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Sovereignty, Borders, and
Transboundary Biodiversity:
Turning a Potential Tragedy into a True
Partnership an Introduction to the
Theory and Practice of Conservation
Biology in the Security Bisected
U.S.-Mexican Border Region

D. Rick Van Schoik, Elena Lelea, and John Cunningham

It was here that I first clearly realized that land is an organism. —Aldo Leopold in 1936, on Northern Mexico's Gavilan River

I do not believe that this undertaking in the Big Bend will be complete until the entire park area in this region on both sides of the Rio Grande forms one great international park. —Franklin Roosevelt in 1944, establishing Big Bend National Park

ABSTRACT

International borders, by their very nature as geographic boundaries, are marginalized. Governments naturally invest less planning and infrastructure at their frontiers, which historically were hinterlands – uninhabited regions that acted as natural buffers to neighboring nations. Today, however, as border regions become more populated, developed, and contested, they also demand more attention. As these once relatively unused regions become increasingly important sites for commerce and development, and as they become important ports of entry for trade and tourism, they also become regulators of migration, commerce, and tourism. These borders are artificial, political divisions in that they unnaturally bisect natural processes, distributions, and movements. Borders affect, but certainly do not control, natural systems. However, while the components that make up a border confound conservation efforts, they also offer unique opportunities for transboundary cooperation.

There are two dimensions to transboundary ecosystem management. On the one hand, there is tension between conservation needs and the actual practices of transboundary ecosystem governance. On the other hand, there is a discrepancy between the theory of conservation and ecosystem governance and the results of the actual government practices. Despite the discord between theory and reality, theoretical principles provide a framework for action. Moreover, the discord provides institutions with the opportunity to work to coherently merge theory with reality.

Threats to biodiversity abound in the border region and in certain hot spots, vulnerabilities are acute. While large refuges, reserves, and parks are adequately preserved (purchased) they are not necessarily actively protected because a series of natural protected areas straddle national borders, which makes these areas harder to protect. The stories of successful and failed conservation efforts showcase lessons on transboundary conservation tools, incentives, “banking” opportunities, and on ways to evaluate the costs and benefits of each option.

This chapter provides an overview of the conservation issues and of the policy challenges for the U.S.-Mexican border region. The several subsections fall under six main sections:

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- An introduction to border issues in general, and then specifically to U.S.-Mexican border issues
 - A description of the general status of biodiversity in the region
 - An exploration of transboundary conservation governance
 - A description of the current threats, biodiversity hotspots, protections, and lessons learned
 - A portrait of the conservation tools, incentives, and policy options
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Soberanía, Fronteras y Biodiversidad
Transfronteriza: La Conversión de una
Tragedia Potencial en una Alianza
Verdadera Introducción a la Teoría y
Práctica de la Conservación Biológica
en la Región Fronteriza México-Estados
Unidos Dividida por la Protección

D. Rick Van Schoik, Elena Lelea y John Cunningham

Fue aquí donde, por vez primera, claramente me percaté que la tierra es un organismo. —Aldo Leopold, 1936, Río Gavilán, Norte de México

No creo que se concluya el proyecto de Big Bend sino hasta que la zona íntegra del parque de ambos lados del Río Bravo forme un gran parque internacional. —Franklin Roosevelt, 1944, establecimiento del Parque Nacional de Big Bend

RESUMEN

Por su misma naturaleza de constituir límites geográficos, las fronteras internacionales están marginadas. Los gobiernos, por lo general, invierten pocos recursos en la planificación e infraestructura de las fronteras que históricamente eran regiones abandonadas, zonas inhabitadas que servían como amortiguadores naturales entre las naciones vecinas. Hoy en día, sin embargo, a medida que las regiones fronterizas aumentan de población y desarrollo, generando más controversia, exigen más atención. Estas regiones que antaño se aprovechaban poco, ahora cobran más importancia como sitios de comercio y desarrollo, además de haberse convertido en puertos de importancia para el ingreso del comercio y del turismo, también se han convertido en agentes reguladores del comercio, turismo y migración. Estas fronteras son divisiones artificiales y políticas ya que dividen los procesos, distribuciones y desplazamientos de manera poco natural; afectan pero, en definitiva, no controlan los sistemas naturales. No obstante, aunque los componentes que integran una frontera confunden las actividades a favor de la conservación, a su vez, ofrecen oportunidades únicas en el ámbito de la cooperación transfronteriza.

Se perfilan dos dimensiones en el manejo transfronteriza del ecosistema. Por una parte, existe tensión entre las necesidades de conservación y las prácticas verdaderas de gobernabilidad transfronteriza de los ecosistemas. Por otra parte, existe una discrepancia entre la teoría de conservación y la gobernabilidad del ecosistema con respecto a los resultados de las prácticas reales del gobierno. A pesar de la discordia entre la teoría y la práctica, los principios teóricos proporcionan un marco de acción. Más aún, tal discordia ofrece a las instituciones la oportunidad de trabajar por la fusión coherente de la teoría con la práctica.

Abundan las amenazas contra la biodiversidad en la región fronteriza y, en algunos lugares candentes, las vulnerabilidades se han agudizado. Aunque se practica la conservación (adquisición) adecuada de grandes refugios, reservas y parques, no se ejerce una verdadera protección activa ya que algunas de estas zonas protegidas se encuentran en la franja fronteriza, lo que dificulta aún más la tarea de proteger estas zonas. Los éxitos y fracasos de los proyectos de

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conservación demuestran lecciones sobre el aprovechamiento de las herramientas, incentivos y oportunidades de financiamiento en aras de la conservación transfronteriza, además de ofrecer formas de evaluar los costos y beneficios de cada opción.

Este capítulo proporciona un panorama general de los problemas inherentes a la conservación y los retos que presentan las políticas en la región fronteriza México-Estados Unidos. Las diversas subsecciones se dividen en seis secciones principales:

- Introducción a los problemas fronterizos en general y, después, más concretamente, a los problemas de la frontera México-Estados Unidos
- Descripción del estado general de la biodiversidad de la región
- Exploración de la forma de gobernar la conservación transfronteriza
- Descripción de las amenazas actuales, de los puntos candentes de la biodiversidad y las experiencias derivadas
- Panorama de las herramientas, incentivos y opciones de políticas dentro del marco de la conservación

INTRODUCTION TO BORDER ISSUES

International borders, by their very nature as geographic boundaries, are marginalized. Governments naturally invest less planning and infrastructure at their frontiers, which historically were hinterlands – uninhabited regions that acted as natural buffers to neighboring nations. Today, however, as border regions become more populated, developed, and contested, they also demand more attention. As these once relatively unused regions become increasingly important sites for commerce and development, and as they become important ports of entry for trade and tourism, they also become regulators of migration, commerce, and tourism. These borders are artificial, political divisions in that they unnaturally bisect natural processes, distributions, and movements. Borders affect, but certainly do not control, natural systems. However, while the components that make up a border confound conservation efforts, they also offer unique opportunities for transboundary cooperation.

Borders as Geography

Human beings – and not borders – limit or demarcate pollutions, natural flows, or living systems. As such, ecosystems that straddle international borders are more challenged than those that are contained within the boundaries of one nation. An ecosystem that only lies within the United States involves multiple jurisdictions that are usually mismatched to the dynamics and needs of the ecosystem—mixing U.S. jurisdictions with Mexico’s jurisdictions makes conservation of trans-international boundaries doubly complex. The demands of reconciling the differences in government legal systems and asymmetric economies can hamper conservation efforts. When rivers form boundaries between states and nations, as they do in the U.S.-Mexican border region, issues and disputes over the moving boundary, the river’s water supply, the consequences of dumping pollution into the river, and the river’s recreational or hydroelectric uses, often exacerbate and overshadow any discussions on ecosystems (Blumenthal 2003). The conflicts among such jurisdictions and an ecosystem are also illustrated when examining the environmental impacts of increased security along the U.S. side of the border.

Borders as Security

The post-September 11th government scrutinizes borders more than any government before it has. They have strengthened interdiction activities and reinforced boundaries, which have impinged upon ecosystem conservation efforts. In the post-September 11th landscape, the U.S.-Mexican border has experienced heightened vigilance and augmented security activities. The efforts and physical infrastructure developed by both the U.S. Department of Homeland Security (DHS) (which was formerly a conglomeration of customs, border patrol, and immigration agencies) and by the Joint Task Force North (JTF-N), which is comprised of approximately 160 U.S. soldiers, sailors, marines, airmen, and Department of Defense civilian employees, have damaged habitats. These agencies’ use of sensor fields, roads, and triple fences, which sometimes run 50 meters deep, creates erosion and dust. The physical presence of the security forces that seek view and access points along the border –

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their vehicular patrols, their all-night artificial lighting and noise, their dragging of screens to smooth dirt and make footprints visible, and their clearing of brush – also degrade sensitive habitat.

For example, proposed triple fencing along the San Diego segment of the border has been contested on environmental grounds. The project pits the federal government's need to secure borders against the state and local jurisdictions' environmental concerns. The proposed triple fence will be 14-miles long and 150-feet wide and it will cut across habitat that houses some of the state's rarest plants and at least three endangered wildlife species (Rodgers 2004a). Construction and border patrolling activities near the third fence also pose a significant threat to sensitive habitat, even though some proponents of the fence argue that its presence would improve ecological conditions in the area because it would reduce the pedestrian traffic of illegal immigrants. To help compensate for environmental degradation, a mitigation plan to restore habitat elsewhere was completed. The United State's proposed triple fence along the U.S.-Mexican border illustrates the complexity of reconciling security concerns with ecological integrity and with balancing the needs of DHS and JTF-N with the State of California and the County of San Diego. Yet, despite these jurisdictional challenges and conflicts, borders are also areas of significant interdependence.

Borders as Opportunities

Depending on the relationships between neighboring nations, border regions can provide unique opportunities for conservation. The demilitarized zone between the Koreas is an example of an extreme case for conservation, as the region has become an almost pristine, if unofficial, refuge. Thus, the cold relations that created a natural barrier between the north and the south also created an opportunity for transboundary ecosystem conservation. In areas where interaction across the border is more regular than in the Koreas, ecosystems and economies are interdependent. This interdependence provides the opportunity for innovative cooperation and collaboration.

“Peace parks,” or parks along international borders, serve as examples of the types of cooperation and collaboration that can occur at a border. For example, in chapter eight of this monograph,

Dr. Dallen J. Timothy notes that “many of the frontier zones of the former Iron Curtain in Eastern Europe, which are essentially zones of untouched vegetation and wildlife, have now been designated as nature preserves (Young and Rabb 1992)”. Besides promoting peace and goodwill, transborder conservation areas “improve protection and management of other natural resources including cultural values” (Cornelius 2000). They also facilitate more effective research and monitoring, bring economic benefits to local and national economies, and ensure better crossborder control of problems, such as fire, pests, poaching, pollution, and smuggling (Sandwith, et al. 2001). Put simply, borders provide an interface for creative cooperation, which can be used to jointly protect a shared resource, such as biodiversity.

Conservation of Biodiversity and Borders

Conserving biodiversity is both a serious and urgent concern. Of all the much-discussed and somewhat-feared environmental futures, the loss of biodiversity is perhaps the most perilous to Earth. Each species, habitat, and ecosystem represent the optimal species, habitat, and ecosystem because it is the result of a 3-billion year-long experiment. The current extinction rate, which is estimated at four species per hour but which is actually unknown, presents such a monumental loss because once an ecosystem loses too many parts, it cannot function. Moreover, once ecosystems are destroyed, they can never be recovered. We simply do not understand them well enough to recreate them.

