THE U.S.-MEXICAN border environment:

Transboundary Ecosystem Management

Edited by
Kelly Hoffman

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Southwest Consortium for Environmental Research and Policy

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The Southwest Consortium for Environmental Research and Policy (SCERP) is a collaboration of U.S. and Mexican universities dedicated to addressing environmental issues of the U.S.-Mexican border region through applied research, outreach, and regional capacity building.

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The views of the authors contained herein are not necessarily the views of SCERP, the U.S. Environmental Protection Agency, or the Secretaría de Medio Ambiente y Recursos Naturales. They are presented in the interest of providing a wide range of policy recommendations to prompt discussion and action in the U.S.-Mexican border region.

Contents

Preface

Human beings artificially impose international boundaries onto the natural landscape. Sometimes, they build walls and fences to demark these political boundaries, which prevent plants, animals, water, and other natural resources from crossing these boundaries. Fences and walls unnaturally bisect natural resources, and thus affect these natural resources in special ways.

Biodiversity hot spots in the border region – which represents the intersection of a set of unique climates with widely ranging topographic, geologic, and soil extremes – include an extraordinarily high number of rare and endemic species. Rapid population grown and urbanization in this region have also caused disproportionately higher rates of listed species, legal protections, and even extinction.

Many border issues, including the protection of habitats and ecosystems, are low-priority issues to local, state, tribal, and federal authorities. However, these frontier and binational issues require collective concern and action. Border stakeholders should therefore discover ways to elicit the involvement of all levels of government. In the post-September 11 security regime, the obstacles to conserving species, habitats, and ecosystems that require large, set-aside tracts of land – and thus some degree of border permeability – are especially acute. The new security mandate seeks to bolster, harden, and increase patrol activity throughout the border regions. According to Southwest Strategy, the federal government owns much of the border and its nearby land. For example, the federal government owns 86% of the Arizona-Sonora border and 62% of its adjacent lands. Thus, the prerogatives of the Department of Homeland Security are increasingly at odds with conservation efforts and with the natural distributions and migrations. Additionally, the environmental effects of undocumented immigration continue to plague the region.

The Southwest Consortium for Environmental Research and Policy (SCERP), a collaboration of five Mexican and five U.S. universities, conducts environmental, ecological, and human health research to address the binational environmental issues in the entire 10 state U.S.-Mexican binational regions. SCERP applies its information, insights, and innovations to better the lives of the region's 14 million residents. SCERP acts as a "boundary organization," which Jorge Soberon defined in 2004 as an organization that is mandated and able to "translate and communicate between the world of the policy-makers and the world of science...Such institutions obtain, create, or contract for the required data, organize and analyze it to turn into information, check with experts as needed, and translate the information into knowledge that are relevant to the user."

SCERP and its co-sponsors – the Office of International Affairs at the U.S. Environmental Protection Agency (EPA), the International Affairs Unit of the Mexican Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT), the Border Trade Alliance, and the U.S.-Mexico Chamber of Commerce – dedicated their sixth annual policy conference, or Border Institute, to understanding and resolving the ecosystem management differences that exist between the two principal and the several tribal nations in the U.S.-Mexican border region.

This monograph's 10 chapters were presented at Border Institute VI as background information and discussion and preparatory points during three plenary sessions, a keynote address, and break-out sessions to develop policy recommendations on transboundary ecosystem management. The Executive Summary contains a summary of the proceedings, as well as the participants' policy recommendations for government agencies, non-governmental organizations (NGOs), and private property owners, which they can implement at the international, federal, state, tribal, and local levels. A list of Border Institute participants and their affiliations is also included herein.

The first chapter, by D. Rick Van Schoik, Elena Lelea, and John Cunningham, who are on the SCERP Directorate, orients border experts to biodiversity and conservation issues. It then asks the central question of whether the vulnerabilities of hotspots in the

U.S. and Mexico to threats are commensurate with the size of the land tracts that their governments, private entities, or NGOs set aside. The chapter also asks whether a new protective legal framework and/or institution is warranted. Consultant Joanna Salazar updated a paper she and Mark Spalding, of The Ocean Foundation, wrote five years ago that listed and examined natural protected areas and efforts on each side of the border. The chapter also discusses the correspondence between the urgency and size of conservation need and the corresponding protection efforts on that landscape, and it further identifies a number of local successes that could be linked together to create overarching and workable regional conservation strategies. Christopher Brown of New Mexico State University (NMSU) and his geographic information system (GIS) colleagues, NMSU's Robert Czerniak and Christopher Buscaglia of the assessor's office in Doña Ana County, N.M., show how GIS can portray and analyze these complex relationships. Their mapping efforts are available through the SCERP website at http://www.scerp.org.

Jaidev "Jay" Singh, a science and diplomacy fellow at the U.S. Agency for International Development, was the keynote speaker for the Border Institute. Singh discussed how lessons learned in different regions of the world can be applied to the U.S.-Mexican border region. His message about "sovereignty bargaining" showed how both the U.S. and Mexico can benefit from transboundary cooperation and collaboration and still retain strict sovereign powers.

In chapter five, Carlos Graizbord, an urban planner, and Emilio de la Fuente, an environmental engineer, address the contentious issues over land ownership/tenure and water rights/use and how these two issues overlap. The authors describe complex land ownership patterns and the vast differences in ownership patterns in the U.S. and Mexico and within the different regions of each country. Graizbord and de la Fuente also discuss how history shaped these land ownership patterns. In the following chapter, Mary Kelly, of Environmental Defense, and Héctor M. Arias Rojo, of WWF Mexico, demonstrate the intimate relationship between water availability and quality and how this relationship affects habitat viability and restoration. They also present an overall prognosis of the arid region's ecosystem health. The concept of nature's need for

water linked many of the themes that were present at the Border Institute and this concept is one of the overarching themes of this monograph.

The final chapters consider actual conservation designs and tools within a binational context. Michael White of the Conservation Biology Institute and his diverse binational team of conservation biologists have been identifying ideal conservation cores, corridors, and buffers throughout the southern California and northern Baja California region for the last several years. In the chapter co-authored by Jerre Ann Stallcup, Katherine Comer, Miguel Ángel Vargas Téllez, José María Beltrán-Abaunza, Fernando Ochoa, and Scott Morrison, the authors discuss how the different priorities and methods of the U.S. and Mexico can be reconciled. The central issue, as it always is, is acquiring funding for acquisition and/or conservation easements, which dovetails with funding for management and control efforts that will continue into perpetuity. Dallen Timothy, an economist from Arizona State University, portrays unique opportunities in the binational sector for innovative revenue streams that can fund protection and preservation.

The last two chapters range from discussions on very practical solutions to critical, but somewhat lofty political discussions. Katherine Comer, of the Institute for Regional Studies of the Californias at San Diego State University, uses an actual project to protect land that straddles the U.S., Mexican, and Campo tribe national boundaries to illustrate local and immediate issues that should be considered and to illustrate the variety of options available. Comer's chapter contrasts with the chapter by Kelly Hoffman, who is a graduate student from Princeton University. Hoffman presents the difficulties that surround sovereignty issues and she illustrates how quickly treaties become dated and can no longer address contemporary issues.

SCERP thanks all Border Institute participants for their efforts to make the event on transboundary ecosystem management a success. SCERP also salutes Guillermo Torres Moye, Alan Torres Páramo, Ignacio M. Barrientos, Bertha Hernández, and Gabriela Carrillo for their work on the Spanish translations of the abstracts in each chapter, and SCERP staff Amy Conner and Courtney Baird, who edited and coordinated the publication of this volume.

Executive Summary

Proceedings of Border Institute VI: Transboundary Ecosystem Management

D. Rick Van Schoik, Elena Lelea, and Amy Conner

Introduction

The conservation of biodiversity is a challenging endeavor. (Biodiversity is the biological diversity that is found at all levels of biology, from the gene pool, to species, to habitats, to ecosystems.) However, jurisdictional boundaries, where cooperation and planning break down or never develop in the first place, complicate this challenge. Moreover, national security has begun to take priority over all other concerns at international borders, which has reduced the permeability of the border's infrastructure. This reduced permeability bisects ecosystems – and this bisection may become permanent. Population pressures, which lead to sprawl along the border and which connect border urban areas across wild lands, further compound the ecological problems associated with barriers at the border.

Bisected ecosystems are appearing along the U.S.-Mexican border, where infrastructure and the heightened security activities essentially sever the north-south cores, corridors, and buffers, which are essential to the preservation of ecosystems. Additional threats, such as water that is transferred away from nature, the introduction of exotic species, and the intersection of varying traditions within each nation, make many unique and rare ecosystems vulnerable. These threats hamper the vitality and survival of nearly 100

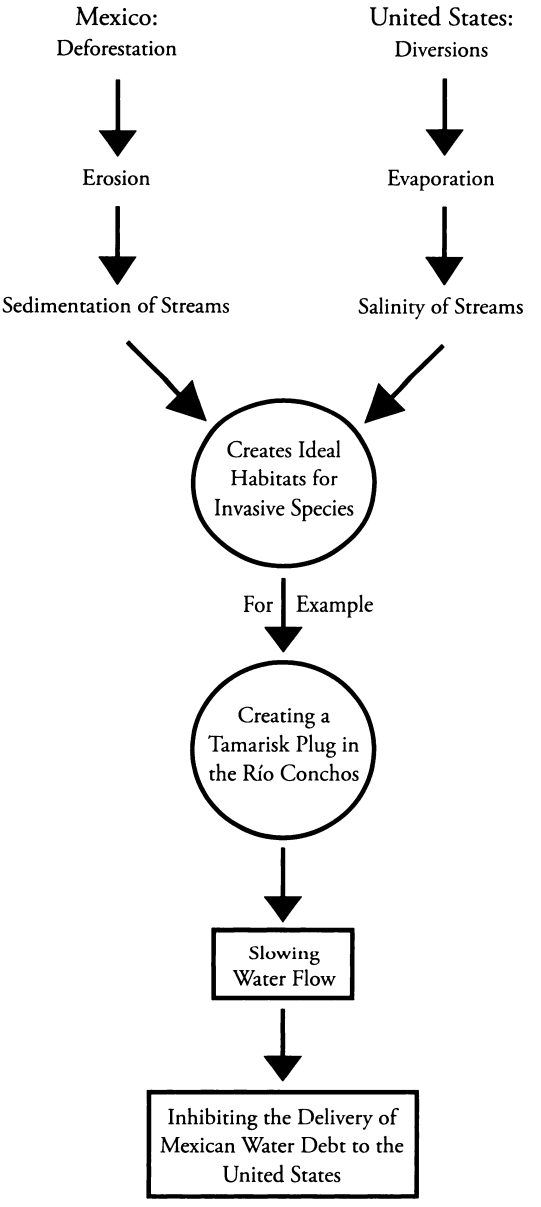
individual species. For example, the direct and indirect consequences of the deforestation rate in Mexico and the out-of-basin water transfers in the United States have created a number of environmental hazards, ecological threats, and economic development obstacles, and they have even heightened international tension. For example, headwaters deforestation, larger diversions for irrigation, and outdated reservoir operations in the Río Conchos basin stress the aquatic ecosystem, allow large invasions of water-consumer, non-native species, such as the salt cedar, and create binational tension over water delivery obligations.

The Scale of Conservation

The most significant principle of biodiversity conservation is the protection of the largest intact landscapes possible. On many occasions, political boundaries divide these landscapes and ultimately slow or hamper the conservation process, as neighboring governments must coordinate and reconcile their differences. While nations can easily and quickly agree to conserve migrating species in their territories, as Mexico did in 1936 when its government signed on to the United States' Migratory Bird Treaty Act, protecting adjacent prime natural areas proves much more difficult. Often, governments protect convenient (and usually federally owned), no-mans lands, such as deserts or other uninhabited areas. Threats, vulnerabilities, hot spots, and threatened ecosystem processes do not necessarily exist in these areas.

The Southwest Consortium for Environmental Research and Policy and its partners convened their annual policy conference, titled Border Institute VI, to address the issues of transboundary ecosystem management throughout the U.S.-Mexican border region. The members of this policy conference found that while a number of parallel policies and regulations, letters of intent to preserve adjacent natural areas, and similar land acquisition and easement mechanisms exist, as this monograph demonstrates, they are too few and scattered. Moreover, without consistent political leadership and the continuity of public policy, progress toward transborder ecosystem protection may be derailed.

Figure 1. Effects of the Mexican Deforestation Rate and U.S. Out-of-Basin Water Transfers



Source: Authors

Finding of Border Institute VI

At the culmination of the three-day conference, participants developed policy recommendations to enhance the management and conservation of transboundary ecosystems. Overall, participants concluded that the definition of transboundary environmental protection must include locally based, overarching visions, and it must be culturally sensitive, economically compatible, and include a region that has been defined by its stakeholders. Transboundary environmental protection also must incorporate elements of sustainable development, resource management, and border security, as these issues are currently affecting the border region. Differing local and national interests must also be recognized. Participants' specific statements and recommendations follow.

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 that were provided at Border Institute VI were inexpensive, as they were largely constructed by using assets and data that were found on the Internet. EPA, U.S. Geological Survey, National Oceanic and Atmospheric Administration, and other organizations 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). GIS, remote telemetry, and other contemporary scientific applications can help coordinate the overall efforts of both the United States and Mexico.
2. Find a binational, emblematic species. Although purely for publicity purposes, the designation of a charismatic species as the emblematic species for the border region can catalyze other issues. The borrego cimarrón, or bighorn sheep *(Ovis canadensis mexicana, californiana, or nelsoni)*, is one of the few species that exists in almost every Mexican and U.S. border state, but that is both protected and harvested throughout these states. Use of the symbol can boost visibility and actions toward protecting other species.

3. Plan jointly. Ordenamiento Ecológico is a particularly commendable and innovative mechanism in Mexico. It strives to determine the most environmentally and ecologically compatible uses for land, and it then encourages these uses. It also dissuades the least compatible uses through discretionary "zoning" and mandatory protections. This approach diminishes potential conflicts among all the players. Empowered by both the constitution and Ley General de Ecología y Protección de Ambiente (LGEEPA), Mexico develops holistic environmental policies for an entire area by negotiating land and water use, by designating natural areas, and by developing special protections. Various secretariats are actively present and involved in the negotiations for land and water use, and they base their considerations on private productivity and the social uses of resources. The United States should consider and adopt such ecological planning so that the two nations' efforts can be merged.
4. Conduct quick transboundary assessments throughout the border zone. Because of the high threat level, perform a rapid biodiversity assessment protocol of the entire border zone as a baseline review, even if the area is not pristine. Engage both the U.S. and Mexico in all surveys, as the San Diego Natural History Museum does, to increase understanding in both countries. The survey could contrast different areas within the border region, compare it 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 have proposed a border-wide geographic information system (GIS) for water and energy. Its development could serve as such a clearinghouse. Without a clearinghouse, it is difficult for conservationists on one side of the border to know the range and health of habitats and populations on the other side of the border.
6. Think regionally and on a landscape-scale. Use the ecosystem, landscape-scale approach, like the one that has been suggested for watersheds, to conserve ecosystems. Coastal sage scrub, maritime chaparral, and the border's version of vernal pools are

unique to the U.S.-Mexican border region. These resources 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, instead of individual elements. But Mexico can identify more areas of concern, designate more sensitive habitat, and align more land acquisitions by adding species to its list. The ability to designate protection on one side must be met by commensurate designation, understanding, and protection on the other.
8. Redirect subsidies to nature. The implementation of macro-policies would help remove and redistribute currently perverse subsidies. The USDA's proposed $50 billion subsidy would provide funding for the rehabilitation and restoration of wetlands, and for the renewal of the North American Wetlands Conservation Act. Certain provisions would enable implementation in Mexico. Even if perverse subsidies cannot be removed, the mitigation of their effects, which spill across borders, can benefit both sides.
9. Engage binational private and philanthropic sectors. The Corporate Wetlands Restoration Partnership and the multiple-agency Coastal America Program conduct voluntary activities (Connaughton 2004). Stronger corporate citizenship should 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 comes 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. No single effort will benefit nature and inhabitants more.
11. Set up transboundary easements. One example of a creative transfer of development rights occurred in Tecate, B.C. between the land title holder, Rancho La Puerta; the broker, Pronatura; and the development easement conservator, BLM.

More conservation easements, reserves, and transfers should be encouraged. Successful arrangements will set aside land that might otherwise be developed, destroying its biodiversity.

12. Integrate. The DOI Field Coordinating Committee has recommended an integrated environmental education, research, GIS, and habitat restoration plan. Concerted efforts among government, NGOs, industry, and communities are necessary to address threats comprehensively.
13. Act locally. Pronatura advocates for municipal reserves and agricultural easements (Conservation Biology Institute 2004). The Co-development of nature and the economy assures the vitality of both.
14. Swap debt for nature. The popularity of Debt-for-nature swaps has peaked, but they still offer some remedy. Two U.S. debt treatment statutes, the Enterprise for the Americas Initiative and the Tropical Forest Conservation Act, have received little attention. However, together they stand to generate more than $237 million for natural resource conservation (Lampman 2003). Local, state, and national debt in Mexico can be traded for nature reserves.

Conclusion

The U.S.-Mexican border region has the highest rate of species endangerment in the United States. Some 31 percent of the species that the U.S. Department of Interior has listed as endangered live in the U.S.-Mexican border region. On the Mexican side of the border, 85 species of plants and animals are in danger of extinction. The ecosystems where these species live provide services and renewable resources that human beings under-appreciate, undervalue, and under-conserve.

Sixty top-level border organization representatives developed these recommendations at Border institute VI in April of 2004. These recommendations aim to recast the status quo. They will be widely circulated among all levels of U.S. and Mexican federal, state, and local agencies; tribal nations; non-governmental organizations; the private sector; and others who have a stake in the U.S.-Mexican border region. It is hoped that these recommendations will increase

the inclusion of ecosystem considerations in the design and implementation of policies and projects along the U.S.-Mexican border.

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Resumen Ejecutivo

Memoria del VI Instituto Fronterizo: Manejo del Ecosistema Transfronterizo

D. Rick Van Schoik, Elena Lelea, y Amy Conner

La Introducción

La conservación de la biodiversidad es una empresa desafiante. (La biodiversidad es aquella diversidad que se encuentra en todos los niveles de la biología, desde el conjunto de genes, a las especies, a los entornos, a los ecosistemas.) No obstante, esta empresa se complica por los límites de jurisdicciones donde no llegan a establecerse la cooperación ni la planeación o ni siquiera se llegan a concretar. Además, el tema de la seguridad nacional ha comenzado a emerger como prioridad sobre todos los demás aspectos que afectan las fronteras internacionales, lo que ha reducido la permeabilidad de la infraestructura de la frontera. Esta permeabilidad reducida divide los ecosistemas, y tal división puede llegar a ser permanente. Las presiones ejercidas por la población, que llevan al crecimiento de la mancha urbana a lo largo de la frontera y que conecta a las zonas urbanas fronterizas a través de tierras silvestres, agravan aún más los problemas ecológicos vinculados con las barreras en la frontera.

Comienzan a surgir los ecosistemas divididos a lo largo de la frontera entre los Estados Unidos y México, donde la infraestructura y el aumento de las actividades de seguridad básicamente cortan los núcleos norte-sur, los corredores y las zonas de amortiguamiento – elementos esenciales a la conservación de los ecosistemas. Las amenazas adicionales, tales como el agua que se le desvía a la

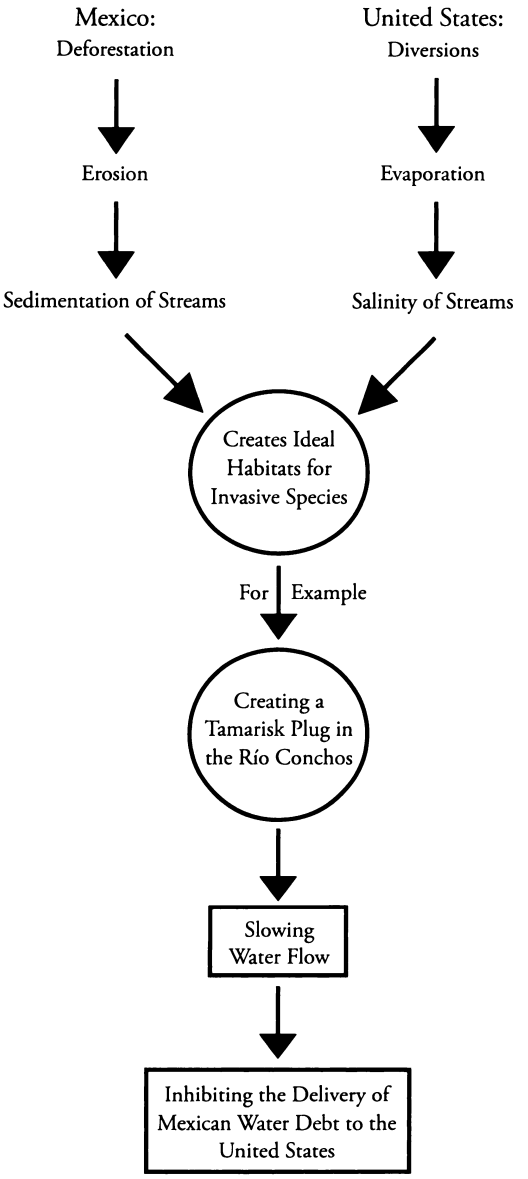
naturaleza, la introducción de especies exóticas y la intersección de diversas tradiciones dentro de cada nación, exponen la vulnerabilidad de muchos ecosistemas únicos y singulares. Tales amenazas representan un obstáculo a la vitalidad y supervivencia de unas 100 especies individuales. Por ejemplo, las consecuencias directas e indirectas de la deforestación en México y las desviaciones de agua que se extrae de las cuencas hidrográficas en los Estados Unidos han generado una serie de riesgos al medio ambiente, amenazas a la ecología y obstáculos al desarrollo de la economía e, inclusive, han elevado la tensión internacional. A manera de ejemplo, la deforestación río arriba, más desviaciones empleadas en el riego y sistemas de operación obsoletos en la cuenca del Río Conchos ejercen presión al ecosistema acuático, fomentan las invasiones de especies exógenas que consumen gran cantidad de agua, como el pino salado, y generan tensión binacional sobre las obligaciones de entrega de agua.

La Magnitud de la Conservación

El principio más significativo de la conservación de la biodiversidad es la protección de la mayor cantidad posible de zonas de paisajes intactas. En muchas ocasiones, las fronteras políticas dividen tales zonas y, a la larga, desaceleran u obstaculizan el avance del proceso de conservación ya que los gobiernos vecinos deben coordinar y reconciliar las diferencias entre ellos. Aunque las naciones pueden llegar a acuerdos con facilidad y agilidad para conservar las especies migratorias entre sus territorios, tal como fue el caso del gobierno de México en 1936 al aceptar la Ley del Tratado de Aves Migratorias de los Estados Unidos, la protección de las principales zonas naturales adyacentes resulta una tarea mucho más difícil. Con frecuencia, los gobiernos protegen tierras que les convienen (y, por lo general, terrenos federales), que no pertenecen a nadie, tales como los desiertos y demás tierras deshabitadas, donde no necesariamente existen factores amenazantes, vulnerabilidades, puntos candentes ni procesos que atenten contra el medio ambiente.

El Consorcio de Investigación y Política Ambiental del Suroeste y las organizaciones aliadas celebraron la conferencia anual de políticas, VI Instituto Fronterizo, donde se abordaron los temas del

Figura 1. Efectos del Índice de Deforestación en México y Transferencias fuera de la Cuenca Hidrográfica de los Estados Unidos



Fuente: Autores

manejo de ecosistemas transfronterizos a lo largo de la región fronteriza entre los Estados Unidos y México. Los integrantes de esta conferencia de políticas determinaron que, no obstante que existe un sinnúmero de políticas y reglamentos paralelos, cartas de intención para conservar las zonas naturales adyacentes y mecanismos similares de adquisición de tierras y de servidumbre, como se demuestra en la presente monografía, tales instrumentos son muy pocos y dispersos. Además, sin un liderazgo de política congruente y continuidad de la política pública, podría descarrilarse el avance hacia la protección del ecosistema transfronterizo.

Hallazgos del Instituto Fronterizo

Al culminar la conferencia de tres días, los participantes trazaron recomendaciones de políticas tendientes a mejorar el manejo y conservación de los ecosistemas transfronterizos. En general, los participantes concluyeron que la definición de la protección del medio ambiente transfronterizo debe incluir horizontes amplios con base en las comunidades locales, y debe ser sensible a las culturas, compatible desde el punto de vista económico, además de incluir una región definida por los interesados. También debe incorporar los elementos de un desarrollo sustentable, manejo de recursos y seguridad en la frontera, ya que tales factores afectan hoy en día a la región fronteriza. También se debe reconocer los intereses diversos locales y nacionales. Las declaraciones y recomendaciones concretas de los participantes se enumeran a continuación:

1. Modernizar la práctica de la conservación transfronteriza. El Internet ofrece la facilidad de establecer contacto, reproducir y perpetuar los esfuerzos de protección y conservación (Levitt 2003). El mapa y los acetatos electrónicos subyacentes que se presentaron en el VI Instituto Fronterizo fueron económicos; la mayoría se elaboraron mediante el uso de recursos y datos obtenidos de Internet. La EPA, el Servicio Geológico de los Estados Unidos, la Administración Nacional Oceánica y Atmosférica (de EUA) y otras organizaciones cooperan en los trabajos desafiantes de cartografía a escala de paisaje de las cuencas hidrográficas y de los ecosistemas. El gobierno y los grupos académicos ofrecen oportunidades a las comunidades

para consultar, bajar y revisar mapas y conjuntos de datos (Comer et al. 2003; Kepner et al. 2003). Los sistemas de información geográfica (SIG), la telemetría a distancia y otras aplicaciones científicas contemporáneas pueden ayudar a coordinar los esfuerzos en general de los Estados Unidos y México.

