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Designing and Establishing Conservation Areas in the Baja California-Southern California Border Region

Michael D. White, Jerre Ann Stallcup, Katherine Comer, Miguel Ángel Vargas Téllez, José María Beltrán-Abaunza, Fernando Ochoa, and Scott Morrison

Abstract

The border region of Baja California in Mexico and California in the United States is a biologically diverse and unique landscape that forms a portion of one of the world's global biodiversity hotspots. While the natural resources of this border region are continuous and interconnected, the land conservation practices on both sides of the international boundary are quite different. These binational differences may cause certain natural resources, ecological processes, and wildlife movement patterns to fall through the cracks of conservation efforts implemented in each country. Thus, effective conservation in this region requires binational cooperation in planning and implementation. This paper describes the differences in land conservation patterns and land conservation mechanisms between Baja

California and Alta California (Southern California). The Las Californias Binational Conservation Initiative is discussed as a case study for binational cooperation in addressing local threats and conducting true transboundary conservation planning.

Diseño y Estableciemiento de Zonas de Conservación en la Región Fronteriza Baja California-Sur de California

Michael D. White, Jerre Ann Stallcup, Katherine Comer, Miguel Ángel Vargas Téllez, José María Beltrán-Abaunza, Fernando Ochoa, y Scott Morrison

Resumen

La región fronteriza de Baja California, México y California, Estados Unidos, es un paisaje único y biológicamente diverso que forma una sección de una de las zonas clave (candentes) de biodiversidad del mundo. Aunque los recursos naturales de esta región fronteriza son continuos y están interconectados, las prácticas de conservación de la tierra en ambos lados de la frontera internacional son muy diferentes. Estas diferencias binacionales hacen que algunos recursos naturales, procesos ecológicos y patrones de desplazamiento de la fauna silvestre están en peligro de caer entre las lagunas de los esfuerzos de conservación instrumentados en cada país. Por lo tanto, la conservación efectiva en esta región requiere de la cooperación binacional con relación a los planes de conservación y su instrumentación. En este documento se describen las diferencias en los patrones y los mecanismos de conservación de la tierra entre Baja California y Alta California (Sur de California). La Iniciativa de

Conservación Binacional de Las Californias se presenta como estudio de caso para la cooperación binacional que aborda las amenazas locales y que establece una verdadera planificación de la conservación transfronteriza.

Introduction

The California-Baja California border region encompasses a portion of one of the world's biodiversity hotspots—geographic locations that support very high levels of biological diversity and are under a high degree of threat (Dobson, et al. 1997; Mittermeier, et al. 1999; IUCN 2000). More than 400 species in this region have been identified as endangered, threatened, or otherwise sensitive to human impacts. However, the biodiversity and environmental functions provided by the region's natural resources, such as water quality protection, water supply, flood control, and scenic and recreational resources, are increasingly threatened by expanding human land uses and modifications of the natural landscape (Ganster and Metzner 1993). Thus, effective conservation in this region of more than 5 million people requires binational cooperation in planning and implementation.

Natural resources conservation efforts in San Diego County, Calif., and in Baja California have historically treated the border region as two separate planning areas divided by the international boundary, which leaves the natural resources of the region vulnerable to habitat fragmentation and to loss of biodiversity. Such an approach in this historically interconnected landscape could result in two severed, dysfunctional landscapes instead of one larger, integrated ecosystem. In addition, land ownership patterns and available mechanisms for implementing land protection differ in California and Baja California, which complicates the establishment of a binational reserve system. This chapter outlines the biogeographical significance of the border region, describes land ownership patterns and conservation mechanisms on both sides of the border, describes some of the local threats, and discusses a binational collaboration to identify a reserve network that would conserve a functional representation of the border region's ecosystems. The ultimate conserva-

tion goal is for U.S. and Mexican governments, academic and research institutions, and non-governmental conservation organizations to embrace and adopt a shared conservation vision for this border region and to collaborate in its implementation.

Biogeography of the Border Region

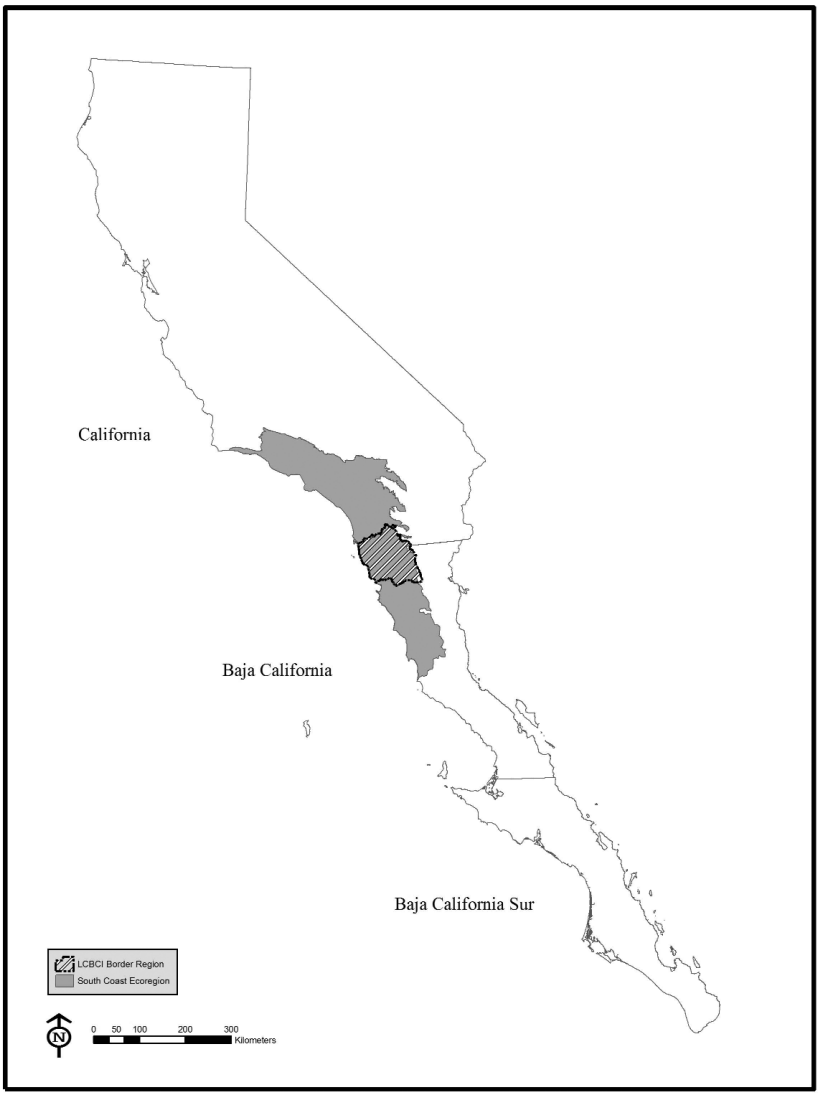
The border region lies at the center of the Peninsular or South Coast physiographic region or "ecoregion," which is part of the California Floristic Province—a recognized global biodiversity hotspot (Hickman 1996; Mittermeier, et al. 1999). The South Coast Ecoregion is defined as the land area that lies westward of the crest of the Peninsular Ranges, and that extends from approximately Santa Barbara, Calif., to El Rosario, B.C. (Figure 1). To focus attention on the status and conservation needs of the border region, this chapter examines a subset of the South Coast Ecoregion, bounded generally by the Sweetwater River watershed to the north and the Río Guadalupe watershed to the south, including a relatively small land area on the eastern side of the Peninsular Ranges (Figure 2).

