# Conservation and Sustainable Use of Natural Resources in Baja California: An Overview

***Briefing Paper***

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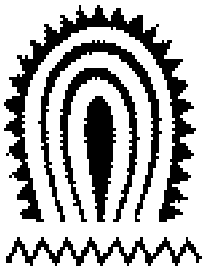

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## Executive Summary

The natural history of Baja California is the tale of the deep causes of the diversity of life on Earth. All along Baja the driving theme is insularity. During the last six million years the Sea of Cortés has kept the long and dry peninsula separated from the Mexican mainland, and the peninsula of Baja California has kept the Sea of Cortés engulfed in its own depths, sequestering it from the Pacific Ocean. On this landscape of sea and land that mutually embrace each other, keeping in solitude the genetic secrets of their founding life forms, smaller patches of insularity are superimposed at even smaller scales. Marine islands, high mountains, palm oases, and coastal lagoons, all represent fragmented habitats that repeat the isolation theme at smaller and smaller scales.

The Cochimí Indians developed here one of the most incredible assemblages of cave paintings in the world. Later, the Jesuit fathers founded here a system of missions that evolved in complete independence from the hard and cruel rules of the mainland *conquistadores*. Even in recent decades, journalists have referred to Baja California as "the other Mexico" (*el otro México*). It has always been a land of fantasy and adventure, of surprising, often bizarre growth-forms, and of immense natural beauty.

The peninsula of Baja California is being very slowly torn away from the Mexican mainland by a series of rifts that are gradually opening up the Gulf of California or Sea of Cortés. In Southern California the drifting movement of the peninsula generates a long line of friction known as the San Andreas fault. The ridges and crumples that are formed by this very active tectonic interface are the main causes of the regional topography, which in turn drives local climates and ultimately is a major causal force of the region's unique biological diversity.

In the same way as the geological processes shaped the abrupt geology of the peninsula, the circulation of winds and oceanic currents is the underlying mechanism that generated the region's incredible ecosystems. In the Pacific coasts of Baja, the cold California current is deflected westwards by the rotational movement of the Earth. The deflected layers are replaced by an upwelling of cool water that is transported upwards from the nutrient-rich layers of the ocean floor, bringing fertility to the surface. Similar upwellings fertilize the Sea of Cortés. Cold seas are also the major cause of the aridity of the land, as the moisture-laden winds that run from the sea into the hot land become drier.

Few places show the extraordinary environmental heterogeneity of the peninsula of Baja California and of the Sea of Cortés. The isolation in which the region has evolved has generated an inordinately high biological richness and an extremely high level of endemism. Almost 30% of the plants in Baja are endemic to the peninsula. High endemism is found in land mammals (22%), reptiles, and reef fishes (19%). Even in the case of birds, which tend to be more cosmopolitan, there is a high level of endemism at the subspecies level (22%). The Sea of Cortés is also extremely rich in marine mammals, harboring 33 species. Of these, 28 are cetaceans, including the highly endemic *vaquita* porpoise (*Phocoena sinus*) that is only found in the Upper Gulf.

The region is not only one of Mexico's richest areas in terms of natural resources; it also holds one of Mexico's fastest growing regional economies. The *maquiladora* industries in northern Baja California, the high-input crops in the agricultural valleys, and the booming tourism industry, are all powerful driving forces of economic and

demographic growth. Some selected indicators of economic development (education, housing, and human fertility) show values that suggest a relatively high economic development compared to the rest of Mexico. The *per capita* contribution of the peninsular inhabitants to the GDP is more than 20 % above the national average.

The relative success of the peninsular economy has brought a large demographic increase to the region, mostly derived from immigration. While national growth rates in Mexico have descended considerably during the last decades, the rates in the peninsula still remain high. The cities with the most dynamic and active economies, Tijuana and Los Cabos, have grown very rapidly with annual rates of 6.52% and 9.67%, respectively. It is difficult to control pollution and to keep an adequate supply of services in cities that double in size in less than a decade. Rapid demographic growth means, almost by definition, an increasing lag in water and electricity supply, in sanitary infrastructure, in pollution control, and in environmental conservation. Driven by the attendant rapid increase in demand for resources, the region is confronting a series of environmental threats. Among them, the following are of preeminent relevance: (a) uncontrolled urban sprawl along the Mexico-U.S. border, (b) exhaustion of the underground aquifers, (c) replacement of native vegetation by weedy exotic grasses, (d) off-road vehicles, (e) tourism in the fragile environments of the islands, (f) degradation of estuaries and coastal lagoons, and (g) unsustainable commercial fishing in the Sea of Cortés.