Borders and boundaries both present obvious challenges to conservation and resource management. To overcome the restrictions created by an individual public agency’s mandate, there must be an incentive for public officials to consider sharing information and resources with outside agencies and organizations. Thomas (2003) argues that this incentive is a worldview – one that focuses on interdependence and common goals. He asserts, “the more endangered species and the more jurisdictions, the more likely ... agencies [will] cooperate to manage this habitat.” If different jurisdictions, agencies and nations do not share goals, their battling priorities will stymie conservation efforts.

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For example, the National Wildlife Refuge plan for a region of San Diego, which borders Mexico in several places, never mentions any coordination or data-sharing with a Mexican agency. Data-sharing practices between the United States and Mexico increased under the auspices of the Natural Resources Workgroup, which was created under the La Paz Agreement. Although this group was active and productive under the Border XXI Program (Border XXI Program 1999), progress has faltered under the current Border 2012 Program. Since the U.S. Department of the Interior (DOI) has not joined the U.S. Environmental Protection Agency (EPA) and the Mexican Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) in the Border 2012 Program, data-sharing efforts have slowed. While SEMARNAT and DOI continue to collaborate, DOI's lack of involvement in the Border 2012 Program increases bureaucratic fragmentation, which hinders progress on natural resource conservation efforts.

While some may believe that biodiversity conservation efforts directly oppose security efforts, the link between biodiversity and security can be turned on its head. Instead of impeding security, biodiversity conservation efforts can actually augment security. For example, in 1997, tensions over fishing rights drove Canada to blockade an American tourist ship in Vancouver Harbor (Nierenberg 2003). This shows that competition for species and/or ecosystems may elevate tensions to actual conflicts. A time may come within the next century when, not only will outside interests seek erratically distributed and highly prized living assets, but they will also guard and defend them (Van Schoik 1997). Over the last decade, the definition of security has changed to include environmental and ecological components, and this definition is taught in many universities.

The U.S.-Mexican Border

Ecosystem studies are complex enough without international borders. The nature of ecosystem studies as multi-scalar, -disciplinary, and -media makes them extremely difficult to conduct and interpret without the added reality of crossing borders between two nations, especially when they are as different as the United States and Mexico are.

Transboundary Ecosystem Management

The United States and Mexico differ in language, culture, legal system, economy, and attitude, but the countries share a series of unique climates, geographies, and soils that together create some of the most interesting desert and arid ecosystems in the world. These natural wonders both flourish and suffer at the intersection of realities and attitudes. For example, each side of the border views open spaces very differently. In the United States, open spaces are valued as a quality of life. As much land as possible is set aside in as pristine a condition as possible. The U.S. population values open space for its intrinsic character. In Mexico, practical concerns cause the Mexican population to value and use that same open space as an economic and natural resource. The land is used, for example, as sustenance (grazing), as a sink for waste, and can be neglected by the government. Similarly, the U.S. population values water for its economic use and the population increasingly values water for its recreational use. In Mexico, water bodies are considered economically valuable, but Mexico also views water bodies as places to drain irrigation tile water or as destinations for diverted unwanted wastewater.

The extraordinary population growth and commensurate residential and industrial urban sprawl in the border region engender doomsday predictions for the entire border region, from the Pacific Ocean to the Gulf of Mexico. Already, scientists estimate that, within the municipio of Tijuana, the rate of habitat loss is 2.5 hectares per day (see Chapter V). While not probable, the possible doomsday scenario issues an urgent call to conservation biologists and border decision-makers. They must find binational ways to preserve and protect the critical natural habitat and corridors that straddle the border. This will steer the U.S. and Mexico away from their current path, which will lead to the permanent destruction or the severe alteration of ecosystems in the border region.

Significant trade of stocks, goods, services, and tourism occurs at the U.S.-Mexican border, especially since the signing of North American Free Trade Agreement (NAFTA). Such trade introduces exotic species to the region, which can include diseases and other invasive species that harm humans and ecosystems. Maquiladoras (mostly assembly plants) represent the globalizing economy and they encourage industrial sprawl and increase migration to the border

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region. Both maquiladoras and the globalizing economy negatively impact water use and ecosystem services. Pollution in all media (air, water, land, etc.) is a mix of the type of pollution that comes from a developing nation (i.e., open burning of trash and fuel during cooking, human and animal waste in water, and traditional pesticides), as well as the type of pollution that comes from a developed nation, such as high-technology emissions and effluents (i.e., acetaminophen and water that contains hormones that affect the gender of marine species). Thus, NAFTA spurred, crossborder trade exacerbates environmental degradation and taxes an already-stressed water supply. NAFTA-related development has disproportionately benefited the several social classes in the border region, as poverty continues to be endemic.

This border's poverty and its economic and financial asymmetry (U.S. wages and the U.S. tax coffer vs. Mexican wages and the Mexican tax coffer) complicate conservation attitudes and efforts. Often, impoverished people can only survive if they exploit the natural resources that surround them. For example, the New York Times reported that "The [Mexican] green world is ravaged by people whose only path from starvation lies in slashing and burning the jungle to plant a patch of corn" (Weiner 2002). Economic and financial asymmetry – the vast differences between the fiscal assets of the populations and jurisdictions of the U.S. and the fiscal assets of the populations and jurisdictions of Mexico – create stark and troubling realities, even within the relatively affluent border region of Mexico. Marked differences in intensity of land use make it easy to identify where Mexico's land ends and where the United States' territory begins. The differences between the countries are detectable by space telemetry instruments, they are noticeable in aerial photographs, and they are even evident to casual observers from airliners. Land ownership and its use, as well as water rights and their uses, contrast the two sides as dramatically as any map would.

The link between poverty and biodiversity manifests itself in many ways. "Poverty remains the leading cause of deforestation and thus the extinction of flora and fauna. Specifically, the expansion of subsistence farm areas into marginal lands to increase yields to compensate for price declines remains the leading cause of forest clear-

Transboundary Ecosystem Management

ing followed by felling of trees for poor-income household fuel use,” according to Vaughan (2004). Another example of this link is that although Arizona and Sonora are of comparable size and have a comparable amount of preserved and protected land, Arizona employs 85 wildlife rangers while Sonora employs none (Abarca 2004). Arizona’s rangers therefore represent Arizona’s capacity to not only enforce laws and catch poachers, but to monitor and actively protect the preserved land.

Conservation is stalled in the U.S.-Mexican border region because of the reasons suggested above and because of other, emerging reasons. George Kourous, in a survey of borderland biodiversity titled “Borderlands Biodiversity: Walking a Thin Line” (1998), identifies the following “irreconcilable differences”:

- There is no overarching strategy for coordinating resource management
- The traditional weaknesses of protected areas in Northern Mexico abound
- The political atmosphere and lack of interagency communications on the U.S. side hamper efforts
- Conservation is a luxury the border’s low-income families cannot afford

Other obstacles to transborder conservation include dissimilar capacities, communication barriers, consolidated versus decentralized authority, treaty obligations, conservation philosophies, native rights, high profiles, extra work, lack of a meeting place, and inadequate budgets (Cornelius 2000). However, conservation of biodiversity is important because of its strong and direct connection to economic development, quality of life, water availability, land use, and population growth.

A number of books, articles, and workshops deal with the topic of transboundary ecosystem management, but by and large, they deal with the topic in a broad, theoretical sense or in an overly specific sense that does not apply to the U.S.-Mexican border region. Additionally, most discussions about the topic deal with biodiversity (Brey Meyer and Noble 1996), political organizations (Benvenisti 2002), or local issues. As well, some officials in the U.S.-Mexican border are sensitive to the use of particular terms. “Binational” con-

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ervation is not used because it implies reciprocity that may not exist or may be impossible to create because of land and water ownership issues. The term “natural protected areas across international boundaries” is preferred in Mexico (Enkerlin 2004).

International security concerns on the U.S.-Mexican border also conflict with concerns about water rights and ecosystem conservation. Section 321 of the National Defense Authorization Act of 2004 clarifies the primacy of federal security concerns and the extent of federal responsibility for water consumption impacts that are directly related to national security concerns. It also specifically exempts the federal government from some responsibility for the “continued existence of any listed species or ... destruction or adverse modification of designated critical habitat” (108th Congress 2004). Thus, issues of U.S. federal security on the northern side of the border can supersede efforts by local or state officials on each side of the border to cooperate in the interest of conserving habitat.

However, as explained in the following example, conservation of water and habitats can also protect the interests of military forts and thus enhance international security. During discussions about Arizona’s Fort Huachuca Army Base, Senator John McCain has made the connection between international security, water, and ecosystem conservation and has urged community leaders to become involved with all three. “There is no denying the importance of the post to national security,” he said. When it comes to the San Pedro River, McCain said that unless actions are taken immediately, the waterway will die. “It’s not a matter of whether it will dry up, it is when will it dry up,” he said. The partnership among international security, water, and ecosystem conservation can play a vital role in ensuring the river and the base survive, he added. The senator was told that since the San Pedro River is a binational waterway, action is being taken to work with Mexico to help with water conservation in that country. McCain responded that people worldwide see the river as an important wildlife corridor. One result of protecting the river will be the fort’s survival and its benefit to the nation as a critical installation for national security will be assured, the senator added. He advised the partnership among national security, water, and ecosystem conservation be strengthened (Hess 2003).

Transboundary Ecosystem Management

Several global influences on the border region are outside the control of local resources, but must nevertheless be considered before transboundary ecosystem conservation can be successful. The global impacts to border biodiversity include rapidly increasing international trade and climate change. A recent article in *Nature* quantifies how necessary habitat shifts lead to species loss, citing “more than one-third of the 1103 native species ... could disappear or approach extinction by 2050.” These estimates might be optimistic considering that “other factors such as landscape modification, species invasions, and build-up of carbon dioxide could magnify the impacts” (Pounds and Puschendorf 2004).

Global climate change threatens to raise the temperature in the already arid region. This would further limit water supply for humans and nature and it would increase the evaporation rates of surface water and groundwater. Rising sea levels may completely destroy wetlands along coasts. Global climate change also presents new threats to humans in the form of new or re-emerging infectious tropical diseases and water-borne or water-associated diseases. West Nile Fever has spread across the southern United States and can easily cross the border into Mexico. Authorities blamed a recent outbreak of Hepatitis in the U.S. Northeast on wastewater-contaminated produce from Mexicali (Lindquist and Dibble 2003). As mentioned previously, the global impacts of trade in the border region also exacerbate local environmental conditions and make transboundary ecosystem conservation a challenge.

Current Political Climate

The protection of listed and rare species is a contentious political issue. There are at least eight cases where problematic factors complicate the process of protecting species. First, there are issues over the extent, power and need to monetarily compensate land owners for taking private lands associated with the implementation of the Endangered Species Act (ESA) in the United States. Second, some DHS activities and Department of Defense training activities are exempt from sections of ESA and/or the National Environmental Protection Act (NEPA). Third, private property rights advocates have prompted the U.S. government to withhold some funds for the

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designation of sensitive habitat for some species. Fourth, protection of habitat upstream for one species may threaten other species downstream, as evidenced by Albuquerque's ability to withhold water from the downstream habitat of the silvery minnow in the upper Rio Grande. Fifth, agencies have the power to divert funds away from conservation. For example, the U.S. House of Representatives shifted funds away from the restoration of public parks to fund vehicle barriers in two parks along the Arizona-Sonora border (House 2004). Sixth, conservationists can face violence when they attempt to combat illegal harvesting; recent extreme violence associated with the harvest of turtles and turtle eggs demonstrates this (Economist 2004). Seventh, energy issues are at odds with conservation. For example, in South Padre Island National Seashore, drilling and other energy-related activities compete with the sensitive and preserved habitat of the last U.S. population of the highly threatened Kemp's ridley sea turtles (Echols 2002). Finally, the political process of listing endangered species can change at any time. An incident in Arizona illustrates this point: although there are only 30 cactus pygmy owls left in Arizona, authorities decided to lift their endangered protection status, according to Scripps Howard News Service (2003).