The astounding biodiversity of the border region is largely a result of the high diversity of topography, geology, climate, and soils, which form a landscape of unique biogeographic subunits. The subunits are distributed throughout the region, along a coastal to desert continuum and within several different elevation gradients. These various and diverse subunits are the reason for the rich tapestry of biodiversity that characterizes the border region. Effective conservation efforts must account for the distribution of these biogeographic subunits, allow the movement of species between them, and maintain the processes that underlie the ecosystems of the region.

Topography

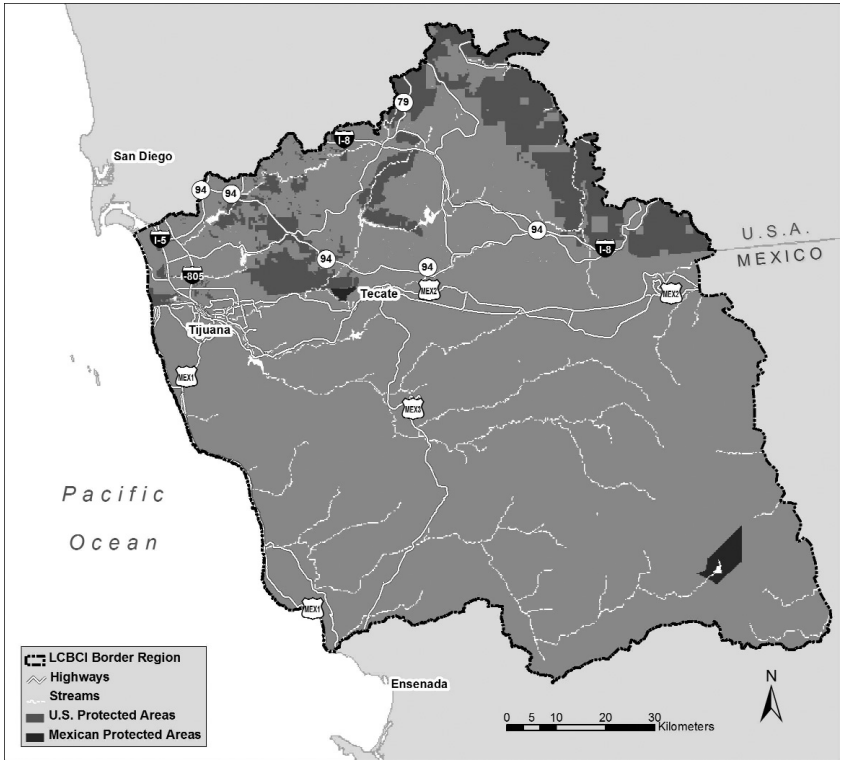
The diverse topography of the border region ranges from flat coastal mesas and rolling foothills, to inland valleys and foothills, to isolated mountain peaks and steep mountain ranges. Within the coastal plain, coastal mesas are fairly level, uplifted marine terraces that occur at elevations that are generally less than 400 meters (m).

Figure 1. Location of Las Californias Binational Conservation Initiative Border Region within the South Coast Ecoregion



Source: Authors

Figure 2. Location of Las Californias Binational Conservation Initiative Border Region



Source: Authors

Eastward from the coast, coastal mesas transition into the foothills and ultimately into the peaks of the Peninsular Ranges, which reach more than 1,800 m in the Cuyamaca Mountains and Sierra Juárez. The Jacumba and In-Ko-Pah Mountains (1,200 m) and Laguna Mountains (1,600 m) are other notable mountain ranges in the region. The mountains of the Peninsular Ranges are tilted to the west, which produces the rolling foothill topography of the western slope and the steep escarpment on the east. The border region also supports several significant valleys, including the Valle de Guadalupe, Valle de Ojos Negros, Campo Valley, and Jacumba/Jacumé Valley. Remnants of Mesozoic-era volcanoes (from approximately 128 million years ago to 117 million years ago [Abbott 1999]) form isolated peaks or *cerros* of gabbro and metavolcanic rock in a generally north-south swath throughout the western portion of the border region, including Otay Mountain, Tecate Peak/Cerro Cuchumá, Cerro San Isidro, Cerro Bola, Cerro Dieciseis, and Mother Miguel. In the eastern portion of the border region, near Jacumba and Jacumé, more recent Miocene-age volcanic events (from about 19 million to 18 million years ago [Walawender 2000]) formed cinder cones and lava flows, such as those that constitute Table Mountain. The major drainage systems of the border region, including the Sweetwater River, Otay River, Tijuana River, Tecate River/Río Alamar, and Río Guadalupe, dissect the western flank of the Peninsular Ranges, whereas steeply incised canyons and *cañadas* characterize the eastern flank.