Both the Mexican government and the conservationist non-governmental organizations (NGOs) have developed actions to protect the incredibly rich and increasingly endangered ecosystems of Baja California. The region now harbors 11 natural protected areas, including six that have been created during the last five years, that protect a combined 2,612,126 hectares. Efforts have been also developed to promote the sustainable use of fisheries and natural resources. In July 1998, the governors of the four states surrounding the Sea of Cortés signed an agreement with the Secretary of the Environment, to pursue a joint program for the sustainable use of the Sea of Cortés.

It is difficult to say at this time if the increasing pace of conservation efforts in Mexico is being able to stall the rapid environmental degradation that the region is suffering. The optimistic note is that there seems to be in the peninsula of Baja California and in the Sea of Cortés a growing awareness, as never was observed before, of the importance to take urgent action to protect the environment. The swelling number of conservation actions that have been taking place is not the sole merit of any sector. Conservation groups, research institutions, federal and state governments, NGOs, and conscientious businesspersons and eco-tourism operators have all been contributing to the growing appreciation of the environment, and to the attendant conservation actions. But the new Secretary of the Environment deserves great credit in having listened to these rising voices, and in having acted accordingly. The time seems to be perfect to promote true cooperative work, not only within Mexico but also across the border, between Mexican and U.S. conservation groups. The region is only one large continuum, with shared watersheds, species, and natural resources that do not recognize a boundary line. The protection of these unique environments is of the uttermost importance for the survival and well being of all of us, for generations to come.

## Introduction

The history of Baja California is one of evolution in isolation. It is a natural account of the deep causes of the diversity of life on Earth. All along Baja the driving theme is insularity. During the last six million years the Sea of Cortés has kept the long and dry peninsula separated from the Mexican mainland, and the peninsula of Baja California has kept the Sea of Cortés literally engulfed in its own depths, sequestering it from the Pacific Ocean. On this landscape of sea and land that mutually embrace each other, keeping in solitude the genetic secrets of their founding life forms, smaller patches of insularity are superimposed at even smaller scales. Marine islands surround the peninsula on all sides, and high mountains, true sky islands in a desert sea, imprint the landscape all the way from the U.S. border down to Los Cabos. Palm oases in deep, disjunct canyons form yet again thousand of wetland islands within the rocky matrix of the peninsular ranges. The seacoast is fringed by coastal lagoons that repeat in a fractal manner the isolation theme in smaller and smaller bodies of water.

These patches of segregation are the driving force of biological speciation, of adaptation to local conditions, of specializing to particular isolated environments. After millions of years, fragmentation yields unique life forms. It also yields unique cultures. Quite separated from the rest of Mesoamerica, the Cochimí Indians developed here one of the most incredible assemblages of cave paintings in the world. Later, during the Spanish colony, the Jesuit fathers founded here their own Utopia in a system of missions that evolved in complete independence from the hard and cruel rules of the mainland *conquistadores*. True to the etymology of the word, the peninsula has been indeed almost an island. Even in recent decades, some journalists in Mexico City have referred to Baja California as “the other Mexico” (*el otro México*). It has always been a land of fantasy and adventure, of surprising, often bizarre growth-forms, and of immense natural beauty.

At present, however, modern transportation, population growth, urban sprawl, agricultural technology, and modern fishing techniques, among other causes, seem to be putting stress on the fragile peninsular environment. This paper is an attempt at discussing some of the issues related to environmental degradation and natural resource conservation in the region within a regional perspective.

## The Shaping of a Singular Landscape

While most of the continental mainlands of Mexico and the United States are attached to the North American Plate, the southwestern part of California, along with all of Baja California, is a sliver of continental crust that has become affixed to another slab of the Earth’s crust–the Pacific Plate–and rides on it. The peninsula of Baja California is being very slowly torn away from the Mexican mainland by a series of rifts that are gradually opening up the Gulf of California (also known as the Sea of Cortés), moving the whole plate towards the northwest. In Southern California the drifting movement of the peninsula generates a long line of friction, where the two plates are not pulling apart nor squeezing together, but rather they are sliding against one another. This line is known as the San Andreas fault. The ridges and crumples that are formed by this very active tectonic interface are the main causes of the regional topography, which in turn drives local climates and ultimately is a major causal force of the region’s unique biological diversity.

Hence, as a natural region the peninsula of Baja California is really born at Point Conception. At this place the coastal ranges, which descend from the north along a faulted axis that parallels the coastline, suddenly turn eastward, following the deflection of the San Andreas fault that leads into the Sea of Cortés. The entire coast begins an eastern jog to form a crescent bight extending 250 miles to San Diego, where the curve renews its southern tack into the Gulf of California. South of San Diego, at the Mexican border, the main ecosystems of Southern California–coastal plains, inland deserts, and mountain backbone–spill naturally into Baja California. Ecological corridors link the region from north to south; the long continuum of the peninsular ecosystems defines a homogeneous natural region: Greater Baja California.