2. Designar una especie binacional como emblema. Aunque sea sólo para efectos publicitarios, la designación de una especia carismática, una especia que sirva de emblema de la región fronteriza, puede actuar como agente catalizador de los demás temas. El borrego cimarrón (*bighorn sheep*, en inglés) *(Ovis canadensis mexicana, californiana o nelsoni)*, representa una de las pocas especies que existe en casi todos los estados de la frontera entre México y los Estados Unidos pero que también se protege y se caza en estos estados. El uso del símbolo puede ayudar a reforzar la visibilidad y las medidas emprendidas para la protección de las demás especies.
3. Planeación conjunta. El ordenamiento ecológico es un mecanismo de México particularmente elogiable e innovador. Se esmera por determinar los usos de suelo que sean más compatibles con el medio ambiente y la ecología y, además, fomenta tales usos. También desmotiva los usos menos compatibles mediante la "zonificación" discrecional y protecciones obligatorias. Este enfoque reduce los conflictos potenciales entre los protagonistas. Con base en la constitución y la Ley General del Equilibrio Ecológico y la Protección al Ambiente (LGEEPA), México desarrolla políticas integrales del medio ambiente para toda una zona al negociar el uso del suelo y del agua, al designar zonas naturales y mediante el desarrollo de protecciones especiales. Varias secretarías participan directamente en las negociaciones del uso del suelo y del agua y basan sus consideraciones en la productividad privada y en los usos sociales de los recursos. Los Estados Unidos debería tomar en cuenta y adoptar tales medidas de planeación ecológica con el propósito de fusionar los esfuerzosde las dos naciones.
4. Realizar evaluaciones transfronterizas rápidas de toda la zona fronteriza. Debido al alto nivel de amenaza, realizar un protocolo de evaluación rápida de la biodiversidad de toda la

zona fronteriza para obtener una evaluación de referencia, aún cuando no se trate de una zona virgen. Lograr la participación de los Estados Unidos y México en todos los estudios, tal como lo hace el Museo de Historia Natural de San Diego, con el fin de aumentar la comprensión en ambos países. El estudio podría contrastar diferentes zonas de la región fronteriza, establecer comparaciones con las zonas internas de cada nación y servir de referencia para estudios posteriores.

5. Establecer un centro binacional de intercambio de datos de la biodiversidad y de los ecosistemas. Los gobernadores fronterizos han propuesto un sistema de información geográfica (SIG) de toda la frontera sobre agua y energéticos que podría servir como centro de intercambio. Sin la presencia de un centro de intercambio de información, les resulta difícil a los ecologistas de un lado de la frontera conocer la amplitud y estado de salud de los hábitats y de las poblaciones del lado opuesto de la frontera.
6. Pensar a nivel regional y a escala de paisaje. Utilizar el enfoque de ecosistema, a escala de paisaje, como el sugerido para las cuencas hidrográficas, para conservar a los ecosistemas. El matorral costero, el chaparral marino y la versión fronteriza de los estanques vernales son únicos en la región fronteriza de los Estados Unidos y México. La única manera de proteger estos recursos estriba en aumentar las medidas que aborden las amenazas, vulnerabilidades y necesidades de los sistemas.
7. Aumentar la cantidad de especies enumeradas y protegidas de México. Los esfuerzos de protección y conservación deben concentrarse en los hábitats y ecosistemas, en lugar de los elementos individuales. Sin embargo, México puede identificar más zonas de interés, designar más hábitats sensibles y alinear más adquisiciones de terrenos al agregar más especies a su lista. La capacidad de designar la protección de un lado debe complementarse con la designación, entendimiento y protección por parte del otro lado.
8. Volver a dirigir los subsidios a la naturaleza. La instrumentación de macropolíticas ayudaría a eliminar y redistribuir los subsidios actuales de conservación. El subsidio de 50 mil millones de dólares propuesto por el Departamento

de Agricultura de EUA proporcionaría financiamiento para la rehabilitación y restauración de los humedales y para la renovación del Acta Norteamericana para la Conservación de Humedales. Algunas de las disposiciones permitirían su instrumentación en México. Aún cuando no puedan eliminarse los subsidios perversos, la mitigación de sus consecuencias, que afectan a ambos lados de la frontera, puede beneficiar a los dos lados.

9. Lograr la participación de los sectores privados y filantrópicos binacionales. La Alianza Corporativa de Restauración de Humedales y el Programa de América Costera (Coastal America) multisecretarial realizan actividades voluntarias (Connaughton 2004). Debe fomentarse más civismo empresarial en las plantas maquiladoras propiedad estadounidense. Al invertir en las comunidades, invierten en sus empleados y, a la larga, en su productividad. La salud económica proviene del estado de salud del ecosistema y de la comunidad.
10. Sembrar árboles. La reforestación capta carbono, estabiliza los suelos, genera los hábitats y genera empleos. Los Estados Unidos puede compensar su inmensa deuda de carbono al pagarle a México para que siembre y cultive árboles. Ni un solo esfuerzobeneficiará más a la naturaleza y a los habitantes.
11. Establecer servidumbres de carácter transfronterizo. Un ejemplo de una transferencia creativa de derechos de fraccionamiento ocurrió en Tecate, BC, entre un propietario del terreno, Rancho La Puerta; el intermediario, Pronatura; y el albacea de la servidumbre del fraccionamiento, la Oficina de Administración de Tierras de EUA (BLM, por sus siglas en inglés). Deben fomentarse más servidumbres de conservación, reservas y transferencias. Los acuerdos exitosos conservarán tierras que, de lo contrario, se podrían desarrollar, destruyendo su biodiversidad.
12. Integrar. El Comité de Coordinación de Actividades de Campo del Departamento del Interior de EUA ha recomendado un plan integral de educación ambiental, investigación, SIG y

restauración de hábitats. Se requiere deesfuerzos concertados entre el gobierno, ONGs, industria y comunidades para enfrentar extensivamentea las amenazas.

13. Actuar a nivel local. Pronatura aboga por las reservas municipales y las servidumbres de la agricultura (Conservation Biology Institute [Instituto de Conservación de la Biología] 2004). El codesarrollo de la naturaleza y de la economía asegura la vitalidad de ambas.
14. Canjear deuda por naturaleza. La popularidad de este tipo de operaciones de canje ya alcanzó el nivel máximo pero aún ofrecen algo de remedio. Dos estatutos estadounidenses de tratamiento de deuda , la Iniciativa de la Empresa para las Américas y la Ley de Conservación de los Bosques Tropicales, han recibido poca atención. Sin embargo, en su conjunto podrían generar más de 237 millones de dólares para la conservación de los recursos naturales (Lampman 2003). La deuda municipal, estatal y nacional de México podría canjearse por reservas de la naturaleza.

Conclusión

La región de la frontera entre los Estados Unidos y México tiene el índice más alto de especies en peligro de extinción de los Estados Unidos. Un 31% de las especies enumeradas en la lista de peligro de extinción por el Departamento del Interior de EUA habita en esa región. Del lado mexicano de la frontera, 85 especies de flora y fauna están en peligro de extinción. Los ecosistemas donde habitan estas especies ofrecen servicios y recursos renovables que los seres humanos subvaloran, subestiman y no conservan debidamente.

Sesenta representantes de alto nivel de organizaciones fronterizas trazaron las recomendaciones presentes durante el VI Instituto Fronterizo celebrado en abril de 2004. Estas recomendaciones están dirigidas a darle nueva forma al status quo. Se distribuirán ampliamente a todos los niveles de las dependencias federales, estatales y locales de los Estados Unidos y México; a las naciones de los grupos indígenas; a las organizaciones no gubernamentales; al sector privado; y a las demás partes interesadas en la región fronteriza entre los Estados Unidos y México. Se espera que tales

recomendaciones aumenten la inclusión de las consideraciones del ecosistema en el diseño e instrumentación de las políticas y proyectos a lo largo de la frontera entre los Estados Unidos y México.

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I

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:

- 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

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 –

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.

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.

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

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-

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 (Breymeyer 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-

servation 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).

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

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

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.

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

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.

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.

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-

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,

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

- 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).

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¬continental 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 outcompete 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

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 cites and squatters	Present and increasing	Very significant

Sources: Authors

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 ubiq-uitous	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

- 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-

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.

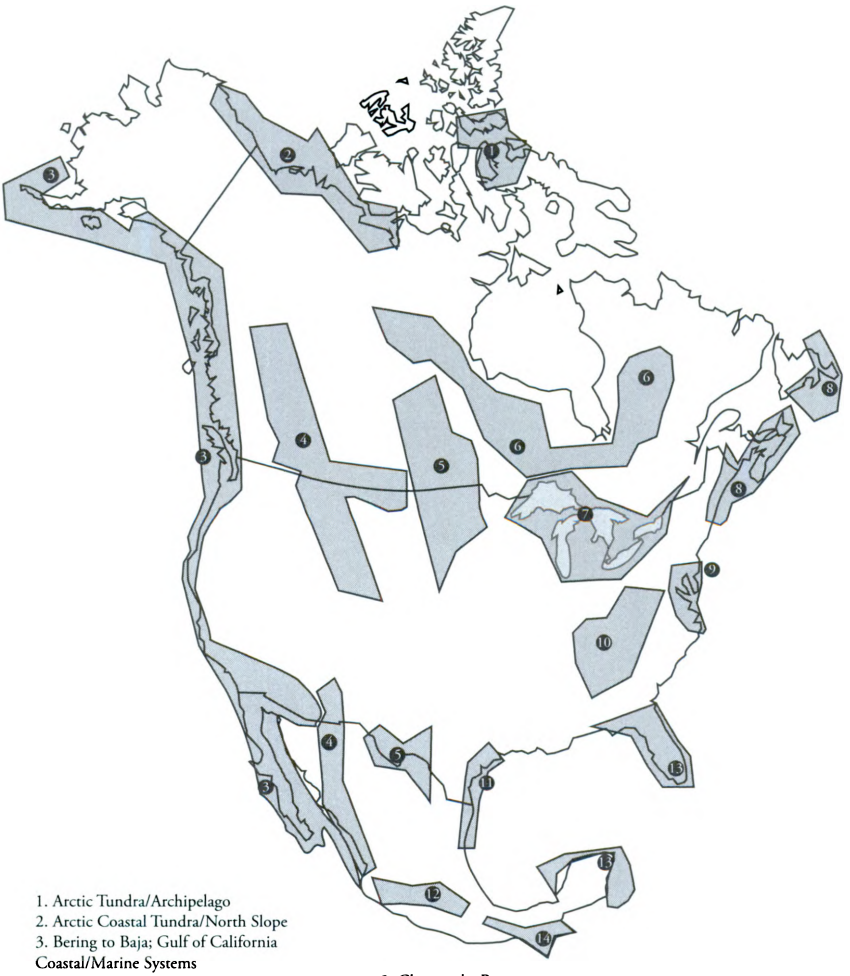
Again, the authors' assessment overlapped with other assessments, but indicated new areas as well. This demonstrates that that as long as these assessments are made in a non-scientific way or without agreed-upon criteria or priorities, the different lists of biodiversity hotspots will never completely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



1. Arctic Tundra/Archipelago
2. Arctic Coastal Tundra/North Slope
3. Bering to Baja; Gulf of California Coastal/Marine Systems
4. Yukon/Yellowstone/Sierra Madre Corridor
5. Prairies/Chihuahuan Desert Corridor
6. Northern Forests/Softwood Shield
7. Great Lakes/St. Lawrence Lowlands
8. Greater Gulf of Maine/Coastal/Marine System (Newfoundland to New England)
9. Chesapeake Bay
10. Southern Appalachians
11. Rio Bravo/Laguna Madre Corridor
12. Transverse Neovolcanic Belt
13. Maya Reef and Southern Florida Coastal/Marine Systems
14. "Selva Maya," Tropical Dry and Humid Forests

Source: CEC

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

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 hairsteak, 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 word, 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

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

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 SEMARNAT/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.

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
Mexico	Tijuana-Tecate green belt	Preservation and protection	TDR easement to BLM
	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

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
Combined	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
	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.

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

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

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.

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 macropolicies 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.

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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II

Adjacent U.S.-Mexican Border Natural Protected Areas: Protection, Management, and Cooperation

Joanna Salazar and Mark Spalding

Abstract

A number of adjacent parks and adjacent natural protected areas exist along the U.S.-Mexican border. They serve as models that other sections of the U.S.-Mexican border can use and they serve as testing grounds for binational, collaborative management. The vehicle for a discussion of their binational management is the two cooperation pilot programs for binational natural protected areas. A 1997 Letter of Intent between the U.S. Department of the Interior and Secretaría de Medio Ambiente y Recursos Naturales established these pilot programs. This chapter briefly describes the set of natural protected areas in these pilot programs and it describes the U.S. federal policies for natural protected areas management. It then delineates the extant binational cooperation on adjacent natural protected areas. The chapter closes with a focus on the barriers and opportunities for further cooperative efforts regarding those parks. The result of the analysis indicates there is a remarkable amount of

local cooperation at the present time, as well as significant opportunities for more cooperation, including cooperation at higher levels. However, many, and in some cases large, obstacles still remain.

Zonas Naturales Protegidas Adyacentes a la Frontera Estados Unidos -México: Protección, Manejo y Cooperación

Joanna G. Salazar y Mark J. Spalding

Resumen

Existen varios parques y otras zonas naturales protegidas adyacentes a lo largo de la frontera entre Estados Unidos y México. Se utilizan como modelos que pueden aprovechar otras secciones de la frontera entre Estados Unidos y México y estas zonas también se aprovechan para poner a prueba el manejo a nivel de cooperación binacional. El medio para la deliberación sobre su manejo binacional se integra de dos programas piloto de cooperación de zonas naturales protegidas binacionales establecidos en la Carta de Intención de 1997 entre el Departamento del Interior y la Secretaría del Medio Ambiente y Recursos Naturales. Este documento presente una breve descripción el establecimiento de zonas naturales protegidas en estos programas piloto, así como las políticas federales de los Estados Unidos relacionadas con el manejo de zonas naturales protegidas. Luego, se describe la cooperación binacional existente en las zonas naturales protegidas adyacentes. El documento culmina con un enfoque sobre las barreras y oportunidades de los esfuerzos cooperativos futuros con respecto a esos parques. El resultado del análisis indica que, en la actualidad, hay una gran cantidad de cooperación, además de oportunidades significativas para establecer más cooperación; sin embargo, aún existen muchos obstáculos.

INTRODUCTION

Mexico and the United States have well-developed policies regarding protected natural areas, particularly in their national parks and other officially designated natural sites. The policymaking in this sphere of government has not always been coordinated at the binational, national, or state levels. Often, different government agencies have developed components of such policies; however, because of limited mandates or internally conflicted mandates, they could not always define a comprehensive vision of protection for natural areas. That said, there have been some government inter-agency coordination initiatives within and between the national governments of the U.S. and Mexico. For example, as a manifestation of a binational shared concern, information and expertise on protected natural areas have been shared for mutual benefit.

The United States, and to a lesser extent Mexico, has also been developing policies and programs for cooperative management with local and aboriginal communities. Such tribal issues are of critical importance in the United States because tribal governments are the primary managers of tribal trust land and tribal natural and cultural resources that are located both on and off current reservations. Also, all federal agencies and departments, including the National Park Service (NPS), The U.S. Department of Agriculture Forest Service, the Bureau of Land Management (BLM), and the Fish and Wildlife Service (FWS), must consult with tribes on a government-to-government basis before they can take any action that affects tribal members, lands, or other resources. To further complicate matters, there has been a strong conflict between some states and the federal government in the United States over the regulation of federal natural areas that fall within these states' boundaries.

Needless to say, there is a tremendous opportunity for more binational cooperation related to adjacent protected natural areas. Because Mexico and the United States have many ecosystems that cross their shared border, there is a need for a broader perspective on protected natural areas, or at least binational principles and goals. Once such principles are established, there is a need for coor-

dination and implementation at the national level, because protected-area management cuts across departments. From an ecosystem point of view, such national-level coordination is needed.

At present, there has been significant environmental degradation in protected natural areas, particularly in the most popular parks. This coincides with the under-funding of protected areas management, a trend toward less government spending, and pressure to generate funds from tourism. Thus, the time is ripe for a new direction that balances economic, social, cultural, and environmental interests without sacrificing the human need for connectedness with nature or the productive and compatible use of land.

Although cooperative relationships have developed locally among border communities, non-governmental organizations (NGOs), and state and federal agencies, efforts have generally been area- or issue-specific and uncoordinated along the east-west border spectrum. Stakeholders along the border have rallied around specific issues and formed coalitions that address border environmental problems, and as such, these coalitions have generally been north-south focused. In the same vein, there have been cases where local management staff from U.S. federal and state authorities have sought cooperation from their southern counterparts, local research organizations, and communities to successfully carry out natural resource protection in designated areas along the border. While traditionally these efforts have been fragmented and specific, in the last decade, agencies within the U.S. and Mexican federal governments have made great strides in coordinating their efforts both along and across the border. These efforts have been supported through a number of agreements, memoranda of understanding (MOU), and letters of intent (LOI) that were signed to address such binational, environmental issues.

In particular, this chapter will highlight the spirit, intent, and effect of the Letter of Intent on Adjacent Protected Areas that the U.S. Department of the Interior (DOI) in the United States and the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) in Mexico[1] signed in 1997. Two pilot areas were named in the LOI – the Western Sonoran Desert region and the Big Bend region of the Chihuahua Desert. Within each region, the LOI also designated adjacent protected areas on either side of the border that share sim-

ilar ecosystems, habitat, and wildlife. The purpose of the LOI was to "expand existing cooperative activities in the conservation of contiguous natural protected areas in the border zone and to consider new opportunities of cooperation in the protection of natural protected areas on the U.S.-Mexico border (DOI 1997)." The LOI was signed during a time of increased interest in the U.S.-Mexican border environment, which resulted from the passage of the North American Free Trade Agreement (NAFTA) and its related side agreements, and which occurred before September 11, 2001. Inevitably, September 11th shifted the type and degree of attention given to U.S. international borders. However, while the political and economic environment has changed considerably in the last seven years, the natural protected areas that lie in the border region are still home to shared ecosystems that are both treasured and threatened. Consequently, a great deal of crossborder activity still exists that can help address natural resource issues along the entire 2,000 mile *frontera*, especially at the local level, as this chapter will reveal.

Description of Properties

The border region – the southwest United States and northern Mexico – combines the ecoregions of eastern dry temperate forests, North American deserts, Mediterranean California, temperate sierras, the southernmost part of the Great Plains, and some southern semi-arid highlands. The landscape varies from mountains and grasslands to canyons and deserts. It hosts many impressive United Nations Biosphere Reserves, National Parks, National Monuments, National Wildlife Refuges (NWR), Natural Protected Areas, National Forests, military reservations, state lands, and other public lands, much of it with wilderness status.

As part of the 1997 LOI, two pilot project areas were established. These are made up of eight different protected areas that lie on both sides of the U.S.-Mexican border (Table 1). These areas will be examined throughout this chapter to demonstrate successful cooperative efforts, to point out obstacles that still exist, and to explore opportunities for collaboration in binational protected areas' management.

Big Bend National Park

The Big Bend National Park is situated on the U.S. side of the border and lies along the Rio Grande as it flows to the northeast and separates the states of Texas on one side and Chihuahua and Coahuila on the other. First authorized in 1935 and established June 12, 1944, the park was designated a biosphere reserve in 1976 under the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Man and the Biosphere Program (MAB). More than 1,200 species of plants, 75 species of mammals, 450 species of birds, 40 species of fish, 56 species of reptiles, and 11 species of amphibians live within the park's 801,000 acres.

Since its founding in 1944, the area included in Big Bend National Park has greatly increased. In 1988, the Texas Parks and Wildlife Department purchased the Big Bend Ranch State Natural Area, which lies adjacent to the national park. This purchase substantially added to the total existing acreage of the protected area. In addition, the Rio Grande Wild and Scenic River lies next to and within the park. This is a more than 300-kilometer (km) long portion of the Rio Grande that extends from the Chihuahua-Coahuila state line in Mexico to the Terrell-Val Verde county line in Texas. In 1978, Congress designated this portion as part of the National Wild and Scenic Rivers System, and although only 110 km of it actually lie within the boundaries of Big Bend, the entire section is administered by the park.

Big Bend National Park also makes up a large portion of the Chihuahuan Desert Biosphere Reserve. The reserve, in addition to Big Bend, contains the Agricultural Research Service's La Jornada Experimental Range in New Mexico and Bolson de Mapimi, located in the Mexican states of Chihuahua, Coahuila, and Durango. Together, these three sites form a regional reserve where natural resource protection, research, and implementation coincide. Under the structure of the Biosphere Reserve System, Big Bend serves as the "core" protected area where national and cultural resources are fully protected. This provides baseline information that results from inventory and monitoring activities. La Jornada serves as the "buffer zone" where research and field application takes place, and Mapimi serves as the "transition area," although it also contains its own core

and buffer zones. Scientists, policymakers, landowners, and ejidatarios cooperatively manage Mapimi and they involve local residents in the implementation of sustainable practices researched and designed in the core and buffer areas of the reserve.

Cañón de Santa Elena/Maderas del Carmen

The "sister area" that lies adjacent to Big Bend on the Mexican side is actually made up of two areas that, after more than 60 years' effort, finally attained protected status in the Mexican system in 1994. These areas are the Cañón de Santa Elena and the Maderas del Carmen, which lie within the Chihuahua desert along the northeast border of the state of Chihuahua and within the northwest border of the state of Coahuila, respectively. Both areas were named Flora and Fauna Protected Areas (Área de Protección de Flora y Fauna) on November 7, 1994, and together they constitute nearly 600,000 hectares. Within their desert ecosystem, which harbors many endemic plants and a variety of wildlife, mountainous islands rise 2,400 meters (m) into the sky. Called the Chisos Mountains, these peaks south of the Rio Grande contain an even greater diversity of flora and fauna than those mountains that lie north of the border in Big Bend National Park. Animal life, plant life, and topography are similar on both sides of the border, but because Mexico has a larger amount of higher-elevation acreage, many mammals and birds are found in greater numbers there. These areas also grow large oak, juniper, and pine forests, as well as chaparral vegetation, all of which support a distinct fauna and serve as refuges for animals, such as black bears, mountain lions, and Sierra de Carmen white-tailed deer.

Organ Pipe Cactus National Monument

Organ Pipe Cactus National Monument, named after the large cactus that is characteristic of the Sonoran Desert, is a nearly 150,000-hectare (ha) (330,689-acre) natural preserve in southern Arizona. It lies directly on the U.S.-Mexican border to the northeast of its sister area, El Pinacate y el Gran Desierto de Altar Biosphere Reserve in Mexico. In addition to sharing a 56 km-long border with the state

Table 1. Case Study Areas

Name	Date Established	State	Acres
	Pilot Sister Area #1		
Organ Pipe Cactus National Monument	In 1937 named a national monument, then designated a biosphere reserve in 1976	Arizona	330,689
Cabeza Prieta National Wildlife Refuge	Established in 1939 as a wildlife refuge, then added to the wilderness system in 1990	Arizona	860,000
Reserva de la Biosfera El Pinacate y Gran Desierto de Altar	In 1979 set aside as a forest protected zone and wildlife refuge, in 1982 named an ecological reserve, and then designated as a biosphere reserve in 1993	Sonora	1,764,953
Reserva de la Biosfera Alto Golfo de California y Delta del Río Colorado	First recognized in 1955 as a refuge zone, then established as a biosphere reserve on June 15, 1993	Baja California	2,308,847
Imperial National Wildlife Refuge	Designated in 1941	California	25,125
	Pilot Sister Area #2		
Big Bend National Park	In 1944 established as a national park, then designated a biosphere reserve in 1976	Texas	801,000
Área de Protección de Flora y Fauna Maderas del Carmen	November 7, 1994	Coahuila	514,701
Área de Protección de Flora y Fauna Cañón de Santa Elena	November 7, 1994	Chihuahua	684,709

Source: Authors

of Sonora, the monument also shares an approximately 53 km eastern boundary with the Tohono O'odham Nation. This nation encompasses more than 1 million ha (2.8 million acres) of land to the east of Organ Pipe and includes approximately 16,500 tribal members that live throughout its territory (Pearson 1998). Fifty-five species of mammals, 43 species of reptiles, four species of amphibians, and one species of fish exist within the monument. The desert pupfish is endemic to the area, although a related species is believed to live in the Río Sonyata in Mexico – this has given further impetus for cooperative crossborder protection efforts.