Climate

The border region enjoys a Mediterranean climate pattern, with mild, wet winters and hot, dry summers. However, because of differences in elevation and the rain shadow of the Peninsular Ranges, temperature and precipitation patterns vary significantly throughout the region. Mean annual temperatures range from 17.5°C along the coast, 16°C in inland valleys, to 11°C at the highest elevations in the Cuyamaca Mountains and Sierra Juárez. Freezing temperatures and frost are uncommon in coastal areas, but more common in the inland areas and at higher elevations. Average annual rainfall is about 225 millimeters (mm) to 285 mm along the coast and it varies

widely in the inland valleys (235 mm to more than 500 mm) and at higher elevations of the Peninsular Ranges (Delgadillo 1998; Western Regional Climate Center 2004). The Cuyamaca Mountains receive more than 850 mm of rainfall each year, whereas the Sierra Juárez receives less than 400 mm. Higher elevations in the Peninsular Ranges also receive regular snowfall.

Biological Resources

The border region supports a particularly high biodiversity of flora and fauna, including many endemic species that have evolved within the diverse physical and climatic conditions of the region (Stebbins and Major 1965; Raven 1988; Mittermeier, et al. 1999). Biological resources are organized into biological communities characteristic of specific biophysical and climatic conditions. For example, lower elevations within the border region support coastal scrub and grassland communities whereas higher elevation areas support chaparral; conifer, oak, and cypress forests; and woodlands. Willows and cottonwoods dominate coastal-draining stream systems where water is abundant, and sycamores and oaks populate dryer areas. Eastern-draining streams and oases often support native palms. Community diversity in the border region is similarly high. For example, nearly a dozen different chaparral communities are distributed along different elevation and climate gradients and among different soil types. Many communities, such as vernal pools, are highly restricted in distribution and their species compositions are unique to the border region.

The South Coast Ecoregion, which encompasses part of the border region, is one of the most species-rich regions of the California Floristic Province (Stebbins and Major 1965; Raven 1995). This statistic is particularly notable because the California Floristic Province is recognized as one of the world's richest floristic regions (Mittermeier, et al. 1999). Within the California/Baja California border region, endemic plant species live in isolated habitats, such as vernal pools (e.g., Otay Mesa mint), peaks of metavolcanic and gabbro rock (e.g., Tecate cypress), and high elevation "islands" (e.g., Cuyamaca cypress). Many plant species are listed as threatened or endangered or are otherwise considered sensitive, primarily due to

habitat loss and fragmentation from development (Flores Villela and Gerez 1994; Minnich and Franco Vizcaino 1998; Stephenson and Calcarone 1999).

Although levels of animal endemism are not as high as the levels of plant endemism, many resident and migratory wildlife species in the border region are listed as threatened or endangered or are otherwise considered sensitive. These species include invertebrates (e.g., Thorne's hairstreak, Quino checkerspot butterfly, and San Diego fairy shrimp), herpetofauna (e.g., arroyo southwestern toad, San Diego horned lizard, and San Diego pond turtle), birds (e.g., California gnatcatcher, coastal cactus wren, and least Bell's vireo), and mammals (e.g., bighorn sheep, mountain lion, and American badger). It is particularly difficult to sustain viable populations of mammalian species because they require large areas of unfragmented habitat.

In summary, the border region's high topographic, geologic, and climatic variations produce conditions that support the region's diverse and unique flora and fauna. Many of these species are found nowhere else in the world and are threatened with extinction. The ecosystems that support these species were historically continuous across the landscape. Today, however, the U.S.-Mexican border bisects these ecosystems. Without proactive efforts to develop a binational conservation network, they may be irretrievably isolated from each other. Effective conservation of ecosystems in the border region must address the distribution and characteristics of natural resources, while at the same time it must consider differential land ownership patterns and the conservation-implementation mechanisms that are available in the United States and Mexico.

Land Ownership Patterns

Comparison of Land Ownership in Mexico and the United States

There is a tremendous difference between the patterns of Mexican and U.S. ownership of undeveloped, natural open space. Approximately 61% of undeveloped land in the U.S. border region is federal, state, and locally-administered land that is set aside for

conservation or multi-use open space. A local jurisdiction (city or county) regulates land use on privately owned parcels. Land use on Indian reservations is outside the county's land use authority, but it must comply with federal regulations.

In contrast, less than 1% (5,000 hectares [ha]) of undeveloped land in the border region of Mexico is publicly owned. Ownership of the remaining undeveloped lands includes *ejidos, comunidades, pequeñas propiedades,* and *títulos colonias*. The *ejido* lands include urban plots, individual parcels, and lands that are worked on under communal social structures. Lands that are part of a *comunidad* are collectively worked, usually by indigenous people. Communities may privatize and become *ejidos*. *Ejidos* and comunidades can make decisions on appropriate land uses within their boundaries. A 1992 constitutional change allows ejidos to sell individual parcels under the Programa de Certificación de Derechos Ejidales y Titulación de Solares Urbanos (PROCEDE) process.

Protected Areas

The U.S. federal government and State of California have already designated more than 150,000 ha as protected, public open space in the border region of San Diego and Imperial Counties. These lands are complemented by more than 5,400 ha of county and city lands. In contrast, only 5,828 ha in Mexico (5,009 ha at Parque Constitución de 1857 and 819 ha at Rancho Cuchumá) are currently protected within the border region. The biological integrity of these public conservation investments will be jeopardized if additional conservation efforts are not implemented in a cooperative, binational manner.

Protected Areas in Baja California

Historically, the federal government has been responsible for the protection of natural resources in Mexico. The federal government established the Sistema Nacional de Áreas Naturales Protegidas (Natural Protected Areas System) to achieve this conservation objective. However, in contrast to U.S. practices, the Mexican government can establish natural protected areas with land use restrictions

over private lands without compensating landowners. Moreover, there is little funding for the administration and management of these protected areas.