*Cycles of abundance and scarcity*

In the same way as the geological processes are the force that shaped the abrupt geology of the peninsula of Baja California, the circulation of winds and oceanic currents is the underlying mechanism that generated the region's incredible ecosystems, and is the motor that still maintains their existence.

In the Pacific coasts of Baja, the cold California current, which runs from north to south along the coast, is deflected westwards by the rotational movement of the Earth (an effect known as the "Coriolis force"). The deflected surface layers of the California current are replaced by an upwelling of deeper cool water that is transported upwards from the nutrient-rich layers of the ocean floor, bringing fertility to the surface. Local currents produce similar upwelling phenomena in the Sea of Cortés, making it one of the most productive seas on Earth.

But cold seas are also the major cause of the aridity of the land, as the moisture-laden northwesterly winds that run from the cold Pacific into the warm Peninsula become hotter and hence drier. Only in the mountain ranges ascending air cools sufficiently as to generate significant rainfall and sustain temperate forests. Additionally, in the northern part of Baja California the land cools sufficiently in winter so as to cause atmospheric condensation and induce winter rains.

During El Niño years, random variation in the earth's flow of air weaken the trade winds, and the westward deflection of oceanic currents decreases. Warm oceanic waters accumulate in the coast of the American Continent, the upwelling of nutrient-rich waters decreases, and the sea becomes warmer. Thus, the natural cycle becomes inverted: as the ocean currents slow down and warm up, the sea becomes less productive while the land is soaked by the abundant rainfall that originates from the now warm ocean waters.

**Biological Uniqueness**

Few places show the extraordinary environmental heterogeneity of the peninsula of Baja California and of the Sea of Cortés. The regional climates vary from mediterranean-type winter rains in the north, to monsoon-type summer rains in the south. The steep slopes of the mountain ranges generate some of the most dramatic environmental gradients on Earth. The northern part of the peninsula extends from a coastal sclerophyllous scrub in the west, to a dry subtropical desert in the west, with a

sequence of mediterranean scrubs (chaparral) and temperate pine-oak forests covering, respectively, the intermediate and the highest altitudes of the central mountain ranges. A rare form of tropical deciduous forest occupies the lowlands of the Cape region, in the southern part of the peninsula. Also in the Cape region, but in higher elevations, temperate pine-oak forests are found in the mountains of the Sierra de la Laguna. This unique temperate ecosystem–a relictual memory of past glaciations–has evolved in extreme isolation, and is composed mostly of rare, highly endemic species. Similar areas of geographic isolation and biological rarity are found in the central mountain ranges (San Francisco, Guadalupe, and La Giganta), and in the oceanic islands of the Sea of Cortés and of the Pacific coast.

Wiggins' *Flora of Baja California* describes 2,958 species and 686 endemic plants. Adding recent discoveries and a more complete review of the literature, the flora possibly consists of more than 3,500 plants with a very high proportion (almost 30%) of these being endemic species. Endemism (i.e. the property of being uniquely restricted to a small area) is particularly high in the island ecosystems of the region, both in the Pacific and the Sea of Cortés, and in the isolated *sierras* such as San Pedro Martir, Juárez, San Francisco, Guadalupe, and La Laguna. Similar levels of endemism are found in reptiles and land mammals. For example, the terrestrial mammals of Greater Baja California comprise 109 species, 25 of which (22%) are endemic.

Even in the case of birds, which by their volant nature are more cosmopolitan, the region of Southern California and Baja California harbors 11 strictly endemic species and 114 endemic subspecies out of some 550 species and around 700 taxa (species + subspecies). In short, 2% of the avian species richness is endemic, and a remarkable 22% of the diversity at the subspecies level is unique to the Baja/Southern California region. Additionally, extinction is already a major threat for many avian species. The Guadalupe storm petrel (*Oceanodroma macrodactyla* Bryant), a rare and highly endemic marine bird, has already become extinct, and so have some seven other local, very restricted subspecies. Some of these subspecies, like the Guadalupe crested caracara (*Caracara plancus lutosa* Ridgway) were sufficiently distinct as to be considered separate species by some taxonomists. Many other endemic species and subspecies, such as the storm petrel (*Oceanodroma microsoma*), the yellow-footed gull (*Larus livens*), or the Yuma clapper rail (*Rallus longirostris yumanensis*) are rapidly disappearing or becoming increasingly threatened by habitat destruction.

