Part Four

MANAGEMENT OF THE GULF OF MEXICO

COASTAL ZONE

CONSERVATION PROSPECTS IN THE GULF OF MEXICO

Roberto de la Maza and Amaya Bernardez

BACKGROUND

There are testimonies that between 1900 and 1940 native Gulf of Mexico ecosystems covered practically the whole Chihuahua desert region and the Tamaulipas thicket, almost all of Huasteca, a large part of the Totonaca region, Los Tuxtlas, the Isthmus of Tehuantepec, a significant stretch of the Sierra Madre Oriental, the coast of Tabasco and practically all of Chiapas and Campeche. Furthermore, the freshwater, brackish and marine bodies of water were in a good conservation state. Population density in the Gulf of Mexico basin was very low, with an average of less than 10 inhabitants per km^2. This was due mainly to the presence of infectious diseases, such as melanoptysis and malaria, which forced the population to settle in less adverse regions (Tyler-Townsend 1898; Genin 1931; Revel-Mouroz 1980; Challenger 1998).

Revel-Mouroz (1980) explains that until the 1930s the colonization strategy started in the 1920s was based on irrigation and establishment of agricultural settlements in dry regions which, in this case, correspond to the irrigation districts of the Río Conchos basin in Chihuahua, as well as in Coahuila (Don Martín, Nadadores), Nuevo León and Tamaulipas (San Juan, Purificación, Mante, etc.).

The same author also highlights that the country's demographic growth multiplied rapidly, from 18 million inhabitants in 1930 to 48 million in the 1970 census. It is important to note that the most intense demographic growth, as well as the colonization of the humid tropics of the Gulf of Mexico, coincided with the arrival of penicillin and other antibiotics, which reduced endemic sanitary problems from those ecosystems. Thus, as of the 1950s, there was a change in settlement policy, which sought to move landless peasants to uninhabited regions, regardless of their productivity, sanitary conditions and development potential. Rather than an attempt to economically develop areas open to colonization, it was done to avoid the concentration of population in productive regions which would unbalance the land ownership and social peace. In fact, the author defines the occupation of large part of the humid tropics of the Gulf of Mexico as a way of preserving the advantages of landlords in the irrigated land zones, in face of growing demand for land.

Parallel to this process a series of industrial development projects were implemented, which began with petroleum extraction in the Huasteca and the Totonaca region, and continued in Tabasco, Chiapas and Campeche. This industrial development created the need to open means of communication to be used by land claimers to gain access to parts of wild ecosystems and settle therein. By the 1970s the petroleum extraction was moved to the marine continental shelf where a series of wells were established in the Campeche Bay.

As a complement to the mega projects, agricultural development programs were also introduced, stemming from the Green Revolution established on the Río Papaloapan, La Chontalpa, Uxpanapa, Pujal-Coy, Valle de Edzná, etc. Even if they did not produce tangible results in wealth production and in raising the standard of living of the inhabitants of the regions where they settled, they have had an impact on nearly twenty million hectares of native ecosystems, mainly tropical rain forests and tropical wetlands.

Another factor that contributed to the environmental deterioration of this watershed was the deficient mechanism established to manage the increasing volume of sewage and liquid

industrial waste which, through a common drainage system, mixes with stormwater and is transported to the nearest streams or rivers. Similarly, pesticides and fertilizers used in agriculture inevitably end up in water bodies and the sea. Furthermore, the free establishment of inappropriate productive activities in mountainous regions, such as nomadic agriculture and extensive cattle farming, has promoted intensive erosion that has caused sedimentation of large part of the lower river basins, almost all the coastal lagoons and estuaries, as well as the hydraulic infrastructure.

In an attempt to solve environmental problems, the different federal administrations began the task of establishing measures to reduce the deterioration of forests, mountains and basins. In 1923 national forest reserves were decreed non-transferable and non-acquirable. In the study area they are represented by the Región Boscosa (forest region) de San Luis Potosí, in San Luis Potosí, and El Gavilán, Veracruz. All of them were established on national territory that was subject to land redistribution without heeding or revoking the decree. In 1931 the Zona Protectora Forestal (Forest Protection Zone) of the Río Tocuila in Orizaba, Veracruz, was decreed, and in 1933 it was complemented by the dispatch of similar mechanisms in the upper basin of the Río Blanco and of the Río Carbonera in the same region (it should be mentioned that a series of landslides occurred in this basin recently, as a result of deforestation).