Parques Nacionales and Áreas Naturales Protegidas

In Mexico, protected areas are classified by a management category that infers the ecological function(s) contributed by each area. Of all the Mexican states, Baja California supports the largest area (as opposed to the largest number) of government-decreed protected areas (Flores Villela and Gerez 1994), including:

- National Parks (such as Parque Nacional Constitución 1857 and Parque Nacional San Pedro Mártir)—the objective of these protected areas is to conserve a biogeographic representation of one or more ecosystems that have aesthetic, scientific, educational, recreational, and/or historical value and that can be used for tourism
- Biosphere Reserves (such as Alto Golfo de California and Delta del Río Colorado)—these areas are representative of one or more ecosystems that humans have not significantly altered and that support endemic, threatened, or endangered species
- Areas of Protection of Natural Resources (such as Valle de Los Cirios)—these areas are conserved for the preservation and restoration of forested areas and for conservation of land and water

Within the border region, Parque Nacional Constitución de 1857, which encompasses approximately 5,000 ha, is the only government-decreed protected area.

Private Conservation Areas

Mexico encompasses 197.7 million ha of land, of which 89.6% is rural (nearly 175 million ha). Of this, 41% is private property owned by 1.4 million people from *pequeñas propiedades,* and 58.6% is social property owned by 3.5 million people from *ejidos* and *comunidades* (CESPEDES and Pronatura 2002). However, due to the

lack of education and incentives, most of the private and social landowners do not attempt to conserve the biological resources on their lands.

The recent efforts of conservation organizations in Baja California promote the establishment of private conservation reserves together with economic incentives or compensation for landowners. Examples of these efforts include the *servidumbres ecológicas* (conservation easements) established in Baja California in Tecate and Bahía de Los Ángeles through agreements between landowners and the Mexican nonprofit group Pronatura.

Protected Areas in Southern California

Areas of natural open space in the United States are owned by federal, state, and local government agencies, private non-governmental organizations (NGOs), and private landowners. Many of these lands have management mandates for multiple uses, such as recreation, timber harvest, grazing, and resource extraction, which can conflict with the protection of natural resources. The Gap Analysis Program (GAP) describes the land management and protection status of natural open space in the United States (Scott, et al. 1993). GAP category 1 lands are those with the strictest, natural resources-driven management programs. In the border region, designated wilderness areas are considered GAP category 1 lands (Figure 2).

Federal Land

The federal government owns the largest area of protected land in the U.S. portion of the border region. The land totals approximately 129,715 ha and includes the Cleveland National Forest (including the Pine Creek Wilderness), San Diego National Wildlife Refuge (Otay-Sweetwater Unit, South San Diego Bay Unit, Vernal Pool Unit), Tijuana Slough National Wildlife Refuge, Sweetwater Marsh National Wildlife Refuge, Otay Mountain Wilderness, Hauser Wilderness, Sawtooth Mountains Wilderness, Carrizo Gorge Wilderness, Jacumba Wilderness, and other properties that the Bureau of Land administers.

State Land

The State of California administers 41,542 ha in the border region. The Department of Fish and Game manages the Rancho Jamul Ecological Reserve (including Honey Springs Ranch), Crestridge Ecological Reserve, Hollenbeck Canyon Wildlife Management Area, and McCain Valley Wildlife Management Area. The Department of Parks and Recreation manages Anza-Borrego Desert State Park, the largest state park in California (including the Whale Peak Wilderness, Sombrero Peak Wilderness, and Carrizo Canyon Wilderness); Cuyamaca Rancho State Park in the Cuyamaca Mountains; and Border Field State Park on the coast. The Department of Forestry and Fire Protection administers a single property on the border, Tecate Peak.

Local Government Land

The City of San Diego, the City of Chula Vista, and the County of San Diego own preserve lands within the Multiple Species Conservation Program (MSCP) area. These lands are conserved to mitigate development impacts in the region. These include Marron Valley on the border, Otay River Valley Park, and Tijuana River Valley Park. The City of San Diego Water Department also owns watershed lands around the Otay Lakes, Barrett, and Morena reservoirs, which are protected to prevent degradation of the municipal water supply.

Private Conservancies

Private conservancies, such as The Nature Conservancy and Trust for Public Land, purchase properties for conservation and relinquish ownership and management to a government agency or community-based land trust. Many of the lands within the San Diego National Wildlife Refuge were acquired under this scenario. For example, McGinty Mountain, which The Nature Conservancy owns, will be deeded to the U.S. Fish and Wildlife Service as part of the refuge. There are few community-based land trusts in the border region that own and manage protected land.

Examples of Binational Conservation Projects (Baja California-California)

The United States and Mexico signed the first binational easement *(servidumbre)* in March 2003. The easement protects the highest peak in Tecate, known as Cerro Cuchumá to the native Kumeyaay Indians, who consider the mountain sacred. This chaparral-covered mountain supports endemic plants and other species protected by Mexican Official Rule 059-ECOL-1994. The approximately 819 ha easement restricts land uses to those consistent with the conservation of its biodiversity, such as research.

Two binational conservation and restoration projects have been initiated under the Coastal Training Program of the Tijuana River National Estuarine Research Reserve in San Diego County. Both projects would result in an extension of the reserve into Baja California. The first binational effort focuses on Los Laureles Canyon in urban Tijuana, which is a significant source of sediment released into the Tijuana River Estuarine Reserve. Plans are underway to revegetate the canyon, remove invasive species, stabilize the least-degraded part of the canyon, construct an artificial wetland, and establish a recycling center administered by community groups. The second initiative, the proposed Matadero Canyon Conservation Park within the City of Tijuana, will provide crossborder educational opportunities, environmental interpretation, and low-impact recreational use. A new NGO will be created to administer the park in collaboration with Pronatura and Mexican government officials.

The Tijuana River watershed straddles the U.S.-Mexican international boundary and includes approximately 1,750 square miles (4,465 km^2), with one-third in California and two-thirds in Baja California. The Binational Watershed Advisory Council, a binational team of multi-jurisdictional and multi-sector researchers and practitioners, meets quarterly[1]. The stakeholders participate in the development of a binational vision for the Tijuana River Watershed and help devise strategies and options for achieving that vision. The resulting group is planning for binational conservation of natural resources, and funding is being sought for implementation of the plans.

To summarize, land ownership patterns in California and Baja California are dramatically different. Approximately 61% of undeveloped natural open space in the U.S. section of the border region is publicly owned, while less than 1% of land in the Mexican section of the border region is publicly owned. On the U.S. side, these public lands can serve as the building blocks of a conservation network that can extend into Mexico. Land use regulations in California provide additional protection to biological resources on private lands. In Baja California, individuals or community groups own a majority of the undeveloped land. The dearth of financial resources and incentives for private and social landowners in Baja California has constrained resource protection efforts.