Organ Pipe Cactus National Monument is part of the Sonoran Desert, which includes the area from the tip of Baja California north to southeastern California and the southernmost third of Arizona. It is also part of the "Greater Sonoran Desert Protected Ecosystem," a nearly 3 million ha (6 million acre) area that includes the following regional lands in addition to Organ Pipe: the Tohono O'odham Nation, the Cabeza Prieta National Wildlife Refuge, the Barry M. Goldwater Air Force Range, the Pinacate and Alto Golfo Biosphere Reserves in Mexico, and the Bureau of Land Management Areas of Critical Environmental Concern in the United States (Pearson 1998). Although NPS primarily controls Organ Pipe, the entire area's characterization as one protected ecosystem has benefited cooperative management practices beyond respective area boundaries.

Cabeza Prieta National Wildlife Refuge

Cabeza Prieta National Wildlife Refuge lies in the Sonoran Desert of southwestern Arizona, nestled between the Barry M. Goldwater Air Force Range to the west, the Organ Pipe Cactus National Monument to the east, and Mexico to the south. It is the largest wilderness refuge in the lower 48 states, with 860,000 acres off-limits to development. It was set aside in 1939 largely to protect the desert bighorn sheep and the endangered Sonoran pronghorn, although more than 200 bird species, 40 mammal species, an array of reptiles and amphibians, and more than 420 species of plants populate the area.

Pinacate y el Gran Desierto de Altar Reserva de la Biosfera

The Pinacate is also found in the Sonoran Desert, and it encompasses the area just south of the Cabeza Prieta National Wildlife Refuge in Arizona and just north of the Alto Golfo Biosphere Reserve in the state of Sonora. Long revered as a sacred area by the Tohono O'odham, El Pinacate is made up of two very distinct characteristics. One is the Pinacate lava field that was created by volcanic activity related to Earth's cooling. This portion of the protected area is characterized by hundreds of black cinder cones that haphazardly jut out of the surface, and by two peaks that reach more than 1,000 m (Zakin 1995). The largest sand dune in North America, the Gran Desierto, sits on the other side of the peaks.

By presidential decree, El Pinacate was first recognized as a forest protected zone and wildlife refuge on March 1, 1979. At that time, the protected area consisted of nearly 35,000 ha (70,790 acres). However, by 1993, the Sonoran state government, with the help of local academic institutions, put together a proposal that suggested the possibility that both the Alto Golfo and the Pinacate be made U.N. Biosphere Reserves. This, in conjunction with the efforts of Luis Donaldo Colosio, the head of SEMARNAT, led to the June 10, 1993 declaration of El Pinacate y el Gran Desierto de Altar as a Biosphere Reserve, by presidential decree (Ezcurra 1998). The new designation greatly expanded the coverage of the protected area to its current size of nearly 800,000 ha (1,764,953 acres), which is made up of 36% federal property, 63% ejido land, and 1% private land.

The ecological and cultural values of the Pinacate include more than 200,000 ha of volcanic shield with approximately 700 cinder cones, more than 1 million acres of active sand dunes of various types, prehistoric and cultural sites from the Tohono O'odham culture, 500 species of vascular plants, 41 species of amphibians, and two types of freshwater fish (Pearson 1998). Threats to the area include ecological degradation from illegal roads, drug smuggling activities, the increasing numbers of off-road vehicles, the poaching of plants and animals such as the ironwood tree and the antelope, and thievery of cactus and historical artifacts (Zakin 1995).

When named as a biosphere reserve, the government of the state of Sonora charged the Ecological Center of Sonora with creating an integrated management program for the area (Rojas-Caldelas 1999). However, the Pinacate is still a federal protected area and the Instituto Nacional de Ecología (INE) manages it within SEMARNAT. The resulting management program is a joint work program for an integrated team made up of government agencies, academic institutions, and local nonprofit organizations.

Reserva de la Biosfera Alto Golfo de California y Delta del Río Colorado

The allotment of water rights along the Colorado River has altered the ecosystems of the upper Gulf, which has spurred efforts over the past 45 years to protect this expansive area. The need to design and implement a conservation program in the area was first highlighted in 1955 when the Mexican Office of Fish and Related Industries decreed the Upper Gulf area a Refuge Zone (Alto Golfo 2004). Various decrees were made throughout the following 37 years, often propelled by concerns over the threatened Totoaba and the related harmful fishing practices. By 1992, the Technical Committee for the Preservation of the Vaquita and the Totoaba in the Upper Gulf of California Reserve was established (the Vaquita and the Totoaba are the two most notable threatened species in the area). These events and actions culminated on June 15, 1993, when the expansive delta of the Colorado River and the many surrounding wetlands, estuaries, and desert ecosystems were formally protected as a U.N. Biosphere Reserve.

The reserve covers more than 1 million ha (2,308,847 acres) and is largely made up of sand dunes, halophilic scrub, intertidal mudflats, and estuary ecosystems. The varied ecosystems that fall within the reserve make it distinct. These ecosystems include: desert sand dunes, salt marshes, estuaries, and near shore marine life. This is the third marine reserve in Mexico but the first that contains a large marine area and the participation of two states (Baja California and Sonora) and the federal government. The reserve is significant for its specific geological, biological, and marine qualities. Many endemic species exist there, including the aforementioned Gulf of California

harbor porpoise, or the Vaquita, and the Totoaba, both of which are threatened species. It also serves as a nursery for many marine species, as well as a resting-place for a variety of migratory birds that migrate in large numbers.

Given the reserve's status as a biosphere, it has designated core and buffer areas. The core area occupies more than 200,000 ha (407,005 acres) and the remaining nearly 1 million hectares (1,901,841 acres) are designated as its buffer zone. Thirty-three percent of the area is federal land, 62% is categorized as ejido land, 2% is state owned, and 3% is unaccounted for. Management of the reserve includes a partnership of state agencies, local communities, and academic institutions under the supervision of federal authorities.

Imperial National Wildlife Refuge

The Imperial National Wildlife Refuge, which contains a mere 12,000 ha (25,125 acres) of land, is miniscule when compared to its more than 1 million ha (2,308,847-acre) "sister area" on the gulf to the south. Despite its small size, it is a key connection to the Alto Golfo Biosphere Reserve because it is the southern-most wildlife refuge in a chain of national wildlife refuges along the Colorado River. These refuges – through management at Havasu, Bill Williams, and Cebola – also participate in partnership projects with Imperial NWR and the Alto Golfo Biosphere Reserve. Imperial lies along the Colorado River, approximately 56 km north of Yuma. It is the only protected area named in the pilot project that does not actually lie directly on the U.S.-Mexican border. However, it was included in the LOI to provide a northern connection to the Alto Golfo area, and a large part of its migratory bird population finds temporary residence in both areas. This refuge represents the last non-channelized section of the Lower Colorado River and is characterized by an array of wildlife, primarily: waterfowl, marsh and waterbirds, shorebirds, songbirds, mule deer, and desert bighorn sheep. The U.S. Fish and Wildlife Service manages and maintains the refuge.

U.S.-Mexican Borer Environmental Cooperation on the National Level

Crossborder cooperation between the United States and Mexico has been relatively successful over the last 150 years. Despite significant differences in cultural and economic attributes, the two nations have been able to solve border-related issues and problems fairly amicably. This is due in part to the geographic location of the border region, which lies hundreds of miles away from both respective central governments, which enables a degree of local autonomy. Until the last decade, this distance between the U.S.-Mexican border and both countries' capitals has allowed central policymakers to maintain a sort of peripheral attitude regarding the border region, one that has attached less importance to the region than other regions of each country. However, as industrialization, development, and population have increased along la frontera, so have a plethora of social, political, economic, and environmental issues.

As a result, policymakers in Mexico City and Washington, D.C. have had to take a more active role in governing the binational affairs that pertain to the distant border. Ironically, in creating national policy that is designed to manage the border regions' problems, opportunities have arisen for more local and regional collaboration and cooperation. In fact, the inability of the central governments to adequately manage or even address border issues from afar has led to the formation of a complex network of cooperative efforts among local, state, tribal, and federal officials; various government agencies; NGOs; and communities on both sides of the border.

Most attempts to coordinate natural protected areas along the border before 1983 were unsuccessful (Table 2). In 1983, the federal governments signed what is commonly referred to as the La Paz Agreement, making such issues a concern of both central governments. Since the La Paz Agreement, the pace has quickened in the establishment of binational accords to address border environmental issues, and more specifically, protected areas' management along the U.S.-Mexican border. The signing of NAFTA elevated environmental concern for the border among U.S.-Mexican relations, culminating in the Integrated Border Environment Program, the subsequent

Border XXI Program in 1996, and finally, in the current Border 2012 Program. Border XXI was presented as a comprehensive plan for protecting public health and the environment along the U.S.-Mexican border. Border XXI was a five-year program that ended in 2000 and the current border environmental program, Border 2012, has replaced it.

It was within the Border XXI context that the Letter of Intent to Cooperate on Border Region Protected Areas was signed in May 1997. This LOI, signed by then-Interior Secretary Bruce Babbit and then-SEMARNAT Secretary Julia Carabias, stated an intent to expand upon the existing activities on the conservation of contiguous protected areas. Moreover, at the time, the LOI named the Border XXI Natural Resource Workgroup the monitoring body for such activities.

The information in Table 2 is by no means an exhaustive list of agreements signed by the United States and Mexico for addressing border issues. In fact, there have been many other accords, memoranda, and agreements that have dealt with specific border-related problems, such as hazardous waste, endangered species trade, solid and residual waste management, and drug enforcement. The agreements shown do, however, provide the framework within which the various states, agencies, communities, and other stakeholders along the border negotiate their strategies and actions. It is also this broad understanding of cooperation between both countries' central governments that has allowed such an extensive network of local binational cooperative relationships to flourish both within and around the various protected areas. Without such a framework, local initiatives would be hindered because legal restrictions would require central government approval for each and every action.

U.S. Natural Protected Areas Management

Because the United States does not have one overriding policy for natural protected areas, no one systematic approach to protected area conservation exists. Responsibility for protected areas' management falls under a number of agencies within DOI, each of which attempts to manage each area or responsibility with respect for the

area's unique qualities and attributes. Through its agencies, DOI manages nearly 5 million ha (10 million acres) of land within 100 km of the border. NPS, FWS, and BLM are the agencies that are primarily responsible for protected areas. However, other bureaus within DOI also provide services and have other responsibilities within the border region. Thus, responsible agencies include NPS, BLM, FWS, Bureau of Reclamation, Minerals Management Service, U.S. Geological Survey, and Bureau of Indian Affairs (BIA).

These agencies manage 37% of the total land that borders Mexico (Table 3 outlines responsibilities). However, while each of these seven agencies falls under the umbrella of DOI, these agencies' responsibilities, administration and management styles, land use priorities, and cultures differ quite dramatically. Additionally, other federal agencies not under the DOI umbrella, including the Department of State, International Boundary and Water Commission (IBWC), U.S. Department of Agriculture (USDA) through the Forest Service, and the Department of Defense (including its Army Corps of Engineers and its individual services' bases), either control land or are involved in initiatives along the border.

The lack of a national comprehensive ecosystem management plan or umbrella agency has created some problems in promoting cooperative stewardship across respective administrative boundaries within the United States. Subsequently, this has created some obstacles in the coordination of land use planning with Mexico and with the indigenous nations in the area, such as the Tohono O'odham and Cocopah Nations in the Sonoran Desert. On the other hand, if all protected areas were managed the same way – for example, as a park, wildlife refuge, or national forest – the unique qualities of any specific area might not be adequately addressed. For example, the protected areas on the U.S. side that are part of the pilot project established by the 1997 LOI fall under various protected areas status and have varying management agencies. However, coordination among and within the agencies mentioned above, coordination among these agencies and their counterparts in Mexico, and coordination within Mexico's agencies, is critical in adjacent natural protected areas management. Government-level coordination occurs through a number of mechanisms.

Table 2. Federal Binational Agreements Between the United States and Mexico Relevant to Protected Areas' Management

Year	Agreement
1944	Treaty Relating to the Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande signed
1966	La Comisión para el Desarrollo Fronterizo y la Amistad (CODEF) established (it dissolved less than one year later)
1983	Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area (the La Paz Agreement) signed
1984	FWS and SEDESOL sign an accord for cooperation in wildlife conservation
1988	Memorandum of Understanding on Cooperation in Management and Protection of National Parks and Other Protected Natural and Cultural Heritage Sites (between FWS and SEDUE)
1992	Release of the Integrated Border Environment Program (IBEP) 1992–1994
1993	U.S. and Mexico agree to conduct a joint field study of Big Bend National Park
1994	"NAFTA environmental side agreement (the North American Agreement on Environmental Cooperation, NAAEC) signed"
1994	Memorandum of Understanding between the U.S. National Park Service and the Instituto Nacional de Ecología (INE) signed
1995	Letter of Intent signed by DOI and SEMARNAT counterpart to work together in protected areas management

Sources: Authors

Table 2. continued

Year	Agreement
1995	Memorandum of Understanding Concerning Scientific and Technical Cooperation on Biological Data and Information signed
1996	USGS and INEGI sign agreement to cooperatively acquire compatible aerial photography for the entire border region
1996	Border XXI Program (building on IBEP) begins
1996	"Memorandum of Understanding to Establish the Canada/Mexico/United States Committee for Wildlife, Plants and Ecosystem Conservation and Management signed"
1997	Letter of Intent to Cooperate on Border Region Protected Areas signed
May 1997	Memorandum of Understanding between SEMARNAT and U.S. Department of Agriculture (USDA) on forest cooperation signed
June 1999	Wildfire Protection Agreement between SEMARNAT and USDA for the common border signed
June 1999	Joint Declaration made between SEMARNAT and DOI to work jointly in the Upper San Pedro River Basin
May 2000	Memorandum of Understanding between SEMARNAT and DOI to work jointly in environmental protection and conservation signed
May 2000	Agreement made between SEMARNAT and National Park Service on cooperation in management and protection of national parks and other protected natural areas

Sources: Authors

Table 3. Major U.S. Agencies Involved in Management of Natural Protected Areas

Agency	Department	Internet information	Mission	Land	Year Established
Forest Service	Department of Agriculture	http://www.fs.fed.us/	"Recreation, timber harvesting, livestock grazing, fish and wildlife habitat, and wilderness"	100 million hectares (about one-half forested areas)	1905
Bureau of Land Management	Department of the Interior	http://www.blm.gov/	"Recreation, timber harvesting, livestock grazing, fish and wildlife habitat, and wilderness"	130 million hectares (mostly range lands)	1946 (from the combination of the General Land Office [1812] and the Grazing Service [1934])
Fish and Wildlife Service	Department of the Interior	http://www.fws.gov/	"Conservation and protection of fish and wildlife"	40 million hectares	1939
National Park Service	Department of the Interior	http://www.nps.gov	"Preserving, protecting, and interpreting the natural, cultural, and historic lands and resources of the nation"	35 million hectares	1916

Source: Cody 1995

Mechanisms for Cooperation

In order to promote a more systematic approach to border-related activities, on August 11, 1994, the seven agencies listed above signed an Environmental Charter. This charter recognized the need for a "comprehensive, integrated inter-bureau approach to working cooperatively with Mexican counterparts in the shared responsibility for monitoring, preserving and managing the U.S.-Mexican shared border ecosystems," according to the DOI website. Before this charter, many of the agencies had been working with Mexico on specific projects for decades. This charter marks the first time, however, that the DOI formed a cohesive unit for the monitoring and coordination of each of the activities of the nine agencies, in order to better use resources among them and to generally work more efficiently to address border environmental problems with Mexico. The first article of the charter formally established the DOI U.S.-Mexico Border Environmental Issues Field Coordinating Committee, which oversees 10 inter-bureau "issue teams" (GNEB 1998). These issue teams have representation from the various agencies that have a relevant interest in each specific issue area. Each team is defined to address a specific problem area or topic, which can range from environmental education to the research and management of shared water resources.

One of the issue teams has as its defined priority U.S.-Mexican "Sister Areas," and is specifically charged with collaborating with Mexican counterparts in the design and management of protected areas along the border. The DOI bureau agencies that participate in this team are BLM, FWS, BIA, and NPS. These agencies collectively control nearly 5 million ha (10 million acres) of land within 100 km of the border. This issue team is involved in various activities within the three contiguous protected areas examined in this chapter. However, while a number of successful collaborative efforts have occurred in the past, recently the agencies appear to be less focused on multi-partnering (Ness 2004).

The U.S. agencies most involved in land management along the border are NPS, FWS, BLM, and the Forest Service. NPS is the most visible, as it manages five units directly on the border. NPS employees and their Mexican counterparts had been informally working

together for many years on protected areas management along the border. However, in 1988, such efforts were formalized with the signing of the MOU. Spurred by the MOU, in 1991, NPS established the United States-Mexico Affairs Office (MEAF) to promote information exchange among all NPS units along the border, as well as to strengthen cooperation with Mexico. MEAF serves as the lead office for the coordination of international conservation projects among NPS, the National Institute of Anthropology and History of the United Mexican States, SEMARNAT, and among other organizations in Mexico and the United States (National Park Service 2004). NPS is the most visible and active agency that engages in collaborative planning with Mexico and it is the only agency of DOI that maintains an office that is dedicated to this purpose. NPS has signed a number of MOUs with Mexico, the most recent of which was an NPS-CONANP (Comisión Nacional de Áreas Naturales Protegidas) Joint Work Plan, which was signed at the Binational Commission meeting in 2002. NPS also signed an MOU in 2000 to extend a crossborder program of technical exchange and cooperation for five years. This program dates back to 1997 (National Park Service 2004).

Nonetheless, while the various U.S. agencies do attempt to coordinate programming that relates to natural protected areas along the border, a confusing mosaic of activities exists among, between, and within various agencies, which makes it difficult to clearly define one overall cooperative strategy. The Good Neighbor Environmental Board (GNEB) was created to present an overall view and to advise the U.S. President and Congress on environmental needs of the border (GNEB 1998). The board is comprised of representatives from appropriate government agencies, from the four border states, and from private and nonprofit organizations. The board meets annually with its Mexican counterpart, Region I of the Mexican National Advisory Council for Sustainable Development, and it submits annual reports to the U.S. government.

The Federal Relationship

While DOI maintains contacts with SEMARNAT, it is DOI's agencies that appear to move the crossborder work forward. The agreements DOI has signed with SEMARNAT provide a framework within which its agencies are free to move about and to conduct their work, but the larger DOI does not micromanage their work. The strongest crossborder institutional bonds appear to exist at the lower agency level among the managers working in the border region. DOI gives a great deal of autonomy to its field offices (Ness 2004) and, in a sense, relies on each of its agencies working on border projects to manage their relationships with Mexico on an agency-to-agency level.

Since signing the LOI in 1997, DOI and SEMARNAT have gone on to sign a number of other border environment-related agreements to further work in adjacent protected areas management. These agreements include declarations to work cooperatively in the Colorado River Delta, the Upper San Pedro River Basin, and in the Rio Grande/Río Bravo. The agreements also include a successful initiative for managing wildfires in the borderlands. All of these declarations of cooperation were signed from 1999 to 2000, highlighting the positive working relationship held by Babbit and Carabias. The strong bond that had been developed between these two leaders should not be underestimated in its ability to foster new cooperative agreements between the two countries (Harris, et al. 2001). Relationship-building plays an integral role in the development of successful crossborder initiatives.

Since 2000, DOI has undoubtedly been working under a new set of constraints than it was when it signed the LOI in 1997. These constraints, along with the change in administrative relationships since 2000, have led to a relative decline in such agreements. The passage of NAFTA was still fairly recent and a great deal of attention was being devoted to the potential affects of increased trade on the binational border environment. This attention translated to funds for the agencies responsible for managing natural resources on the border and to support of and encouragement for further developing crossborder relationships and programs to address environmental woes in the borderlands.

Currently, DOI is operating within a very different context – one overshadowed by national security concerns and terrorist threats. Nationally, this has translated to a shifting of funds away from protected areas management (and many other resource issues) toward initiatives and programs to further secure the borders. This does not necessarily mean that those working along the border have been directed against seeking crossborder solutions to border resource issues, but it does mean that attention is no longer focused on these endeavors. Nonetheless, those land managers working in protected areas management adjacent to the border are continuing their work toward binational collaborative initiatives, albeit without the level of fanfare or resources once received (Ness 2004).

The Trilateral Committee and the U.S.-Mexico Binational Commission

The Canada-Mexico-U.S. Trilateral Committee for Wildlife and Ecosystem Conservation and Management is another federal-level mechanism for communication and cooperation in this arena. This committee was established in 1996 through an MOU, and it works towards the coordination, cooperation, and development of partnerships among the three countries' wildlife agencies. FWS is the United States' main participatory agency in this committee, which functions through a number of working tables. One of those tables is the Wildlife Without Borders-Mexico program, which was developed through FWS and SEMARNAT. This program supports a number of projects related to training, ecosystem management, and information and technology exchange both in the border region and in nature reserves in other areas of Mexico.

The U.S.-Mexico Binational Commission is specific to the U.S.-Mexican relationship. This commission is a mechanism that is maintained through the U.S. Department of State for the high-level discussion of any number of topics that relate to cooperation between the United States and Mexico. The commission meets annually, alternating between Washington, D.C., and Mexico City, and topics discussed vary from year to year. Cabinet officials and agency chiefs from both nations also meet in working groups to deal with

specific topics (U.S. Department of State 2003). The working group for natural resources typically deals with questions relating to adjacent natural protected areas.

While topics related to national security, immigration, and economic development have dominated discussions at the most recent Binational Commission meetings, the natural resources working group has maintained an ongoing dialogue on resource issues along the border. Some recent actions include a Joint Action Plan, which was signed at the annual meeting in 2002 to encourage exchanges and cooperation among national parks throughout the two countries. Additionally, in 2003, a Wildfire Protection Agreement was signed (U.S. Newswire 2003) and a continued vow of support for the Wildlife Without Borders program was declared. Most recently, at the last meeting of the natural resources working group, participants discussed the potential to give sister parks status to a number of protected areas in the border region (Clark 2004). This was based in part on Interior Secretary Gale Norton's request to name at least one new set of border sister-parks in 2004. Potential sister-park areas include the many areas that are already conducting some level of collaborative work, such as the Saguaro National Park in the United States with the San Pedro Martir Protected Area in Mexico, and the Coronado National Memorial in the United States with El Chico Protected Area in Mexico (Ness 2004).[2]

Border XXI to Border 2012

From 1996 to 2000, Border XXI provided a framework for the U.S. and Mexican federal entities that were responsible for the border environment to work cooperatively in addressing environmental protection and natural resource management along the U.S.-Mexican border. It did so through the establishment of nine workgroups, the Natural Resources Workgroup being the most relevant for this discussion. At the closing of this five-year program, evaluations and recommendations were made regarding the success of each workgroup and the design and foci of the new program. Overall, those involved agreed that Border XXI was successful in deepening cooperation on border environmental issues as a whole, and that many achievements were made in natural resource management in

the border region.[3] The Natural Resource Workgroup served as a positive forum for the many U.S. agencies working on the border to communicate with each other and with their counterparts in Mexico. However, while the workgroup did provide a forum for improved federal agency communication on border environmental issues, it did a less effective job of integrating state, local, and tribal officials into its structure – something that agencies on both sides of the border are still working to improve.

Border 2012 looks significantly different than Border XXI, the most striking difference for this discussion being the absence of any group related to natural resources or natural protected areas. This is primarily because DOI, which is the federal umbrella agency for most U.S. resource management agencies, opted out of mandating the participation of its various agencies in the Border 2012 program. Since DOI agencies are responsible for most of the protected areas on the border, it made it much less likely that Border 2012 could address resource protection issues without those agencies at the table. It should be noted that DOI has encouraged its agencies to participate on a voluntary level, if they have the resources available (Clark 2004). However, DOI maintains its own mechanisms (primarily DOI's U.S. Mexico Border Field Coordinating Committee [FCC] and MEAF) for managing and promoting cross-border initiatives in these areas and in some cases, Border 2012 would be a redundant use of its limited resources (Fege 2004).

Current State of Crossborder Cooperation

The original purpose of the 1997 LOI was "to empower local land managers from both countries to exchange information and work together (DOI 1997)." This LOI, in concert with the many other such federal agreements, has had a positive effect on protected areas management in the border region, and as a whole, there are more collaborative efforts visible in the pilot areas than in other areas of the border (Clark 2004). However, it is impossible to give credit to any one agreement or agency for the many projects, programs, initiatives, studies, management plans, and collaborative training programs that have been undertaken. Likewise, it is unclear whether the

success in binational cooperation in the pilot areas is due to the support received through the LOI, or if the LOI named the two pilot areas because of the existing successful crossborder relationships already established.