In the same way as the peninsula is isolated from the Mexican mainland by the Sea of Cortés, the Sea itself is also a sort of "marine peninsula", isolated from the rest of the Pacific by the 1,500 km of land of Baja California. Biologically, the Sea of Cortés–also known as the Gulf of California–is one of the most productive and diverse seas in the world, harboring some 4,500 known invertebrate species (excluding the single-celled protozoans), with a very high level of endemism. Some authors estimate that a similar amount of invertebrate species remains undescribed in this extraordinarily rich environment. A similar situation of exceptionally high diversity is found in marine fishes. Around 872 species have been recorded in the Gulf, 86 (10%) of which are endemic to the region. Of these, teleostean fishes comprise some 750 species. Reef fishes, in general, have more restricted distributions than deep-sea, pelagic, or sandy shore species. Of 271 known reef fishes in the Sea of Cortés, some 52 species (19%) are

endemic to the region. The Gulf is also extremely rich in marine mammals, harboring 33 species. Of these, 28 are cetaceans, including the highly endemic *vaquita* porpoise (*Phocoena sinus*) that is only found in the Upper Gulf.

The high diversity of the Gulf of California is largely due to two phenomena: (a) the great variety of general habitats that are found in the Gulf, including mangrove swamps, coastal lagoons, coral reefs, shallow and deep sea basins, hydrothermal vents, and a diverse array of shore and subtidal substrates; and, (b) the complex geological and oceanographic history of the Gulf, including past invasions of animal immigrants from Tropical South America, the Caribbean Sea (before Earth's tectonic forces sealed the Panama seaway), the cold shores of California (during past glacial periods), and across the vast stretch of the Pacific Ocean from the Tropical West Pacific. The Gulf is important both biologically and economically. It houses an inordinately high proportion of the marine species richness of Mexico, and yields some 30-50% of the catch of national fisheries. The sustainable use and the conservation of the Sea of Cortés are critical issues under both points of view.

**The Socioeconomic Background**

The Baja California region is not only one of Mexico's richest areas in terms of natural resources; it also holds one of Mexico's fastest growing regional economies. The *maquiladora* industries in northern Baja California, the high-input crops and associated agro-industries in the agricultural valleys (Mexicali, Tecate, San Quintín), and the booming tourism industry, are all powerful driving forces of economic and demographic growth. Some selected indicators of economic development (education, housing, and human fertility) show values that suggest a relatively high economic development compared to the rest of Mexico (Table 1). Globally, the peninsula of Baja California has levels of illiteracy of less than 4% (illiteracy was calculated as the proportion of illiterate adults in the whole population). The number of houses with electricity approaches 90% (the calculation includes rural dwellings, in urban areas this percentage is even higher). The mean number of live children per woman over 12 years is around 2.4. For comparison purposes, the state of Oaxaca in southern Mexico has 17% of illiteracy, only 73% of its houses have access to electricity, and the mean number of live children per woman above 12 years of age is 3.1.

With some 2.5% of the population of Mexico, the peninsula of Baja California produces almost 3% of the country's gross domestic product. That is, the *per capita* contribution of the peninsular inhabitants to the GDP is more than 20% above the national average. The *per capita* income in the peninsula in 1996 was $3,774 ($3,722 in Baja California, and $4,068 in Baja California Sur). Although this may seem low by the standards of a developed country, it is substantially higher than the national average of Mexico, which was $2,880 for the same period.

**Table 1.** Selected indicators of economic development in the peninsula of Baja California: (a) percentage of the population that is illiterate, (b) percentage of houses that have electricity, and (c) mean number of live children per woman older than 12 years (source INEGI: Instituto Nacional de Estadística, Geografía e Informática).

| | Illiteracy | Houses with Electricity | Mean No. of Live Offspring |
|---|---|---|---|
| **Baja California** | **3.16** | **86.95** | **2.3** |
| Ensenada | 4.09 | 83.97 | 2.4 |
| Mexicali | 3.14 | 93.58 | 2.4 |
| Tecate | 3.72 | 77.32 | 2.4 |
| Tijuana and Playas de Rosarito | 2.80 | 83.29 | 2.2 |
| **Baja California Sur** | **3.60** | **86.93** | **2.4** |
| Mulegé | 4.25 | 86.44 | 2.6 |
| Comondú and Loreto | 5.15 | 87.36 | 2.6 |
| La Paz | 2.74 | 91.72 | 2.3 |
| Los Cabos | 3.55 | 70.13 | 2.4 |

The success of the peninsular economy has brought a large demographic increase to the region (Table 2), mostly derived from immigration. While the national demographic growth rates in Mexico have descended considerably in recent decades, from a national average of more than 3% to less than 2%, the growth rates in the peninsula of Baja California still remain very high. Between 1990 and 1995, the state of Baja California grew at an annual rate of 4.77%, while the neighboring Baja California Sur grew at a rate of 3.34%. The cities with the most dynamical and active economies grew even more rapidly: Tijuana, fueled by the immigration magnet of the *maquiladora* industry, grew at a rate of 6.52%, while the population of Los Cabos, under the impulse of a rapidly-growing tourism boom, grew at the extraordinary rate of 9.67%. If these rates are maintained, Tijuana would duplicate in population size every 11 years, while Los Cabos would double every 7 years. When these remarkably rapid growth rates are analyzed against the demographic data on female fertility (Table 1) it becomes obvious that the fast population growth of the region cannot be ascribed to reproductive habits, as the Baja families have a relatively low number of children compared to the rest of the nation. It chiefly is the result of internal migration within Mexico, from the impoverished southern states into the more dynamic economy of Baja's border region.