In 1934 the agreement that established forest protection zones for national irrigation districts was published, which in the watershed of the Gulf of Mexico involves the protection of the Río Tula and Río Tulancingo basins, in Hidalgo, Conchos and Florido river basins, in Chihuahua and Durango, Sabinas and Nadadores river basins, in Coahuila, Alto San Juan and Salinas river basins, in Coahuila and Nuevo León, Mante and Purificación river basins, in Tamaulipas, and the Río Actopan river basin, in Veracruz. In 1936 the decrees were issued for the Los Mármoles national park, in Hidalgo, and El Potosí, in San Luis Potosí. In 1937 the Zona Protectora Forestal of the Laguna de Catemaco basin, in Veracruz, was established, and in the same state decrees for the Cofre de Perote and the Pico de Orizaba national parks were issued. In 1938 decrees were issued for the Parque Nacional Cañon de Río River Blanco and forest protection zones for the cities of Orizaba and Veracruz, in Veracruz, and in the Cuenca Hidrológica (hydrologic basin) del Río Necaxa, in Puebla and Hidalgo. In the following year a similar decree was issued for the city of Zacualtipán, in Hidalgo.

In 1949 the federal executive branch published a decree establishing closed forest protection zones for basins that feed irrigation districts, overriding the previous agreement without revoking it, entailing the protection of more than fifteen million hectares in the watershed under study. In theory, the territory protected by these decrees should have prevented, to a high degree, the misuse of mountain ground and the resultant degradation of soils and hydrological basins, with favorable implications for the Gulf of Mexico, final destination of all its tributaries. Unfortunately, these regulations were never enforced, administered by the authorities, or taken into account by those in charge of land redistribution, so that the territory in question has been handed over to colonization and the establishment of traditional production activities, often contrary to the natural vocation of the land without any particular regulation (De la Maza 1998).

CURRENT VIEW OF THE GULF OF MEXICO ECOSYSTEMS RELEVANT FOR CONSERVATION

Mexico has a population of 104 million inhabitants, and the population density in the Gulf states has increased dramatically. Chihuahua, Coahuila and Campeche have up to 30 inhabitants per km^2, Nuevo León, Tamaulipas, San Luis Potosí, Oaxaca and Chiapas, up to 70, and Puebla, Hidalgo, Veracruz and Tabasco, up to 169. By the year 2020, population is expected to have increased to around 122,000,000 inhabitants (De Alba and Reyes 1998).

As a consequence there is an excessive demand of land for agricultural, forest and urban activities, as well as an increase in the population that depends on the extraction of natural resources (wood, fishing, hunting, gathering, etc.), which have caused the extirpation of large areas of native ecosystems. As a result Mexico occupies third place in deforestation in the Americas. The national food policy developed during the 1970s and early 1980s strongly contributed to the destruction of whole ecosystems that encompassed enormous surface areas in the region. It is calculated that, following the guidelines for food self-sufficiency, around 20 million hectares were cut down, including several million hectares of high evergreen jungle. In Uxpanapa alone over half a million hectares of high jungle were eliminated to create rice fields, which never produced a harvest due to the characteristic violent rains in the region (Caamal and del Amo 1987).

Likewise, tropical savannas in Tabasco, the Isthmus of Tehuantepec and Veracruz, and the tropical rainforest have disappeared, which in the past stretched from Córdoba and the Tuxtlas to the Selva Lacandona. At present there is less than 10% of its original distribution, it is considered endangered as an ecoregion and is a maximum priority for conservation. The mangroves from Laguna Madre to Alvarado, the Cuatrociénegas and Rio Grande (Río Bravo) basins are in the same situation, considered as a vulnerable ecoregion, under medium risk of extinction and high regional conservation priority (Dinerstein 1995; Olson 1995).