The agreements in place seem to have encouraged efforts toward:

- Technical data exchange
- Human resource development programs
- Environmental education
- Research regarding invasive plant removal
- Reintroduction of disappearing animal species
- Field trip-type exchanges
- International forums for land managers from the United States and Mexico

Such efforts continue to thrive in the border region, even in the current atmosphere of tighter border control. The U.S. agencies working in this arena appear to access each other as needed, when they must work together to achieve common goals. Each specific program or project will not be listed for the purposes of this chapter, as there are too many to describe here. Overall, crossborder efforts tend to be issue-specific, and they encompass stakeholders from both north and south of the border and usually do not span an east-west spectrum. Instead, they are targeted at a particular location or area along the border.

Chihuahua Desert Pilot Area

This area includes the following five natural protected areas:

- Big Bend National Park in Texas
- Big Bend Ranch State Park in Texas
- Black Gap Wildlife Management Area in Texas
- Maderas del Carmen Flora and Fauna Protected Area in Coahuila
- Cañón Santa Elena Flora and Fauna Protected Area in Chihuahua

Attempts to collaborate on natural resource protection in these areas date back to 1935, long before the establishment of the protected areas on either side of the border. At the time, the two governments discussed the possible establishment of an International Peace Park. These discussions have resurfaced a number of times over the years. Most recently, the National Parks Conservation Association supported the idea of creating an International Park in a report that highlighted the need for more funding in Big Bend National Park. Establishing such a park goes beyond naming the areas as sister-parks, a status they already enjoy given the 1997 LOI and their willingness to work collaboratively in those areas.

The establishment of an international park would require a more formal agreement, authorized by the Congress of the United States and by Mexico, to jointly manage the adjacent protected areas as one park. This would imply that while recognized, international boundaries would not separate the park in the way they currently do. While efforts are being made by some to encourage Congress to enact legislation to create an international park for the Big Bend/Maderas del Carmen/Cañón Santa Elena adjacent protected areas (LoBello 2004), it appears unlikely that such a designation will occur in the near future. In fact, quite the opposite has occurred, as a number of border entry points within these park areas have been closed since September 11, 2001, further isolating the areas as opposed to integrating them (Davila 2004).

Specific binational activities that relate to species research, wildfire management, air quality monitoring, invasive plant removal, and training and outreach continue to occur. The "Diablos Firefighting Program" has been particularly lauded as a successful cooperative venture and regular, binational patrols of the Rio Grande have been as recognized and lauded. However, no cohesive cooperation on overall ecosystem protection nor development of collaborative management plans currently exist.

Most recently in the Big Bend area, binational efforts to address issues in the Rio Grande/Río Bravo basin and its tributaries have emerged. A number of efforts are underway among both federal agencies and environmental groups interested in attaining a balance between the competing water demands on this system. In 2000, DOI and SEMARNAT signed a Joint Declaration to work collabora-

tively to protect the ecology of the river (DOI 2000). This effort, led by IBWC and supported by its Mexican counterpart, Comisión Internacional de Límites y Aguas (CILA), as well as by other agencies, is addressing concerns over declining water quality and quantity, habitat degradation, and development pressures on the river (Spener 2004). However, IBWC has had difficulty responding to the implications of greater water demand on the river (Kelly and Szekely 2004) to balance environmental and human needs, and has been criticized for not truly engaging other stakeholders, such as environmental groups, research institutions, and local landowners, into its processes.

Western Sonoran Desert Pilot Area

This region was also named in the 1997 LOI and includes the following protected areas:

- Organ Pipe Cactus National Monument
- Cabeza Prieta National Wildlife Refuge
- Imperial National Wildlife Refuge
- Special management areas administered by BLM
- Alto Golfo de California y Delta del Río Colorado Biosphere Reserve in Baja California and Sonora
- El Pinacate y Gran Desierto de Altar Biosphere Reserve in Sonora

Binational collaboration in these areas has continued to progress and the positive working relationships that were established both before or as a result of the 1997 LOI have further solidified. The Tohono O'odham Nation continues to be an active partner in general planning activities as well as some specific initiatives, and NGOs, such as the Sonoran Institute, the International Sonoran Desert Alliance, the Arizona-Sonora Desert Museum, The Nature Conservancy, and Pronatura, among others, are active in these protected areas (EPA 2001). Successful collaborative efforts include:

- Flora and fauna surveys on both sides of the border that will help accurately assess populations and migratory routes
- Various species monitoring and vegetation inventory projects
- Geographic information system (GIS) data sharing

- Land manager training programs and exchanges
- Training programs to enlist local landowners in protection and management of sensitive ecosystems
- Programs aimed at developing opportunities for ecotourism and sustainable income generation
- A great deal of hydrologic, flora, and fauna studies to support riparian habitat restoration of the lower reaches and the upper delta of the Colorado River

Again, the projects are too numerous to be listed here, and in most cases each project has a number of participatory stakeholders involved.

Colorado River Delta

The response to environmental issues in the Colorado River Delta exemplifies how the United States and Mexico have failed to assert common goals for a difficult binational environmental issue, and how other non-governmental stakeholders are working to fill the policy vacuum.

Work in the Colorado River Delta has particularly flourished since the signing of the LOI. Currently, more than 20 nonprofit and academic groups are actively working to restore the delta (Marcos and Cornelius 2004). In addition, Mexican public agencies are working closely with these groups. For example, CONANP continues to provide leadership for the reserve. Additionally, the Sonora Institute for the Environment and the Instituto del Medio Ambiente y el Desarrollo Sustentable (IMADES), which are also actively involved in its management and protection. IBWC-CILA also maintains a Colorado River Delta Workgroup, which has conducted hydrologic studies and restoration feasibility studies (Spener 2004). IBWC and CILA are the appropriate federal agencies to address this issue, but until now they have only attempted to address the environmental symptoms that are caused by the lack of water for the riparian ecosystem. They have not made strides in determining innovative ways to assure water delivery to the delta.

To a great extent, the health of the delta ecosystem depends on the availability of water that flows down through the final reaches of the Colorado River. Unfortunately, the Upper Basin states' water demands are increasing during the same time the Colorado River Basin is facing a long-term drought, which makes it less likely that surplus flows will be delivered to Mexico and the delta. The Lower Colorado Multiple Species Conservation Program was established to address critical habitat issues along the Colorado River in the United States. The development of this plan has moved forward significantly since 1997 and was projected to be finalized by the end of 2004. This plan, however, does not address habitat south of the border and has been criticized for not integrating Mexican participation into the process. Although, many individuals involved in this process are also involved in restoration efforts in Mexico and all the data derived through this program will be available to Mexico (Harris 2004).

The current efforts of environmental groups and other stakeholders in the delta are remedying the environmental issues that resulted from a lack of proactive and innovative bilateral solutions. However, a consummate solution to the problems facing the delta would ensure a consistent flow of water to the region. Given the highly politicized nature of Colorado River water rights, the United States and Mexico have been unable or unwilling to develop any creative policy to fully remedy the problem. As stated by Cornelius, et al. (2004), "absent affirmative, cooperative political action by the governments of the United States and Mexico, it seems likely that both the quantity and quality of water available to support the Colorado River Delta will continue to decline."

Funding Protected Areas Management in the Border Region

Funding woes have long been an issue in natural resource management along the U.S.-Mexican border. Usually, discussions on this issue refer to the lack of resources on the Mexican side. While there is still a relative lack of human and capital resources for protected areas management in Mexico, some significant gains have been made. Since 1997, Mexico has dedicated larger amounts of federal

funding to Mexico's CONANP and has successfully sought outside funding through such organizations as the Global Environmental Facility and international nonprofit conservation groups (Gonzalez-Montagut 2003). Protected areas are still pressured to generate funds through tourism, to increase stakeholder involvement, and to promote local stewardship to alleviate some of the burden of managing natural protected areas throughout Mexico. However, in recent years, CONANP has made great strides in developing management plans and undertaking ecosystem restoration activities in many of its natural protected areas.

In the United States, agencies responsible for protected areas management have seen funds shift away from resource management areas toward programs and initiatives that are aimed at border defensive strategies. In general, DOI has a growing law enforcement focus, as some of the areas it manages along the border have become increasingly dangerous for its land managers. According to National Park Service staff, this has not negatively affected its partnerships with Mexico, just changed the realities of its daily activities on the U.S. side of the border (Ness 2004).

From a funding perspective as well as to achieve a more holistic approach to environmental management, stakeholders not affiliated with government agencies continue to play an important role in resource management in protected areas on both sides of the border. This includes local landowners, tribal nations, NGOs, and universities and research institutions from both sides of the border and internationally. The agencies responsible for protected areas are working to better include these groups because they bring valuable ideas and resources to the table, and in some cases, own land in or around the protected areas themselves.

Conclusions

Given their inconsistent, often incongruent legal systems, cultures, and resources, it is difficult to even imagine genuine cooperation between the United States and Mexico on natural protected areas. In the United States, there remains a plethora of agencies with different and sometimes conflicting responsibilities. These agencies are usually under-funded when their conservation mandates are consid-

ered. Meanwhile, Mexico's natural protected areas policy is more centralized, which can create as many problems as the United States' relative chaos does. Environmental authorities on both sides of the border are short on human and capital resources that could be used for a true natural resources effort in protected natural areas. While both nations are adding land to their natural protected areas systems, there is a continuous loss of and threat to natural protected areas from encroachment – both by outsiders and through serious land tenure conflicts. In Mexico, the land in natural protected areas in the border region is primarily private property or ejido/communal lands over which the government has less control. In the United States, state and federal entities often compete for authority over conservation efforts. These lands are variously controlled by a diverse set of stakeholders, including indigenous communities, peasant farmers, fishermen, ranchers, and miners, among others. As a result, both federal governments are subject to constant pressure for land use change. They are faced with a lack of sustainable development options and are instead saddled with a situation that has resulted from many decades where little attention was paid to protection and financing of their natural protected areas. Successful protection of natural resource areas requires:

- Information collection, dissemination, and exchange
- Similar goals across administrative boundaries
- An approach that is broad and ecologically based
- Stakeholder input (from communities, NGOs, government, and private landowners) and a long-term vision
- The willingness of individuals (or governments, in this case) to cede some control, as well as social and cultural understanding of management tactics on the other side
- An ability to identify the nature of any conflicts
- Workable solutions that include local partnerships
- The support of the national governments to implement and monitor solutions

That being said, adjacent protected areas management along the U.S.-Mexican border is flourishing and progressing, thanks to the dedication and tenacity of local NGOs, landowners, border communities, and land managers. Despite a shift in national attention away

from fostering environmental cooperation and toward efforts to protect borders from potential threats to national security, those working on the ground continue to seek partnerships, exchange information, and work to develop new sister-park designations with counterparts in Mexico. Institutional relationships remain intact, largely due to personal relationships built over many years and supported by a number of government-to-government agreements, letters of intent, and declarations to work together to preserve, protect, and enhance this shared border environment. In this vein, while the 1997 LOI has not necessarily been a lightning-rod for the cooperative management of the pilot areas, it has certainly served as a tool that provides legitimacy, support, and encouragement for new collaborative efforts to flourish along the border. Ultimately, it is such high-level agreements that provide a framework and allow local initiatives to occur. Likewise, the work being undertaken by land managers; local, state, and federal agencies; NGOs; and others in protected areas along the border help meet the goals of these overarching federal agreements.

Consequently, there are many opportunities for more cooperation. The two countries can continue to build on joint commitments on environmental and conservation issues. There is certainly more room to engage the private sector and non-governmental and conservation organizations in these efforts. Mexico and the United States can also look to jointly manage and monitor the ecological impacts and benefits of tourism and other economic development in these natural protected areas. The two nations can jointly develop adequate and environmentally sound transportation, infrastructure, and financing for tourism. In doing so, they can share techniques that reconcile consumptive and non-consumptive multiple uses of natural resources (e.g. forest management). Finally, and perhaps most importantly, the logic behind crossboundary stewardship should be established in the collective government consciousness – natural ecosystems do not recognize administrative boundaries, and boundaries themselves often pose the greatest threat to the area they are serving to protect.

Endnotes

[1] At the time of signing, the Mexican agency responsible for protected areas management was the Secretaría de Medio Ambiente, Recursos Naturales y Pescas (SEMARNAP). This agency has since changed its name and is now called the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT). For simplicity, the authors will use the acronym SEMARNAT for references both past and present.

[2] The notion of establishing a sister-park relationship differs from that of establishing an International Park, which has also been discussed over the years and is still being sought in the Big Bend/Maderas del Carmen/Cañón Santa Elena area by a number of non-governmental groups.

[3] For a list of accomplishments and programs cited by the Natural Resources Workgroup at the end of Border XXI implementation, see EPA 2001.

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III

GIS Mapping of Areas of Critical Ecological Concern on the U.S.-Mexican Border: Selected Binational Watersheds

Christopher Brown, Robert Czerniak, and Christopher Buscaglia

Abstract

Contemporary urbanization and economic development patterns in the U.S.-Mexican borderlands are generating increasing pressures on the viability of important ecosystems. Binational watersheds in the U.S.-Mexican border region are especially important and interesting areas of concern. In this research, the authors employ the use of geographic information systems (GIS) to map the physical geography of five target basins in the U.S.-Mexican borderlands, to introduce specific topics of concern to the ecosystems involved, and to provide some initial ideas about protecting regional areas of ecological concern in the face of mounting development pressures. The outcomes of the project include a GIS-based poster that highlights the five study areas, a website hosted at http://www.scerp.org that provides an overview of the project, and this monograph chapter that describes the project in greater detail.

Mapeo SIG de Zonas de Preocupación Ecológica Crítica en la Frontera México-E.U.: Cuencas Binacionales Seleccionadas

Christopher Brown, Robert Czerniak y

Christopher Buscaglia

Resumen

La urbanización contemporánea y los patrones de desarrollo económico en tierras de la frontera México-E.U. están aumentando las presiones sobre la viabilidad de ecosistemas importantes. Las cuencas hidrográficas binacionales en la región entre México y los Estados Unidos representan zonas de especial importancia e interés. En esta investigación, los autores utilizan sistemas de información geográfica (SIG) con miras a: trazar un mapa de la geografía física de cinco cuencas seleccionadas de la zona fronteriza México-E.U.; introducir temas específicos de interés dentro de los ecosistemas en cuestión; y ofrecer algunas ideas iniciales sobre la protección de zonas regionales de preocupación ecológica ante las crecientes presiones del desarrollo. Los resultados del proyecto incluyen: un póster basado en SIG resaltando las cinco zonas de estudio; un sitio de Internet en www.scerp.org donde se presenta un panorama general del proyecto; y el presente capítulo monográfico que describe el proyecto con más detalles.

GIS Mapping of Areas of Critical Ecological Concern on the U.S.-Mexican Border: Selected Binational Watersheds

Introduction

Contemporary urbanization and economic development patterns in the U.S.-Mexican borderlands are generating increasing pressures on the viability of important ecosystems. Binational watersheds are especially important and interesting areas of concern (Brown 2003; Brown, et al. 2003; GNEB 2000; and EPA and SEMARNAT 2003). Because of the importance of water to ecosystem health in the region, Southwest Consortium for Environmental Research and Policy (SCERP) researchers in the Department of Geography at New Mexico State University (NMSU) have undertaken a geographic information system (GIS) mapping project that highlights several binational watersheds on the U.S.-Mexican border, details the physical geography of these basins, introduces relevant issues of ecological concern, and provides some preliminary ideas for how to meet the challenges of retaining ecological integrity in the face of the contemporary development pressures that these regions face. The five areas that this project investigates are:

- The Colorado River Delta that lies in the lowermost portion of the Colorado Basin and empties into the Sea of Cortez
- The confluence of the Río Conchos and the main stem of the Río Bravo/Rio Grande near Ojinaga, Chih.
- The Upper San Pedro Basin that lies within the Sonoran Desert along the Arizona-Sonora segment of the border
- The Tijuana River Watershed that lies on the California-Baja California segment of the westernmost U.S.-Mexican border
- The Upper Santa Cruz Basin that lies within the Sonoran Desert along the Arizona-Sonora segment of the border

The outcome of this project is threefold. Working with a variety of U.S.-Mexican border water and environmental researchers, project staff at NMSU produced a large-format GIS poster that highlights the GIS maps at the heart of this work. This poster was presented and distributed at Border Institute VI in Rio Rico, Ariz., in April 2004. Project staff also developed a website that features various elements of the mapping poster (see http://www.scerp.org). The website provides an alternative vehicle by which the data and related products of the research project can be accessed. Specifically,

this website serves the digital map products involved in the poster, discusses each region and the related ecosystem management challenges in some detail, serves the underlying GIS data and related metadata, serves the large-format poster in various digital graphic formats, and provides details on the sources of data and the contributing partners whose generous efforts made this project possible. Lastly, this chapter serves as a hard-copy companion product to the poster and website and describes the project in greater detail.

Mapping Elements

Working with colleagues at various SCERP institutions, governmental agencies, and non-governmental organizations (NGOs) in the United States and Mexico, as well as with a private-sector mapping firm in the United States, project staff developed a series of GIS maps that feature the basic foundational mapping layers of elevation, the major water bodies, the relevant jurisdictional and administrative boundaries, and the key protected natural resource areas. These maps provide a "snapshot" of the physical geographies of each of these basins. Details of the data employed and the numerous individuals and organizations that have collaborated on the project are provided in the poster and on the website. These mapping elements provide an overview of the larger border region and feature key locational elements to "paint the picture" of the borderlands. The website developed for the project also features these map elements and it provides access to select GIS data.

Key Issues of Ecological Concern

This chapter identifies several issues of concern that face each of the five regions that were investigated. These issues are not presented as the only or the most critical issues of concern, rather, these issues are introduced as points of discussion on which further research and discourse can be built. This chapter provides a regional view of these areas and issues of concern and focuses on the challenges that face each watershed, not on the general issues that can be more applicable throughout the entire border region. Based on preliminary research, the maps highlight ideas about how the underlying chal-

lenges may be met, and they focus on regional and watershed approaches that have been introduced or explored through previous research by the NMSU project team, through collaborators that have provided data for the project, and through researchers at other institutions. Each of these areas of investigation is discussed in detail below.

The Lower Colorado River Delta

Covering nearly 1 million hectares, the Colorado River Delta once extended from just north of the U.S.-Mexican border to the confluence of the Colorado River and the Gulf of California. Prior to the damming of the Colorado River, the delta was tremendously important for more than 300 species of resident and migratory birds, which depended on the delta for food and shelter. The plentiful fish and wildlife prompted the native Cocopah Indians to settle the area more than 1,000 years ago, where they lived off the bounty of flora and fauna and farmed the fertile soils. Sixty-five years of vigorous water management that was meant to satisfy agricultural, industrial, and urban needs in the United States and Mexico has reduced the delta to 10% of its original size (Sonoran Institute 2004; Cornelius, et al. 2004).

Specific Issues of Concern

The aggressive anthropocentric use of the river's waters over the last 65 years has transformed this ecosystem from a lush riparian delta into a region wholly altered by humans. Long-term drought in the Colorado River Basin is greatly reducing lower basin supplies to the point that maintaining flood flows that native forests need for survival along the river channel is increasingly unlikely. Increased demand for water among upper basin users threatens to exacerbate the general deterioration in ecosystem health.

Possible Solutions for Ecological Problems

The Sonoran Institute's Colorado River Delta Project is attempting to conserve and restore crucial stretches of the Colorado River and Delta, thus increasing riparian, wetland, and intertidal habitat while enhancing human livelihoods (Sonoran Institute 2004). The International Boundary and Water Commission (IBWC) has advanced the Binational Technical Task Force, which serves as a binational forum for U.S. and Mexican agencies and other stakeholders to cooperate in a formal framework (IBWC 2000). The Pacific Institute's Colorado River Delta-Upper Gulf Restoration Project seeks to apply the key concepts and criteria for sustainable water use developed in "California Water 2020: A Sustainable Vision" to the Colorado River Basin (Pacific Institute 2004).

The Confluence of the Río Conchos and Río Grande Rivers

The region defined by the confluence of the Río Conchos and the Río Grande is called La Junta de los Ríos in Spanish (Morgenthaler 2004). The Río Conchos is the largest of the Rio Grande's tributaries that flows in Mexico, and the Río Conchos Basin covers approximately 66,000 square kilometers, or 14%, of the total drainage area of the Río Grande Basin. Several large urban areas lie within the basin, and more than 1 million people rely on the waters of the Río Conchos. Several surface water impoundments have been built on the Río Conchos; these have a combined capacity of approximately 3.4 million acre-feet and meet a range of irrigation, hydro-electric, municipal/industrial, and flood control demands (Kelly 2001).

Specific Issues of Concern

From a water balance perspective, meeting the competing demands of irrigation, hydro-electric, municipal/industrial, and flood control is challenging, and the most recent period of severe drought has intensified these challenges. Crossborder issues are related to this set of challenges. The above-referenced drought and the manner in which Mexico has used the waters of the Río Conchos have caused

the country to amass a major water debt to the United States under the 1944 water treaty. Texas farmers allege that Mexico should be operating its reservoirs to meet international demand, while Mexican interests argue that these demands cannot be met during this period, which they argue is an "extraordinary drought." The larger issues in this binational basin concern how to balance the needs of regional economic development, traditional agricultural activities (both ranching and farming), and ecological preservation for water resources and management in a transboundary context.

Possible Solutions to Ecological Problems

Environmental Defense and World Wildlife Fund's Chihuahuan Desert Ecoregion Project have published analyses of current and future water use trends, worked to increase awareness of environmental water needs, and are working with local interests to identify specific options for the enhanced management and protection of the Río Conchos and the upstream portion of the Río Grande, which is often referred to as the Forgotten River (Kelly 2004).

The Upper San Pedro River Basin

The Upper San Pedro River is one of the last free-flowing rivers in the desert borderlands region. It supports a rich riparian corridor that is critical to local and regional biodiversity. The land contained within the San Pedro Riparian National Conservation Area is of particular biological value. The Conservation Area comprises approximately 18,000 hectares, which many migratory birds rely upon for habitat. The groundwater aquifer that supports the San Pedro River also sustains the municipal, agricultural, and industrial land uses that exist in the basin. Since the early 1990s, resource managers have recognized that the Upper San Pedro Basin and its natural resources are indeed binational in nature, which means the basin is of critical concern for this research project (Browning-Aiken, et al. 2002).

Specific Issues of Concern

Land use changes in the last 30 years have seen major grassland areas become mesquite shrub lands. The extraction of groundwater to meet urban and industrial demands is raising questions about the long term viability of the region's aquifers. This extraction of groundwater is also creating a negative effect on surface water hydrology and it is reducing the viability of the riparian areas in the basin. Poorly treated municipal wastewater and effluent from mines, which both flow from upstream areas, are decreasing groundwater quality.

Possible Solutions to Ecological Problems

Researchers in both the United States and Mexico recognize that the management needs of the river transcend the cultural, political, and economic differences that exist across the international border (Browning-Aiken, et al. 2002). The San Pedro Partnership is a consortium of 20 U.S. agencies and organizations that work together to meet the water needs of area residents while they protect the San Pedro River (San Pedro Partnership 2004). The Sonora-Arizona Regional Environmental Association is a group of teachers, doctors, mining engineers, attorneys, and citizens from the United States and Mexico who have come together to address the regional environmental issues in the basin (Browning-Aiken, et al. 2002).

The Tijuana River Watershed

The Tijuana River Watershed (TRW) is a binational river basin that lies on the westernmost section of the U.S.-Mexican border; approximately 30% of the basin lies in the United States and 70% lies in Mexico. The drainage basin of the river covers nearly 4,450 square kilometers and encompasses portions of the City and County of San Diego in the United States and portions of the municipios of Tijuana and Tecate in Mexico. Elevation in the basin ranges from mountainous areas that rise more than 2,000 meters to the coastal areas that lie at sea level (Brown 1998). The Tijuana River Estuary

is of particular interest in this hydrology. The estuary is a wetland-dominated coastal plain estuary that lies in the lowest reaches of the basin (Zedler, Nordby, and Kus 1992).

Specific Issues of Concern

Lack of adequate wastewater collection and treatment facilities in the Tijuana portion of the basin causes renegade sewage flows to negatively impact the lower reaches, the Tijuana River Estuary, and the health of the region's human inhabitants (Brown 1998). Uncontrolled and unmitigated urban sprawl that covers the area from Otay Mountain through the corridor between Tijuana and Tecate and south again to Rosarito causes many of the region's residents great concern (Comer 2004). The plan to further channelize portions of the river in Mexico is one specific impact of urbanization. This plan prevents these areas from being developed as urban river park corridors (Michel and Graizbord 2002).

Possible Solutions to Ecological Problems

Universities and public agencies from both sides of the border have combined their efforts to help address environmental problems in the TRW with a binational GIS database and with a water resource management program. Researchers at San Diego State University and Colegio de la Frontera Norte initiated this program, and the combined efforts of SCERP, the National Oceanic and Atmospheric Administration, and other regional and national agencies funded the program (Department of Geography, San Diego State University 2004). The Bight of the Californias Program encourages countries to develop or strengthen programs to address land-based sources of pollution to the marine environment, and the overall goal of this project is to establish the information and methodological bases for protecting the nearshore marine environment in the Bight of the Californias from land-based sources of pollution (SANDAG and CEC 2000). The TRW Visioning Program is an effort of a binational team of researchers and practitioners to develop baseline information for the watershed and to identify key stakeholders. The stakeholders are participating in the development of a binational vision,

or ideal state, for the Tijuana River Watershed and are helping devise strategies and options for achieving that vision (Tijuana River Watershed Binational Visioning Project 2004).

