservation efforts in the Gulf of California Region have yielded promising results, however there is still a lot more to be done. Several groups have already identified the areas of conservation importance as well as threats and those areas where pressure on natural resources is greatest.
- Some of the areas considered of conservation importance have been declared NPAs, while some other are in the process of obtaining this status. Efforts should focus on obtaining NPA status on areas that are not protected but are considered to be important. This will result in the creation of a marine protected area/marine reserve network for the Gulf of California.
- The management of this MPA network needs to have a regional perspective because of the connectivity between MPAs and resources. The administration of each MPA should be a community management and through properties such as community access to resources, identity, administrative equity, transparency and activity reports, the region's sustainability can be achieved.
- Important elements of the MPA network are the marine reserves that need to be established within each MPA. Marine reserves will bring benefits not only to the fishing industry, but to other important industries like tourism because there will be an improvement in the health of the marine environment. A fully protected marine reserve network within a wider MPA system will allow the recovery of natural ecosystems through stricter regulations including the prohibition of all extractive activities.

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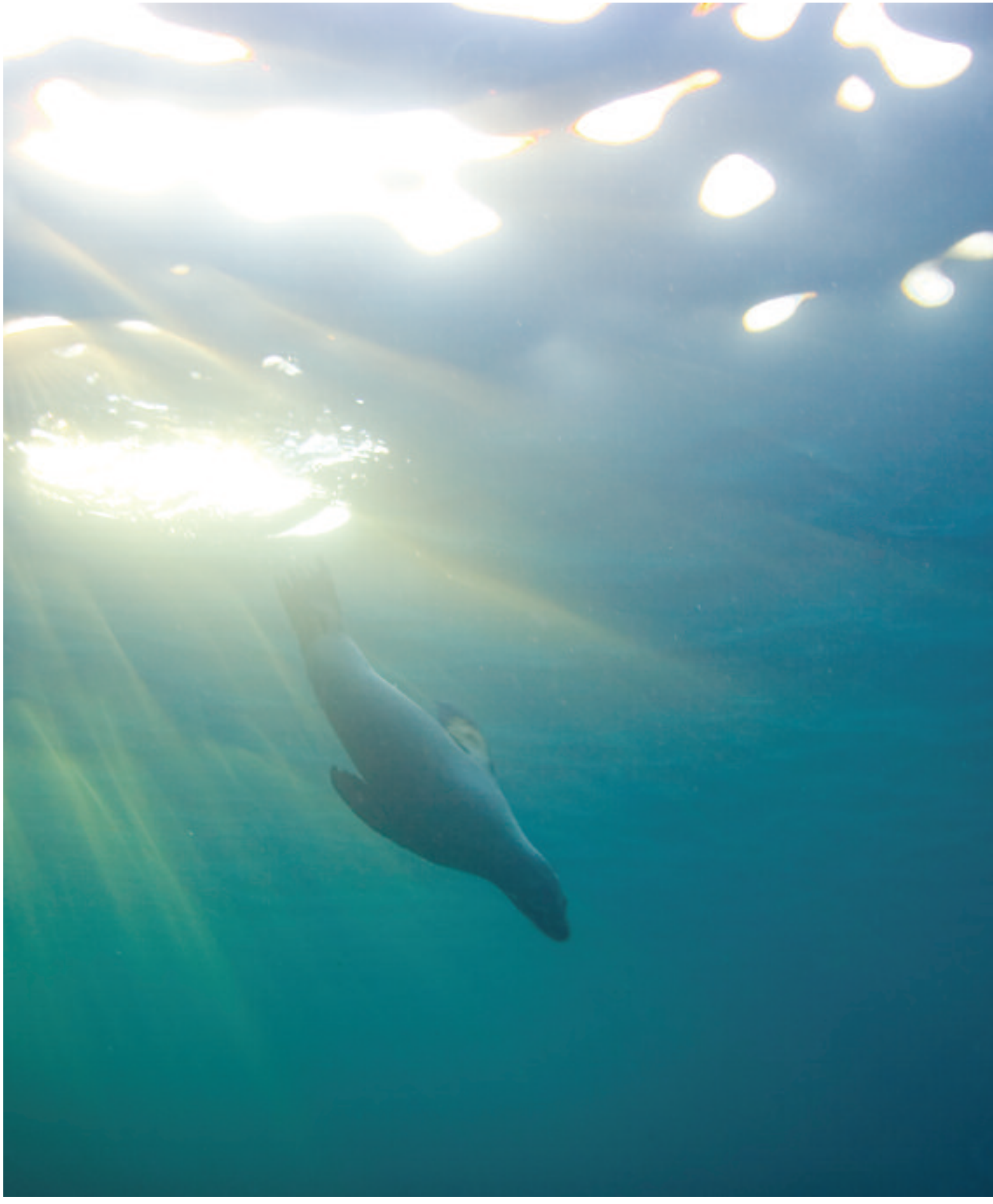

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