The differences across the border can only be reconciled (and not necessarily resolved) if stakeholders obtain an understanding and appreciation for the vast differences in the U.S. and Mexican legal, economic, and political origins, systems, and conditions. While a more in-depth discussion of legal and economic issues follows in a later section of the chapter, an overview of current politics is included below.

Many cite progress on general environmental issues in the U.S.-Mexican border region and recognize that much more has yet to be done. For example, SEMARNAT and its affiliated agencies have an exemplary strategic plan for addressing long-neglected environmental concerns. The plan prioritizes among issues and dedicates funding to each. However, problems still riddle issues that relate to living resources: progress towards solving these issues has been stalled and there is a wide range of opinions about how much needs to be done—some security and border agencies have needed to assert their priority over natural resources while conservation biologists

stress how important it is to save the small amount of rare habitat left, before it is swallowed by development. Environmental politics in the border region progresses in a pattern of decades. To date, the Wilderness Act is 40 years old, ESA is 30 years old, the La Paz Agreement is 20 years old, and NAFTA (and its environmental institutions) is 10 years old. The timing is ripe for a transboundary conservation policy.

Although these political factors can make obstacles to the conservation process seem impenetrable, it is possible to overcome the obstacles if organizations of complementary jurisdictions and knowledge bases understand their interdependence and the need to collaborate with “matching of capacities” (Sandwith, et al. 2001) towards a common goal. Support from one sector, non-governmental organization (NGO), or agency on the U.S. side of the border can be elicited to match support from an unrelated entity on Mexico’s side, or vice versa. This and other options are explored in subsequent sections.

GENERAL BIODIVERSITY SUMMARY

Diversity Begets Biodiversity

The U.S.-Mexican border region is a biological and ecological treasure. The region begins at the Pacific Ocean and reaches eastward across the North American continent to the Gulf of Mexico. The region also includes the Sea of Cortez, the Gulf of California, and the inland Salton Sea, which is the largest lake in California. The region includes portions of the Peninsula of the Californias and the Rocky Mountain spine. Three major coastlines and two major river systems (Río Bravo/Rio Grande and Colorado River) lie within the region. The vast majority of the U.S.-Mexican border region has been named to the North American Commission for Environmental Cooperation’s list of the continent’s 14 Most Ecologically Important and Threatened Regions (CEC 2004).

The region’s extreme biodiversity can be explained with a fascinating tale about the region’s geological history. For example, shifts in continental plates created the entire Baja California peninsula, the mountains, and a range of soil types. Moreover, California’s fault

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system is still active. Geological events also gave rise to all of the region's habitat types, which include geothermal pools, mud volcanoes, high desert mountain tops, below-sea-level depressions and extraordinary salt and alkaline flats. "The regional climates vary from Mediterranean-type winter rains in the west to monsoon-type summer rains. The steep slopes of the mountain ranges generate some of the most dramatic environmental gradients on earth," according to Ezcurra (1998).

The border, which is 1,952-miles long, spans two major global zones— it begins below the 26° latitude in the tropics and it nearly reaches the 33° latitude, which lies in the Earth's temperate zone. The border crosses three major mountain systems with altitude extremes that range from record depths below sea level in the California valleys, to nearly mile-high plateaus and peaks of more than 8,000 feet. Sky Islands and the Baja Peninsula, which are situated south of the border and off the continent on a tectonic plate, are just two examples of unique geological formations. The region also includes major climatic types, such as desert, montane (mountain-related), Mediterranean, and subtropical. Moreover, ranges of altitudes create a diversity of microclimates within each larger climate type.

Because the overall border region is diverse, the number of species that live in the region is staggeringly large. The United States and Mexico are two of the most biological diverse countries in the world – in fact, they both rank among the top ten most biologically diverse countries in the world. The U.S. and Mexico also possess high endemism rates, as well as a disproportionately large number of unusual biodiversity islands (isolated areas of high diversity surrounded by areas populated with more common species, and with less species diversity).

Biodiversity in the U.S.-Mexican border region, measured at the species, habitat, and ecosystem levels, is immense and in some cases record-making. Mexico is a member of the megadiverse club, home to 10% of all known species— and some 30% to 50% of these species are endemic (Table 1). Mexico, unfortunately, also has one of the highest deforestation rates.

Transboundary Ecosystem Management

The United States' portion of the border region is equally rich in the number and diversity of its species. For example, when diversity of species, endemism and vulnerability are taken into account, the richest counties in the United States (outside of Hawaii), are situated within the border region. They include San Diego County in California, Pima and Cochise Counties in Arizona, and Brewster County in Texas. Diversity, rarity, and risk are high across all biological kingdoms (plant, animal, and fungi, among others).

When compared to the rest of the United States, there is a great amount of diversity in the four U.S. border states. However, the rate of species listing and loss is higher in these border states than in any other comparable region in the U.S. All four U.S. border states have the highest or second highest diversity indices and rates of loss for total number of species, plants, vertebrates, mammals, and birds. The border zone is especially critical because it is a wintering site for migratory tropical birds, reptiles, and amphibians; freshwater fish in the border region are also at a higher risk of extinction than the freshwater fish of other regions are.

The juxtaposition of different geology and soils, the range of elevations, and the variety of climates within the border region create a broad variety of different biomes (life zones) including:

- Coasts
- Warm deserts—the Sonoran and Mojave—at a range of altitudes
- Prairie and semi-arid grasslands
- Mixed montane and riparian (riverine or river-related) habitats
- Deciduous, coniferous, and mixed forests at higher elevations
- Thorny, coniferous, and deciduous dry forests at lower elevations
- Temperate grasslands
- Maritime, coastal, and inland chaparral

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Table 1. Country Ranking by Number of Species Found

Group	First	Second	Third	Fourth	Fifth
Mammals	Brazil 524	Indonesia 515	China 499	Columbia 456	Mexico 450
Vascular Plants	Brazil 55,000	Columbia 45,000	China 30,000	Mexico 26,000	Australia 25,000
Amphibians	Columbia 583	Brazil 517	Ecuador 402	Mexico 284	China 274
Reptiles	Australia 517	Mexico 717	Columbia 520	Indonesia 511	Brazil 468

Source: Group of Like-Minded Megadiverse Countries 2002

A large variety of habitats, natural and human-influenced communities, and assemblages of species, are situated within each biome. There are innumerable coastal, estuarine, maritime, riparian, and freshwater habitats and more than 300 ecological communities and assemblages. Terrestrial habitats include deserts, chaparral, grasslands, deciduous, and pine forests. The U.S. Department of Agriculture (USDA) found more than 30 habitat types in the pine forests alone. The life found along the Rio Grande/Río Bravo is so rich and abundant that it is often called the “River of Life.” The Cocopah Indian tribe, who live along the Colorado River and who call themselves “people of the river,” survived for millennia on the abundance of life in the lower delta. The Maderan Sky Island Archipelago is just one example of the different and diverse biological forms found in the region.

History of Conservation

The United States and Mexico have a relatively parallel history when it comes to their practices of designating areas for conservation and establishing parks as protected areas. In particular, activities over the past two decades have created institutions and conservation programs in Mexico that facilitate crossborder conservation partnerships with the United States. The following brief chronology (Table 2) outlines the designation of parks and preserves that can be linked and that demonstrate a significant degree of concordance. However,

the historical progress towards conservation and neighborliness may not continue without federal government facilitation, state government involvement, and local government action. A coordinated campaign for continued cooperation among them may also be needed.

Jurisdiction and Parallels

Several agencies have jurisdiction over the border and have constructed mandated infrastructure. For example, the Army Corps of Engineers and the Coast Guard have treated the Rio Grande as a navigable river and have constructed bridges and levees appropriately. The International Boundary and Water Commission (IBWC) has constructed dams, levees, and channels to “control” and maintain the border; has placed buoys, monuments, road bumps, and fences to designate the border; and has retained certain rights to clear and manipulate natural areas. While these all add obvious value to their mission, they can have negative impacts on habitat, migration, and ranges. At least one ocelot population and one jaguarundi population, in addition to other species, will have habitats destroyed in the Customs and Border Patrol Rio Grande Operations Plan (FWS 2003).

Although activities and construction bisect the border’s ecosystem, several similar sites of conservation rules exist on both sides of the border. Among the complex laws, regulations, and policies are a number of legal concordances, outlined in Table 3.

THEORY AND PRACTICE OF CONSERVATION

There are two dimensions to transboundary ecosystem management. On the one hand, there is the gap between conservation needs and the practices of transboundary ecosystem governance. On the other, there is a gap between the theory of conservation and ecosystem governance and the actual activities implemented. However, despite the obstacles inherent in blending of theory and reality, theoretical principles still provide a framework for action. Moreover, the study of the gap between ideals and realities can provide opportunities and suggest institutions that can resolve current problems.

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Table 2. Chronology of Designation of Parks

Year	Event
1917	Mexican Constitution promulgated and Article 89 guaranteed environmental quality for Mexican citizens
1932	Joint U.S.-Canadian Waterton-Glacier Park established
1938	Mexican President Lazaro Cárdenas created Forest Protected Areas
1944	U.S. President Theodore Roosevelt designated Big Bend National Park and called for a binational park
1963	Isla Tiberón set aside as Conservation Park
1965	U.S. Secretary of the Interior Stewart Udall designated Sonoran Desert International Park (El Gran Desierto)
1973	Submarine habitat protected off Los Cabos, Baja California Sur
1984	Bioreserve Vizcaino established in Mexico
1992	National Commission for Knowledge and Use of Biodiversity (in Spanish CONABIO) and Mexican Fund for Nature Conservation established
1993	United Nations Educational, Scientific and Cultural Organization (UNESCO) designated the Vizcaino Bioreserve a World Heritage site
1995	System of Protected Natural Areas was established in Mexico
1997	U.S. Department of Interior and SEMARNAT signed Sonoran Desert Binational Agreement Letter of Intent
2000	National Commission of Natural Protected Areas (in Spanish CONANP) established
2001	U.S. President Bill Clinton signed Sonoran Desert National Monument

Source: Authors

Table 3. Legal Parallels

United States	Mexico
National Environmental Protection Act (NEPA) created the U.S. Environmental Protection Agency (EPA)	Constitution Article 89
Wilderness Act	Ley General de Ecología y Protección de Ambiente (LGEEPA) created the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT)
Endangered Species Act of 1973 lists endangered (E) and threatened (T) species	General Wildlife Law of 2000 coordinated among jurisdictions the conservation and sustainable harvest of wildlife and their habitats
Habitat conservation planning (HCP) allows taking of listed species after setting aside conservation areas	NOM-059-ECOL-2001 lists threatened (A), endangered (P), and special protection (Pr) species
Take Permits allow limited killings and habitat loss for development	Ordenamiento Ecológico balanced ecological protection and economic production
Critical Habitat Designation sets aside designated areas for recovery	Unidades de Manejo Ambiental (UMAs) are Units of Conservation, Management, and Progress of Sustainable Wildlife
Recovery Plans designate actions necessary to rehabilitate a species	Programa de Regulación de Especies Prioritarias (PREP)
National Wildlife Refuges, Waterfowl Production Areas, Wetland Management Districts, Wildlife Management Areas, Game Preserves, Wildlife Ranges, State Coordination Areas with various designations, Coordination Areas with various designations	Natural Protected Areas of the Comisión Nacional de Áreas Naturales Protegidas (CONANP)

Source: Authors

Principles and Practice of Conservation Governance

Because biodiversity is a renewable resource, natural resources can be harvested in the U.S.-Mexican border region. If a natural resource lies on binational land, coordinated harvesting efforts produce larger sustainable yields than uncoordinated, unilateral efforts do. Thus, conservationists must determine how to get both sides of any international border to act binationally.