The Upper Santa Cruz River Basin

The Upper Santa Cruz Basin is a transboundary watershed that is located along the Sonora-Arizona section of the U.S.-Mexican border, and that houses the binational twin cities of Ambos Nogales (Nogales, Son., and Nogales, Ariz.) and the large urban area of Tucson, Ariz. (Brown 2002). Ambos Nogales has an estimated population of 200,000 people (INEGI 2001), making this binational conurbation a third to a quarter the size of Tucson and an urban region of increasing importance for regional water resource management. The Santa Cruz River originates in the San Rafael Valley, and from these headwaters the river flows in a southerly direction until it crosses the border just east of Lochiel, Ariz., and into Mexico. After flowing through agricultural regions in Mexico, the river crosses back into the United States, eventually flowing through largely channelized reaches in the Tucson urban area (Brown 2002).

Specific Issues of Concern

The largely unpopulated San Rafael Valley has experienced land fragmentation pressures as large areas of ranchland are sold for "ranchette" development, thus splintering this viable and stable grasslands region. Given the limited water resources and financial and human capital, as well as the increasing urban demands for water, the Mexican ranching areas face the mounting challenges inherent in maintaining the viability of agricultural activities. Reaches of the river that are downstream from the International Wastewater Treatment Plant in Nogales have wrestled with water quality issues because of the quality of the treated effluent that enters the river, even though this effluent is a major supply input into the regional water balance in this part of the river. Regional aquifer resources are experiencing increasing demands while Tucson and the Ambos Nogales region continue to extract fossil groundwater to meet urban water demands.

Possible Solutions to Ecological Problems

A range of stakeholders with an interest in preserving and promoting the cultural and natural heritage and landscapes of the valley are united by the vision of a congressionally designated Santa Cruz Valley National Heritage Area (Center for Desert Archeology 2004). The Center for Desert Archaeology, under collaboration with Western Mapping, Inc., and regional environmental educators and researchers, is leading the effort on the National Heritage Area. This work is based on a watershed approach to ecological and historical preservation (Center for Desert Archeology 2004). The Friends of the Santa Cruz River, the Santa Cruz River Alliance, the San Rafael Valley Association, and the San Rafael Valley Land Trust are also working in various parts of the basin to advance preservation and conservation efforts (Brown 2002).

Future Work

The overall goal of this project was to introduce the regions and the topics of concern in each, to demonstrate the usefulness of a watershed approach to these issues through a GIS framework, to explore the usefulness of GIS tools and data in examining these issues, and to stimulate a wider discussion among SCERP researchers and participants at Border Institute VI on the potential ways to meet the challenges these regions face. Out of this dialogue, specific future areas of research emerged and interested parties that can work together in collaborative research efforts were identified. This project stimulated efforts by which interested parties can collaborate on the development and sharing of geo-spatial data in these areas of investigation, on which future research can be conducted.

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IV

Sovereignty Bargains and Transboundary Natural Resource Management: Crossborder Perspectives for the U.S.-Mexican Border

Jaidev "Jay" Singh[1]

Abstract

The chapter presents a brief analysis of the complexities of natural resource management across international borders, starting with the political realities associated with terrestrial resources, including sovereignty. This discussion does not critically analyze the notion of sovereignty, but instead "unpacks" the term and introduces the concept of "sovereignty bargains," or opportunities that states make to enhance governance capacities in specific areas. The discussion also highlights the role that science plays in creating opportunities, through sovereignty bargains, for crossborder collaboration. Implicit in this discussion is that although the complexities and security concerns of a post-September 11th world may have created "harder" borders, an understanding of the role that science plays in creating sovereignty bargains may increase opportunities to address environmental and natural resource issues along the U.S.-Mexican border. The chapter also addresses general principles associated with

successful transboundary natural resource management and sovereignty bargains. Moreover, it presents broad observations about potential transboundary natural resource management within the U.S.-Mexican border region.

Ofertas de Soberanía y el Manejo Transfronterizo de los Recursos Naturales: Perspectivas Transfronterizas de la Frontera México-Estados Unidos

Jaidev "Jay" Singh

Resumen

En este capítulo se presenta un análisis breve de las complejidades del manejo de recursos naturales a través de fronteras internacionales, comenzando con las realidades políticas asociadas con los recursos terrestres, incluyendo la soberanía. En este documento no se analiza con óptica crítica el concepto de soberanía, sino que en lugar de eso, "desmenuza" el concepto e introduce el de "ofertas de la soberanía" o las oportunidades que los estados generan para mejorar las capacidades de gobierno en zonas específicas. En el documento también se resalta la función que desempeña la ciencia en la generación de oportunidades de colaboración transfronteriza a través de la negociación u ofertas de soberanía. Implícito en este documento está el hecho que aunque las complejidades y preocupaciones de protección de un mundo posterior al 11 de septiembre pudieron haber creado fronteras "más duras", si se entiende la función que desempeñan las ciencias en generar ofertas de soberanía, quizá sea factible aumentar las oportunidades para abordar la problemática del medio ambiente y de los recursos naturales a lo largo de

la frontera entre Estados Unidos y México. En el capítulo también se incluyen los principios generales asociados con el manejo exitoso de los recursos naturales transfronterizos y las ofertas de la soberanía, así como amplias observaciones sobre el manejo potencial de los recursos naturales transfronterizos en la región entre los Estados Unidos y México.

A recent conversation[2] on transboundary environmental cooperation, which took place in the Netherlands, revolved around maintaining, sustaining, and providing an equitable flow of "natural" services along international borders and across regions (Singh and Ganster 2003). However, bilateral policy attempts to define and confine nature's highly fluid services within nation-state containers made it difficult to obtain coherent methods and best practices. This conversation in the Netherlands also focused on a "larger philosophical discussion on the role of scientific management of the environment. Scientific management of nature gets even more complicated across states that share borders but little else. Some of these complicating transborder factors include asymmetrical economies, along with vastly different cultures of knowledge creation and dissemination" (Singh and Ganster 2003).

Despite criticism that policies based on scientific management of natural resources do not do an effective job of controlling unpredictable, complex ecosystems and socio-political interactions, science (both natural and social) plays a fundamental role in defining and rationalizing policies. More importantly, science that is related to transboundary natural resources management (TBNRM) and environmental phenomena needs to translate the information and policy implications in political terms to state and non-state actors. This is critical. An interdisciplinary understanding of the political implications of common environmental threats and natural resources will greatly help all levels of government create effective policies to ensure ecological, socioeconomic, and political coherence, especially on issues related to the U.S.-Mexican border. This chapter draws on lessons learned during the author's extensive work

in many parts of the world – these lessons could help the U.S. and Mexican governments develop policies within their shared border region.

This chapter begins with a brief analysis of some of the complexities of natural resources management across international borders, starting with the political realities associated with terrestrial resources, including sovereignty. The intention of this discussion is not to critically analyze the notion of sovereignty, but instead, to "unpack" the term and introduce the concept of "sovereignty bargains," or opportunities that states make to enhance governance capacities in specific areas (for fuller treatments, see Mattli 2000 and Litfin 1997). Additionally, this discussion highlights the role that science plays in creating opportunities, through sovereignty bargains, for crossborder collaboration. Implicit in this discussion is that although the complexities and security concerns of a post-September 11th world may have created "harder" borders, an understanding of the role of that science plays in creating sovereignty bargains may increase opportunities to address environmental and natural resource issues along the U.S.-Mexican border. Following this, the discussion briefly turns to the general principles associated with successful transboundary natural resource management and sovereignty bargains. Finally, broad observations for potential TBNRM on the U.S.-Mexican border are presented.

Science, Territorial Complexities, Sovereignty Bargains, and Transboundary Natural Resources Management

Sovereignty's relationship to natural resources, especially to fluid or mobile resources, such as water bodies and wildlife, continues to evolve. However, as nations face the need to curb harmful transborder pollutants, such as air pollution from coal-fueled utilities and pollution from upstream industrial runoffs, issues related to sovereignty become even more complicated. Despite these complexities, a number of bilateral and multilateral treaties that relate to transborder air and water pollution have been signed. For example, the 1987

Montreal Protocol for the Protection of the Ozone Layer is a successful multilateral treaty that deals with transboundary air pollution. In contrast, transborder cooperation on terrestrial resources has always been much more complicated, primarily because of issues related to territorial control and integrity (Singh 1999, 2002).

The notion of permanent sovereignty over natural resources has developed as a principle of international economic law. This notion has its roots in two primary concerns of the United Nations: the economic development of underdeveloped countries and the self-determination of peoples and human rights (Schrijver 1993). In the 1950s and 60s, the United Nations answered the call of several South and Central American countries when it passed a series of resolutions that dealt with sovereignty and natural resources. The United Nations General Assembly's (UNGA) basic assertion was that developing nations should be able to freely dispose of their natural resources.[3]

A set of rights and obligations has emerged from the treaties and UNGA resolutions of the past few decades (Table 1). Not only does the set include a state's right to develop its own resources, it also includes a state's right and obligation to equitably share in the management and conservation of transboundary resources and shared ecosystems (Schrijver 1993; Singh 2002).

Table 1 portrays an ambitious and contradictory set of rights and obligations, the political nature of which provides an interesting insight into the nature of sovereignty and resulting "sovereignty bargains." As noted above, it is not the author's intent to fully explain sovereignty here (for a deeper examination of sovereignty see Litfin 1997 and 1998 and Thomson 1995). However, the notion of sovereignty bargains as they relate to TBNRM will be discussed.

The notion of sovereignty bargains comes from sovereignty's arguably three basic elements:

> *[C]ontrol* over state resources and processes – internal and external, *autonomy* of state independence in decision-making, and *authority* in making treaties and maintaining legal relations with other states. Control is a prime prerogative of the state and an empirical aspect of sovereignty. However, control is limited by the capacity of states to govern effectively as external forces such as

Table 1. Rights and Obligations of States from the Principle of Sovereignty over Natural Resources

Rights of States Emanating from the Principle of Sovereignty over Natural Resources	Obligations of States Emanating from the Principle of Sovereignty over Natural Resources	
	National Level	International Level
Possess, use, and dispose of its natural resources within the limits of its exclusive economic jurisdiction	Exercise its permanent sovereignty over natural resources in the interest of national development	Respect international law and the rights of other states
Regulate the admission of foreign capital and to tax and exercise authority over activities of foreign investors	Exercise its permanent sovereignty over natural resources in the interest of the well-being of the people, including the realization of socio-economic human rights	Fulfill international obligations in good faith
Control the outflow of capital	Respect the rights and interests of indigenous peoples	Provide fair treatment to foreign investors and to observe limitations relating to, for example, the exercise of the right to take foreign property
Nationalize or expropriate property, both of nationals and foreigners	Provide and secure fair treatment for foreign investors	Cooperate in world economic development
Conserve and manage its natural resources pursuant to its own developmental and environmental policies	Respect acquired rights and the freedom of investors to determine their own investment and production policies	Cooperate in the development of developing countries
Share equitably in the management and benefits of transboundary resources	Prevent the waste of natural resources, and to provide for reservations for future generations	Cooperate and assist developing countries in the exercise of their permanent sovereignty over natural resources
		Prevent significant harm to the environment of other countries and to the global environment as a whole
		Cooperate for collective ecological and environmental security, including reservations for future generations

Sources: Schrijver 1993; Singh 1999, 2002

> international economy/markets, global telecommunications, and the environment put constant pressure on the state's ability to manage internal processes and resources. The autonomy component of sovereignty "involves independence in decision-making ... to act independently in the global commons ... the right to act unilaterally with respect to resources held in common" (Litfin 1997). Implicit in the concept of state autonomy is the limiting role of inter-state interactions, which are effected by regional and international environmental agreements... The third component ... authority, is somewhat related to state autonomy however, authority is the mutual recognition among states of the exclusive right to make rules that govern the state's national policies as well as treaties that govern inter-state behavior (Singh 2001).

However, as Litfin (1997), Ritcheson (1996), and Dyson (1980) point out, the above explanation would not be complete or accurate without the notion of legitimacy (Singh 2001). Elsewhere, the author has argued that the notion of legitimacy implies that the domestic and international societies have accepted state actions, which allows for policymaking within a positive democratic experience (Singh 2001, 2002). In contrast, authoritarian rule-making negatively affects state control, authority, and legitimacy. Examining sovereignty within the prism of these aspects allows for the understanding of state interests and allows for the examination of why states do what they do, especially within asymmetrical regions and within parts of the developing world where state legitimacy is a major concern.

International norms and practices that are defined by other state and non-state actors strongly influence state actions. Often, these interactions "teach" states to act or pursue certain goals, such as clean air and biodiversity conservation, because these goals have been scientifically justified and internationally held to be "good and appropriate" (Finnemore 1996). Civil society actors and international institutions have important causal weight in shaping state interests because they legitimize state policies and actions, usually through research and by providing scientific criteria. By developing

scientific criteria for state policies, civil society and other actors often extend their reach in state policymaking by inhibiting or enhancing states' autonomy and/or control in domestic rule-making.

To explain further, although externally generated norms and practices may infringe on state autonomy, these norms may also enhance a state's ability to effectively govern and control its territory. This exchange between aspects of sovereignty is, in essence, a "sovereignty bargain." Although they are poorly understood, sovereignty bargains provide the greatest room to achieve TBNRM objectives. It is important to realize that sovereignty bargains are not zero-sum games between states that are giving up some autonomy in exchange for more control, but win-win situations where states can be "taught" to achieve legitimate and enhanced opportunities to effectively govern their population and control their territory.

It is within the realm of sovereignty bargains that civil society, research institutions, and other stakeholders can play an increasingly important role. Science may be able to justify policy options; however, the translation of science into socioeconomic and political terms determines a policy's efficacy. For instance, Finnemore (1996) traces the evolution of science bureaucracies in states with little capacity to manage scientific research to the "teachings" of the United Nations Educational, Scientific and Cultural Organization (UNESCO). By creating these bureaucracies, lesser-developed states were able to access donor funds to build their capacities for research and development, which increased their global competitiveness and ultimately enhanced their sovereignty. Similarly, non-governmental organizations (NGOs), such as the World Conservation Union and World Wildlife Fund, have "taught" states to prohibit trade in endangered species and to create mechanisms for international monitoring and sanctions (Singh 2001), which enhanced these states' law enforcement capacities and thus increased all three aspects of state sovereignty legitimately.

In the case of TBNRM, where sovereignty and territorial integrity often represent key obstacles, the translation of science and research into policy options and implications across various sectors of government, such as defense, security, and border management, ensures a cross-sectoral buy-in. Several TBNRM programs in southern

Africa, such as the Limpopo Transfrontier Conservation Area, are successful because these programs have defined and met each member state's national security and law enforcement objectives. These southern African programs demonstrate that TBNRM programs must define and meet these objectives before they can be successful. Social science research on the benefits of TBNRM must do more than clearly define the interests of various local, state, and federal agencies but research must also define benefits that are large enough to gain their support. The next section further illustrates the role of science and sovereignty bargains by summarizing key lessons learned during the development of TBNRM programs.

Role of Science in Sovereignty Bargains: Lessons Learned

One of the first and critical lessons that should be learned before a group or groups attempt to establish a TBNRM program is that it is an extremely time-consuming and expensive process. And, it is necessary to assess the feasibility of the TBNRM. A feasibility assessment would include gauging various state agencies' interest levels and developing a cost-benefit analysis for the agencies that may get involved. Moreover, before a formal TBNRM – characterized by high-levels of inter-state collaboration – can be created, significant amounts of political will and political resources must be available. Before high levels of support can be mobilized, TBNRM must be "an effective approach for natural resource management and biodiversity conservation, where shared cross-border threats can be tackled jointly and/or mutual benefits can be gained collaboratively across a border," according to van der Linde, et al. (2001). Further, for TBNRM to be successful, it must not replace the existing natural resource management practices of each nation, but instead build on or enhance each state's capacity to effectively manage resources and govern populations along the border. Therefore, discussions and scientific rationale for TBNRMs must nudge states through sovereignty bargains to identify and implement win-win situations to enhance state capacity in border regions.

Before TBNRM can gain political will and resources, it must also garner the sustained interest of various stakeholders, as well as participation and support at the grassroots level. "The process should not be seen as a 'top down' process, but instead should be inclusive of, and transparent to, all stakeholders. The process should build upon the existing informal relationships between management authorities, community groups, and other groups and individuals. These informal operating systems may lead to more formalized agreements," according to Griffin, et al. (1999). It is not sufficient to say that top-down and bottom-up processes must work together; the relationship and tensions between state agencies and civil society actors must be recognized:

> State and civil society are thus indissolubly bound in an unfolding relationship of conflict and cooperation. The state by its very nature seeks to rule, to uphold its domination over civil society as indispensable to performing its role. In the exercise of rule, constant application of coercion devalues its currency; the state seeks pathways to domination that rest on authority rather than force, that preserve and enhance its legitimacy...recognition of the state is interlaced with undercurrents of conflicts. Civil society is vigilant as well as differential. The inherent tendency of the state to accumulate power engenders resistance and a constant struggle to enforce limits on state prerogatives. Civil society, like the state, values autonomy (Young 1994).

This discursive relationship between state and civil society forms what Foucault termed, a "knowledge/power nexus." This nexus, according to Foucault (1991), determines "how to be ruled, how strictly, by whom, to what end, by what methods, etc." and it provides insight into the role of science, producers of science, and non-state actors and their influences on the state's ability to govern:

> This clarification of the relationship between science and "governmentality" has shown how knowledge creates and enhances power. His notion of the diffusion of power among social agents constituting the production and implementation of knowledge does not diminish the

> power of the state; in fact it enhances the state's ability to exact compliance. For Foucault, knowledge is already a function of human interests and power relations. He asserts that the constant inter-play between the "exercise of power" and the production of knowledge lead to the continual expansion of both sources of power and new disciplines of knowledge (Singh and van Houtum 2002).

Two assertions can be derived from this constant interplay between knowledge and power: first, that power is not centralized at the state but diffused among the users of knowledge, such as state actors, and the producers of knowledge, such as academic institutions and non-governmental actors; and second, scientific knowledge enhances not only the power of the states, but also the reach of producers of the knowledge. As Fisher (2000) noted, knowledge and disciplinary discourses produce "truths" that "supply systematic procedures" for the generation, regulation, and production of policies that not only empower states, but also empower the producers of knowledge.

For example, conservation science and expert knowledge in community-based natural resources management that academic institutions and NGOs produced and disseminated established certain "truths," such as the need for protected areas and empowered local communities to manage resources. These "truths" legitimized the state practice of clearing people from vast tracts of land to establish national parks, thereby moving communities into smaller areas along the peripheries of the park – these truths thus allowed for effective social services delivery and control. By empowering local communities, states were able to establish local civil institutions that were accountable to provincial and national state institutions, which not only provide essential services but also draw communities, especially those along the borders, closer to the center. In both cases, by allowing science and expert knowledge to create the criteria for legitimate governance, states "traded" a degree of autonomy in rule-making for enhanced control.

An interesting case where sovereignty bargains based on science achieved multiple goals of enhancing governance, control, economic growth, and conservation is the Association of Caribbean States'

(ACS) innovative move toward trade integration and more integrated coastal environmental management. ACS's innovation in establishing these multilateral policies lay in its approach that did away with traditional notions of borders (Nicol 2002). "The ACS recognizing common environmental and economic stresses and the importance of their maritime resources within their joint jurisdictions have approached the management of the 'Special Zone' through a multilateral process that challenges the widely accepted Law of the Sea" (Singh and Ganster 2003). Nicol's (2002) analysis of the ACS reveals competitive territorial and juridical issues that relate to structure versus superstructure, as well as notions of traditional sovereignty and nation-state prerogatives to enter into non-traditional multilateral agreements. She explains that ACS used environmental science and environmental metaphors, which allowed for a re-shaping of traditional sovereignty through sovereignty bargains, when it established the Special Zone:

> More than a legalistic instrument, however, The Special Zone is also a very powerful maritime metaphor, in the sense that it constitutes an important rallying point for regional cooperation and legislative framework in support of an environmental agenda, complementary to existing supranational decision-making institutions, which are now forming within the region. Interested as they are in multilateralism, the Caribbean nations are attempting to forge a common identity, space and set of policies, which will carry them forward in their development initiatives. Indeed, the ACS attempt to create a common space using the maritime context also amounts to much more...It is a recognition of a common geopolitical space in which environmental hazards and resource exploitation are common threats and opportunities, and in which all member states have a stake (Nicol 2002).

A large reason for the success of ACS was the identification of innovative sovereignty bargains between control and development priorities, which is a remarkable accomplishment in an asymmetrical region. The ACS's TBNRM area was driven by local consensus and high degrees of flexibility, rather than by third parties or

donors' priorities. Another example of the ACS's ability to create a transboundary agreement is the Specially Protected Areas and Wildlife (SPAW) Protocol, which also provides some key lessons:

> It (SPAW) adopts a two-tiered approach, whereby the general and common objectives are agreed upon but implementation is left to each state; implementation by each state is based on its level of economic development, resource capabilities, and dependence on the resources. It (SPAW) aims to facilitate technical and scientific research and mutual assistance without imposing strong obligations (Griffin, et al. 1999).

The role of informal transboundary cooperation is implicit in an earlier discussion on bottom-up versus top-down approaches to TBNRMs. In many cases, informal TBNRM processes exist, or have existed, between park managers and communities across international borders. This especially occurs in areas where international boundary lines divide communities. Additionally, border areas are often an interfusion of two distinct societies. This interfusion creates a unique crossborder, sociopolitical culture, one where families live on both sides of the international boundary. This culture is definitely prominent along the U.S.-Mexican border. These unique socioeconomic regions offer an additional reason beyond natural resource management to sustain a dialogue of crossborder cooperation. This dialogue includes issues related to crossborder economic dependence on trade and livelihoods and the dependence of these activities on ecosystem services. However, to make this dialogue meaningful at the national level, it must include community-based initiatives that provide synergy to and/or support national security and law enforcement priorities. Similarly, state agencies must recognize the socioeconomic realties of the border regions from economic, ecological, and familial perspectives. Moreover, these informal processes offer a strong foundation for the use of sovereignty bargains to meet and legitimize common national objectives.

Despite the appeal of rationalizing policies through sovereignty bargains, this process is lengthy and expensive. Often, this process is easiest when local border communities self-identify or foster ongoing crossborder links and then build constituencies that can be

used for advocacy purposes within their respective central governments. Usually, it is these informal links that are the most innovative and yet sustainable. For example, communities and state agencies along the borders of East and West Timor, Zimbabwe, and Mozambique, create informal border regimes that cater to specific and contextual needs. In her dissertation, Zbicz (1999) argues and provides evidence that funding for communication equipment, such as telephones and faxes, in border areas goes a long way in fostering crossborder communication and informal TBNRM. In asymmetrical border regions, simply enhancing the communication capacity of the lesser developed side of the border can create increased opportunities for cooperation, especially on issues that concern natural resource management and law enforcement. Informal sovereignty bargains may happen at the local level, and thus allow states to govern effectively while taking advantage of the myriad opportunities that the border presents. Similar examples of crossborder cooperation occur along the India-Nepal border, where park officials communicate frequently and exchange information on a number of issues, including movements of people and wildlife.

Conclusions: Lessons for the U.S.-Mexican Border

This discussion provides a number of key lessons that can be used to establish TBNRM areas. Science and expert knowledge on the environment play a fundamental role in shaping policy at every level. However, the impact of this knowledge depends on how well it is translated into cross-sectoral policy implications. That is, while it is important to define the core objectives of transboundary environmental and natural resource management, advocates of transboundary environmental and natural resource management must also describe how these core objectives relate to the objectives of national and regional socioeconomic, security, and law enforcement interests.

Further, the process of identifying the political and socioeconomic implications of TBNRM and transboundary environmental issues needs to include the identification of specific sovereignty bargains to meet the core objectives of the TBNRM. These sovereignty

bargains may include a combination of formal and/or informal TBNRM arrangements. The rationale is to identify interstate vehicles or mechanisms to meet critical TBNRM objectives. However, based on feasibility studies on the creation of formal TBNRM arrangements, the costs (including transaction costs of negotiations, among others) are too high. Informal TBNRM arrangements may be a much faster and more effective means of achieving larger ecosystem management goals.