Conservation-Implementing Mechanisms

There are many cultural, socioeconomic, and language barriers to transborder conservation efforts, and there is inadequate public education on the benefits of habitat conservation to the economy and to quality of life of border communities. Moreover, legal mechanisms for land conservation differ widely in Mexico and the United States, which further complicates binational conservation implementation. The following section discusses some of the legal mechanisms available to implement a binational conservation strategy. Different mechanisms may be appropriate for different parts of the border region, depending on ownership, land use, socioeconomic factors, and participation by government and non-governmental organizations and community groups.

Implementing Mechanisms in Baja California: Decreto Federal o Estatal (Federal or State Decree)

Federal, state, or municipal government agencies can decree parks or natural protected areas *(áreas naturales protegidas)*. However, land within these areas may be privately owned and often land owners within natural protected areas are not compensated for the economic losses associated with the decreed land use limitations. Consequently, since these land owners are not compensated and

have no incentive to act accordingly, these private lands may not be managed in a manner that is consistent with the protection of natural resource values. Incentives and land management guidelines are needed to supplement this designation.

Plan de Ordenamiento Ecológico Territorial (Ecological Master Plan)

This is a governmental policy tool for regulating and controlling land use and production activities, for providing for environmental protection, and for allowing for the preservation and sustainable use of natural resources. For example, scientists from the Universidad Autónoma de Baja California are assisting the Municipality of Tijuana with the identification of important natural resource areas (áreas verdes) as part of the ordenamiento ecológico for the municipality. The ordenamiento will be used to guide land development within Tijuana. One challenge is that this tool loses legal enforceability if land use zoning is changed from conservation to development (Gobierno de Baja California 1995).

Plan de Desarrollo Urbano del Municipio (Municipal Development Master Plan)

This municipal plan for urban development, which is updated every two years, establishes strategies, policies, and actions that will support sustainable growth. See, for example, El Plan de Desarrollo Urbano del Centro de Población de Tijuana 2025 (IMPlan 2002). One drawback is that the plan can change if there is turnover among government representatives.

Other Land Use Policies or Zoning

A *declaratoria* is a special zoning tool that the state or municipality could use to conserve woodlands. *Declaratorias* have proven ineffective in Baja California because of the lack of public sector enforcement and resources (see Chapter V, "Land Tenure and Preservation").

A municipal land bank allows municipalities to designate lands they own for special uses, such as low-income housing or conservation. They can also sell land for a low price. *Permutas* allow cities to exchange land in ecologically sensitive areas for less sensitive land of equal monetary value.

The Unidad de Manejo para la Conservación de la Vida Silvestre (UMA) can be obtained from the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT). An UMA legally allows local communities to manage resources, such as endangered species, under an approved management plan. The plan not only protects the resource, but includes methods to incorporate the resource into the legal market and provides economic gain to the communities (SEMARNAT 2002). Examples of such methods include controlled harvesting, such as hunting and fishing; research; or husbandry of endangered species. The economic incentives foster a genuine interest in protecting the resources for the community, and the UMA often results in more vigilant monitoring of the species by authorities. This tool has been successfully used for gray whale protection in Laguna San Ignacio, B.C., and could be used for the conservation, reproduction, and commercialization of bighorn sheep (Cariño 2004).

Legal Conservation Tools for Changes in Land Use Rights

The primary obstacles to establishing tools for the protection of natural resources in Baja California are Mexico's conservation policies and the mosaic of private land ownership. For this reason, changes in land use rights have been explored as a mechanism for conservation. Individuals, indigenous groups, and NGOs, such as Pronatura, have been working to develop mechanisms for the protection of natural resources on private lands (Gutiérrez Lacayo, et al. 2002). Legal conservation tools that allow landowners to voluntarily restrict the type and amount of development to protect natural resources are relatively new in Mexico (Gutiérrez Lacayo, et al. 2002). Some examples are described below.

Donation or purchase—This is the most complete and secure method of protecting land, but it is rare in Mexico. There are legal restrictions on the amount of land a person can buy or own. Tax-exempt NGOs are restricted from owning more land than "their immediate goals require" (Corcuera, et al. 2000). Moreover, most NGOs don't have the resources that are required to administer the land. Foreigners are not allowed to own land within the 100 kilometer (km) strip along the border or within the 50 km strip along the coast, unless they own land through a bank trust *(fideicomiso)*. Income tax deductions are allowed for land donations, although one must petition the Secretaría de Hacienda y Crédito Público.

Reassessment—Some landowners reassess their land to decrease its value to development and thus protect it. However, current low land values in Mexico decrease the effectiveness of this practice. This tool works best on large, low-income *ejidos*.

Bequest—This is the same as a land transfer or donation, but stipulated in a will and transferable after death (Corcuera, et al. 2000). Parques privados—The establishment of private parks in Mexico occurs mostly without legal guarantees (Corcuera, et al. 2000). El Edén research station in Quintana Roo, which was established in 1990, was the first private conservation park.

Usufructo (right of use)—An *usufructo* is a written agreement that gives a third party the right to use the resources on a property for certain purposes (in this case, conservation) during a stipulated time. The contract is not tied to the land and it expires with the death of the landowner. The owner also retains the right to use, sell, donate, or pass on the land to heirs (Gutiérrez Lacayo, et al. 2002). As an economic incentive, an NGO could purchase or receive lands and subsequently grant a restricted *usufructo* back to the seller or donor for living or working purposes. The previous landowner could also rent the *usufructo* land to private companies for purposes agreed upon with the NGO, such as camping or ecotourism.

Fideicomiso (property trust)—A person can use a financial institution (usually a bank) to grant property for conservation purposes; this arrangement must be documented by a rights of use contract. *Fideicomisos* even allow foreigners to own property within the restricted areas, although the ownership title is held by the financial institution. *Fideicomisos* are easy to create under the Ley de

Operaciones de Crédito and allow many people to invest land, money, and services in Mexico. Depending on the kind of *fideicomiso*, there is a limit to the contract period. Nationally, the tourism department of Mexico, FONATUR, uses this system to develop land (Gutiérrez Lacayo, et al. 2002). PRODUTSA in Tijuana used this tool to develop projects such as the Río Alamar 3a. Etapa, Corredor Tijuana-Rosarito 2000, and San Antonio del Mar. However, this tool can be used for conservation as well.