In principle, international government institutions would lead both the United States and Mexico to consider the transboundary environmental impacts that they both effect on each other. In practice, federal governments usually unilaterally deal with their resources. The water shortage in the Colorado River delta, which lies on the Mexican side of the border, illustrates an example of the United States unilaterally managing its water resource. Another example of unilateral development planning is Mexico's permitting of power plants (that contribute to pollution) on the northern Mexican border. Local and international concerns over economic resources tend to eclipse international concerns over natural resources.

In principle, transboundary environmental impact assessments (TEIAs) and bilateral cooperation in transboundary ecosystem management are needed to ensure that natural resources are properly renewed and that human residents can live in perpetuity. The conflicts in jurisdiction that are mentioned earlier in this chapter are some of the reasons why these binational practices are rarely instituted. Esty and Ivanova (2003) expound upon this point:

Fragmentation, gaps in issue coverage, and even contradictions among different treaties, organizations, and agencies with environmental responsibilities has undermined effective, results-oriented action. As pointed out by Charnovitz 'like a city that does not have a zoning ordinance, our environmental governance spreads out in unplanned, incongruent, and ineffective ways.' A pervasive lack of data, information and very limited policy transparency adds to the challenge.

Transboundary Ecosystem Management

Water in the U.S.-Mexican border region represents one resource where fragmented jurisdictions and unequal access to information especially hinders effective, binational management. On the U.S. side of the border, multiple agencies each have partial jurisdiction over water governance and the division of responsibilities varies significantly among the border states. In Mexico, mostly state and federal entities handle water governance, although in some parts of the border, municipalities manage water treatment. Further, as the process of decentralization progresses in Mexico, jurisdiction and ownership of information will fluctuate.

In practice, governance is comprised of many activities:

- Data collection
- Monitoring and compliance
- Science networking
- Bargaining and trade-off evaluation
- Rule making
- Civil society participation
- Financing mechanisms
- Technology transfer
- Implementation strategies

In its Border Institute policy conferences, the Southwest Consortium for Environmental Research and Policy (SCERP) has repeatedly found that international trade governance issues often arise when local groups attempt to gain control over their environment's destiny. For example, some maintain that the three lawsuits that followed the construction and operation of energy maquiladoras in Mexicali could have been averted if more local comment during the proposal and permitting processes had been allowed. Trade in general and trade of biomass specifically fall under international, binational, and federal trade treaties and agreements that often ignore or trump local issues.

Framework and Institution for Conservation Governance

The Mexican constitution already guarantees environmental quality for Mexicans and some have suggested that “the time is ripe for bold action to head off the worst of what may lie ahead, beginning with a constitutional amendment” in the United States that deals with environmental quality, ecosystem integrity, and environmental health, according to Orr (2004). Prior to the creation and adoption of a federal amendment, a framework and institution for border biodiversity and ecosystem services governance can be put in place, which would enable a binational board to oversee and guide preservation and protection actions across an invisible border.

Fires and the hydrological cycle are two natural processes that would benefit from frameworks and institutions for governance. Management or maintenance of fire regimes (periodic, “cool” wildfires) and conservation of hydrological levels and flows almost do not exist in the U.S.-Mexican border region, primarily because of complex ownership and regulatory regimes. For example, most eastern U.S. land is privately held, while western open space in the U.S. is usually federally owned. That ownership pattern creates a patchwork of land that is owned by nearly all the land-holding and controlling departments and agencies in the U.S. federal government, including DOI, the Bureau of Land Management (BLM), Bureau of Indian Affairs, National Park Service, Department of Defense bombing ranges, and the USDA Forest Service. In other words, open space in the U.S. is a patchwork of public land that is peppered with small lots of private land. Mexican land tenure, on the other hand, is determined largely by use patterns that arise from communal ejido farms, large private grazing haciendas and ganadería ranches, and smaller subsistence farms called milpas, which usually support an individual family. Habitat conservation plans, agricultural conservation and conversion programs, and mitigation banks are, so far, rare.

Potential water management strategies in the U.S.-Mexican border region provide other opportunities for creating a transboundary framework. The region’s arid ecosystems are somewhat tolerant of deep and protracted drought, but the current model of water transfers, which moves water from natural areas to towns and farms with-

Transboundary Ecosystem Management

out portioning a share for nature, currently threatens sustainability. Development of a framework or creation of an appropriate institution will ensure that water needs are met for humans and ecosystems in the region.

A 2002 report of the U.S. Government Accountability Office (GAO) suggests a sample framework for conservation governance. This report discusses transboundary conservation challenges and expresses concern that each country's agencies "did not review or consider a number of available articles, papers and other literature" that explained conservation concerns for the region on the other side of the border. While this negligence was expected, it also leads to incomplete information, upon which management plans and implementation activities can be based. GAO suggests coordination and collaboration on a number of activities, including: joint recovery plans, species technical committees, habitat mapping, aerial monitoring, nest counts and other surveys, radio telemetry and other range assessments, permitting and law enforcement, as well as dead specimen exams and other mortality calculations. The joint (meaning binational, but usually transborder) recovery and protection activities that GAO advocates include: eliminating extraction and other incompatible land uses, limiting public access, restricting commercial enterprises, restoring habitat, augmenting populations, prohibiting fishing and hunting, managing predators, and implementing outreach and educational programs. Finally, GAO lists "land exchanges to protect species habitat" as one of the best options. These types of activities comprise a potential framework for transboundary ecosystem conservation.

Another framework can be found through the United Nations Educational, Science and Cultural Organization (UNESCO) Man and the Biosphere Program, which has "Recommendations for Establishing and Functioning of Transboundary Reserves," which is also known as the Seville Strategy (Sandwith, et al. 2001). Nothing precludes a framework and/or institution dedicated to biodiversity or conservation. Indeed, some long-time border specialists think green issues are sufficiently isolated from other larger and more contentious concerns and they believe that a potential binational agreement on biodiversity warrants serious investigation. Alternative mechanisms include treaties, executed agreements, state compacts,

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or state-retained rights under the 10th Amendment. Indeed, sister city municipalities have developed cooperative agreements on many issues. Various asymmetric (city to state, for example) and funding agreements also exist (McNeece 2002).

Effective resource management may be modeled after:

- Mexican Consejos de Cuencas (Watershed Councils)
- U.S.-Canadian International Transboundary Watershed Boards
- U.S. watershed councils
- The Pan-American Convention for Natural Protection and Wildlife Preservation in the Western Hemisphere
- The Neo-tropical Migratory Bird Conservation Act and its North American Bird Conservation Initiative
- The Trilateral Committee for Wildlife and Ecosystem Conservation Management, which can be used as a mechanism that implements the North American Wetlands Conservation Act and the North American Waterfowl Management Plan
- The International Union for the Conservation of Nature (IUCN)
- The Global Environment Fund (GEF), which gave Mexico an endowment of \$50 million for conservation efforts
- The U.S. Good Neighbor Environmental Board (GNEB) and its Mexican equivalent, the Consejo de Desarrollo Sustentable

All provide good models for moving the visibility of biodiversity and ecosystem issues up to the national agendas while they are being institutionalized (i.e. if these models are used, they could provide more funding for biodiversity and ecosystem issues, they could help acquire more dedicated land, and they could make job descriptions permanent, etc.)

A World Conservation Union-sponsored World Commission on Protected Areas report (Sandwith, et al. 2001) suggests the following steps to develop a framework and institution for conservation governance:

- Identify and promote common values and visions
- Involve and benefit local people
- Obtain and maintain support of decision-makers
- Promote coordinated and cooperative activities
- Provide for contingency planning

Transboundary Ecosystem Management

- Achieve coordinated planning of protected areas
- Develop cooperative agreements
- Work toward funding sustainability
- Monitor and assess progress

The overall effort to control erosion and protect habitat in the binational Los Laureles Canyon in the Tijuana Estuary provides an excellent example of effective co-mingling of funds, as well as effective crossborder and cross-sector exchanges of funds. California Coastal Conservancy funds were passed through the International Community Foundation and its sister philanthropy, Fundación Internacional Comunidad, and into the treasuries of the independent planning organization in Tijuana, IMPLAN and the local Municipal Urbanization Unity, or IMO. The Mexican federal governments' Instituto Mexicano de Tecnología del Agua (IMTA) and Comisión Nacional del Agua (CNA) matched the funds, and the U.S. Fish and Wildlife Service (FWS) provided permitting and technical assistance. The project not only provides habitat restoration, but also quality passive recreational value to the residents of Tijuana (CTP 2004).

To date, myriad agreements have already initiated some steps toward developing F&I for the United States and Mexico. For example:

Secretary Norton and her Mexican counter-part Alberto Cárdenas-Jimenez, SEMARNAT, signed an agreement on Nov. 12, 2003 to extend cooperation for the next ten years... the agreement continues the designation of a zone of mutual assistance up to 10 miles on each side of the border... this pact was just one of the topics of discussion of the Natural Resources Working Group (set up under the La Paz Agreement). The two nations co-manage a successful training and small grants program called Wildlife Without Borders. As a result of the signing, National Park Service [NPS] and Comisión Nacional de Áreas Naturales Protegidas [National Commission on Natural and Protected Areas, in Spanish CONANP] have engaged in several training courses. Secretaries Norton and Cárdenas asked NPS and CONANP to finalize a proposal for a new sister park designation for 2004 (DOI 2004).

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The Wildlife Without Borders program “has supported the training of over 6,000 individuals in natural resource management and biodiversity conservation, benefiting 40 priority ecosystems in Mexico,” according to Raffaele (2004). One of the most formidable challenges to implementing a joint framework and institution is the United States’ and Mexico’s increasingly polarized views about security at the borders. This political tension damages biodiversity and conservation efforts. In a recent and near precedent, the U.S. Congress allowed an exemption to the ESA for the silvery minnow; specifically, even though the diversion of waters would harm the endangered silvery minnow, the U.S. Congress allowed agricultural and urban users upstream access to the minnows’ traditional shares of the Rio Grande. Both the Department of Defense and DHS have used security arguments to try to obtain exceptions to both ESA and NEPA. In some cases, these arguments have been successful.

Several environmental organizations are suing DHS because it has strengthened border infrastructure and increased activities. However, border security and ecosystem conservation need not compete with each other. Security measures can be accomplished remotely or with sensors and mitigation can be mandated for lost habitat. The Bureau of Customs and Border Patrol (CBP), which is housed within DHS, has proposed a project to build roads and fences that “would permanently alter 3.5 miles of sensitive habitat including over 10 acres of wetlands and coastline. This habitat is critical to the survival of the local ecosystem, which does not recognize borders. The border region is actually the northern range of habitat for many Baja California flora and fauna. The area supports 53 rare or endangered species,” according to California State Senator Moreno Ducheny (2004). CBP is also proposing a project that will revegetate 85 miles of unpaved roads—or 145 acres—that will no longer need to be patrolled (Rodgers 2004c). CBP has proposed this because the lost habitat and the proposed recovered habitat are within a planned habitat conservation plan – the San Diego County Multiple Species Conservation Plan. The California Coastal Commission has criticized CBP and the San Diego Regional Water Control Board has cited CBP (Rodgers 2004c) for not adequately addressing habitat quality and sensitivity or developing a comprehensive mitigation plan. As a response, CBP is attempting to use

other methods to conserve ecosystems. For example, horse patrols are not only tried and true, but less damaging, as well. One border patrolman called them “one of the most effective and ecologically sound means” of patrolling the border (Rico 2004). Mexicans have security concerns as well, but these concerns manifest themselves in different ways.