U.S.-Mexican crossborder cooperation manifests itself in a number of areas and issues, many of which are informal in nature, as well as related to natural resource management and the environment. A summary of the current context provides a foundation for enhancing current and potential formal and informal sovereignty bargains that relate to the U.S.-Mexican border:

> Despite the asymmetries and priorities for services dictated by rapidly growing human populations, some of the most successful examples of cooperation across the border are in the area of the environment. A fragile arid environment and shortages of ground and surface waters for human consumption characterize the U.S.-Mexican border....These conditions produced international political conflict and an activist role by local border populations, initially mainly by officials and non-governmental organizations in U.S. border communities, but increasingly by Mexican officials and Mexican NGOs. Important federal recognition for the need for formal government-to-government cooperation on border environmental issues came with the 1983 La Paz Agreement between Mexico and the United States that included binational workgroups by media, such as air, water, and hazardous waste. This process has gone through a number of iterations that have broadened participation to include state and local government and significant community involvement. The negotiations and implementation of the North American Free Trade Agreement included strengthened environmental cooperation and plans for addressing border environ-

> mental concerns. Clearly, the economic concerns provided the backdrop for enhanced border environmental cooperation (Singh and Ganster 2003).

Moreover, research and academic institutions along the border have contributed significantly to the ongoing process, and have created further opportunities to identify specific sovereignty bargains. If these sovereignty bargains are going to be effective, they need to account for the reality of illegal immigration, drugs, and security concerns, which unfortunately over-shadow much of the successful cooperative programs and measures along the U.S.-Mexican border. In light of this reality, there is a need to begin building coherence and synergies along each side of the border. In other words, the notion of TBNRM must be deconstructed to include intra-state jurisdictions and agreements to foster inter-state arrangements. More platforms are necessary, such as the Southwest Consortium for Environmental Research and Policy sponsored Border Institute. Border Institute VI was organized to understand and coordinate the efforts and interests of various federal, state, county, and civic agencies and to discuss how these interests and objectives can be met through TBNRM. This would entail advancing and/or developing an understanding of environmental security along the U.S.-Mexican border. The discourse on environmental security would elicit the help of interested agencies and enhance the current scientific discourse and political rhetoric on the environmental problems that communities along the border share. Additionally, an inter-disciplinary and cross-sectoral understanding of environmental security could assist in developing broad sovereignty bargains on TBNRM negotiations. For example, the demand for water and energy and the unsustainable population growth rates will adversely affect the fabric of society along the border and will lead to human insecurity. A collapse in the border's regional economy would hamper the larger American economy. The North American Free Trade Agreement (NAFTA) and other agreements have provided, and continue to provide, key spaces for discussions on environmental security; however, the success of any TBNRM will rest squarely on the initiative of the local communities and on their ability to advocate for their interests.

Endnotes

[1] Jaidev "Jay" Singh is an American Association for the Advancement of Science (AAAS) Diplomacy Fellow and a specialist in Natural Resources and Conflict in the Office of Conflict Management and Mitigation, U.S. Agency for International Development. This paper is based on his keynote address to the SCERP Border Institute VI meeting, titled Transboundary Ecosystem Management, held in Rio Rico, Ariz., April 26–28, 2004. This paper is an expression of the author's views and does not reflect those of the U.S. Agency for International Development. For more information, please contact the author at jsingh@u.washington.edu.

[2] The word "conversation" signifies a process marked with cordiality, lack of controls, and unpredictability over the course of a dialogue to achieve a level of respect, coherence, meaning, and most importantly, to achieve innovative understandings and deeper insights related to the topic of discussion.

[3] See UNGA Resolution No. 523 (VI) (VII) (Jan. 12, 1952) "Integrated economic development and commercial agreement," 100% in favor. Also see UNGA Resolution No. 1803 (XVII) (Dec. 14, 1962) "Permanent sovereignty over natural resources," 79% in favor.

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V

Land Tenure and Preservation

Carlos Graizbord and Emilio de la Fuente

Abstract

Political boundaries between countries, such as the border between the United States and Mexico, affect the way natural resources and ecological systems are allocated, protected, and preserved. Not only does the fragmentation of geographic space impede the optimal use of a resource, but the differences in political, legal, and planning systems between both countries make it difficult to create a coordinated approach to preserving natural resources.

Groundwater management practices differ according to land ownership. On the U.S. side, groundwater is mostly used by private landowners. On the Mexican side, the federal government owns the aquifers, as well as all natural resources, and the Comisión Nacional del Agua (National Water Commission, in Spanish CNA) manages them. The binational International Boundary and Water Commission (IBWC) could conceivably deal with aquifers, however, at present, it mainly manages only surface waters in the U.S.-Mexican border region, including the Rio Grande/Río Bravo and the Colorado River.

In the absence of a coordinated, transborder effort for preservation, many of these resources will be irrevocably depleted and destroyed. If that is the case, a balanced and sustainable natural and

man-made environment will not be possible and the future quality of life and the survival of the natural environment will be endangered.

Conservación y Tenencia del Suelo

Carlos Graizbord y Emilio de la Fuente

Resumen

Los límites políticos entre los países, tal como la frontera entre los Estados Unidos y México, afectan la manera de asignar, proteger y conservar los recursos naturales y los sistemas ecológicos. La fragmentación de un espacio geográfico no sólo impide el uso óptimo de los recursos sino que, además, las diferencias entre los sistemas políticos, jurídicos y de planeación entre los dos países generan dificultades en el establecimiento de un enfoque coordinado para conservar los recursos naturales.

Las prácticas relacionadas con el manejo del agua subterránea varían conforme a la tenencia de la tierra. En los Estados Unidos, los propietarios privados utilizan el agua subterránea en su mayoría. En cambio, en México, los acuíferos, así como todos los recursos naturales, son propiedad del gobierno federal, y la Comisión Nacional del Agua (CNA) se encarga del manejo del agua. La Comisión Internacional de Límites y Aguas (CILA), en teoría, se podría encargar de los acuíferos; sin embargo, en la actualidad, se concentra principalmente en el manejo de las aguas superficiales a lo largo de la frontera entre los Estados Unidos y México, inclusive del Rio Grande/Río Bravo y del Río Colorado.

Ante la ausencia de un esfuerzo coordinado transfronterizo de conservación, se agotarán y se destruirán irrevocablemente muchos de estos recursos. Si así fuese, no será posible lograr un entorno

equilibrado y sostenible natural y artificial; a futuro, se pondrá en peligro la calidad de la vida y la supervivencia del medio ambiente natural.

The Importance of Preserving Natural Resources and Environmentally Sensitive Areas in the Border Region

Natural resources are not used optimally in border regions because political boundaries fragment their geographic locations; therefore, management and preservation cannot be adequately performed. This is especially true of groundwater aquifers, forests, agricultural areas, and habitats.

The aquifer of a watershed (and/or sub-basin) provides a good example of the types of problems that exist with natural resources that are located in a border region – they are resources that are fragmented by an international boundary. The Tijuana River Watershed and the sub-basin of the Alamar-Tecate-Cottonwood Rivers are specific examples in California and Baja California. The aquifer within these basins and sub-basins crosses the border and is exploited on both sides without a joined, coordinated water management system. As a result, further pollution and the eventual depletion of the aquifer appear imminent.

Groundwater management practices differ according to land ownership. On the U.S. side, groundwater is mostly used by private landowners. On the Mexican side, the federal government owns the aquifers, as well as all natural resources, and the Comisión Nacional del Agua (National Water Commission, in Spanish CNA) manages them. The binational International Boundary and Water Commission (IBWC) could conceivably deal with aquifers, however, at present, it mainly manages only surface waters in the U.S.-Mexican border region, including the Rio Grande/Río Bravo and the Colorado River.

Another issue also confounds entities when they are attempting to effectively manage natural resources – flooding. To control flooding on the Mexican side, the Tijuana River channel was lined with concrete. However, on the U.S. side of the Tijuana river channel, the

river's estuary has been designated a natural preserve. These two different approaches to natural resource management exemplify the challenge of transborder resource management when allocating and protecting a resource. The two different approaches have led to two different policies. In Tijuana, the channeling of the river was intended to both provide protection from flooding and to reclaim land for future development, while in San Diego the main criterion was preservation of the riparian habitat.

Water quality must be considered when discussing water quantity. On the Mexican side, discharges from poorly operated sewage treatment plants and industrial facilities pollute rivers and aquifers. Raw sewage and latrines from squatter areas, industrial discharges, illegal trash dumping sites, and other adjacent land uses also pollute rivers. Furthermore, riverbeds are disturbed by sand and gravel mining operations.

Water pollution and the depletion of aquifers harm both nature and the population living in the border area, and thus create international conflicts that are likely to worsen over time. Similar problems also affect other natural resources, such as forests; agricultural land; ecological habitats; and historical, archeological, and paleontological resources.

In the absence of a coordinated, transborder effort for preservation, many of these resources will be irrevocably depleted and destroyed. If that is the case, a balanced and sustainable natural and man-made environment will not be possible and the future quality of life and the survival of the natural environment will be endangered.

Analysis of Natural Resources

This section details various ecological subsystems and their importance for transborder collaborative planning and management efforts. Although presented separately, they form an integrated system and should be seen as such. As mentioned in the previous section, lack of transborder collaboration presents a risk for natural resources and for the transborder population. The differences in the

legal and planning systems between both countries exacerbate the difficulties of developing a better collaborative process. The differences in land ownership are explored later in this chapter.

Hydrology

Rivers and creeks serve many public purposes. They affect the quantity of a community's water resources because increased runoff and sedimentation will choke a stream's connection with the underlying groundwater, which leads to decreased and irregular groundwater recharge. Streams also affect the quality of water for a community, as they are sources for groundwater recharge, reservoir storage, and surface water supply. Streams are riparian habitats and environmental corridors, which are pathways for many animal species, as well as a means of transporting nutrients and sediments. Streams bind ecological communities such as hillsides, woodlands, and wetlands with shared water resources and are thus part of the hydrological and nutrient cycles.

Water has become a scarce resource in the border region. Water is supplied to a rapidly growing urban population that competes for this resource with agricultural uses. Most of the rivers and natural streams within the border region face urbanization pressures. As mentioned earlier, municipal and industrial waste discharges, sewage from illegal settlements, illegal trash dumping, and gravel and sand mining pollute these streams.

Land development also causes river and stream pollution. Uncontrolled development on hillsides, woodlands, wetlands, and even along river banks has removed hillside soil and vegetation and graded and leveled hilltops. Soil has been removed and used to fill parts of riverbanks and marshes. Urban development and runoff have eliminated the protective vegetative cover and, as a result, flooding has increased. Rivers have become a health hazard because of pollution and because the natural filtering system of the marshes has been destroyed by fill and sedimentation.

To protect and conserve streams and rivers, one must look beyond the watercourses and consider the watersheds (basins and subbasins), which include wetlands, lakes, reservoirs, groundwater resources, and the rivers and creeks within a system. Streams and

rivers should be cleaned, and their riparian ecosystems and flora and fauna should be restored or rehabilitated. Streams and rivers should be developed for extensive recreation, tourism, preservation, education, and research. These undertakings will protect streams and rivers as water recharge areas and as ecological corridors that connect open space with urban areas.

If the discharge of wastewaters into rivers is permitted, strict control measures must be effectively implemented. These measures should prohibit any discharge that causes environmental and aesthetic damage, pollutes beaches, or deteriorates groundwater quality. Effluent standards should be set for chemical, physical, and microbial elements of suspended solids, organic and nitrogen concentrations, and pathogenic microorganisms. An appropriate balance must be sought between environmental requirements and economic costs.

Coastal Areas

Coastal areas are unique ecological, geological, and biological habitats for an array of terrestrial and aquatic life forms including, increasingly, humans. Coastal areas are important because they:

- Have commercial value as productive areas with fish and other seafood that are extracted for the dietary needs of millions of people; as well, fisheries and aquaculture are commercial activities that are important to many people
- Are a barrier to natural hazards: beaches, dunes, cliffs, and islands act as buffers against strong winds and waves from ocean storms
- Are unique recreational areas: swimming, boating, fishing, sunbathing, and walking are some of the various tourist and recreational activities in coastal areas
- Have an aesthetic and scenic value and are one of the most dramatic natural environments
- Have a unique ecological value – many interconnected subsystems, including estuaries and coastal wetlands, cannot be duplicated elsewhere

Marine and coastal environments are integrated systems. Degradation of one system can damage the ecosystem as a whole. However, pressures on the coastal environment come from various sources, some of which are natural, such as hurricanes and coastal storms. These events change the coastal topography and are hazards to structures. Coastal areas usually recuperate from such pressures, but uncontrolled development stresses these areas and could overload their carrying capacities. Public policies affect the coastal environment when development in the coast is encouraged by, for example, new roads and bridges and the provision of public water supplies.

Development requires infrastructure, which exerts pressure on the coastal zones by increasing runoff into coastal waters. Groundwater extracted close to the coast leads to changes in the water table, which results in saltwater intrusion. Human settlements can also pollute groundwater. Oceans have become dumping grounds for garbage, sewage, and medical waste. Over-harvesting of fisheries threatens the sustainability of these areas. Human activities and global climate change affect coral reefs and coastal wetlands. The expansion of energy production can adversely affect the recreational and aesthetic qualities of the coast.

Beaches and estuaries on both sides of the international border are being polluted with direct discharges of sewage and partially treated effluents from failing treatment plants, among other sources. Land use pressures are destroying riparian systems and specific valuable plants, such as the coastal sage scrub. Fisheries are being overexploited, such as the lobster fishery along Puerto Nuevo in Rosarito, B.C. Inadequate information about saltwater intrusion into aquifers, which comes from over-pumping, threatens water supplies and jeopardizes efforts to manage coastal areas. The lack of uniform standards hinders planning and management activities.

Hillsides

Building structures on slopes disturbs the surface of the land by making cuts and fills. The steeper the natural slope, the greater the area that must be disturbed. Soil is then destabilized and becomes more susceptible to erosion, primarily rain erosion. Disturbed sur-

faces create loose materials, which tend to move downhill. Structures experience a component of gravitational force that will tend to move them downhill. Grading a level pad or roadways, even for pedestrian paths, disturbs more than just the resultant leveled area. Cuts and fills extend some distance up and down slope before meeting their natural grade. A good solution is to minimize disturbances by building roads and structures on piers. As yet, regulations do not specify the rules for building in this manner.

Hillsides are inherently unstable. Changes in these areas can result in erosion or landslides, which can result from rains, flowing rivers and creeks, excessive landscape watering, or the concentration of storm runoff by human-built channels or storm drain outlets. Earthquakes and faults also affect erosion.

Landslides damage roadways, residences, and other structures. They are a common natural means of adjusting slopes to more stable configurations over surfaces that have been steepened by uplift or weakened by weathering. These areas need to be identified. When the forces that bring about movements exceed the forces that resist movement, the "factor of safety" is overwhelmed. Resisting forces decrease with:

- The introduction of water (through rainfall or human intervention)
- Long-term weathering
- The removal of deep-rooted vegetation, thus reducing roots' resistance to movement

Destabilizing forces can increase as a result of:

- The removal of support by excavation or undercutting by flowing water
- Loading by structures, fills, or sediment accumulation
- Movements caused by earthquakes and heavy traffic
- Rapid build-up of underground water pressure from heavy rains

Human alterations contribute to slope destabilization by:

- Placing fills on top of marginally stable slopes
- Cutting slopes at steep angles or undermining the bottom of a slope

- Redirecting storm runoff to concentrate flows in portions of the landscape not prepared to receive them
- Removing woody vegetation
- Adding water with hillside septic systems at rates that exceed average annual rainfall
- Excessive landscape irrigation at rates that exceed average annual rainfall

The main interrelated reasons to regulate hillside development include the protection of:

- Lives and property from landslides and fires
- Natural resources, such as water supply
- Environmental features and systems, such as river corridors, wildlife habitat, and natural vegetation
- Aesthetic or scenic quality
- Access for residents, visitors, and public service providers

In the United States, development is prohibited on hillsides with grades of 25% or more; in Baja California, development is prohibited on hillsides with grades of 35% or more. Because of the variety of geological settings and the different possible planning purposes and contexts, hillside regulations must adapt to each possible scenario. In the border scenario, a single slope category and all regulatory measures related to hillsides, such as densities for different slopes, should be established. Hillside overlay zones can be an instrument to control building within permissible high slopes (from 10% on up to 35%), and all projects should undergo a review process.

Woodlands

The general forest types in the U.S.-Mexican border region are the coastal forest, desert, and scrub. Forests differ according to elevation, latitude, topography, and other environmental factors. They also differ according to their stage of succession. Environmental conditions influence the stability of their flora and fauna. If environmental factors remain constant, the forest communities will remain intact, keep their identity, and continue reproducing.

However, disturbances by fire, humans, or other alterations in climate and environment, can create conditions more favorable to invading species.

Irresponsible development and woodland destruction affect the environment in a variety of ways – they increase erosion, cause siltation, lower water quality, diminish landscape diversity, increase flooding risks, reduce land values, and produce other detrimental effects. The elimination of forests fundamentally changes the surrounding ecology of wildlife and related herbs and shrubs.

Woodlands are beneficial in many ways. Forests produce timber, house wildlife and habitats, provide recreation, are aesthetic, and they produce other, non-monetary values. Woodlands are environments rich with animals and plants. Treetops, branches, trunks, shrubs, and plants provide breeding, feeding, and refuge for mammals, birds, and insects. Woodlands protect watersheds and soils. Forest vegetation moderates the effects of winds and storms, stabilizes and enriches the soils, and slows runoff from precipitation allowing it to be filtered by the forest floor as it replenishes the groundwater reserves. Decreased runoff and increased groundwater infiltration protect communities from flooding.

Woodlands moderate climatic extremes. The microclimate of a forest is partly produced by the shade of trees and the evapotranspiration rate of water from the leaves, which moderates the surrounding air temperature. Forest temperatures are cooler in the day and warmer at night than temperatures in un-forested areas. Thus, forests act as natural air conditioners for urban areas.

Forests located close to urban areas are usually unsuitable for economic use, such as tree forestry, but their value remains for environmental health, watersheds and soils, they improve air and water quality, and they act as noise buffers and climate modifiers. Woodlands also buffer noise from freeways and factories, absorb some air pollutants, and screen ugly views.

Wooded areas promote high real estate values, but they do not necessarily play a role in development decisions. Usually, if a wooded area is near an urban area, real estate values are high. Yet, development normally destroys wooded areas. The elimination of wooded areas lowers land development costs because streets and

sewer lines are less expensive to build in flat, treeless terrain. Clusters of housing developments within forested areas are a better type of development for the environment.

The different patterns and rates of succession in forests depend on natural disturbance and aid the diversity of woodland flora and fauna. Adjoining forests and meadow communities create ecologically crucial edges where animals feed and intermingle with open-field species. Some species feed in the meadows and seek shelter in the forest. This variety of natural environments is crucial to a healthy environment. The more variety within the area, the more likely it is to absorb the effects of any disturbance. Woodland diversity should be protected because it is more capable of absorbing stress.

This goal to protect forests is especially important for suburban forests where humans disturb the natural ecosystem. The forest should be able to adapt to human influence, but man's impact on forests has been extensive. Land dedicated for settlements, timber, and agriculture has destroyed forests. Competition among urban growth, agricultural, grazing, and forest land uses are continuous and increasing. Although replacing lost forests is difficult, regulation and mitigation will protect the diverse character of ecological subsystems.

The coastal sage scrub is on the brink of extinction. Additionally, less valued species of desert vegetation are being smuggled from Baja California to be sold in the United States. Some of these species are unique to the eastern parts of California and Baja California.

Poorly regulated use diminishes the benefits of woodlands. To create policies that protect and conserve rural woodlands, the following points should be considered:

1. It can take decades to replace lost woodlands. Usually, woodlands are replaced by plants that are unsuitable for recreation, habitats, and provision of other benefits.
2. Decisions have to be made that balance the short-run productive use of woodlands with their long-run use. The long-term use of woodlands should depend on development compatible with woodland ecology, but that is rarely the case.

3. If a wooded area or forest is to be replaced, the public benefits of the proposed land use must be weighed with the costs. Proper land use policies can allow woodlands to be used for many purposes while still conserving the original lands. Effective land use is not usually the reality, though, because woodlands are constantly being pressured by several other proposed land uses.

Woodland regulation has been ignored despite the benefits of woodlands as buffers and mitigators of flooding, erosion, noise, and air pollution, which are important for the public good. Trees in urban areas within the public domain, such as those growing on city streets, parks, and forest preserves, should be protected. Woodlands found on private lands should also be protected. Several types of ordinances would be appropriate, for example, to:

- Preserve yard and street trees of residential or commercial land uses
- Regulate commercial forestry within urbanizing areas
- Identify sensitive wooded areas
- Preserve not just trees, but the entire woodland ecology

Other implementation mechanisms include *declaratorias*, or special zoning provisions, which can help preserve woodlands. *Declaratorias* have proven ineffective in Baja California because of the public sector's poor enforcement capability. However, other "inductive" mechanisms could be used, such as fines and taxation that provide "rights" for the use of a natural resource. Woodland protection ordinances seek to protect the entire woodland; that is, not only the trees but the associated flora and fauna as well. In the usual case of woodland protection ordinances, some land uses are permitted and others require permits. Permitted uses include:

- Conservation of soils, vegetation, water, fish, and wildlife
- Extensive outdoor recreation, such as play and sporting areas, field trails for nature study, hiking, horseback riding, boating, trapping, hunting, and fishing where otherwise licensed and regulated

- Grazing, farming, gardening, harvesting of crops, forestry, and nursery practices, where otherwise legally permitted and regulated
- Operation and maintenance of existing dams and other water-control devises, if in compliance with state or federal statutes
- Driveways and roads where alternative means to access prove impractical

These uses are not necessarily compatible with woodland ecology. For example, grazing and agriculture could disturb these areas and/or prevent woodland reproduction, as well as destroy understory vegetation. All uses should be processed for permits and analyses for each case should be required and performed by specialists. Woodland regulations should be tied to a grading plan and a plan for the control of erosion and sedimentation.

For any development in a wooded area, review requirements should include lot coverage, open or natural areas, a grading plan with cut and fills limitations, and an erosion and sedimentation plan. New regulations might be needed. A promotional or educational approach with the public may be necessary for the preservation of natural resources, including woodlands.

Habitats

Urban growth fragments and/or destroys natural wildlife habitats. Agricultural areas also contribute to the loss of wildlife habitat because they drain wetlands, disturb grasslands, and reduce the diversity of wildlife. Buildings, roads, fences, and other obstructions also restrict wildlife migration. Some species do not seek alternative routes around fences and instead remain within them until they starve. Impermeable surfaces create heavy runoff that erodes riparian areas. Air and water pollution affect the quality and quantity of wildlife habitat in developed areas.

The monetary value or general value of habitats is difficult to assess even though it has been studied extensively. For example, the recreational value of fishing, bird watching, hiking, and hunting depend on the availability of wildlife. Likewise, the protection of wildlife promotes tourism and thus contributes to economic devel-

opment. It has been estimated that in some U.S. states, the opportunity to view wildlife contributes approximately 20% to revenues from tourism.

Border habitats are fragmented, especially those located within or near urban areas. Conceptually, an ecological subsystem should be viewed as an integrated system that encompasses climate, land uses, and human activities. For the purpose of transborder governance, a comprehensive pro-active approach that includes land use and the environment should be taken.

Transborder Differences in Land Ownership as They Relate to Preservation

This section explores the relationship between preservation and land tenure in both Mexico and in the United States. Land tenure makes a significant difference in both successful and unsuccessful preservation practices. There are also other factors important to consider, namely:

- The location of the preservation area in relation to urbanization pressures
- The size of the area in question
- The differences in regulatory environment on both sides of the border

It is believed that wider and more systematic research needs to be conducted on this subject. In general, successful preservation on both sides is possible when the area considered is large enough and located far enough away from urban areas or urbanization pressures.

Land Ownership and Preservation in Mexico

The following table represents possible cases of land ownership types and the probability that they will successfully preserve land in Baja California. In Table 1, two variables are considered: land ownership type and location relative to urbanization pressures (when urbanization occurs close to the area to be preserved and when no significant urbanization pressures exist near the preservation area).

Usually, areas that have high urbanization pressures are close to a present or potential urban area. Conversely, areas that have insignificant urbanization pressures are usually large tracts of land that are located far away from urban areas. The table identifies the probability that the area will be preserved as high where examples of successful preservation exist and few factors affect these efforts negatively, medium where some favorable factors exist that could allow for successful preservation, or poor where few or no examples of successful preservation were found and the public sector could not intervene effectively.

The following explains the specific cells of the matrix below. They were made as a result of observations of various cases in Baja California.

Ejidos (or collective properties) located far away from urban centers and related development pressures, could use *declaratorias*, or special zoning, to protect ecological resources. This assumes there is a plan or context for identifying and designating such areas. For example, Terra Peninsular, a non-governmental organization (NGO) in Baja California, signs land conservation agreements, which are legal procedures in Mexico, with *ejidatarios*, or tenants of the collective properties. Even with urbanization pressure, *ejidos* have an organization and representatives to support preservation through a *declaratoria* or through other legal resources. However, there are no plans to identify which areas to preserve and which to urbanize. The

Table 1. Land Ownership Types and Probability of Success in Land Preservation in Mexico

Land Ownership Type	Without Urbanization Pressures	With Urbanization Pressures
Collective (*eijdos*)	High	Medium
Private (with various land owners)	Medium	Poor
Private (with few land owners)	High	Medium
Government (federal)	High	Poor
Government (state)	High	Medium
Government (local)	High	Medium

Source: Authors

preparation of a *plan parcial* or community plan can correct this situation. This is a requirement for large areas, under any type of ownership, that are located adjacent to urban centers that are under urbanization pressures. If there are squatters on these properties, the *ejidatarios* or landowners of the parcels, can file a legal complaint (*denuncia de despojo*, or denunciation of dispossession) with the state attorney to remove squatters. In the case of creeks and rivers, CNA is responsible for the protection of the natural resource and for taking any required legal action.