Other ecosystems under stress, although there are no statistics regarding their situation, are the deciduous subtropical jungles of Veracruz and Tamaulipas, the xerophilous thicket of Puebla, the coastal dune thicket and the mountain mesophilic forest (Dinerstein 1995; Challenger 1998).

The demographic explosion in the state of Chiapas, added to a confusing and chaotic social situation, is putting what remains of the Selva Lacandona under stress, and moreover, is moving towards the Sierra Madre de Chiapas, as well as to the neighboring region of the humid isthmus of Oaxaca, also putting at risk what remains of the Selva Zoque.

The high rate of deforestation is clearly illustrated by the fact that 78% of land surface in the country shows some degree of erosion, and that between 60 and 80 million hectares suffer severe or very severe erosion (Peña and Neyra 1998). In the Gulf, it is one of the causes of desertification processes on the north coast of Tamaulipas, on the borders of Coahuila and Nuevo León, in part of the Huasteca and in almost all the Totonaca region, as well as in the Sotavento region (De Alba and Reyes 1998).

It is also important to highlight that deforestation in the Gulf of Mexico basin has promoted damage to development infrastructure. For example, the Miguel Alemán (Temascal) dam, inaugurated in 1951, became fully sedimented in only 30 years due to solids brought from the upper basin of the Río Tonto, subject to aggressive nomadic agriculture. This situation could occur, in the medium term, in the Río Grijalva hydroelectric system, involving the generation of La Angostura, Chicoasén and Malpaso (De la Maza 1992). Deforestation is also the direct cause

of a large increase in terrigenous sediments in the Gulf of Mexico, which constitute a severe threat to coastal and marine ecosystems.

In addition to deforestation there is overgrazing, which has deteriorated the water retention capacity of soils, and added to water extraction from groundwater aquifers has caused some rivers, such as the Río Conchos in Chihuahua, to have had no flow along its bed for nearly a decade. Other rivers that have had a crisis in their flow are the Río Soto la Marina in Tamaulipas and the Río Tancochín in Veracruz. The scarcity of water in these basins is identified by increasing salinization of the soils (De Alba and Reyes 1998).

The unrestrained demographic pressure is accompanied by the lack of urban development planning, which has caused, especially in the coastal fringe of the Gulf of Mexico, uncontrolled, eclectic growth, insufficient urban, industrial and port services, industrial activity with minimum environmental regulation and an increase on the pressure of use of natural resources, with the discharge of untreated municipal and industrial sewage, frequent dredging in ports, disorderly construction of infrastructure with high environmental impact, worsening of groundwater aquifers for water supply and significant eutrophication processes, among others. The lack of planning is also reflected in tourism development in the region. There has been no order in this activity and no medium or long term planning. Tourism loading capacity has not been determined and uncontrolled or even unnecessary development of tourism infrastructure has been observed. Inefficient tourism growth in the region may affect not only the environment, but also introduce elements of risk expressed by an increase in contamination, ecosystem degradation, consequent loss of tourism appeal, and impoverishment of the population.

The consequences of the absence of urban and tourism planning are reflected in degradation of relevant ecosystems: coral reefs opposite the Ports of Veracruz and Tuxpan, mangroves in the Papaloapan basin and wetlands in Tabasco, coastal lagoons and estuaries from Tamaulipas to Yucatán, to mention but a few.

In the Gulf of Mexico it is necessary to highlight petroleum activity carried out by Petróleos Mexicanos (PEMEX) for several decades. It is worth pointing out that the Great Caribbean basin, where the Gulf is geographically located, is considered one of the ocean areas of highest density of hydrocarbon transport in the world (Intergovernmental Maritime Consultative Organisation 1979). Over 78% of the Mexican national petroleum production is extracted from the two Gulf marine regions, while land production in the south of the country, mainly Tabasco and Chiapas, contributes with an additional 20%. There are over 150 marine platforms and 1,500 kilometers of submarine pipelines just in the marine exploration regions (PEMEX 1999).

Hydrocarbon extraction and exploitation has a negative impact associated with the natural development of the activity itself, as well as inherent risks, despite of constant technological innovations. Accidents of considerable magnitude have occurred in the Gulf of Mexico. High risk accidents are a constant threat to ecosystems in the region. There is an environmental liability associated to petroleum exploitation that is important to acknowledge, although it has been diminishing as the country's regulations have tightened.