**Table 2.** Population in the Municipalities of the states of Baja California and Baja California Sur for 1990 and 1995, and calculated exponential yearly growth rates (expressed as a percentage; source INEGI). The Municipalities of Playas de Rosarito and Loreto were created after 1990. Their 1995 values, indicated in perentheses, were added to those of Tijuana and Comondú, respectively, to calculate the growth rates.

| | 1990 | 1995 | rate (%) |
|---|---|---|---|
| **Baja California** | **1,660,855** | **2,108,118** | **4.77** |
| Ensenada | 259,979 | 314,281 | 3.79 |
| Mexicali | 601,938 | 695,805 | 2.90 |
| Tecate | 51,557 | 62,617 | 3.89 |
| Tijuana (Playas de Rosarito) | 747,381 | 989,287 (46,128) | 6.52 |
| **Baja California Sur** | **317,764** | **375,450** | **3.34** |
| Mulegé | 38,528 | 45,887 | 3.50 |
| Comondú (Loreto) | 74,346 | 65,969 (10,003) | 0.43 |
| La Paz | 160,970 | 182,348 | 2.49 |
| Los Cabos | 43,920 | 71,243 | 9.67 |

These economic indicators highlight some of the most pressing environmental problems of the peninsula: On the one hand, it is extremely difficult to keep adequately 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 lag in water and electricity supply, and in sanitary infrastructure, including poor drainage and lack of water-treatment facilities, with the concomitant results of pollution and environmental degradation. On the other hand, rapid growth means an ever-increasing demand for water and other natural resources, which are scarce in the peninsula, chiefly due to the aridity of the region. Thus, the rapid expansion of the peninsular population is mostly done at the expense of depleting underground aquifers and of destroying the natural ecosystems and the watersheds that surround the large urban conglomerates.

**The Environmental Threats Confronting the Region**

Driven by the rapid increase in resource demand, the biologically unique region of Baja California is confronting a series of growing environmental threats. Among them, the following are of preeminent relevance:

1. Along the Mexico-U.S. border, growing industrialization is generating uncontrolled urban sprawl that puts the long-term conservation of the chaparral scrub under grave danger. At the other extreme of the peninsula, in the Cape region, the rapid growth of tourism is also creating a similar phenomenon of explosive urban expansion. In both areas, the growing demand for drinking water is depleting the aquifer resources.
2. Some agricultural areas that were developed in the mid-20$^{th}$ century are now facing the exhaustion of the underground aquifers, which were used in an unsustainable manner with no consideration for recharge. For example, some specialists estimate that Ciudad Constitución, some 50 km north of La Paz, is facing the closure of most of its wells within a time horizon of 10 years. Whatever the true time horizon really turns to be, the final result once the aquifer is exhausted will be barren wasteland of salinized agricultural soils that present a challenge for ecological restoration. In some parts, the descent of the regional aquifers has also meant the drying-up of surface water springs with the consequent degradation of freshwater wetlands. In many parts of the Baja deserts, water is indeed a non-renewable resource, or a resource with very slow turnover. Regional agricultural techniques, however, frequently use water wastefully, with a very low efficiency of conversion of water input to crop yields. The consumptive use of the aquifers for wasteful agricultural activities is a major factor of long-term ecological deterioration.
3. In some areas, vegetation cover is being rapidly destroyed for agricultural development and/or the planting of weedy exotic grasses –such as the African Buffel grass *Pennisetum ciliare*–to improve forage productivity for cattle in desert environments. In southern Baja, the weedy Buffel grass does not seem to need previous land clearing to become established. Highly adapted to the hot and dry tropical environment, Buffel is rapidly invading some overgrazed desert lands. Once invaded by the rapidly-growing and leafy Buffel, the accumulated biomass burns easily during the dry season, turning the Baja desert into a fire ecosystem that burns seasonally and prevents the re-establishment of the original biologically-rich scrub.
4. Adventure-tourism has had large impacts on some of the peninsular ecosystems. Perhaps the most destructive form of wild-land recreation is the use of off-road vehicles in the open desert and the coastal sand ridges. The vegetation in these environments has an extremely slow growth rate. For example, a barrel cactus that can be destroyed in seconds by a rash driver may have taken centuries to grow to its adult size. Quite obviously, the destruction wrought by a vehicle on a single weekend may take centuries to recover.
5. Additionally, nature tourism has had an increasing impact in the island ecosystems of the Gulf of California, which are extremely fragile environments. Biological evolution in isolation has made of the Islands of the Gulf of California areas that are highly vulnerable to ecological impacts, such as the introduction of exotic species, habitat deterioration, hunting, or fishing. In particular, the introduction of exotic