Servidumbre (easement)—There are many types of *servidumbres*. The *servidumbre ecológica* (conservation easement) is a voluntary legal agreement between two or more property owners where the type or intensity of land use is restricted. The objective of this easement is to preserve natural resources, scenic beauty, or historical and cultural values of the land for a designated period of time, or in perpetuity. The *servidumbre* stays with the land and not with the property owner. Two parcels of land from different owners are needed. There are also *servidumbres ecológicas recíprocas* in which there are reciprocal restrictions on each property. The properties can be contiguous or noncontiguous. *Servidumbres ecológicas* have been used to conserve areas of biological richness, to protect endangered species, to preserve wildlife movement corridors, or to maintain sustainable land use practices. Restrictions have included policies that forbid: hunting, cutting or clearing trees and other vegetation, impeding wildlife movement, burning, construction, subdividing the property, or increasing housing density. Ecotourism can benefit from such restrictions. Rancho Cuchumá is the only example of a *servidumbre ecológica* in the border region.

Implementing Mechanisms in Southern California

There are a multitude of federal, state, and local regulations that restrict adverse impacts to the environment, including air, water, land, cultural resources, and socioeconomic impacts. Some of these regulations provide mechanisms to protect natural resources and open space. The following discussion summarizes a few of the laws that affect conservation of natural resources in California.

Federal Regulations

National Environmental Policy Act (NEPA) and Endangered Species Act (ESA)—Federal projects, projects on federal lands, and projects that receive federal funding are subject to environmental review under these acts. In addition, non-federal projects that may affect federally listed threatened or endangered species are subject to federal ESA regulations. Projects that may cause significant adverse impacts to natural resources or that may jeopardize the continued existence of federally listed species must mitigate these impacts, often by establishing conservation areas. Where there are incidental, adverse impacts to listed species by non-federal projects, a habitat conservation plan (HCP) must be prepared to demonstrate that habitat and species conservation actions, including long-term biological management and monitoring, will mitigate impacts and contribute to the recovery of those species.

Clean Water Act—The U.S. Army Corps of Engineers administers this act with oversight from the U.S. Environmental Protection Agency (EPA) and the U.S. Fish and Wildlife Service. The Clean Water Act regulates adverse impacts to "waters of the United States" and wetlands, and requires mitigation for permitted impacts in the form of wetland and aquatic habitat conservation and restoration.

Federal Conservation Programs

National Fish and Wildlife Refuge—Within the border region, federal funding is being used to purchase private lands within the Otay-Sweetwater Unit of the San Diego National Wildlife Refuge and to develop a management and land use plan for the South Bay Unit of the San Diego National Wildlife Refuge. These lands are considered federal contributions to the MSCP preserve system in southwestern San Diego County.

Recovery Land Acquisition Grants Program (subsidized through Section 6 of the Endangered Species Act)—Funding from this program is available to purchase land that benefits federally-listed threatened and endangered species.

Forest Legacy Program—The U.S. Forest Service administers this voluntary program in cooperation with the California Department of Forestry by purchasing qualified private properties and conservation easements to maintain forest integrity. The Descanso Legacy Area is an example within the border region.

Natural Resources Conservation Service—Under provisions of the Farm Bill 2002, this branch of the U.S. Department of Agriculture works with private landowners to manage land for the conservation of natural resource values.

State Regulations

California Environmental Quality Act (CEQA), California Endangered Species Act, and Natural Community Conservation Planning (NCCP) Act—Development projects are subject to environmental review under CEQA and must comply with a host of other environmental regulations and permitting requirements. Projects that may cause significant adverse impacts to natural resources or that may jeopardize the continued existence of state-listed endangered or threatened species must mitigate these impacts by modifying the project or by providing long-term conservation and management of natural resources that the project affects. For example, land developers and other project proponents often purchase or establish conservation easements as mitigation for biological impacts.

Historically, open space mitigation was accomplished on a project-by-project basis, which resulted in a fragmented patchwork of conserved land that cannot sustain biological resources over the long term. In 1991, California adopted the NCCP Act, which provides for comprehensive land use planning to comply with California Endangered Species Act regulations. The NCCP Act allows local jurisdictions to plan for conservation of ecosystems and ecosystem processes while allowing for economic growth. Compliance with the NCCP Act and California Endangered Species Act is often coordinated with federal ESA compliance, resulting in the preparation of joint NCCP/HCP plans that specify reserve systems of natural open space for protected currently listed species and preclude the need for future listings of other species.

Local jurisdictions in Southern California, including the City and County of San Diego, were among the first to undertake joint NCCP/HCP planning. NCCP/HCP planning is conducted on a subregional basis – a subregion consists of a group of local jurisdictions within an ecoregion (such as the South Coast Ecoregion). In southern San Diego County, the coastal jurisdictions have almost completed their conservation planning efforts, and in the near future the county will initiate planning for inland areas. Both the City and the County of San Diego must annually appropriate funds for acquisition, management, and monitoring of this open space. The Sweetwater Authority and Otay Water District in San Diego County are in the process of completing NCCP/HCP plans that will formally designate the watershed lands they own as conserved open space. NCCP/HCP plans have resulted in a significant amount of open space conservation in San Diego County and are an important conservation tool for local governments.

State Conservation Programs

Multiple State of California departments and agencies have programs for habitat conservation, including the Department of Parks and Recreation, Department of Fish and Game, State Lands Commission, California Coastal Commission, and Wildlife Conservation Board, which provide some funding for land acquisition. In recent years, California voters have enacted several state propositions that authorize bonds for the conservation of natural open space, water resources, and park lands. These bond measures have provided substantial funding for natural resources conservation that are often used to leverage additional funding from private foundations and non-governmental conservation organizations.

Local Regulations

The border region encompasses portions of the cities of Chula Vista, Imperial Beach, National City, and San Diego in the west and portions of the County of San Diego in the east. Each municipality regulates land use and development within its jurisdiction. Many of these land use regulations require developers to avoid sensitive or

declining natural resources and to mitigate impacts to species and habitats by conserving additional lands outside of the development project.