Pollution is another very important factor that has deteriorated the Gulf of Mexico watershed. Any tributary that flows through a town, technical agriculture area or industrial development can be considered as a receptor of contaminants to a greater or lesser extent. The 20 most important hydrological basins in the country are seriously polluted (Challenger 1998).

In terms of industrial pollution the Río Sabinas basin in Coahuila stands out due to coal mining, as well as the lower basin of the Río Coatzacoalcos, which contains residues from the

sulfur and petrochemical industries established between Jáltipan and the Gulf. Waste from sugar mills and coffee production is a common problem in almost all the Gulf of Mexico tributaries.

Agricultural pesticide and herbicide contamination is spread out, cumulative and present in nearly all the basins in varying degrees. It causes several different types of intoxication or carcinogenesis depending on the chemicals, and affects all organisms that consume or live in the water, or those who consume aquatic fauna or fisheries products from contaminated water bodies (wildlife, cattle, riverside inhabitants, restaurant costumers, etc.). This contamination is intensified downriver of any technical agricultural area (grains, cotton, fruit, coffee, etc.) and is more pronounced when the tributaries exhibit salt marshes with intermittent openings to the sea, or in enclosed basins, lagoons and reservoirs.

Other chemical contamination factors are detergents, bleaches and cosmetics, to which their packaging is added. Their presence is also widespread, affecting all basins and even their smallest streams.

Sewage contamination is a product of drainage from any town and, therefore, is present in any tributary that receives flows from human settlements. This contamination becomes more serious when the towns of a basin have hundreds of thousands of inhabitants, and becomes critical in the case of chaotic conjoint areas such as the Tula-Moctezuma-Pánuco basin, which receives the flow of the Valley of Mexico metropolitan zone, that of the Río Santa Catarina, which receives sewage from Monterrey, or the one between Nogales and Córdoba, which has converted the Río Blanco into one of the most polluted tributaries in the Gulf basin. Fecal coliforms can be detected in many lagoons and water bodies in Campeche, Veracruz and Tabasco. Eutrophication processes in the Tampamachoco and Mandinga lagoons are primarily a result of this type of pollution (INE 2000).

The most conspicuous marine and coastal contamination comes precisely from the discharge of municipal wastewater, due to the absence or inefficiency of wastewater treatment plants in the big cities of the region. Direct discharge of wastewater has resulted in potentially dangerous conditions for human health and the marine environment. On the Mexican coast of the Gulf of Mexico practically all the coastal towns discharge their domestic waste in the rivers, estuaries, coastal lagoons and the sea without any prior treatment (Botello *et al.* 1996).

As a consequence of the above, the Gulf of Mexico coastal lagoons are under a great deal of stress and, as previously mentioned, the presence of metals, persistent organic compounds and hydrocarbons has been detected in the sediment of the main coastal lagoon systems of Tamaulipas, Veracruz, Tabasco and Campeche.

Fisheries have been another stress factor on the region's natural resources. The country's second shrimp fleet is located in the Gulf of Mexico, where a large volume of commercially important molluscs (primarily snails) is also extracted, in addition to crustaceans. Disorderly access to fisheries resources has deteriorated the habitat and affected marine and coastal ecosystems in part of the coast of the five adjoining states. Furthermore, fisheries are the cause of considerable social conflict in marginalized zones, where access to resources acquires a higher value.

Not only fisheries resources are under pressure from disorderly access. The absence and/or ambiguity of land property rights promote uncontrolled and alarming extraction of gravel and sand at some points of the Gulf, causing serious alteration to coastal transport dynamics.

Finally, clear fragmentation of public policy and sectarian approaches can be observed throughout the region, blocking conservation actions. There is not a holistic approach to the regulatory policy of coasts and oceans, hydrographical basins, and other land units, resulting in

fragmented action by government institutions at the three levels of government. Tools of environmental policy such as ecological regulation of the territory, fisheries regulations and environmental impact assessments, have to take on regional significance and be applied with greater local emphasis.