Private landowners within a potential preservation area might have plans for their parcels that do not include preservation efforts, so it might be difficult to create a consensus among them to abide by special zoning or any other legal mechanism for preservation. With urbanization pressure, landowners with large properties have to be mobilized and organized to protect their land. In the Valle de Guadalupe, the most important wine-producing valley in Mexico, landowners have organized and are, at least for now, protecting their valley from development pressures.

The owner of a large parcel would have a better chance of preserving land than the owner of a small parcel would, but there should also be an appropriate plan for the preservation of smaller, non-contiguous tracts. A large private parcel could develop an informal plan or a *plan parcial* (depending on its size) and thus could protect the designated land uses. The owner can use various legal recourses, such as a *denuncia de despojo*, a *declaratoria*, or a moratorium *(directriz)*. Moratoria only last for one year, but they can be extended. In many cases, CNA makes an agreement with developers to protect rivers and creeks. CNA might make use of gabions to protect against flooding and to provide more land to developers under a derecho de usufructo, or "usufruct right." In some cases, developers develop parcels on creeks in an effort to encourage the owners to protect them.

In all government cases and without urbanization pressure, there is a moderate probability that large areas will be preserved. The Mexican federal government has few human and financial resources to manage natural resources in a country as large as theirs. For example, many remote archaeological sites that are difficult to access are vandalized because of lack of protection. The state has properties

close to urban areas and is usually successful in controlling them. Examples of these areas include land reserves by the state *inmobiliarias*. Municipal authorities control their properties through the *oficialías*.

The governments' ability to control urbanization pressures is less clear. Federal properties are difficult to protect because few resources are available and government enforcement is weak. There are too many rivers, aquifers, forests, habitats, wetlands, and archaeological sites in the country for the few inspectors, who have limited financial resources, to administer adequately. State and local management of natural resources may be more successful than federal management, despite the lack of funds and weak law enforcement capabilities. Many land reserves are allocated for urbanization purposes – including low income housing and public services, such as schools. The municipalities have land banks or municipal real estate agencies, such as Inmobiliaria Estatal de Tijuana y Tecate (INETT), Fideicomiso de Desarrollo Urbano de Mexicali (FIDUM), and Fideicomiso de Desarrollo Urbano de Ensenada (FIDUE). The municipalities also own land used for special purposes or that could be sold. The agencies in charge of that are the state Oficialía Mayor (or public administration office) in Mexicali and the municipal *oficialías*.

Three more variables must be taken into account if successful preservation areas are to be implemented: the Mexican government's weak enforcement capabilities in land use issues, the lack of appropriate regulations and laws, and the lack of appropriate specific land use analyses and preservation plans. The third variable includes ensuring that there are accurate "capability or suitability analyses" within the plans and that there are appropriate geographic data to perform these analyses. At present, the geographic information from the Instituto Nacional de Estadística e Informática (INEGI) in Mexico and from the U.S. Geographical Survey (USGS) in the United States is essentially unusable because the data are too general and the map's scale is too large, specifically for open spaces located close to cities. It is necessary to consider that, except in a few cases, transborder geographic data have not been coordinated or harmonized. Therefore, such information is not yet available as a basic planning resource.

Land Ownership and Preservation in the United States

Table 2 represents four possible cases of land ownership types and the probability that they will successfully preserve land in the United States. Similar to Table 1, two variables are considered: land ownership type and presence of urban pressures. Again, as is the case in Mexico, the areas with high urbanization pressures are either close to an urban area or plans for development exist for an area. The areas that have few or no urbanization pressures are usually large tracts of land that are located far away from urban areas. The table identifies land ownership types and urbanization pressures and indicates the probability that the area will be preserved as high, medium, or poor. This table assumes that appropriate plans and geographic data exist for large tracts of land.

Only a conflict between the local and the federal authorities over the use of a particular land would jeopardize preservation. One such example could occur if the federal government has one objective for a preservation area and local authorities (or other groups) have other objectives. Such a controversy has arisen over the preservation of the white owl habitat versus forest exploitation.

It is assumed that the U.S. has stronger enforcement capabilities than Mexico does. The issue in the United States is mainly the appropriate level of authority for preservation vested on the responsible agencies and the dilemma is whether to assign regulatory powers for preservation to local, state, or federal authorities.

Table 2. Land Ownership Types and Probability of Success in Land Preservation in the United States

Land Ownership Type	Without Urbanization Pressures	With Urbanization Pressures
Public Property	Medium	High
Private Property	High	Medium

Source: Authors

The Border Area

It is important to differentiate between formal transborder efforts for preservation and informal efforts. Formal efforts include projects or plans with the coordinated participation of both the United States and the Mexican governments. Informal plans or projects are those where other, mainly non- and inter-governmental organizations, are involved.

Land ownership differences within the border area add difficulty to any effort to coordinate land use decisions, especially when these decisions relate to preservation. The main obstacles to successful formal transborder coordination on land use planning in general, and to preservation efforts in particular, are:

- A lack of formal comprehensive binational planning organizations dealing with land use, ecological, and infrastructure issues
- A lack of basic transborder planning resources to identify and map natural resources and environmentally sensitive areas
- Transborder differences in enforcement capabilities, regulatory powers, and regulations
- Transborder differences in organizational structures and roles of the public sector
- Differences in implementation capabilities concerning ordinances, financing mechanisms, public works, and administrative mechanisms

It is possible that the informal coordination of preservation plans, especially of large areas without urbanization pressures, has had, or may have, some successful results. Table 3 represents four possible preservation cases and the probability that they will result in the successful preservation of land in transborder areas. Two variables are considered in the table: size of projects or size of open space area affected, and urbanization pressures. Two types of urbanization pressures are also considered – urbanization pressures close to the area to be preserved and the absence of urbanization pressures in such areas.

Table 3. Land Ownership Types and Probability of Success in Land Preservation in the Transborder Area

Size of Project of Area to be Preserved	Without Urbanization Pressures	With Urbanization Pressures
Large	Medium	Poor
Small	Medium	Poor

Source: Authors

The table shows the differences that can occur in a border area considering the degree of influence that urbanization pressures can have on the preservation of either large or small parcels. For specific cases, it is recommended to consider Tables 1 and 2 in combination with Table 3 to estimate the preservation potential of a specific site.

In this case, areas with no urbanization pressures could be successfully preserved with the support of federal, state, and local governments. Therefore, coordinated plans need to be developed. For areas close to cities, the close cooperation between both governments and among other institutions involved could lead to the successful preservation of land. In the long run, a transborder commission, similar to IBWC, would need to be the official body in charge of protecting preservation areas.

Strategies: Large Projects and Small Demonstration Projects

There are many aspects that have to be dealt with before the mid-term and long-term implementation of coordinated or joint transborder preservation plans can be implemented successfully, including the following:

- Land ownership
- Size of preservation area
- Location in relation to urbanization pressures
- Formal transborder organizations
- Planning and regulatory (or enforcement) capacity
- Implementation mechanisms

In the short term, land ownership or the continuation of ongoing (informal) planning efforts should be considered so that areas with better chances of being preserved are selected for preservation efforts. The Tijuana River Watershed, including the Alamar-Tecate-Cottonwood sub-basin, and the coastal area from Santa Barbara and San Quintín are examples of the informal planning efforts in the Baja California-California region. Both propose the creation of a preservation plan for an area large enough to provide a comprehensive vision for the larger region. Without such a vision, many fragmented projects could be implemented that may encroach on each other.

Large-scale preservation and conservation plans are necessary for areas with strong urbanization pressures as well as for those without them. At present, organizations such as Terra Peninsular are involved in the preservation and conservation of some large areas located in Baja California and in the border area with no significant urbanization pressures.

Besides the need to develop large-scale preservation and conservation plans in areas with significant urbanization pressures, there are urgent problems, such as pollution of the aquifer and surface water, that need to be addressed. Because there are few or no financial resources to solve them, it is proposed to develop small demonstration or pilot projects that are related to the larger, visionary plan. Since many private foundations can finance small projects, it is recommended that pilot or demonstration projects be coordinated as part of a general vision to avoid duplication of efforts or even contradictory objectives. Pilot projects, once implemented, act as catalysts for rehabilitation or revitalization in specific larger areas, create credibility among the community and the public sectors, and help develop a dynamic, cohesive force among all interest groups.

Difficulties in preserving land uses and natural resources exist in each country, including the lack of resources for implementing and/or enforcing the law in large areas. Additional difficulties exist within a transborder context. To respond to this situation, it is recommended that a new transborder committee, or similar group within an existing binational organization, be established. This new institutional framework should be able to use regulatory, adminis-

trative and financial resources, as well as a comprehensive, proactive approach, to collaborate with local authorities that are faced with transborder challenges in land preservation.

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VI

River Habitat Restoration in the Chihuahuan Desert: The Río Conchos and the Forgotten River Stretch of the Rio Grande

Mary E. Kelly and Héctor M. Arias Rojo

Abstract

Like many desert rivers around the world, the transboundary Rio Grande/Río Bravo is literally a biological lifeline. In the vast 630,000 square kilometer (km^2) Chihuahuan Desert, the Río Bravo and its tributaries provide essential aquatic and riparian habitats for hundreds of species of plants and animals, as well as supply water for municipal, agricultural, and industrial needs.

Fresh water is a critical resource in the arid Río Bravo region, not only for aquatic species but for terrestrial species as well. Many of the highest priority terrestrial conservation sites in the Chihuahuan Desert overlap freshwater priority sites. Riparian woodlands are a keystone habitat; they exert powerful influence on the biodiversity of surrounding areas and serve as migration corridors for large mammals, songbirds, bats, and butterflies. The aquatic fauna that have

evolved to live under the river's variable flow conditions – from drought and low flow to large flood events – exhibit a high degree of endemism.

Despite the Río Bravo's status as a wellspring for life, a century-and-a-half of damming, diversion, channelization, poor water management, and inattention to environmental water needs has taken its toll. If the river is to serve the needs of future generations and support the aquatic and riparian diversity that is so uniquely valuable in a desert environment, many portions of the basin now need major restoration efforts.

This chapter explores the current situation in two areas of the transboundary Río Bravo basin:

- The Río Conchos, which begins high in the Sierra Tarahumara in Chihuahua and flows through canyonlands, irrigation districts, and growing municipalities before it reaches its confluence with the mainstem of the Río Bravo just above the twin cities of Ojinaga, Chih., and Presidio, Tex.
- The "Forgotten River" reach of the Río Bravo, which flows through the sparsely populated, remote region that stretches from Fort Quitman, Tex., to Presidio-Ojinaga

For each of these areas, key factors that underlie the river's degradation are briefly examined. The focus of the chapter, however, is on current efforts to restore the Río Conchos and the Forgotten River. These efforts include:

- Assisting Tarahumara communities that seek to protect and improve management of the forested Río Conchos headwaters
- Improving irrigation efficiency in the major irrigation districts in the Río Conchos basin
- Building support for salt cedar removal from the Lower Río Conchos
- Establishing protected areas in key reaches of the Conchos
- Building a broad coalition to support major restoration of the Forgotten River, including removal of salt cedar, revegetation with native riparian species, and enhancement of the river's channel to better convey flows
- Promoting macro-scale policy work to improve binational management of the transboundary Río Bravo

Restauración de Hábitat de los Ríos en el Desierto Chihuahuense: El Río Conchos y la Extensión Olvidada del Río Grande/Río Bravo

Mary E. Kelly y Héctor M. Arias Rojo

Resumen

Al igual que muchos ríos desérticos alrededor del mundo, el Río Grande/Río Bravo transfronterizo es literalmente una línea biológica de vida. En el vasto desierto Chihuahuense de 630 mil kilómetros cuadrados (km^2), el Río Bravo y sus tributarios proveen un hábitat acuático y ribereño esencial para cientos de especies de flora y fauna, así como también el abastecimiento de aguas para las necesidades agrícolas, industriales y municipales.

En esta región árida del Río Bravo el agua dulce es un recurso crítico, no solo para especies acuáticas sino también para especies terrestres. Muchos de los sitios terrestres con mayor prioridad para la conservación en el Desierto Chihuahuense se traslapan con sitios prioritarios de agua dulce. Las zonas de vegetación ribereña son un hábitat clave ya que ejercen una influencia poderosa sobre la biodiversidad de zonas adyacentes y sirven como corredores migratorios para grandes mamíferos, aves cantoras, murciélagos, y mariposas. La fauna acuática que ha evolucionado para vivir conforme a las condiciones de flujo variable del río – de sequía/bajo flujo a grandes eventos de inundación – exhiben un alto grado de endemismo.

A pesar de siglo y medio de construir presas, desviar cauces, canalizaciones, mal manejo del agua y la falta de atención a las necesidades ambientales de agua han dejado mella. Muchas secciones de la cuenca requieren de grandes esfuerzos de restauración si es que

el río ha de seguir cumpliendo con las necesidades de generaciones futuras y brindando apoyo a la diversidad acuática y ribereña, tan excepcionalmente valiosa en un ambiente desértico.

Esta ponencia explora la situación actual en dos zonas de la cuenca transfronteriza del Rio Bravo: (1) la del Río Conchos, que inicia a gran altura en la Sierra Tarahumara de Chihuahua, México, y fluye a través de cañones, distritos de riego, y municipios en desarrollo antes de confluir con el flujo principal del Río Bravo, justo por encima de las ciudades hermanas de Ojinaga, Chihuahua, y Presidio, Tejas; y (2) la extensión de "Río Olvidado" del Rio Bravo, que fluye a través de la región remota y escasamente poblada, que abarca desde Fort Quitman, Texas, hasta Presidio-Ojinaga.

Se examinan los factores clave relacionados con el deterioro del río de cada una de estas zonas. Sin embargo, el énfasis del documento está dirigido a las actividades de restauración actuales en el Río Conchos y en el Río Olvidado. Estas actividades incluyen:

- Ayudar a las comunidades Tarahumara a proteger y mejorar el manejo de las aguas río arriba del Río Conchos
- Mejorar la eficiencia de irrigación de los principales distritos de riego en la cuenca del Río Conchos
- Brindar apoyos para la extracción del pino salado del bajo Río Conchos
- Establecer zonas protegidas en los ramales clave del Río Conchos
- Crear una coalición amplia para apoyar las obras de restauración mayor del Río Olvidado, incluyendo la extracción del pino salado, la reforestación con especies ribereñas endémicas y la ampliación del canal del río para mejorar los flujos
- Promover trabajos de política de macro-escala para mejorar el manejo binacional de la zona transfronteriza del Río Bravo.

River Habitat Restoration in the Chihuahuan Desert: The Río Conchos and the Forgotten River Stretch of the Rio Grande

"A river is more than an amenity, it is a treasure."
Justice Oliver Wendell Holmes

Desert Lifelines

Most of the transboundary Río Bravo lies within the arid and often starkly beautiful Chihuahuan Desert Ecoregion. The Chihuahuan Desert itself is one of the world's biodiversity "hotspots." In fact, it is the only ecoregion in the world that the World Wildlife Fund (WWF) highlighted in its Global 200 Ecoregion Assessment for both terrestrial and freshwater importance.

The extraordinary diversity and endemism of cacti and reptiles are two features for which the Chihuahuan Desert is widely recognized. However, the aquatic environments of the desert are increasingly becoming the focus of preservation and restoration efforts. Because the Río Bravo is the only through-flowing river in the Chihuahuan Desert Ecoregion, the river is a focus for many residents, non-governmental organizations (NGOs), academics, and government decision-makers on both sides of the border, though it is by no means their sole area of concern.[1] As noted in a 2003 report "Hope for a Living River," the Río Bravo:

> ...supports an exceptional web of wildlife, including some 250 species of birds, hundreds of native mammals, and many fish and reptiles. The river corridor fulfills a large-scale ecological function as a major highway for birds and other species that migrate between the Americas (Fullerton and Batts 2003).

This chapter explores the current situation in two areas of the transboundary Río Bravo basin:

- The Río Conchos, which begins high in the Sierra Tarahumara in Chihuahua and flows through canyonlands, irrigation districts, and growing municipalities before it reaches its confluence with the mainstem of the Río Bravo just above the twin cities of Ojinaga, Chih., and Presidio, Tex.
- The "Forgotten River" reach of the Río Bravo, which flows through the sparsely populated, remote region that stretches from Fort Quitman, Tex., to Presidio-Ojinaga

The Río Conchos[2]

The Conchos basin lies almost entirely within the state of Chihuahua (a small section lies within Durango). It is one of the largest river basins in northern Mexico, as it covers more than 7 million hectares.

The Conchos begins high in the pine- and oak-forested Sierra Tarahumara. From an elevation of approximately 2,200 meters (m), in an area with approximately 600 millimeters (mm) per year average rainfall, the Conchos flows east to the first major reservoir – La Boquilla (known locally as Lago Toronto). Begun during the Mexican revolution, La Boquilla is Chihuahua's largest reservoir and is used to supply water to downstream irrigation districts and, when water levels are sufficient, to generate hydropower. Below La Boquilla, the Río Florido, the Río San Pedro, and the Río Chuvíscar (which flows through Ciudad Chihuahua) join the Conchos. The Río Florido is partially impounded by the Presa San Gabriel, which provides for irrigation in the Río Florido District. The waters of the San Pedro are impounded by Presa Francisco Madero (Las Virgenes), upstream from the confluence with the Conchos. Downstream from these irrigation districts, the Conchos flows through spectacular canyons before it reaches the Luis L. León reservoir (El Granero), built in the late 1960s for irrigation supply and flood control (Kelly 2001).

The average annual surface run-off in the Río Conchos basin is about 2,714 million cubic meters (Mm^3) (Jiménez 2002), however, a recent prolonged drought has reduced this figure. The effects of the drought and ongoing water use – particularly for irrigation – are discussed in the next section.

As with many desert rivers, the Conchos provides a ribbon of riparian vegetation, including cottonwood and willow. These ribbons, which depend on sufficient river flows and on periodic overbank flooding, form migration corridors for large mammals and support a wide variety of migratory and resident birds. The Conchos also houses many native and endemic fish species. Recent surveys of the Conchos have revealed a fairly intact aquatic assemblage (as compared to sampling in the mid-1950s) with a relatively high degree of

endemism (Edwards, et al. 2003). Nevertheless, much more data are needed to fully document the biological richness that depends on the Río Conchos and its tributaries (ProFauna, A.C. 2002).

Water from the Conchos is essential to the health of the Río Bravo below Presidio, a stretch that flows through the protected areas of Big Bend National Park, Big Bend Ranch State Park, Cañón de Santa Elena, and Maderas del Carmen. The river also has a U.S. Wild and Scenic River designation downstream from the parks (U.S. Department of Interior No Date). In normal rainfall years, the Río Conchos provides the majority of Río Bravo flow below Presidio-Ojinaga.

Forgotten River[3]

The approximately 300 kilometers (km) of the Río Bravo that run from Fort Quitman to Presidio-Ojinaga constitute one of the most remote sections of the entire transboundary basin. Large ranches and a few sparsely populated agricultural communities border the region. This relatively narrow portion of the basin alternates between a series of canyons that are less than 60 m in width and more open alluvial valleys of 300 m to 1,000 m in width (Fullerton and Batts 2003).

Currently, the open valleys are particularly choked by invasive salt cedar (see the following section for more discussion). This was not always the case.[4] As one riverside resident recently wrote to Environmental Defense:

> As a child I remember playing under a lot of huge cottonwood trees that grew in the fields. Sadly today all 22 of them are dead and gone...the only thing that grows in those old fields are salt cedars. There used to be coveys of quails too large to count, deer used to go to the river to drink and graze in the fields in early evening. Today, only a handful of quail are around and deer only once in a while.

It is sometimes stated or implied that the Forgotten River is always completely dry below El Paso, but in fact, in some years there are significant flows that enter the river's reach from both of its sides. Inflows include irrigation return flows, municipal wastewater discharge, and flash floods from contributing arroyos, as well as

some probable contribution from alluvial aquifers and springs. Figure 1 shows the variation and magnitude of flows that enter and exit the Forgotten River reach. Note that the flows were above 100,000 acre-feet per year between 1989 and 2000, and that there were large flows in 1987 when Elephant Butte reservoir spilled. Of course, upstream dams and diversions have had an enormous impact on this stretch, as evidenced by the years of low flows, sediment build-up, and the loss of any defined channel in many areas (Fullerton and Batts 2003; Schmidt, et al. 2001).

Much more information is needed to accurately characterize the current biological state of the Forgotten River. Data are needed to define the extent of salt cedar and the remaining native habitat, to assess channel condition, to document current aquatic and terrestrial species populations, and as discussed below, to assess restoration potential.

Current and Future Threats

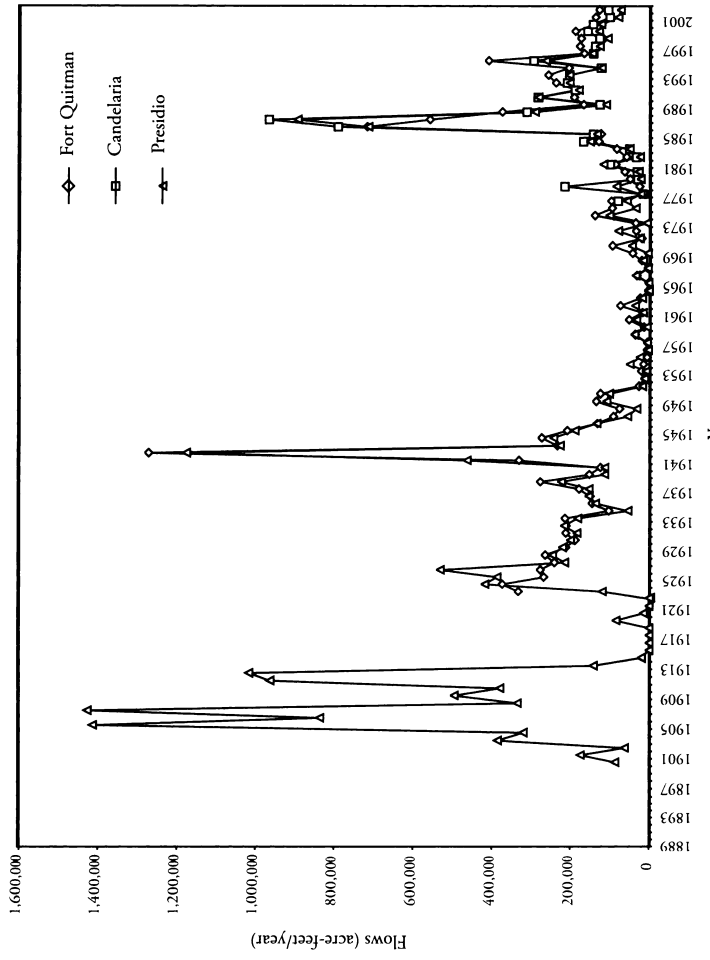
Río Conchos

The Río Conchos basin faces many current threats, and if some of the solutions discussed in this paper are not implemented, the future could bring even more problems. Major issues include over-logging in the Sierra Tarahumara, reduced instream flows, and water pollution.

Over-logging in the Sierra Tarahumara headwaters and the consequent soil erosion represent an extremely serious problem (Guerrero, et al. 2001; Kelly 2001). Further down the basin, the expanding use of the Conchos for irrigation of water-intensive crops, including alfalfa and pecans, is putting increased pressure on the river. Operating plans that restrict releases from La Boquilla and Las Virgenes to spring and summer irrigation periods have also greatly altered flow patterns (Jiménez 2002; Kelly 2001).

Reduced flows, combined with drought and decreased runoff, have reduced the amount of water that makes it through to the lowest reservoir on the Conchos, El Granero (Jiménez 2004). Prior to approximately 1992, the annual flow of the Río Conchos at the Río Bravo averaged 737,000 acre-feet per year, which is more than five

Figure 1. Forgotten River Flows



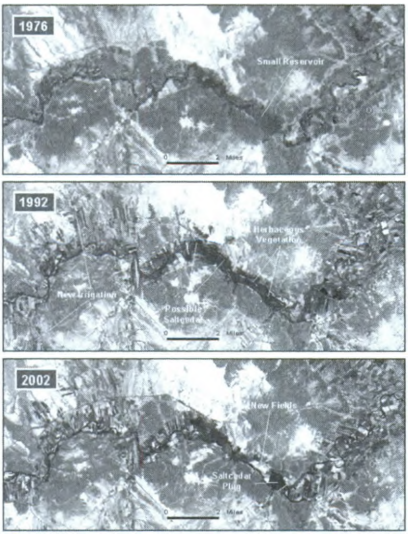
Source: Authors

times the flow of the mainstem of the Río Bravo above the confluence (U.S. Department of Interior No Date). Annual flow from the Conchos into the Río Bravo over the last several years has been less than 100,000 acre-feet.