CURRENT STATUS OF BIODIVERSITY IN THE BORDER REGION

While threats to biodiversity in the border region abound and while vulnerabilities are acute in certain hotspots, large areas are being adequately preserved but the habitats, species, and processes in these areas are not necessarily being actively protected by conservation activities.

Threats

Population pressure, abject poverty, and pollution all affect the U.S.-Mexican border region in different ways, and all three ailments threaten the region’s biodiversity. The region’s ecological richness is vulnerable to these pressures, and therefore, less stable, resistant, and resilient to change and decline. As the director of Mexico’s Instituto Nacional de Ecología, Exequiel Ezcurra (1998), has said, “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 region[al] economies. 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.” In other words, economic development frequently overwhelms the capacity for conservation. Some of the greatest threats to conservation include sprawl, farming, invasive species, water use, overfishing/overharvesting, and energy production and use.

Sprawl

Complete habitat loss and fragmentation threatens biodiversity worldwide, but especially in the rapidly growing border zone. The border towns on both sides of the international line are extending their footprint further into wild places and eating up undisturbed natural habitat. To a lesser extent, wild lands are being converted to agriculture. According to Ojeda Revah (2000), “urban development has been the main cause of habitat loss ... The most alarming process of fragmentation involves coastal sage scrub (CSS), a natural community with a great number of endemic species in peril. CSS declined from 37% of the (Tijuana River Basin) area in 1938 to 29% in 1994. Fragmentation has increased the number of patches of CSS from 10 to 46 and the largest area, which once covered more than a thousand square kilometers, has been reduced approximately by half.” Industrial development includes but is not limited to, energy, mining, farming, transportation, and maquiladoras.

Urban sprawl often spreads into wild and remote lands when people begin to use these lands for recreation. For example, off-road vehicle (ORV) use threatens several plants, including the protected Pierson’s milk-vetch (AP 2004). The Escalera Náutica project envisions a series of marinas that will spring up along the coast of the Baja California peninsula. The consumption and disposal patterns of the visitors will alter the pristine land.

Farming

“Farming is the leading source of pollution in Mexico... Agriculture is by a wide margin the greatest consumer user of freshwater... and the leading cause of changes in land use... Mexico also has one of the highest deforestation rates,” according to Vaughan (2004). Scientists do not know what implications transgenic maize and other genetically modified organisms (GMOs) will have on agriculture and biodiversity in general (Wolfenbarger and González-Espinosa 2004). But many stakeholders believe these implications are great. For example, while there are strict legal guards against the use of GMOs in Mexico, their maize has been infected by GMOs anyway (Ezcurra 2002). Mexico instituted these legal protections

because Mexico is sensitive about its native natural heritage, especially maize's natural heritage. Additionally, Mexico has accused the U.S. of instituting safeguards that are inadequate, especially since GMOs are prolific within the U.S. (Mason 2004).

Invasive Species

Invasive species are one unintended consequence of trade. Intra-continent trade may introduce a species that is native to one NAFTA country into the environment of another NAFTA country where the species is not native and this introduced species could eventually become invasive (CEC 2003b). Invasive exotic species, including agricultural and aquatic plants and animals, threaten indigenous species and systems, as well as human systems, such as irrigation and water conveyance.

The most problematic exotic species in the border region include bullfrogs, exotic grasses, and a variety of non-native fish. Each invasive species has greatly impacted a number of native species. Bullfrogs eat just about anything they can fit into their mouths. The Sonora tiger salamander, Chiricahua leopard frog, and Mexican garter snake have all suffered numerous losses because of the bullfrog's insatiable appetite. Even small mammals, such as shrews, mice, and several species of bat, have fallen prey to bullfrogs. Lovegrasses overgrow the natural habitat of bird species and out-compete native plants. Exotic species are increasingly colonizing sky islands. For example, more than 60 non-native plants having established regenerative populations in the Arizona sky islands (Warshall No Date). The introduction of non-native fish species, such as largemouth bass and green sunfish, which were introduced for sport, has resulted in hybridization of, predation of, and competition with native fish, such as the Sonora chub, Gila chub, and Yaqui catfish.

Water Use

The most at risk habitats throughout the U.S. and Mexico —wetlands, riparian, and freshwater bodies—are even more at risk in the arid border region because water is increasingly being diverted from the wilds for agricultural and city use. These agricultural and city

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uses produce salination, sedimentation, siltation, and subsidence effects. Water and hydrological processes are critical not only to native species and established habitats but are necessary to prevent and inhibit the success of invading species. Riparian habitats that have had water diverted away from them lose native species and then become overwhelmingly populated by nuisance species (Stromberg, et al. 2004).

Overfishing, Overhunting, and Harvesting

The Gulf of California, which is considered a marine biodiversity “hotspot,” is subject to intense fishing activities (Sala, et al. 2004). Animal poaching; illegal international trade of listed species and their parts; and thievery of cactus, succulents, and palms from wild places all threaten individual species and systems.

Energy Development

Proposed power lines through the Coronado National Wildlife Refuge threaten the southwest jaguar’s transboundary habitat. (Bergman 2004). Major habitat impact projects have included Petróleos Mexicanos (Pemex) pipelines, the Bajanorte Gas duct, and the Comisión Federal de Electricidad’s (Federal Energy Commission, in Spanish CFE) energy tower installation (Conservation Biology Institute, et al. 2004). Other threats that Pronatura has cited include tree logging, brick oven operation, sand mining, and sewage runoff.

A meta-survey of the threats to listed species found that threats are more or less equally spread across the 10 border states. The only significant differences in the intensity of these threats depended on how close a species lived to an urban area (Table 4).

Table 4. Threat Assessment

Threat Weight	Threat	California-Baja	Arizona-Sonora	East Arizona, New Mexico, West Texas-Chihuahua	Texas-Coahuila, Nuevo León, Tamaulipas
1	Development	55%	30%	38%	50%
2	Invasive species	42%	44%	30%	31%
3	Overgrazing	21%	54%	33%	35%
4	Agriculture	24%	22%	29%	46%
5	Water issues	32%	44%	33%	12%
6	Pollution	26%	29%	33%	19%
7	Overtake	15%	29%	20%	30%
8	Fragmentation	13%	15%	13%	23%
9	Fire	21%	15%	8%	11%
10	ORV use	31%	13%	4%	4%

Notes: Percentage of species negatively affected by stated threat. Each species may have several vulnerabilities.

Source: Authors

Because of the mix and magnitude of the above threats in the U.S.-Mexican border region, the overall threat to biodiversity, ecological integrity, and ecosystem vitality is higher in the border region than in the interiors of both countries. Sometimes, depending on the location, the overall threat to biodiversity, ecological integrity, and ecosystem vitality is worse on one side of the international boundary than it is on the other. The above threats are fairly non-localized in the border region, which means that resources on both sides are vulnerable. The overall threat is present and increasing. Table 5 outlines the threats and stressors that are general and not specific to one life stage (such as nesting) or season.

Vulnerabilities

A review of the threats in Table 4 generally supports the assertion that the single greatest threat to biodiversity conservation is population-driven sprawl from urban residential, industrial, recreational, and to a lesser extent agricultural land uses. If this assertion is indeed true, then the greatest vulnerability is not so much species-, habitat-, or ecosystem-specific, but a generalized susceptibility of all supporting lands and waters. Surveys in 1967 identified almost all areas as having more than 75% natural vegetation intact while similar measures in the mid-1990s revealed that more than a quarter of the region had less than 25% of its vegetation still in place (Ojedo Revah 2000). Landscape-scale loss of species, habitats, and ecosystems means that the natural capital of ecosystem services is also lost.

Hotspots

While the word “hotspot” has many definitions, and while these definitions vary, these definitions all attempt to explain their own approaches to biodiversity conservation. Hotspot classifications are subjective and biased according to the objectives that the assessment team is attempting to meet. Biodiversity classifications are frequently made according to rarity, range, and richness of diversity. Habitat quality is also sometimes added to the equation. Resources are generally dedicated according to these criteria. Descriptions of three separate assessments follow.

The first classification is rarity or narrow distribution, which is often the focus of NGOs and individual-species advocates. The Nature Conservancy’s “Precious Heritage” project or Conservation International’s “Hot Spots” project have identified the following areas as “high-risk”:

- The coastal Californias, which is one of the highest priorities in all North America
- The Big Bend region, which is of significant importance
- The Sky Island Archipelago of Arizona and Sonora, which is of medium concern

Table 5. Threat Summary Matrix

Threat Type	Origin or Source	Severity (Cause and Effect)	Location	Imminence or Frequency	Overall Assessment
Altered hydrology	Global climate change, water transfers to cities	High, especially for groundwater	Close to hotspots and generally throughout	Present and increasing	Very significant
Water pollution	Point and nonpoint sources	High, especially pathogens	Distributed	Periodic but more regular	Significant
Other water quality-related issues	Human water development patterns	High, especially salination	General	Present and increasing	Very significant
Habitat deterioration	Grazing, deforestation energy, and mining	Medium	Eastern states, but also barrier islands and offshore	Present and abruptly increasing	Significant
Habitat destruction	Sprawl, roads, and ORV and pedestrian traffic	Medium	Localized	Present and increasing	Significant
Habitat fragmentation and edge effects	Ports of entry, industrial, and residential foot prints	High to medium	Near twin cities and squatters	Present and increasing	Very significant

Sources: Authors

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Table 5. continued

Threat Type	Origin or Source	Severity (Cause and Effect)	Location	Imminence or Frequency	Overall Assessment
Invasive exotic species including GMOs	Trade, including food	High, especially from imported crops	Extreme, especially in riparian habitats	Present, spreading, and still incoming	Significant
Pesticides and nutrient loading	Agricultural and residential fertilizer runoff	Medium	Localized near farms but generally ubiquitous	Present and increasing	Very significant
Over-harvesting, hunting, and fishing	Poaching, by-catch from trawling, and illegal hunting and fishing	Medium	Mostly in wild lands and waters	Present and increasing	Significant
Air quality	Vehicles, homes, and industry	Medium	Downwind of sources	Present and periodic inversion	Less significant
Intangible pollution (noise and light)	Human activity	Low	Diffused but spreading	Present	Less significant

Sources: Authors

Transboundary Ecosystem Management

- Riparian habitat along the Lower Rio Grande Valley; the interior ecosystems of the Californias; the dry forests on northern Nuevo León and Tamaulipas; the desert riparian habitats of the Santa Cruz, San Pedro, and Colorado Rivers; and the wetlands of the Lower Rio Grande Valley, which are of only mild interest

This focus on rarity or narrow distribution contrasts with other more systemic approaches to biodiversity hotspots conservation. The second classification scheme uses ecological richness as the barometer to classify hotspots. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO), for example, identifies priority regions more by richness—diversity of habitats with intact assemblages of plant and animal communities. These, in contrast to those outlined above, include:

- Spine of the Californias
- Colorado River and Delta
- Desierto del Altar
- Chihuahuan Desert
- Sierra del Carmen
- Middle reach of the lower Río Bravo

Overlap does exist between these two assessments, but as much non-concurrence does as well.

The authors of this chapter evaluated hotspots according to a third classification assessment, which was based on two criteria: (1) levels of academic interest in an area, which was determined by the amount of monitoring, pure and applied research, management planning, mapping, and surveys, among other activities that occurred in the area; and (2) amount of information available from the Internet on listed species—in other words, the authors determined hotspots by the amount of active preservation and protection that has been documented for an area. The purpose here is not necessarily to designate areas for protection, but instead to show geographically divergent examples of where biodiversity is a critical issue in the landscape in the border region. The authors also con-

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ducted two independent but non-scientific assessments that identified hotspots by their vulnerability to global climate change and water transfers. The areas highlighted are:

- Riparian areas and wetlands of the Tijuana River Watershed
- Colorado River and Delta system
- Upper Santa Cruz basin and Sky Island region
- Upper San Pedro basin
- Confluence of the Río Conchos and Rio Grande
- Laguna Madre and National Seashore off Tamaulipas and Texas

Finally, the Commission for Environmental Cooperation (CEC) has identified four Priority Conservation Regions that straddle the U.S.-Mexican border (Figure 1). They are the Bering to Baja Marine System, the Yukon through Yellowstone to the Sierra Madre Corridor, the Prairies and Chihuahuan Desert Corridor, and the Río Bravo and Laguna Madre Corridor.