PROTECTED NATURAL AREAS

Protected natural areas represent one of the strongest and soundest tools of environmental policy, and constitute the main instrument of conservation. They form true institutions given that they act as well defined units of territorial management, have a solid legal management infrastructure, and count with effective local organization structures and a high degree of certainty. Moreover, they propitiate mechanisms of concurrence between the various levels of government, the private sector and the local population, and become strategic as foundation for environmental policy and holistic public management.

Their objective is to guarantee the full range of ecological services offered by ecosystems, to achieve protection and conservation of all the country's ecosystems, to conserve the areas that provide strategic environmental services and their biodiversity, to collaborate in deterring and reversing processes of erosion and deforestation and in promoting the sustainable use of natural resources, including efficient use of water and energy.

FEDERAL PROTECTED NATURAL AREAS OF THE GULF OF MEXICO

There are 12 federal protected natural areas in the five states that adjoin the Gulf of Mexico (Table 20.1), of which nine count with a budget, equipment and personnel. If the Gulf of Mexico is considered to end at Cabo Catoche, Quintana Roo, it is also necessary to include Yum Balam (Table 20.1), which also shares some ecosystems with the Río Lagartos.

The strategy of the Comisión Nacional de Áreas Naturales Protegidas (CONANP; National Commission for Protected Natural Areas) to conserve and consolidate the Protected Natural Area (PNA) in the region is:

- To conserve the areas that have strategic environmental services, elements of national interest, as well as terrestrial and marine biodiversity, through diagnosis, establishment and consolidation of the zones.
- To promote mechanisms and opportunities for participation and social co-responsibility in the conservation and sustainable exploitation of natural resources and their ecosystems in the PNA, with various sectors of the society involved.
- To promote the exploitation, sustainable use and conservation of wildlife.
- To protect biodiversity, recognizing the economic benefits that it brings to the development of society and the country.
- To consolidate the framework of financial and tourism sustainability of the PNA, through instrumentation and permanent improvement in the charges for right of access to the PNA with tourism potential in the region.
- To promote new mechanisms of biodiversity conservation, such as certification of private lands for conservation.
- To establish new decrees for terrestrial or marine protected natural areas in priority regions for the federation, and to reestablish boundaries, reclassify, annul or revoke the existing decrees..

Table 20.1. Protected natural areas of the Gulf of Mexico.

State	Protected Natural Areas	Surface (ha)	Relevant Ecosystems	Summary of Threats
Veracruz	PN Veracruz Reef System	52,239	Coral reef	Sedimentation
	August 24, 1992		Halophyte vegetation	Discharge of untreated domestic and industrial wastewaters
	Reclassified on June 7, 2000		Native coastal dune ecosystems	Removal of sand and coral matter
				Natural tar pools that increase suspended sediment
				Port activity and traffic (dredging, oil and fuel spills, running aground)
				Red tide
Veracruz	RB The Tuxtlas	155,122	Low deciduous jungle	Fires due to uncontrolled burning
	November 23, 1998		Middle evergreen jungle	Contamination by fertilizers and garbage in local streams
			Mesophilic forest	Deforestation by clandestine tree felling
Veracruz	PN River Blanco Canyon[a]	55,690	Middle evergreen jungle	Increase of human settlements
	March 22, 1938		Pine and mesophilic mountain forest	Clandestine tree felling
				Deliberate forest fires
				Contamination of water bodies by industrial activity
Veracruz	PN Cofre de Perote[a]	11,700	Pine forest	Exploitation of resources (wood)
	May 4, 1937		Mexican fir	Excessive tree felling
				Lack of regulation for land use
				Forest fires
Veracruz and Puebla	PN Pico de Orizabaa	19,750	Pine forest	Growing demand for natural resources
	January 4, 1937		Mexican fir	Decreasing wooded surface due to changes in land use
			Oak	Forest fires
			Alder	Illegal hunting
				Tree felling