species such as rats, cats, or goats may cause true ecological catastrophes in the population numbers of plants, marine birds, or island reptiles. Finally, the growing demand of nature tourism has in turn generated increasing pressures to develop the islands. Although to date no development has been authorized in the Gulf Islands, the number of proposals and of associated environmental impact statements has been increasing steadily over the last decade.

6. The estuaries and coastal lagoons of the region are facing increasing threats from industrial and tourism developments, and from runoff of terrestrial pollutants. The deterioration of the coastal lagoons affects a large number of marine organisms that spend part of their life cycle in these ecosystems, from the gray whales in the Pacific lagoons, to shrimp, mollusks and fish in the Sea of Cortés. It also affects a large number of migratory birds that use these wetlands along their travel routes. Thus, the coastal lagoons provide unique ecological services that are crucial for the maintenance and survival of species that migrate later into other, often distant, ecosystems. These services, however, are not easily perceptible by developers, who have tended to consider these environments as "wastelands" that should be used for more direct economic profit. The cutting of mangroves for aquaculture or for coastal resorts is a typical example of this problem: while the seminal importance of mangroves for open-sea fisheries and marine life in general is not easy to perceive, the immediate utility of their clearing for other less productive purposes seems to be more clear and understandable.
7. Finally, the use of shrimp dragnets in the Gulf of California, gillnets with inadequate mesh sizes, and long-lines in both the Gulf and the Pacific, are creating serious concerns for the long-term sustainability of the marine ecosystems around the Baja California peninsula. For example, incidental by-catch in the shrimp fisheries is often more than 90% of the total harvest, creating an immense waste of resources that are consumed neither by humans nor by other marine species that depend on these organisms.

**Of Whales and Cacti: Conservation Efforts in Baja California**

Both the Mexican government and the conservationist non-governmental organizations (NGOs) have developed actions to protect the incredibly rich and increasingly endangered ecosystems of Baja California. The region harbors now 11 natural protected areas (Table 3), including five Biosphere Reserves (El Vizcaíno, Alto Golfo de California y Delta del Río Colorado, El Pinacate y Gran Desierto de Altar, Sierra de la Laguna, and Archipiélago de Revillagigedo), two National Parks (Constitución de 1857, and Sierra de San Pedro Mártir), and two Marine Parks (Bahía de Loreto and Cabo Pulmo). Formally protected by older and outdated decrees, the Islands of the Gulf of California, the Island of Guadalupe in the Mexican Pacific, and a canyon in the midriff coast of Sonora, are being re-categorized at present to fit them to the new Mexican legislation on protected areas.

**Table 3.** Protected areas in the peninsula of Baja California, the Sea of Cortés, the Mexican Pacific Ocean, and the Gulf coasts of the Sonoran Desert (Source: SEMARNAP).

| Name | Area (ha.) | category | Date of decree | Ecosystems |
|---|---|---|---|---|
| **STATE of BAJA CALIFORNIA** | | | | |
| Alto Golfo de California y Delta del Río Colorado | 934,756 | BR | 15-JUN-93 | Sand dunes, halophilic scrub, intertidal mudflats, estuary. |
| Constitución de 1857 | 5,009 | NP | 27-MAR-62 | Pine-oak forest and chaparral. |
| Sierra de San Pedro Mártir | 63,000 | NP | 26-APR-47 | Fir, pine-oak forest and chaparral |
| **STATE of BAJA CALIFORNIA SUR** | | | | |
| Bahía de Loreto | 206,581 | MP | 19-JUL-96 | Mangroves, coastal dunes, rocky reefs, desert scrub. |
| Cabo Pulmo | 7,111 | MP | 06-JUN-95 | Coral reef. |
| El Vizcaíno | 2,546,790 | BR | 30-NOV-88 | Desert scrub, coastal dunes, halophilic scrub, mangroves, coastal lagoons. |
| Sierra de la Laguna | 112,437 | BR | 06-JUN-94 | Pine-oak forest, tropical dry forest, palm oases, columnar cacti and desert scrub. |
| **ISLAND RESERVES IN THE PACIFIC & SEA OF CORTÉS** | | | | |
| Archipiélago de Revillagigedo | 636,685 | BR | 01-JAN-94 | Tropical dry forest, coastal scrub, coastal shrublands. |
| Isla de Guadalupe | 25,000 | AR | 27-OCT-28 | Pacific coastal scrub. |
| Isla Rasa | 61 | AR | 30-MAY-64 | Coastal scrub. |
| Isla Tiburón | 120,800 | AR | 15-MAR-63 | Sonoran Desert scrub |
| Islas del Golfo de California | 150,000 | AR | 02-AUG-78 | Sonoran & Gulf island scrub. |
| **OTHER COASTAL RESERVES IN THE SEA OF CORTÉS** | | | | |
| Cajón del Diablo | 147,000 | AR | 14-SEP-37 | Desert canyon oasis |
| El Pinacate y Gran Desierto de Altar | 714,556 | BR | 10-JUN-93 | Sonoran Desert scrub |