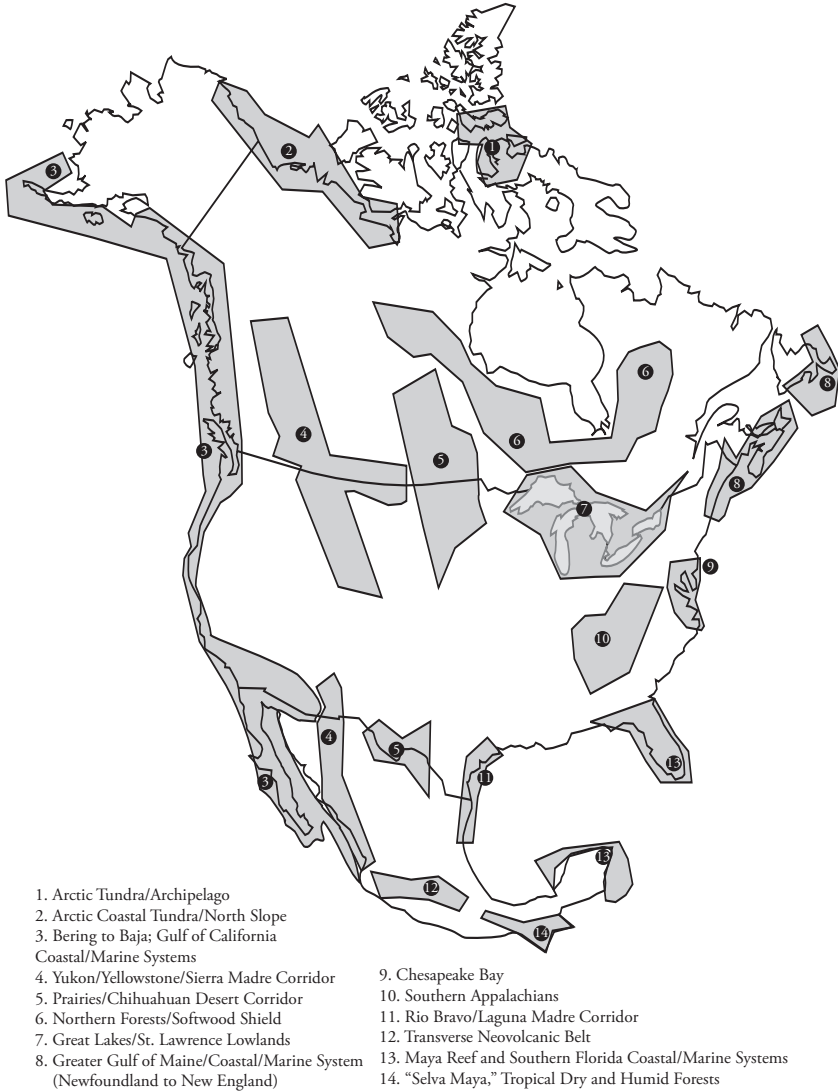
Again, the authors' assessment overlapped with other assessments, but indicated new areas as well. This demonstrates that that as long as these assessments are made in a non-scientific way or without agreed-upon criteria or priorities, the different lists of biodiversity hotspots will never completely align.

Natural Protected Areas

Christopher Brown of New Mexico State University used sources from both sides of the border to prepare a map that identifies many of the preserved and protected areas along the border. By chance, several conservation opportunities matched conservation needs.

However, biodiversity is not always the sole, or even sometimes the primary, criterion when species or areas to be conserved are selected. National conservation priorities are set by many factors and the selection of species to save is swayed by charismatic and emblematic appeal—not keystone or other ecological significance. Conservation has also been criticized because some believe that conservationists only “do the easy work” – the convenient or publicity-generating saves.

Figure 1. CEC Priority Conservation Regions of North America



Source: CEC

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As expected, various groups and institutions are involved in land ownership in various ways and these groups determine what amount or proportion of their land is set aside for preservation. An assessment of where listed species are found (Table 6) is one indicator of how concerned land owners are with conservation. A limited assessment of only the U.S. side of the U.S.-Mexican border region indicates that U.S. and state governments own a greater portion of land west of the Mississippi than the private sector does, while the private sector owns a greater portion of land east of the Mississippi than the federal and state governments do. Therefore, there is greater opportunity in the west for NGOs to acquire land to conserve. Chapter V comments on ownership patterns in Mexico.

Intersections and Gaps

Ideal conservation would optimize the intersection or overlay of biodiversity “hotspots” with protection and preservation from current and emerging threats. Depending upon one’s definition of what needs to be protected, there is relatively good correspondence among urgency and need, as well as protection and preservation. To borrow a phrase from The Nature Conservancy (TNC), saving the “last of the least and the best of the rest” is attempted, but one can wonder how much politics, availability of land, and other considerations sway protection and preservation.

POLICY OPTIONS

Some lessons can be found in stories of successful and failed conservation efforts, including transboundary conservation tools, incentives, “banking” opportunities, and ways to evaluate the costs and benefits of each option. Mexican President Porfirio Díaz lamented nearly a century ago, “Poor Mexico. So far from God and so close to the U.S.” Now the public must take advantage of Mexico’s long history and proximity to the United States to protect biodiversity in both the U.S. and Mexico. The following examples provide illustrations of issues and scenarios where binational collaboration is needed.

Water Distribution

IBWC-CILA recognized the role of water in ecosystem health and signed a minute in December 2000 “to consider a conceptual framework concerning the riparian and estuarine ecology of the Colorado River in its limitrophe and its associated delta” (IBWC-CILA 2000). Minute 306 recognized that each country has its own laws and authorities for preservation, but that cooperation between the two countries is necessary to preserve river ecology, Minute 306 also recognized that “equitable distribution” means that there will be enough water available to support ecosystems as well.

Fire Management

Binational coordination was perhaps most critically acknowledged when, just 10 days before the devastating San Diego wildfires in October 2003, the local binational fire council conducted a transboundary prescribed burn to reduce the amount of highly combustible litter, which reduced fire hazards along the border. The Otay Mesa fire was devastating to some rare species. Although it did not permanently destroy, it significantly altered 3% of the least

Table 6. Preserved Land Areas in the U.S.-Mexican Border Region

	California-Baja California	Arizona-Sonora	East Arizona, New Mexico, West Texas-Chihuahua	Texas-Coahuila, Nuevo León, Tamaulipas
Federal	66%	77%	90%	38%
State	15%	17%	0%	57%
County/Local	18%	6%	0%	5%
NGO/Private	25%	14%	10%	10%

Notes: Overlaps in percentages account for cooperative efforts between different actors. This chart is not representative of all preserved land in the border region. These areas only account for land where species listed in the foregoing meta-survey have been found.

Source: Authors

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Bells' vireo, 12% of the Southern California mountain yellow-legged frog, 16% of the coastal gnatcatcher, and 27% of the Quino checkerspot butterfly habitat (Center for Biological Diversity 2004). "Two of Southern California's rarest butterflies, the tiny Hermes cooper and Thorne's hairstreak, could become the first known species to be driven into extinction after the sweeping autumn wildfires," according to Wilson (2004).

Colorado River Delta Conservation

The Colorado River Delta is an extraordinarily rich and large desert delta. It is the second largest delta in the world, behind the Nile. But water diversions from the Colorado River have threatened the delta for more than a century. In fact, at the GNEB 2004 forecast meeting, Minister Teodoro Maus said that the Colorado River Delta is being "killed from neglect." Saving it is a "binational passion unmatched by funding," the BLM manager for the region also noted. A proposed settlement agreement among the U.S. states that have entitlements to water from the river mandated that waters necessary for the delta's very existence and health be diverted to California. The lining of the All-American Canal, the re-launch of the Yuma desalination plant, and perchlorate contamination—all imminent and substantial threats – make the delta's biodiversity and ecosystem vulnerable. Lining 23 miles of the All-American Canal "conserves" 67,700 acre-feet of water, which is diverted to San Diego's use. But, this prevents the seepage of that same water into the groundwater system that supplies wells that not only serve the agricultural activities in northeastern Mexicali, but also the desert ecosystem and riparian habitat of eastern Baja California. Concerns about the delta elevated biodiversity and green issues to such an extent that IBWC-CILA developed Minute 306 in 2000, which expresses concern over and calls for action that will address the delta's flood and flow water needs.

Policies such as the imminent lining of the All-American canal have devastatingly impacted the Colorado River Delta clam, which exists only at the head of the Gulf of California in the estuary of the Colorado River. The species was once so abundant that its pulverized shells make up a significant portion of the region's beach sand.

Today, the clam is virtually extinct. In fact, less than 30 individuals have been discovered since 1992. Their loss can primarily be attributed to excess diversion of Colorado River water. Despite the significant impacts U.S. activity has had on the Colorado River delta, in April 2003, a federal district court judge ruled that the United States is not responsible for the decline of the Colorado Delta ecosystem in Mexico. This act further destroys hope of obtaining more water flow for the delta to save the clam and dozens of other species that depend on this fragile ecosystem (Flessa, et al. 2001).

San Pedro River Valley

In 1988, BLM designated the first Riparian Conservation Area in the upper San Pedro River Valley as a corridor for 1 to 4 million songbirds. This area of preservation in the United States can be linked to a designation in Mexico. Since that time, TNC worked with mitigation funds owed by the Department of Defense to broker easements to retire agricultural water rights in the valley. Eventually TNC transferred these easements to BLM.

Rio Grande Silvery Minnow

The Rio Grande silvery minnow is affected by a number of threats, including habitat destruction, reduction and changes in water flow in the Rio Grande, competition with introduced species, and pollution from industrial, municipal, and agricultural sources. Currently, the minnow only inhabits a small reach (170 miles) of the river between Albuquerque and the Elephant Butte reservoir in New Mexico. It has been extirpated throughout the rest of its historic habitat, which included the Rio Grande in Texas and Mexico, as well as the Pecos River. Efforts to protect the minnow in this small stretch of the Rio Grande have ignited a firestorm of debates between conservationists and New Mexican state and local authorities. A great deal of time and energy has been put into saving the minnow through a series of back-and-forth court rulings, litigation, and protesting. However, no recovery plan has been completed and the only critical habitat designated for the species is situated in the highly disputed 170 mile stretch of the Rio Grande that lies solely

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inside New Mexican borders. Though organizations such as The Rio Grande Silvery Minnow Refugium (funded by state, federal, and city governments of New Mexico) have devoted themselves to restoring the minnow's populations, no plans have been made to re-introduce the minnow throughout its former range. There is suitable protected habitat available within the species' former range in Big Bend National Park in Texas. The only protected land the species is currently found on is the Sevilleta National Wildlife Refuge, which lies in the heart of New Mexico. Even if plans to repopulate the minnow's former habitat are eventually made, minnows bred in captivity may be restricted to breeding tanks unless water levels that are suitable to the species' survival can be maintained in the Rio Grande (Propst 1999).