Table 20.1. Continued

State	Protected Natural Areas	Surface (Ha)	Relevant Ecosystems	Summary of Threats
Tabasco	RB Centla Marshes	302,707	Swamps	Heavy contamination caused mainly by urban development and petroleum activity, which cause water retention and swamp desiccation, as well as changes in the hydric system
	August 6, 1992		Salt marshes	Illegal hunting (turtle and lizard).
			Low sub-evergreen jungle	Forest fires
			Mangrove	
			Aquatic vegetation	
			Palm forest	
			Middle jungle (*pukte*)	
Campeche	RB Calakmul	723,186	High, low and middle sub-evergreen jungle	Contamination caused by tourism
	May 23, 1989		Hydrophytes	Change in land use
Campeche	RB the Petenes	282,858	Mangrove	Impact caused by spread of urban areas
	May 24, 1999		Arid zone thicket	Organic pollution caused by solid wastes
			Humid evergreen jungle	Threat of impacts caused by natural phenomena
			Sub-humid deciduous jungle	
Campeche	APFF Términos Lagoon	705,017	Submerged aquatic vegetation	Sedimentation of the river-lagoon system caused by deforestation in the upper basin
	June 6, 1994		Mangrove forests	Uncontrolled urban growth: contamination of groundwater, eutrophication, and contamination of the lagoon
			Tule or American bulrush	Intense pressure from rock matter
			Riparian vegetation	Sand extraction, which modifies the coastline and promotes changes in the hydria system
			Grassland	
			Hydrological systems	
			River-lagoon system	

Table 20.1. Continued

State	Protected Natural Areas	Surface (Ha)	Relevant Ecosystems	Summary of Threats
Yucatan	RB River Celestún	81,482	Mangrove	Conflict over fishing resources (Celestún-Isla Arena)
	July 19, 1979		Coastal dune vegetation	Organic pollution caused by solid waste
	Reclassified on November 27, 2000		Vegetation "islands" (*petenes*) and savannas	Impact caused by natural phenomena
			Tule	
			Reeds	
			Low flood-prone jungle	
			Low deciduous jungle with cactaceae	
Yucatan	RB River Lagartos	60,347	Low deciduous jungle	Forest fires
	June 26, 1979		Dunes	Introduction of exotic species
	Reclassified on May 21, 1999		Mangrove	Extensive cattle farming
			Middle jungle	Use of insecticides and herbicides
				Extraction of ornamental plants
				Threat of hurricanes and tropical storms
				Clandestine hunting
Yucatan	PN Alacranes Reefs	333,769	Coral reef	Illegal fishing
	June 6, 1994			Extraction of reef flora and fauna
	Reclassified on June 7, 2000			Impacts caused by natural phenomena
				Impacts to the reef caused by tourism
Quintana Roo	APFF Yum Balam	154,052	Middle-low tropical forest and low flood-prone forest	Tourism development, which can increase contamination
	June 6, 1994		Red mangrove forest	
			Humid areas of the north on the Yucatan peninsula	
			Tropical jungles	

[a] Protected natural areas without federal budget assigned.

- To promote and permanently update information on the Unidades de Manejo para la Conservación de la Vida Silvestre (UMA; Management Units for Wildlife Conservation) in the PNA and establish areas of sustainable management of wildlife.
- To strengthen and develop projects for the recovery of priority species in a risk category
- To develop and promote green markets: ecotourism networks, commercialization of organic products, diversification of production.
- To introduce economic and tax incentives in the PNA: tax exemption (VAT or Income Tax) for ecotourism projects, exemption of property tax to land owners who use their property for conservation, etc.

LONG TERM CONSERVATION OF THE NATURAL HERITAGE OF THE GULF OF MEXICO

A set of public policies should be promoted in the region to ensure the permanence of the natural capital of the Gulf, reinforce economic development and improve quality of life of the population. Therefore, conservation strategies must be linked to the regional economy to reach the desired sustainability objectives.

RELEVANT ECOSYSTEMS TO BE CONSERVED

The Gulf of Mexico harbors ecosystems that must be included in a protection framework, given their relevance in terms of biodiversity and ecological services. It is necessary to highlight the following: the Laguna Madre system, Tamaulipas, the coral reefs off Tuxpan and those located in Campeche Bay, the Otontepec middle jungle and mesophilic forest, Veracruz, the Zoque jungle of Oaxaca, Veracruz and Chiapas, the Chinantla jungle and mesophilic forest in Oaxaca, the high jungle in the region of Motzorongo, Veracruz, the Mixe and Zapoteca jungles in the Isthmus of Tehuantepec, the Laguna Alvarado mangroves and the forests of the Sierra Madre Oriental of Tamaulipas.