Categories: BR: Biosphere Reserve (*Reservas de la Biosfera*); NP: National Park (*Parque Nacional*); MP: Marine Park (*Parque Marino*); AR: Areas currently under re-categorization (*Áreas en Recategorización*).

It is clear from the data shown in Table 3 that since 1993 there has been an immense effort to decree and protect new areas. Indeed, between 1993 and 1998 there were six new protected areas decreed, totaling 2,612,126 ha. under some category of protection (Fig. 1).

In 1993 the Mexican government issued two decrees protecting under the category of Biosphere Reserves the strip of desert land and coastal ecosystems that join the Sonoran Desert with the Baja California Peninsula. The creation of these wilderness protected areas was achieved largely thanks to the initiative and the support of local conservation groups and academic institutions. Both the Pinacate-Gran Desierto Biosphere Reserve and Upper Gulf of California Biosphere Reserve gained immediate national and international support. The Gran Desierto reserve protected the remarkable endemisms of the largest continental sand-dune system and volcanic shield in North America, while the Upper Gulf reserve protected two highly endangered marine species:

the vaquita porpoise (*Phocoena sinus*) and the totoaba (*Totoaba macdonaldii*). In conjunction with Organ Pipe Cactus National Monument and Cabeza Prieta Game Reserve in the United States, these two reserves formed the largest ecological corridor of protected areas in the Lower Colorado Valley desert lands. The most remarkable aspect of the project, however, was the wide cooperation and the partnerships that it involved. The creation of these desert and coastal reserves engaged the participation of many groups, including indigenous peoples like the Tohono O'odham, conservation groups like Pronatura, Conservation International, The Nature Conservancy, and the Audubon Society, together with a myriad of academic and research organizations. Some of these organizations eventually coalesced into a conservation bloc called the Sonoran Desert Alliance.

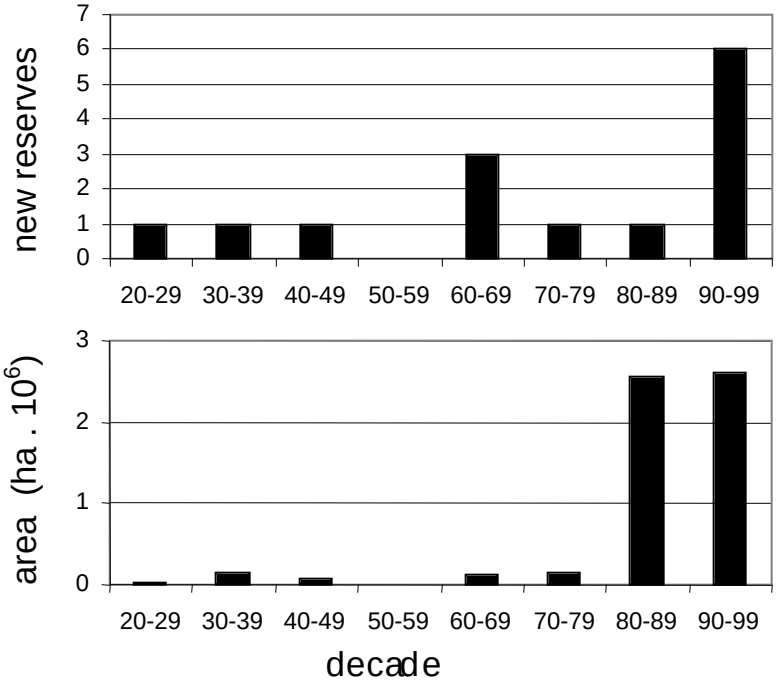


**Figure 1.** (a) New nature reserves decreed in the Baja California/Sea of Cortés region between 1920 and 1998. (b) Area protected during each decade (in millions of ha).