Tarahumara Frogs

The Tarahumara Frog Reestablishment Oversight Group (TFROG) has proposed a binational effort to reintroduce the Tarahumara frog, or "Mexican" frog, into sites within the Coronado National Forest in Santa Cruz County, Ariz. This endeavor has stirred protest amongst cattle ranchers in the area. They believe the frog's reintroduction will lead to its listing under ESA and thus further restrict livestock grazing operations in the area. Believed to be extirpated from the United States in the mid-1980s because of disease and pollution, populations of this frog were thought to be relatively healthy in Mexico. However, recent evidence suggests that populations of the Tarahumara and other species of frogs have suffered sudden declines and local extirpations in Northern areas of Sonora and Chihuahua. Reintroduction efforts, such as the one proposed by TFROG, are essential to long-term recovery of vulnerable species.

Invasive Species

Although binational cooperation to eradicate invasive exotic species has been impressive, the results have been mixed and some invasive species continue to threaten the down-river country. For example, international integrated pest management (IPM) has been successful on the U.S. side in eradicating the Brazilian giant water fern,

Salvinia molesta, through an FWS-approved and experimentally introduced weevil. Another technique used a copper-based herbicide that was applied by mechanical means. Unfortunately, such methods may inadvertently transport the water fern southward through the irrigation infrastructure, and thereby populate Mexico with more invasive water ferns. Introduced on the U.S. side in 1999, the fern became a major and expensive problem to Mexico beginning in 2002; it had only invaded Mexico in 2001. On the other hand, binational efforts since 1985 to control the introduced *Hydrilla* with up to 26,000 introduced carp per year in the shared Rio Grande/Río Bravo has been a model of successful cooperation among IBWC-CILA, USDA, CNA, IMTA, FWS, and the water users in the Lower Rio Grande Valley.

Efforts fail when actions are unilateral. There is no transboundary collaboration in the efforts to eradicate a giant reed, *Arundo*, in the Tijuana River Watershed. *Arundo* spreads through roots and when water or other entities distribute its stem joints. Thus, *Arundo* can easily propagate downstream. The United States' \$560,000 effort to eradicate *Arundo* from 125 acres in the Tijuana estuary is hampered because there are no matching efforts in Mexico, where new "sprouts" originate. Therefore, transboundary source control is needed. On the other hand, the cooperation between the Mexican and California Conservation Corps has successfully eradicated stands of exotic species that span the border in the watershed (IBWC 2004).

Successes

Successful and attempted mechanisms of binational cooperation help identify themes and tools for conservation. For example, local efforts that are focused on a single species or, simply, habitats can grow geographically and their objectives can expand systemically so that these efforts eventually become more comprehensive and, eventually, regional successes. The efforts of the Natural Resources Workgroup (NRW) form one of the most successful binational stories of binational conservation. The NRW was created under the La Paz Agreement and it was implemented in the Integrated Border Environment Program and the subsequent Border XXI Program. The

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work group made progress on transboundary natural resource issues through its U.S. “section” – DOI’s Field Coordinating Committee (FCC) – and the Mexican “sections” – CONABIO and CONANP. Because the Natural Resources Workgroup no longer exists in the Border 2012 program, which is the successor to Border XXI, and because DOI is not participating in Border 2012, binational efforts have stalled.

In Mexico, the UMA program has helped successfully preserve and manage habitats. UMA is a Spanish acronym that translates into “Units of Conservation, Management, and Progress of Sustainable Wildlife” in English. Some 1,639 UMAs have been established in states along the northern Mexican border (NRWG 1999). UMAs span a total of nearly 3 million hectares, and even in the infancy of conservation in Mexico, the border received high attention. “Of the six natural protected areas of the border, two of them already had a Management Plan. Four of the [designated Natural Protected Areas (ANPs in Spanish)] are included in the Letter of Intent of SEMAR-NAT/DOI ... and one other is combined with the Coronado National Forest,” according to the Natural Resources Workgroup (1999). The history and success of CONANP, the commission charged with oversight of the ANPs, is detailed in Chapter II, “Adjacent U.S.-Mexican Border Natural Protected Areas: Protection, Management, and Cooperation,” by Joanna Salazar and Mark Spalding. Mexico’s development of CONABIO is another indicator of the country’s progress in the realm of conservation. One of three in the world, CONABIO’s sister organizations are in Australia and Costa Rica (Delgadillo 2004).

Mexico is also a leader in environmental accounting and estimates that environmental damage costs \$36 billion per year and that it increases the deficit by \$9 billion per year. Environmental accounting methods assess and integrate natural capital into the calculations of the general state of the economy. It can be used to gauge spending on environmental issues (water supply and quality, for example), quantify positive and negative impacts on the economy, and identify revenue streams available for dedication to environmental remediation, ecological restoration, and water or land reclamation. As an example, tourism can generate revenue in the form of user or entry fees, tolls and taxes, and/or pollution or other impact fees. This

income can be directly returned to the environment by purchasing land or water, managing habitat, enforcing rules, or monitoring conditions. The income can also be used to create environmental tourism jobs. Micro-development can take the form of mini-loans, business development consultation, administrative or production technical assistance, and marketing. "Tourism academia" is especially able to help new tourism businesses with interdisciplinary accounting, engineering, management, and quality challenges. More information about the benefits of tourism on the border environment is found in Chapter VII, "Tourism and Conservation in Border Regions," by Dallen Timothy.

In the United States, FWS has recognized the importance of binational efforts for species recovery and has planned revisions of several species recovery plans to officially include Mexico. Revised plans for the Sonoran pronghorn, Mexican gray wolf, and Yaqui catfish, to name a few, will stress cooperation with Mexico to achieve successful results.

In continental North America, CEC has facilitated a trilateral roundtable on invasive species that will investigate the transboundary introduction of exotic species and "achieve a comprehensive understanding of the role of trade as it relates to the ecological, economic and health impacts of invasive species in North America and to share success stories/best practices in their prevention, control and eradication," CEC wrote in 2003. CEC successfully spurred agencies to think outside their boundaries.

The conservation of the Salton Sea offers a localized example of bilateral conservation efforts with international implications. Throughout the Salton Sea's history, many conservationists have failed to successfully preserve and protect California's largest lake. However, times are changing and the Salton Sea is now being successfully restored. In the past, almost all of the long and expensive efforts and plans to save the inland sea were implemented without considering any of the impacts on Mexico. Now that some of the solutions involve Mexico, the conservation effort is attempting to increase the country's engagement. What is most encouraging is that the California Resource Agency mandated that the environmental review of all alternatives include any and all consequences to Mexico.

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Table 7 outlines the range of other recent protection issues and successful, but sometimes contentious, measures taken to resolve them. Some actions are court-mandated while others are voluntary actions of NGOs. Transboundary management is often no harder to institute than unilateral management is, and the newly added jurisdiction sometimes offers some asset, resource, tool, or funding that may be lacking within the adjoining jurisdiction.

Lessons Learned

Locally and worldwide, lessons learned from successful and failed transboundary conservation efforts inform the path to more effective conservation in the border region. Oscar Arizpe of Universidad Autónoma de Baja California Sur, a conservation biologist with extensive experience with conservation in Mexico, wisely states that conservation success depends upon at least five elements:

- Resource fragility
- Demographic pressure
- Land tenure patterns
- The relationship between local people and authority
- Ties to human quality of life

If these are determiners or drivers of success, and the border is indeed threatened, the lessons learned must be applied more aggressively and more regionally to the border region.

Many cooperative efforts between federal parks have focused a great deal of their energy on species reintroductions, primarily on the U.S. side, and not on habitat conservation efforts. Although habitat programs exist, they have often fallen victim to a lack of personnel and funding. The northern Aplomado falcon, for example, is being reintroduced to unprotected habitat. In other words, during the implementation phase of the species' recovery plan, there has been an emphasis on falcon reintroduction, while the falcon's habitat has been neglected (Forest Guardians 2002). A recent incident where five Sonoran pronghorn died while they were being transferred to their new habitat in the U.S. offers another lesson –

Table 7. Resolution of Unilateral and Transboundary Conservation Challenges

Nation	Element	Problem	Resolution
United States	Peninsular bighorn sheep	Inadequate habitat protection	Upon designation of critical habitat, Bureau of Land Management and Forest Service prohibit livestock grazing in designated areas
	Mexican spotted owl	Overgrazing	Federal ruling cancelled seven grazing permits in four national forests in Arizona and New Mexico
	Sonoran pronghorn	Lack of will and common land ethic among agencies	Force by court order
	Tijuana-Tecate green belt	Preservation and protection	TDR easement to BLM
Mexico	Sonoran pronghorn	Poaching	Education programs implemented to stress importance of pronghorn
	California least tern	Numbers rapidly decreasing in Baja	NGO-funded monitoring and protection programs

Source: Authors

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Table 7. continued

Nation	Element	Problem	Resolution
Tribal	Mexican wolf, Spotted owl, others	Species recovery	White Mountain Apache tribe agreement
	Bighorn sheep	Lack of protected habitat	Tribes working with Fish and Wildlife Service for critical habitat
San Pedro River system	San Pedro River system	Riparian habitat loss and reduced water flow	Upper San Pedro River Basin Binational Initiative—proposed protected area in Sonora
	Ocelot	U.S. and Mexican populations separated	TNC and Pronatura Noreste propose a 130-mile-long, cross-border corridor
Combined	Lesser long-nosed bat	Bats and roost sites destroyed	Program for Conservation of Migratory Bats of Mexico and the United States; education and conservation
	Golden-cheeked warbler	Lack of protected areas in Mexico and Latin America	Defensores de la Naturaleza Project

Source: Authors

instead of reintroducing a threatened species to a new habitat, their natural habitat should be preserved, especially when a species' population size has reached a critical level.

The current success, albeit limited, of the masked bobwhite quail can be attributed to a combination of suitable management of federally owned land in Arizona and cooperative efforts with ranch owners in Sonora. Previously extirpated from the United States, the quail was reintroduced into the Buenos Aires National Wildlife Refuge, where their numbers have steadily increased over the last decade. In the 1970s, a reintroduction attempt in this area proved unsuccessful when the reintroduced population was eliminated because of uncontrolled grazing – the same factor that was believed to have caused their extirpation in the first place. When the Buenos Aires region was designated as a wildlife refuge, grazing and hunting were prohibited. These restrictions, combined with cooperative efforts to relocate Mexican quails into the refuge, have contributed to the quail's current upward population trend. Additionally, the only confirmed populations of the quail in Sonora exist on two privately owned ranches. Cooperation between these ranchers and FWS, including the establishment of short-duration grazing systems in the area, population surveys, and translocations, provide a glimmer of hope for the birds' future in Mexico (Hawks No Date). The quail's reintroduction is an excellent example of how species reintroduction combined with adequate habitat protection and binational conservation efforts can lead to successful reintroduction.

Though well-intentioned, some binational agreements fail to meet their full potential. For example, the primary focus of the Sister Park agreements among Coronado National Forest in Arizona and New Mexico, Cleveland National Forest in California, and the Comisión Nacional Forestal (Mexican National Commission of Forestry, in Spanish CONAFOR) in Baja and Sonora has been fire control and suppression. Measures have been taken to reforest many areas on the Mexican side, but little has been specifically done for habitat or ecosystem protection for threatened species in these regions. However, this by no means diminishes the importance and necessity of transboundary fire suppression activities.

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Active protection is sometimes difficult to implement. Federal areas deemed critical to the survival of a species are often made off-limits to the public. However, enforcing this policy is often difficult, time-consuming, and tedious for park employees. Also, this tends to occur only after wildlife organizations, such as the Southwest Center for Biological Diversity, threaten or file lawsuits. Recreational ORV use has seriously threatened the Pierson's milk-vetch, which is found only on BLM land in the Imperial Sand Dunes of Southern California (Center for Biological Diversity 2003). After a federal ruling, FWS designated more than 50,000 acres as critical habitat for the species, against the protest of several ORV interests. Despite this ruling, ORV enthusiasts continue to use portions of these designated areas. A recent interview with several of them revealed that most knew of off-limits areas, but were unsure of why they were off-limits or exactly where the areas were located (Cunningham 2004). This is not entirely surprising. The markers used to distinguish these areas are often small and obscured by sand or ambiguity. This situation illustrates the need for public education in threatened areas and the difficulties that those responsible for protecting them face.