ENVIRONMENTAL SERVICES

Payment for environmental services constitutes a relatively new tool within conservation actions in Mexico. Through its application landowners are induced to maintain the original vegetation cover of the land intact. A forest fund created by the Comisión Nacional Forestal (CONAFOR; National Forestry Commission) already exists, the resources of which will be dedicated to forest and water environmental services. Apart from this fund it will be necessary to use traditional economic resources, such as those provided by the Programa de Empleo Temporal (PET; Temporary Employment Program) and the Programa de Desarrollo Rural Sustentable (PRODERS; Sustainable Rural Development Program) to promote environmental services in PNA and conservation priority regions. Priority would be given to projects that maintain the original vegetation intact over those that intend to rehabilitate deforested land, as currently happens. With the aim of ensuring the water supply through basin conservation, environmental services payment can be introduced to landowners who conserve forests in the upper basin.

INTEGRATION AND HARMONIZATION OF THE LEGISLATION, NEW MECHANISMS OF CONCURRENCE

The regulation of natural resources, above all on the coastal fringe, is carried out under evident overlapping of laws, functions and attributions of institutions in charge of their application. This increases the legal complexity and, paradoxically, creates important gaps that make the regulatory processes for conserving natural heritage difficult. Legislation for the whole of the Gulf of Mexico region must be harmonized, creating a sound legal framework that introduces the concept of holistic management of ecosystems, of natural resources, of the coastal zone and basins, without state borders or fictitious political divisions.

On the other hand, it is imperative to create new mechanisms of concurrence that ensure the inclusion of environmental variables and environmental viability of urban development plans, tourism development plans, and special infrastructure development projects such as ports, wharfs, highways, airports, condominiums and hotels, among others. Agreements must be reached among academic or research centers on monitoring, environmental education and conservation programs, institutional agreements to increase surveillance, and coordination agreements with local and state governments.

SOUNDNESS IN ENVIRONMENTAL POLICY APPLICATION

The preservation of natural capital in the region requires a sound application of some strategic instruments of environmental policy: the creation of new protected natural areas and consolidation of the existing ones; continuity of financial collection and control mechanisms in the PNA (charge for rights); promotion of private land certification for conservation; promotion of the ecological arrangement of the territory in zones of special interest due to their tourism, urban or industrial potential, giving impulse to regional arrangement; fishing arrangement in zones where there is disorderly exploitation and/or excessive exploitation of fisheries resources; promote fisheries management based on habitat (which seeks to maintain or rehabilitate structure and function of an ecosystem that shelters commercial species); if the project requires, require regional displays of environmental impact.

RECREATION

Impetus should be given to ecotourism as a vehicle for regional economic development and also as an instrument of environmental sustainability. However, to be carried out successfully it requires appropriate regulation, order and planning framework, especially within a PNA. The impulse given to ecotourism is fundamental, given that it creates a powerful circle between conservation and economic strengthening of the population, by giving value to a series of important environmental services: biodiversity as heritage of the population, landscape and scenery services, habitat of charismatic species, and the contribution to biological, cultural, evolutionary and ecological information that improves the quality and adds value to tourism products and, therefore, creates more leisure activities. Ecotourism is an activity of intrinsic value, non-consumptive of natural capital given that it promotes the desire of conservation of certain species and ecosystems *per se*. It also implies types of use with low opportunity costs, by increasing social and environmental efficiency. It represents a very good option for internal use of environmental benefits, as those who conserve and use the ecosystems (communities,

landowners and operators) are adequately paid by society. Planned and orderly development of ecotourism can create a new regional framework of incentives in favor of ecological heritage conservation, strengthened by the establishment of institutional agreements with investors and operators. This would ensure local financial benefits, permanent training in the communities and designation of a percentage of the profit from the activity directly to conservation projects.

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