Additionally, during 1993 the Mexican government prepared a series of documents that were presented to UNESCO to dedicate the Vizcaíno Biosphere Reserve as a World Heritage Site within UNESCO's World Heritage Committee. Shortly afterwards, new decrees followed. With the cooperation of researchers from the Instituto de Ecología, A.C., the California Academy of Sciences and the University of California, Los Angeles, the Mexican government issued a decree for the protection of the Revillagigedo Archipelago in the Mexican Pacific. Six months later, in June 1994, a decree was issued to protect the Sierra de la Laguna, in Baja's Cape region. Following an initiative from Pronatura Peninsula de Baja California, a Mexican NGO, in 1995 the greatest and most diverse reef of the Sea of Cortés became officially protected, under the name of *Parque Marino de Cabo Pulmo*. Finally, in July 1996, a decree was issued to protect the Bay of Loreto, also as a Marine Park. It is remarkable that the creation of this last park was totally the result of a grassroots initiative from the local small fishermen, who were concerned about the continuing decrease of their catch and about the degradation of their hatching grounds.

Efforts have been also developed to promote the sustainable use of fisheries and natural resources in general. In July 1998, the governors of the four states surrounding the Sea of Cortés (Baja California, Baja California Sur, Sonora, and Sinaloa) signed with the Secretary of the Environment, Julia Carabias, an agreement to pursue a joint program for the sustainable use of the Sea of Cortés.

**Concluding Remarks**

It is difficult to say at this time if the increasing pace of conservation efforts in Mexico will be able to stall the rapid environmental degradation that the region is suffering. The optimistic note is that there seems to be in the peninsula of Baja California and in the Sea of Cortés a growing awareness, as never was observed before, of the importance to take urgent action to protect the environment. The swelling number of conservation actions that have been taking place is not the sole merit of any sector. Conservation groups, research institutions, federal and state governments, NGOs, and conscientious businesspersons and eco-tourism operators have all been contributing to the growing appreciation of the environment, and to the attendant conservation actions. But the new Secretary of the Environment deserves great credit in having listened to these rising voices, and in having acted accordingly.

It was not by chance that the first Mexican protected areas along the U.S. border were created in the state of Sonora. A number of institutions and organizations on both sides of the border had been working together for years promoting the conservation of these areas. For years research institutions from both Mexico and the United States, conservation groups and organizations, the traditional government of the Tohono O'odham people, and governmental officers both from the state and the federal offices had been teaming together in discussion forums in order to prepare plans and proposals for a joint binational project to preserve the *Gran Desierto*. Eventually, all the non-governmental and academic institutions coalesced into the Sonoran Desert Alliance, a truly participative organization with a great capacity to influence decision-making and to draw the attention of public opinion towards environmental affairs. A time came in which the proposal to protect the Gran Desierto and the coasts of the Colorado River estuary

was ready and had the consensus and support of hundreds of environmental leaders from both sides of the line. Now, the Gran Desierto is protected all the way from the Tohono O'odham (Papago) reservation into the waters of the Upper Gulf of California.

To preserve their shared ecosystems, Southern California and the peninsula of Baja California are in need of a similar effort. It seems to be a perfect time to promote true cooperative work, not only within Mexico but also across the border, between Mexican and U.S. conservation groups from Baja California and Southern California. Recently, a number of Mexican institutions with an interest in the conservation of Baja California and the Sea of Cortés formed the Coalition of the Gulf of California (*Coalición del Golfo de California*), with the participation of several conservation NGOs and academic and research groups. It is the right moment to bring U.S. institutions into this alliance, or into a similar one with a regional scope of interests. The region is only one large continuum, with shared watersheds, species, and natural resources that do not recognize a boundary line. The protection of these unique environments is of the uttermost importance for the survival and well being of all of us, for generations to come.

## ABOUT THE AUTHOR

**Dr. Exequiel Ezcurra** is Director of the Biodiversity Research Center of the Californias at the San Diego Natural History Museum. Prior to joining the Natural History Museum, Dr. Ezcurra served as Director General of Natural Resources for the Mexican federal government (Institute of Ecology) and as Director General of Environmental Planning. Dr. Ezcurra's research interests include the conservation of natural resources, the ecology of arid zones, the biogeography of plants and the management of natural resources in areas under traditional indigenous use. He is the author of two books and fourteen book chapters on the ecology of the Basin of Mexico, as well as more than fifty research articles. His articles have been published in such journals as *Ecology*, *Ecologia*, *The American Naturalist* and the *American Journal of Botany*. Dr. Ezcurra has received multiple awards and honors for his efforts to support binational cooperation in nature conservation along the Mexico-U.S. borderlands, including recognition awards from the Sonoran Alliance and the U.S. National Park Service.