General Plans/Zoning—In California, general plans describe policies that guide land uses within a city or county jurisdiction, generally over a 20-year planning horizon. A conservation element is a mandatory element of a general plan that provides guidance on the conservation, development, and use of natural resources. Once a general plan is approved, the local jurisdiction then "zones" the type and intensity (e.g., housing density) of land uses allowed. Certain land uses are compatible with natural resources protection, while many are not. Thus, while general plans can support conservation implementation, they often reflect the political sentiments of individual boards of supervisors or city councils and, in many instances, facilitate urban sprawl rather than effective conservation.

Transfer or Purchase of Development Rights—Under this policy, a landowner has the right to sell the development rights to his land. The seller gives up the development rights (emitting zone), and the buyer uses them to build on a more appropriate piece of land (receiving zone). This tool is proposed for use as part of the County of San Diego General Plan Update 2020.

County of San Diego Biological Mitigation Ordinance and Resource Protection Ordinance—The County of San Diego enacted the Biological Mitigation Ordinance to legally implement the MSCP. The ordinance establishes criteria for avoiding impacts to important resource areas and it outlines mitigation requirements for all discretionary permit projects. The County's Resource Protection Ordinance applies in unincorporated areas where the MSCP has not yet been adopted. It establishes development controls on environmentally sensitive lands, including wetlands, floodplains, steep slopes, and sensitive biological habitats (which are habitats that support rare or endangered species or function as a wildlife corridor).

City of San Diego Environmentally Sensitive Lands Regulations, Resource Protection Ordinance, and associated guidelines—The City of San Diego enacted these regulations to legally implement the MSCP. The guidelines stipulate the biological standards that must be followed to receive a development permit from the city and the amount and location of lands to be conserved as mitigation.

Local Conservation Programs

Local municipalities have a variety of methods at their disposal for raising money for conservation purposes. These can include, among other strategies, property taxes, sales and use taxes, transportation taxes, special assessment districts, impact fees (a one-time cost to the developer), general obligation bonds, and revenue bonds. Currently, the San Diego Association of Governments (SANDAG) is discussing the parameters for a countywide transportation tax that would not only pay for transportation improvements, but would also support acquisition, management, and monitoring of lands for open space as mitigation for transportation projects.

Mitigation banks—If approved by federal and state wildlife agencies, a property owner can sell "mitigation credits" on his land to other property owners or developers that need mitigation land for their own development impacts. The number and value of credits depend on the level and location of development impacts and the type of natural resources affected.

Private land conservancies—In Southern California, many private non-profit organizations conserve land for natural and cultural resources protection, scenic beauty, recreation, community open space, and agricultural resources. These organizations vary in size and scope from very large organizations with a global influence (e.g., The Nature Conservancy) to small, community-based land conservancies that focus on a particular area or watershed (such as the Back Country Land Trust).

Land transfers—This mechanism is primarily used to avoid the bureaucratic delays that governments experience when they buy land. A land trust typically purchases and holds the land until the government can purchase it.

Land exchanges—Landowners can exchange one property for another without incurring capital gains taxes on the transaction. This allows a landowner to continue to own valuable real estate, but transfer ecologically significant property to a land trust.

Land donations—Federal income tax deductions are a key incentive for land donations for conservation.

Bargain sale—A landowner can sell his property for less than fair market value and claim a charitable deduction for income tax purposes for the difference between the bargain sale price and fair market value.

Conservation easements—A landowner can voluntarily place a conservation easement on his property that legally restricts the land uses within the easement to protect the natural resources. The easement is typically transferred to a conservation organization or government agency for long-term management. The easement is specific to each property and stays with the land in perpetuity, or for a specified period, regardless of transfer of ownership. There are federal income tax benefits to donating a conservation easement. For tax purposes, the value of an easement is generally calculated as the difference between the value of the land with the easement restrictions and the value of the land without the easement restrictions.

Comparison of Implementing Mechanisms in the United States and Mexico

Conservation strategies in the United States and Mexico vary depending on the location, resources, ownership, surrounding land uses, management requirements, and the participation of government and community groups. The large proportion of public lands in the U.S. border region, especially relative to the Mexican border region, provides a framework for building future conservation efforts, both in the United States and in Mexico. However, the United States has more conservation-oriented government agencies and programs that administer financial resources than Mexico does. Moreover, government policies and regulations may be more widely enforced in the United States than in Mexico, partly because of the larger number of environmental "watchdog" NGOs in the United States. Rather than focusing on compliance with the law, Mexican NGOs in the border region have a heavy grassroots educational focus. Perhaps the greatest difference between each country's conservation mechanisms is the availability of financial compensation and incentives for imposing land use restrictions in the United States. However, Mexican groups like Pronatura are working to change this reality with creative reciprocal agreements that benefit

both landowners and the public. Mexican Natural Protected Areas and parks also serve as models for integrating human activities and resource extraction into protected areas.

Las Californias Binational Conservation Initiative

The Las Californias Binational Conservation Initiative is being conducted through a partnership of Mexican and U.S. NGOs, including Pronatura, Conservation Biology Institute, and The Nature Conservancy, to facilitate effective, binational natural resources conservation in the border region (CBI, et al. 2004). The Las Californias Initiative proposes a binational conservation vision for the border region that:

- Lays the foundation for a binational park system that connects the Parque Constitución de 1857 in Mexico to wilderness areas, forests, and park land in the United States
- Protects unique natural resources in an area of rich biological and cultural heritage that stretches from the coast to the mountains to the desert
- Links protected areas to support crossborder wildlife movement, such as that required for the desert bighorn sheep, which is protected in both countries
- Promotes land protection strategies that involve local communities and result in secure and sustainable conservation

The Las Californias Initiative recognizes that conservation of biological resources in the region must include landscape-scale protection strategies, sustainable land use planning, and workable management intervention. In light of today's rapid and uncontrolled growth and socioeconomic realities, this is an enormous challenge.

Threats

The urgency of this program is marked by a rapidly urbanizing triangle of land between San Diego, Tijuana, and Tecate, and their adjacent suburbs. In addition, reasonable land values in the eastern

portion of the border region present a short-term opportunity to shape binational land protection patterns. Population growth and development patterns on both sides of the international border are quickly compromising the ability to conserve a representative portion of the South Coast Ecoregion in Southern California and Baja California.