Environmental education efforts can be focused towards identifying the connections among environmental quality, ecological integrity, and human quality of life. Environmental education efforts can also help citizens become more concerned about those issues, which will eventually motivate them to enforce the rules. For example, in an effort to prevent poaching of Kemp's ridley sea turtle eggs on the shores of Rancho Nuevo in Tamaulipas, several U.S. and Mexican universities have worked together over the years to improve the economic condition of communities near their nesting grounds. The effort has been successful to date and has even encouraged pro-turtle advocacy amongst local communities that have learned to benefit economically from the practice of "turtle tourism" (Arroyo, et al. 2003).

Another emerging, strong influence (especially in Mexico) is the role that NGOs play in determining national environmental policy and in actually conducting some of the important conservation actions. The Center for Biological Diversity, for example, has been instrumental in gaining ESA protection for approximately 30 trans-

border species, including the Texas ayenia, Pierson's milk-vetch, San Diego fairy shrimp, cactus ferruginous pygmy owl, jaguar, southwestern willow flycatcher, and Rio Grande silvery minnow. Also, the Nature Conservancy, Environmental Defense, and Pronatura have taken the lead in creating a 130-mile crossborder travel corridor for ocelots and jaguarundis in the Tamaulipan brushland region of Texas and Tamaulipas.

But each of these techniques or strategies must be instituted multilaterally. Only the concerted effort of all initiatives, at all levels—species, habitat, and system—can perpetuate successes on the ground. The following specific tools can also help.

Conservation Tools

Conservation tools that can be used in the binational or border context consist of core, corridor, buffer, and smart growth planning on each side, as well as some transboundary integration. Only examples of how conservation tools can be applied in a transjurisdictional context can be provided in this chapter.

Species and animal exchanges can perpetuate a species' presence in the wild. For example, California condors raised in captivity have been released in the wilds of Baja California and “in a move to bolster the U.S. population of one of the most endangered mammals in the world, four Sonoran pronghorn does and one buck will be captured in Mexico and transported by helicopter to a captive breeding program in the Cabeza Prieta [National Wildlife Refuge] just across the border. A spring 2003 survey found only 21 pronghorn left on the U.S. side of the border. The Mexican population is somewhat larger and itself endangered but is crucial to helping preserve the species,” GreenLines reported (Endangered Species Coalition 2004). “Without intervention, Sonoran pronghorn would most assuredly become extirpated in Arizona. The effort to sustain this magnificent and unique creature has been a model of cooperation,” according to FWS (2004). There is a collaborative recovery team that engages in Pronghorn research. This team includes scientists from both sides of the border including FWS, the Arizona Game and Fish Department, Organ Pipe National Monument, BLM, the U.S. Air Force, the Marine Corps, the Arizona Air National Guard, El Pinacate y Gran

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Desierto de Altar Biosphere Reserve, and Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora. Staff members in these groups are trying to learn more about the individual species' use of habitat and behavioral ecology (Ikenson 2003).

A TEIA is another binational tool through which neighboring nations can conduct comprehensive assessments that attempt to identify environmental impacts so that efforts can be taken to monitor, minimize, and mitigate these impacts. For example, if a TEIA analysis had been conducted, a number of transboundary alternatives to the IBWC proposal to mow a 75-foot x 34-mile strip of land upstream of Brownsville to convey flood flows could have been implemented. For example, one alternative to the IBWC proposal is a strip that covers only 291 U.S. acres. The FWS has further modified this alternative proposal to reduce impacts to listed species.

Binational habitat conservation planning (HCP) is the comprehensive process of designating and saving large cores and corridors by transferring development rights and ownership away from those cores and allowing development on less sensitive lands. HCP has been practiced in the United States somewhat successfully and is now being implemented across the international boundary. This is the topic of Chapter VII, "Designing and Establishing Conservation Areas in the Baja California-Southern California Border Region," by Michael D. White, et al.

A binational "bank," where credits can be earned, stored, and/or used, can be applied in many settings. This tool has already been applied across jurisdictions and sectors in the U.S. for a decade or more. Air emissions permit trading programs that use permit trading programs on the U.S.-Canadian border as prototypes have recently been tried on the Texas-Chihuahua border. Carbon credits have been bought and sold on the Chicago Board of Trade, as well. In the U.S.-Mexican border region, even though few mechanisms exist, a number of potential buyers and sellers undoubtedly exist. Banks for habitat, water, grass, and mitigation credits offer huge opportunities for binational collaboration that will lead to a win-win scenario for both countries. International mitigation banks or other fee-based arrangements and funds, including land exchange, are available to offset impacts (GAO 2001). For example, the best management practice of rotating range animals to avoid overgrazing

a piece of land can be applied to a transboundary grazing stock, which will benefit both the U.S. and Mexico by relieving pressure on the limited acreage on either side.

Recommendations

Many conservation workers in the border region prefer doing the actual work of conservation over talking and planning. Another way to think about the conservation challenge is to figure out how to move from cooperation and collaboration to actual co-mingling of funds and joint conservation efforts. The following list of recommendations is driven by those concerns and depends largely upon incentives to give poor farmers and communities the opportunity to conserve. Incentives and grants for conservation include transboundary conservation grants (mostly from FWS) for habitat purchase or protection, ranger and warden training, private property ownership for land stewardship, state wildlife agencies, and tribes. While they are small now and used mostly for planning and coordination, these grants are expected to grow significantly to fund actual conservation.

1. Modernize the practice of transboundary conservation. The Internet offers opportunities to link, multiply, and perpetuate protection and preservation efforts (Levitt 2003). The map and underlying electronic overlays provided at Border Institute VI were constructed inexpensively and largely with assets and data found on the Internet. EPA, U.S. Geological Survey, National Oceanic and Atmospheric Administration, and others cooperate on landscape-scale watershed and ecosystem mapping challenges. Government and academia provide opportunities for communities to browse, download, and review maps and datasets (Comer, et al. 2003; Kepner, et al. 2003). The coordination of the overall efforts of each nation can be optimized by taking advantage of geographic information systems (GIS), remote telemetry, and other contemporary scientific applications.
2. Find a binational emblematic species. Although purely for publicity reasons, the designation of an emblematic species for the border region can move other issues. The borrego cimarrón, or

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bighorn sheep (*Ovis canadensis mexicana*, *californiana*, or *nelsoni*), is one of the few species that exists in almost all states in both the U.S. and Mexico.

3. Plan jointly. One particularly commendable and innovative mechanism in Mexico, called Ordenamiento Ecológico, strives to determine and encourage the most environmentally and ecologically compatible land uses. It also uses discretionary “zoning” and non-discretionary protections to dissuade the least compatible land uses. This approach decreases the number of potential conflicts among all the players. Both the constitution and the Ley General de Ecología y Protección de Ambiente (LGEEPA) empower Mexico to develop holistic environmental policies for an entire area. Mexico does this by negotiating land and water uses, designating natural areas, and developing special protections. Various secretariats are actively involved in negotiations of land and water uses and they base their considerations on private productivity and the social uses of resources. The United States should consider and adopt the concept of such ecological planning so that the two nations’ efforts can be merged.
4. Conduct quick transboundary assessments throughout the border zone. Because the U.S.-Mexican border region’s biodiversity, ecological integrity, and natural resources are greatly threatened, perform a rapid biodiversity assessment protocol of the entire region as a baseline review, even if particular sections of the area are not pristine. Conduct all surveys in a binational way, as the San Diego Natural History Museum does, to benefit understanding on both sides. The survey can contrast different areas within the border region, compare the border region to interior spaces within each nation, and act as a baseline for subsequent surveys.
5. Establish a central binational clearinghouse for biodiversity and ecosystem data. The Border Governors, the USGS, and SCERP have proposed a border-wide GIS for water and energy as one possible clearinghouse. Without a clearinghouse, endangered species conservation efforts on each side have difficulty knowing the range and health of habitats and populations on the other side.

Transboundary Ecosystem Management

6. Think regionally and on a landscape-scale. Take the ecosystem, landscape-scale approach, as has been suggested for watersheds. Coastal sage scrub, maritime chaparral, and the border's version of vernal pools are unique in the world. They can only be protected by increasing efforts to address system threats, vulnerabilities, and needs.
7. Increase the number of species listed and protected in Mexico. Protection and preservation efforts should be keyed to habitats and ecosystems and not to individual elements. But, Mexico can, by adding species to its list, identify more areas of concern, designate more sensitive habitat, and align more acquisition. Designation and protection on one side of the border must be met by commensurate designation, understanding, and protection on the other side.
8. Redirect subsidies to nature. The implementation of macro-policies offers some solutions in the removal and redistribution of currently perverse subsidies. The USDA's proposed \$50 billion subsidy has funding for the rehabilitation and restoration of wetlands and for the renewal of the North American Wetlands Conservation Act. Certain provisions within the subsidy enable implementation in Mexico. Even if perverse subsidies cannot be removed, the mitigation of their effects, which spill across borders, can be made to benefit both sides.
9. Engage the binational private and philanthropic sectors. The Corporate Wetlands Restoration Partnership, in conjunction with the multiple-agency Coastal America Program, are conducting voluntary conservation activities (Connaughton 2004). More corporate citizenship needs to be instilled in the U.S.-owned maquiladora assembly plants. By investing in the communities, they are investing in their employees and ultimately in their own productivity. Economic health originates from ecosystem and community health.
10. Plant trees. Reforestation captures carbon, stabilizes soils, creates habitat, and provides jobs. The United States can offset its huge carbon debt by paying Mexico to plant and grow trees. Reforestation will provide more long-term benefits to nature and its inhabitants than any other effort will.

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11. Set up transboundary easements. One creative transfer of development rights in Tecate, B.C., occurred between the land title holder, Rancho La Puerta; the broker, Pronatura; and the development easement conservator, BLM. The success of this arrangement may encourage more conservation easements, reserves, and transfers, which will set aside land that might otherwise be developed, which would destroy its biodiversity.
12. Integrate. One of the recommendations of the DOI Field Coordinating Committee was the development of an integrated environmental education, research, GIS, and habitat restoration plan. Concerted efforts among government, NGOs, industry, and communities are necessary to comprehensively address threats.
13. Act locally. Pronatura advocates for municipal reserves and agricultural easements (Conservation Biology Institute, et al. 2004). Co-development of nature and the economy assures the vitality of both.
14. Swap debt for nature. Debt-for-nature swaps have already reached the height of their popularity, but they still offer some remedy to the degrading border environment. Two U.S. debt treatment statutes, the Enterprise for the Americas Initiative and the Tropical Forest Conservation Act, have received little attention but between them stand to generate more than \$237 million for natural resource conservation (Lampman 2003). Local, as well as state and national debt in Mexico, can be traded for nature reserves.

The post-September 11th security regime has focused on the border's permeability. This focus has aggravated conservation efforts within the U.S.-Mexican border region. However, individual, local efforts are continuing to make a difference, especially when their efforts merge. But their efforts are not enough. The intense demographic pressure and fast-moving changes within the border region are destroying habitat every minute – and once habitat is gone, the chance for a viable ecosystem diminishes. The first step towards bringing about adequate concern for ecosystem health and perpetuity is to increase the greater public's overall understanding of the value of conservation and biodiversity. By enacting some of the rec-

ommendations outlined in this chapter, residents and decision-makers in the border region can help ensure that future generations who live in the border will benefit from the services that nature provides and they will be able to enjoy the multitude of species that exist in the border region today.

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