Connectivity between high value wildland areas is critical to maintaining the values of existing conservation investments. Historically, species dispersed freely across the international border. Road and highway corridors and associated developments are now major impediments to wildlife movement. Interstate 8 and State Road 94 in the United States and Highway 2 in Mexico largely sever connectivity between habitats north and south of these roads. Increasing development along these transportation corridors is closing off opportunities for the designation of a transborder habitat link. Low density rural development of San Diego's backcountry, and sand mining in stream channels and riparian habitats and agricultural activities on both sides of the border are affecting habitats and water supplies, which could severely impact human, plant, and animal communities. In addition, Native American Indian tribes have proposed new casinos and related projects in southern and eastern San Diego County. Tribal regulations govern the reservations and these regulations may not consider regional connectivity outside the reservations.

Increased urbanization heightens the human appreciation for, and therefore the need to protect, open space, particularly in Mexico, where there is very little public land or designated open space. The patterns of ownership, land uses, topography, and biological resources suggest the need for binational conservation areas that reflect this priority and reality. Conserving habitats along the border, as opposed to continuing to allow the development of urban sprawl, would protect ecological integrity and symbolize a unified conservation ethic for the two countries. Additionally, conservation efforts would lay the framework for other and additional binational cooperation.

Approach

Conservation planning may focus on a variety of factors, such as protecting rare or at-risk species or habitat types, ensuring adequate representation of vegetation communities, conserving intact habitats or watersheds, and maintaining important landscape connections or wildlife movement corridors. Habitat conservation efforts are most effective when they use a science-based approach to planning that seeks protection for suites of conservation attributes (Kirkpatrick and Brown 1994; Noss, et al. 1999). The suites of conservation attributes considered in reserve planning must be tailored to the ecosystems of the focal area and shared public values, which are often embodied in environmental regulations and land use policies. Identifying and prioritizing land areas that form a functional reserve system in a collaborative, binational fashion has the potential to produce an outcome that all levels of governmental and nongovernmental agencies on both sides of the border can value and claim as a success.

The Las Californias Initiative employs the Spatial Portfolio Optimization Tool (SPOT) reserve design algorithm. SPOT uses a simulated annealing technique, which was originally developed for the SITES reserve selection algorithm (Andelman, et al. 1999), to find the minimum area that meets established conservation goals, in the least fragmented configuration, and within a landscape of "costs" (TNC 2003). For the Las Californias Initiative, the cost landscape is derived from the spatial distribution of roads and land cover, such as development and agriculture, which reflects the integrity of habitats. Thus, SPOT identifies a reserve system that maximizes achievement of conservation goals within the most intact habitats.

SPOT uses existing digital data sets on a geographic information system (GIS) platform. Inputs to the model include the distribution and magnitude of costs, conservation targets and quantitative goals for these targets, parameters that guide the algorithm with respect to fragmentation, and penalties for missing conservation goals.

The production of seamless, standardized data layers for the border region has been very difficult. Maps of vegetation communities, land use, and roads for the border region were assembled from

numerous U.S. and Mexican sources. The constituent data layers differ with respect to scale, detail, and mapping conventions. More detailed data sets must often be generalized so that they can be merged with less-detailed data sets. Additionally, many data layers (such as vegetation communities) use different classification systems in Southern California and Baja California (Holland 1986; INEGI 1997), which complicates the establishment of binational conservation targets and goals.

Because of the lack of comprehensive and on-the-ground survey data for the region, this landscape-level planning approach uses publicly available GIS databases, that are supplemented with information from individuals that have specific knowledge of the region's biological resources. No new data were collected for this study; however, the assembled databases will serve as a baseline for refining and adding new site-specific data. The modeling approach is systematic, scientifically defensible, and fully transparent for stakeholder and scientific review. Although some of the available data are at a relatively coarse scale, and although the resolution is not consistent across the study area, the scale and thematic detail of information are adequate to support the analysis.

Conclusions

The border region of California and Baja California—Las Californias—lies at the center of one of the world's biodiversity hotspots. It harbors ecosystems and species that occur nowhere else on Earth. It is also a growing, multi-national metropolitan area where more than 5 million people live. The integrity and functionality of ecosystems in the border region, as well as the health, economy, and standard of living of its residents, depend on the creation of a system of open space reserves that are interconnected across the international border. The urgency of this need cannot be overstated, as the ever-growing human footprint of development is beginning to preclude opportunities for protecting a functional open space reserve system.

However, there are institutional and political constraints that can hinder a binational conservation effort in this region. There is a tremendous difference between each country's ownership and con-

servation patterns, with a far greater percentage of both public ownership and conserved land in California than in Baja California. Moreover, differences in legal mechanisms and available financial resources for land conservation efforts in the two countries complicate coordination.

The Las Californias Binational Conservation Initiative takes a systematic, phased approach to conservation in the border region. The planning phase uses a science-based approach, with uniform conservation targets and goals, to identify significant natural resource areas. These areas must be linked to conserve representative biodiversity, functional ecological processes, and wildlife movement across the region. The long-term goal for the initiative is for U.S. and Mexican governments, academic and research institutions, and non-governmental conservation organizations to embrace and adopt a shared conservation vision for the region, and to refine this vision over time with focused research and planning.

Implementation actions must raise the visibility of conservation objectives and consider inherent barriers, such as those posed by U.S. Department of Homeland Security programs. The triple fencing project in the western portion of the border region will significantly compromise landscape connectivity if it is extended eastward. Conversely, increased conservation of open space in the border region could facilitate border enforcement, if the U.S. and Mexico use sensor and remote-sensing technologies. This would prevent the need for extensive barriers.

Using a single, shared conservation blueprint for the border region allows coordinated implementation by different groups on both sides of the border. Coordinated, but separate, implementation tools are necessary because of the differences in land protection status and legal mechanisms available for conserving land in the two countries. Therefore, the implementation strategy developed in subsequent phases of the Las Californias Initiative must identify specific conservation mechanisms for individual portions of the blueprint, based on ownership, surrounding land uses, and available legal tools and funding.

Endnote

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