Reduced flows and lack of periodic floods to clear sediment have allowed a large plug of salt cedar to form in the middle of the Río Conchos, just above Ojinaga. This plug, the development of which is shown in Figures 2 and 3, has blocked much of the river's course and invaded the surrounding farm land.

Finally, the Río Conchos receives large flows of untreated or poorly treated municipal and industrial wastewater throughout much of its basin. Much of the basin also receives irrigation return flows that may be laced with pesticides and fertilizers (Gutiérrez and Borrego 1999). While much more monitoring and analysis is needed to define the extent and sources of pollution in the Conchos, initial studies and anecdotal evidence indicate serious degradation of water quality in some portions of the river.

Figure 2. Development of Salt Cedar Plug in Lower Rio Conchos



Source: University of Texas at Austin Center for Space Research and National Aeronautic and Space Administration

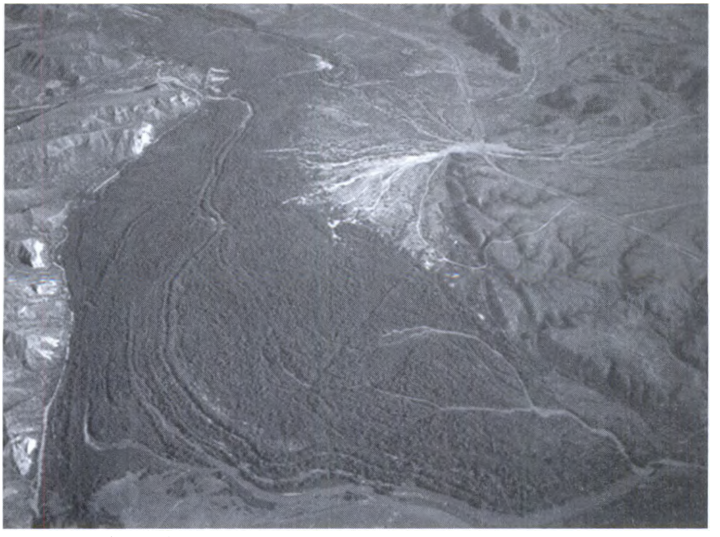
Figure 3. Salt Cedar Plug Near Tarahumara

Source: Cyrus Reed

Forgotten River

Upstream dams and diversions have greatly reduced the magnitude and frequency of flows through the Forgotten River stretch. The widespread invasion of salt cedar in the alluvial valleys (Figure 4) is a fully manifested threat.

Figure 4. Salt Cedar in Alluvial Valleys



Source: U.S. Geological Survey

The salt cedar has choked out native vegetation and pasture grass. Based on anecdotal evidence, the salt cedar has altered the numbers and species of wildlife and birds that use the Forgotten River stretch and has most likely affected the diversity of aquatic species. Many more biological surveys are needed to fully document these changes. Prior surveys have indicated the presence of 20 native fish (about eight of which have been extirpated), 70 reptiles and amphibians, 66 mammals, and more than 250 birds (Stotz 2000). Salt cedar and saline irrigation return flows from upstream have also resulted in serious soil salinity problems in the Forgotten River stretch.

Flaws in the River Management Regime

The recent prolonged drought, as well as increasing surface water use, has illuminated some of the more serious flaws in the domestic and binational management regimes applicable to the Río Conchos and the Río Bravo. Some of these problems have been recognized for years (Utton 1999; Kelly and Székely 2004) and are thoroughly discussed in the applicable literature. From a biodiversity perspective, however, the three key issues are:

- Lack of recognition of or legal protection for environmental water needs/instream flows under Mexican law, Texas law, or under the 1944 U.S.-Mexico water treaty[5]
- An outdated river management philosophy
- An International Boundary and Water Commission (IBWC)[6] in desperate need of modernization

A full discussion of each of these issues is beyond the scope of this chapter. A few observations may be helpful, however. Neither Mexican or Texas law requires water management agencies to allow or reserve a specific amount of water for environmental flow needs. Efforts are underway in both places to change this. Last year, in an overall revision of Mexico's national water law, language that recognizes instream flows was included (though, for other reasons, President Vicente Fox did not ultimately sign the law). In Texas, the ability to voluntarily convert existing agricultural or other rights to

instream use is protected by law, and the legislature has set up a special interim committee to recommend ways in which to protect instream flows, including reserving water for the environment.

Even though environmental flow needs are beginning to be discussed and recognized, the large dams on the Conchos and the Río Bravo are still largely operated almost exclusively to meet the needs of irrigators. This approach to river management stems from the early 20th century, when agriculture dominated the economy of the basin. Though the demand pattern and the economic base have changed significantly since that time, river management philosophy has not kept pace.

Similarly, there have been only modest efforts to modernize the institutional structure and role of IBWC, an entity formed in 1889. Until the last decade, when demand was lower and – except for the drought of the 1950s – rains were generally good, the commission was largely able to fulfill its duty to administer the water allocation provisions of the 1944 treaty without significant problems or controversy. In recent years, however, the commission has had difficulty responding to the implications of greater water demand, which has increased environmental problems and the prolonged drought (Kelly and Székely 2004; CSIS 2003).

Solutions

Despite the manifest and looming threats there are reasonable, practical solutions that could go a long way toward protecting and restoring the Río Conchos and the Forgotten River. The unique nature of the Río Bravo as the Chihuahuan Desert's only through-flowing river, and the absolute centrality of a healthy river system to the economy and quality of life in the Chihuahua-Texas border region, should help compel action. While implementing these solutions will require political will, binational cooperation, community support and, most of all, money, failure to move forward would be a deep disservice to future generations of border residents.

Río Conchos

Four actions would greatly advance the protection and restoration of the Río Conchos. Fortunately, work is underway on each of these solutions. First, there is a need to assist Tarahumara communities in protecting and restoring the forested headwaters of the Río Conchos. The Mexican federal government appears to have somewhat recognized the need to re-activate a 1949 decree that recognizes 1.7 million hectares of the Sierra Tarahumara as "areas of protection of natural resources." This has opened the way for an integrated approach to the management of the headwaters, allowing local communities to identify key areas and sites for river and forest conservation and to develop management plans for these areas. The U.S. Agency for International Development (USAID) has awarded WWF-Mexico a grant to provide assistance in this work. Chihuahua-based intermediary NGOs, such as CONTEC, A.C. and Fuerza Ambiental, are also working toward these ends with indigenous *ejidos* in the Conchos headwaters. The ultimate goal is to have forest conservation plans that benefit both the river and the local communities. A financial mechanism that incorporated the cost of watershed protection into irrigation water pricing, such as an "ecological services" component of the price irrigators pay, might sustain support for these plans. In practice, this last component will require some time to put into place, as many small-scale irrigators currently find it difficult to achieve profitable operations, even with the current low water prices.

Second, there is a serious need to improve efficiency in the major irrigation districts along the Río Conchos (Kelly 2001; Jiménez 2002; Jiménez 2004). One outcome of the drought and Mexico's water deficit with the United States has been much greater attention to the need for such conservation investments. The North American Development Bank (NADBank) has provided $40 million in grants, which, combined with significant funding from the Mexican federal government, are targeted toward major irrigation system improvements. The first projects are being implemented primarily in the Delicias District (Lujan 2003; IBWC 2003).

Whether these efforts are sufficient remains to be seen. Minute 309, negotiated by the U.S. and Mexican governments through IBWC, provides that conserved water will be released through the Río Conchos to the Río Bravo. However, there still seems to be disagreement on how to quantify savings. No specific releases of "conserved water" were made during the predicted December 2003 to January 2004 time frame. Farmers in the Delicias District have been reluctant to agree that the savings will go toward providing flows to the United States (Lujan 2003). Moreover, as discussed below, because of the salt cedar plug in the lower Río Conchos, it is unclear how much of the flows released would even make it to the Río Bravo.

A complementary approach to water conservation would pay farmers for taking land out of production and/or revegetating such lands for wildlife habitat. This approach mirrors the U.S. farm bill's conservation payment programs. Another approach would be to assist farmers in converting from water-intensive but marginally profitable crops, such as alfalfa, to higher-value vegetables and fruits.[7]

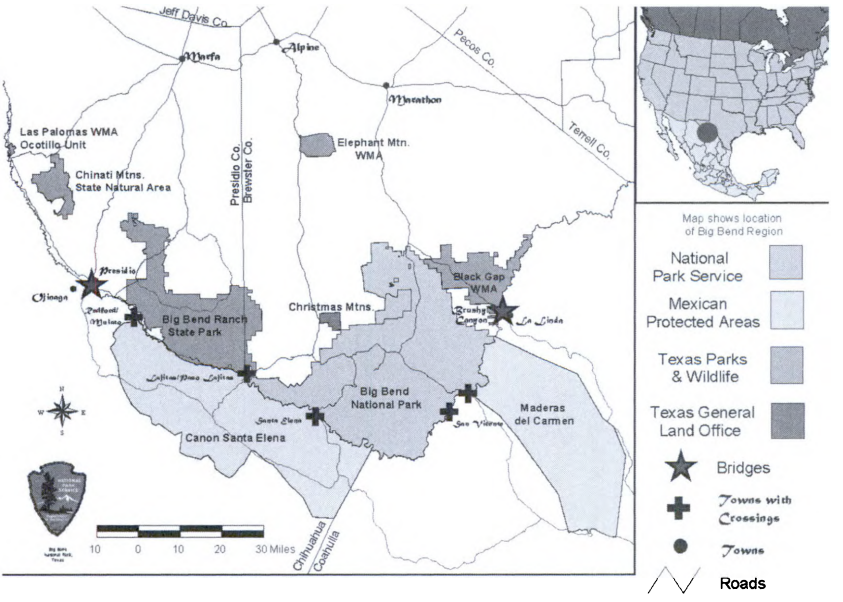
Third, action should be taken in the very near term to remove the salt cedar plug from the lower Río Conchos and control efforts should begin along the entire lower reach. Initial work with producers in the Bajo Río Conchos irrigation district has defined the basic extent of the problem and the adverse effects on river flows and farmland (Lujan 2004). At a recent workshop in Ojinaga, producers indicated support for first focusing on the salt cedar plug in the river.

Finally, consideration should be given to establishing a federal or state protected area in the Cañón Peguis, upstream from the Bajo Río Conchos irrigation district. Protection of this extraordinary canyon (Figure 5) could include a management plan that would provide for more releases from El Granero to support aquatic life and river recreation, as well as support for local *ejidos* interested in ecotourism (Jiménez 2004). A protected area designation for the Cañón Peguis would only enhance the already significant complex of protected areas in this region (Figure 6).

Figure 5. Cañón del Peguis

Source: David Lauer

Figure 6. Transboundary Protected Areas in the Big Bend Region (Brewster and Presidio Counties in Texas, and Coahuila and Chihuahua)



Source: Texas Parks and Wildlife Department

Forgotten River

Although damming and diversion upstream and salt cedar invasion have adversely affected the Forgotten River, the river is still a candidate for a large-scale restoration effort.[8] As noted by Schmidt, et al. (2001):

> Downstream from Fort Quitman, although severely depleted in stream flow, the river continues to be a functioning part of the landscape. Channel dimensions in some reaches have adjusted to the altered discharge so that a smaller river flows in a smaller channel in a relatively broader flood plain. As in pre-dam times, the river continues to meander in some places forming oxbows and in others braiding and forming islands, maintaining the

> topographic irregularities that provide habitat diversity. The mosaic of landscape elements necessary for the foundation of a healthy riparian ecosystem is still present.

Restoring or rehabilitating this segment and "reconnecting" the Río Bravo could have enormous benefits – it could improve local ranching, agriculture, and wildlife habitat; it could create commensurate local economic benefits; more water could be conveyed downstream to benefit protected areas and the Wild and Scenic River, with potential commensurate environmental economic benefits; and it could create more water for the Amistad/Falcon international reservoir system to supply municipal and agricultural needs in the Lower Rio Grande Valley.

But, restoration of this long stretch is complicated. More analysis is required to characterize the current state of the Forgotten River and to identify restoration opportunities and approaches. Environmental Defense and other organizations have been advancing the idea of a "feasibility study" to examine restoration opportunities, costs, and benefits. There is considerable support for this idea at the local and state levels, and interest is increasing at the U.S. federal level. Of course, Mexico's participation will be required for this binational stretch. Discussions are beginning through the Binational Rio Grande Ecosystem Working Group (BREW) and through other channels.

The Environmental Defense, the Nature Conservancy, and WWF's Chihuahuan Desert Ecoregion program are collaborating together and pursuing another approach for this reach – the establishment of a locally controlled Rio Grande water trust in Texas. This trust, which would be governed by a board of local ranchers, business people, and leaders, would seek to lease or purchase unused water rights from voluntary sellers and then convert them to instream flow, as allowed by Texas law. The trust, which would be established as a nonprofit entity, could also accept donations of water rights.

"Regime Change"

There are many areas in which the domestic and binational water management regimes for the Río Bravo could be improved. With respect to the Río Conchos and the Forgotten River, the following are particularly important:

- Securing recognition of and protection for environmental flows to support aquatic and riparian habitats
- Developing new operating plans for upstream reservoirs that provide for the increased use of voluntary water transfers (agricultural to municipal use), year-round flows, and the potential for periodic flood pulses to support riparian habitat (while providing for protection of life and property)
- Modernizing IBWC and its Mexican counterpart, CILA

The following steps – improvements in the management regime that are essential to future sustainability in this basin – should be considered high priorities, as they will modernize the commission to enable it to be more responsive to ecosystem conservation (Kelly and Székely 2004; CSIS 2003):

- Eliminate the requirement that the commissioner be an engineer in order to open up the selection of a commissioner to a much broader range of qualified individuals, including ecologists
- Elevate U.S.-Mexican border water and habitat issues within the respective foreign relations secretariats
- Replace the current separate U.S. and Mexican sections of the commission with a joint, binational office
- Initiate a joint U.S.-Mexican review of the types of resources, technology, and staff skills that the commission will need to better manage and protect transboundary water and ecosystem resources, including the Río Bravo
- Establish a formal, binational notification and consultation procedure for any new projects that could destroy habitat or reduce the flow of tributaries or groundwater springs that contribute to the shared basin

- Consider the potential benefits of establishing a transparent binational basin council, with state and federal representatives, to advise the commission on management of vital transboundary resources

Conclusion

While the drought of the 1990s is sometimes accompanied by inflamed rhetoric on both sides of the border, it has also exposed fatal flaws in the management regimes that apply to the Río Bravo and its habitats. Additionally, it has drawn much-needed government and public attention to the river's problems, and has allowed non-governmental actors – including WWF and Environmental Defense – to catalyze restoration discussions and build the kinds of coalitions that will be necessary to implement solutions. Continued progress will nevertheless require major commitments of government funding from both countries, and some fundamental changes in the overall management policy for the transboundary portion of the Río Bravo basin. The benefits of protecting and restoring this irreplaceable desert lifeline, however, will be well worth the cost.

Endnotes

[1] One only need think of the unrivaled evolutionary laboratory provided by the unique aquatic environments of Cuatro Ciénegas or the beauty of the upper Río Aguanaval in Durango to be reminded of the task facing conservationists and their allies.

[2] For several papers on the Río Conchos, see http://www.environmentaldefense.org/article.cfm?ContentID=2915 and http://www.environmentaldefense.org/article.cfm?ContentID=2902. A slide show on the Conchos is available at http://www.texascenter.org/borderwater/rio_conchos/slides.htm.

[3] For a brief slide show on the Forgotten River, see http://www.environmentaldefense.org/system/templates/page/subissue.cfm?subissue=19.

[4] For early historical accounts of the Forgotten River reach and other portions of the Río Bravo, see Stotz, Nancy G. 2000. "Historic Reconstruction of the Ecology of the Rio Grande/Río Bravo Channel and Floodplain in the Chihuahuan Desert." Prepared for World Wildlife Fund, Chihuahuan Desert Program.

[5] Treaty Regarding Utilization of the Water of the Colorado and Tijuana Rivers and of the Rio Grande, February 3, 1944, United States-Mexico, Stat. 1219, T.S. No. 994.

[6] Its Mexican counterpart is the Comisión de Límites y Aguas (CILA).

[7] These issues were explored at a binational conference in San Antonio in May 2004, co-sponsored by the Mexico Institute of the Woodrow Wilson Center for International Scholars and Environmental Defense.

[8] The term "restoration" is used here to refer to a combination of salt cedar removal, revegetation with native species, and channel restoration or rehabilitation. It is not envisioned that the Forgotten River can be restored to natural flow/pre-dam conditions. See Schmidt, et al. 2001.

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VII

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

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

Abstract

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

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

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

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

Resumen

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

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

Introduction

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

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

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

Biogeography of the Border Region

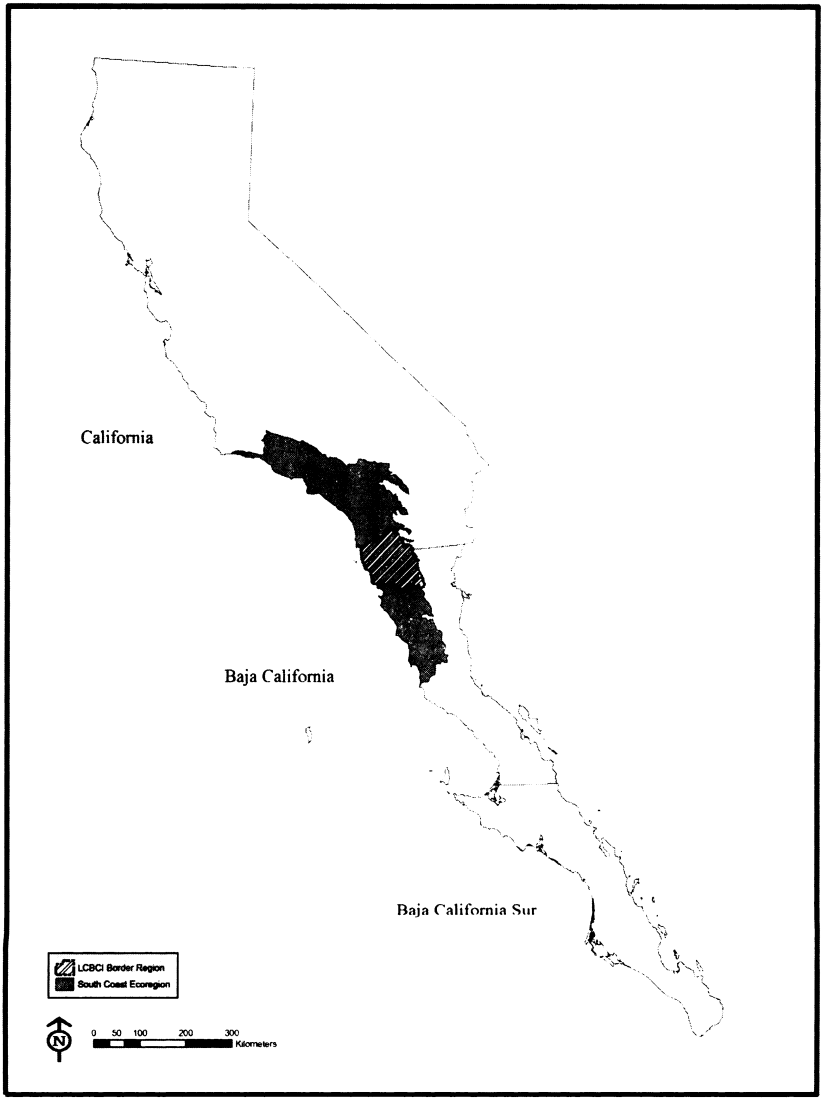
The border region lies at the center of the Peninsular or South Coast physiographic region or "ecoregion," which is part of the California Floristic Province – a recognized global biodiversity hotspot (Hickman 1996; Mittermeier, et al. 1999). The South Coast Ecoregion is defined as the land area that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

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

Topography

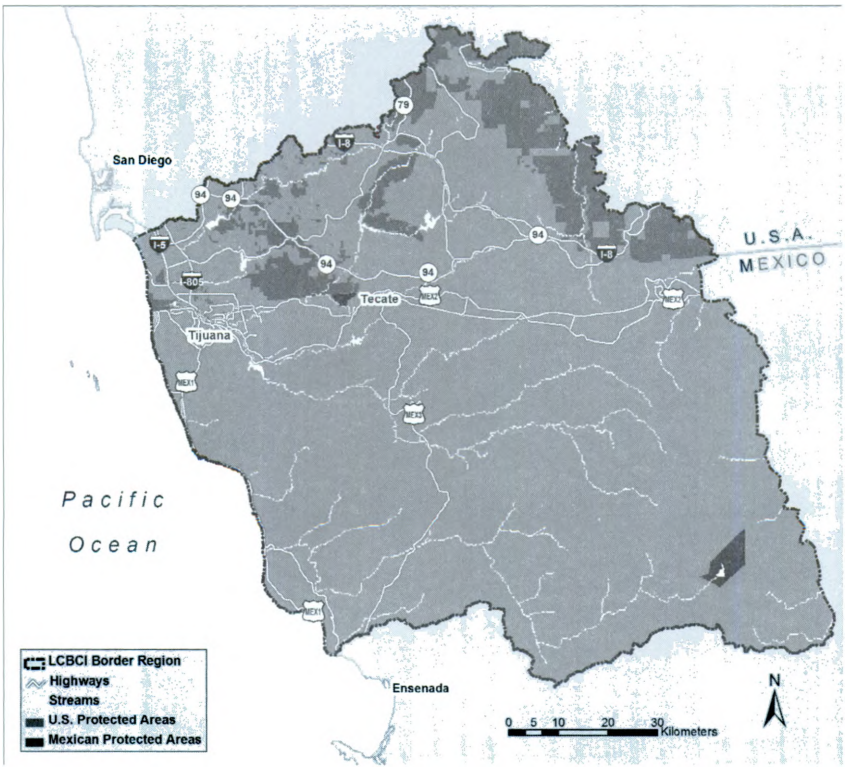
The diverse topography of the border region ranges from flat coastal mesas and rolling foothills, to inland valleys and foothills, to isolated mountain peaks and steep mountain ranges. Within the coastal plain, coastal mesas are fairly level, uplifted marine terraces that occur at elevations that are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

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



Source: Authors

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



Source: Authors

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

Climate

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

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

Biological Resources

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

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

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

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

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

Land Ownership Patterns

Comparison of Land Ownership in Mexico and the United States

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

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

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

Protected Areas

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

Protected Areas in Baja California

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

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

Parques Nacionales and Áreas Naturales Protegidas

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

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

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

Private Conservation Areas

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

comunidades (CESPEDES and Pronatura 2002). However, due to the lack of education and incentives, most of the private and social landowners do not attempt to conserve the biological resources on their lands.

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

Protected Areas in Southern California

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

Federal Land

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

State Land

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

Local Government Land

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

Private Conservancies

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

Examples of Binational Conservation Projects (Baja California-California)

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

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

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

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

Conservation-Implementing Mechanisms

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

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

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

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

Plan de Ordenamiento Ecológico Territorial (Ecological Master Plan)

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

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

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

Other Land Use Policies or Zoning

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

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

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

Legal Conservation Tools for Changes in Land Use Rights

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

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

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

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

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

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

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

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

Implementing Mechanisms in Southern California

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

Federal Regulations

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

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

Federal Conservation Programs

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

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

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

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

State Regulations

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

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

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

State Conservation Programs

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

Local Regulations

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

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

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

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

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

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

Local Conservation Programs

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

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

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

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

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

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

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

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

Comparison of Implementing Mechanisms in the United States and Mexico

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

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

Las Californias Binational Conservation Initiative

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

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

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

Threats

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

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

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

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

Approach

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

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

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

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

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

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

Conclusions

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

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

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

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

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

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

Endnote

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VIII

Tourism and Conservation in Border Regions

Dallen J. Timothy

Abstract

Despite their traditional role as barriers to human interaction, international boundaries have become lines of contact in recent years and their role as separators has relatively decreased. Sovereign nations are beginning to see the importance of crossborder cooperative efforts and their value in promoting economic development and cultural and ecological sustainability. This is especially important in borderlands, where tourism is one of the primary areas of concern.

Of the many advantages to crossborder cooperation in tourism is the ability to promote cultural and ecological balance and integrity. It may also assist in standardizing use and conservation policies on both sides of the border, allowing for valuable amenity areas to be managed more holistically and sustainably. Despite its many advantages, however, there are some significant economic, political, and sociocultural obstacles that typically prevent full cooperative efforts.

Within this context, this chapter examines the role of tourism in border regions and the importance of crossborder collaboration, particularly in the realm of tourism and conservation. It also dis-

cusses many of the economic rationales for tourism-related conservation in border areas and suggests several methods for funding tourism, cultural heritage, and nature conservation.

Turismo y Conservación en Regiones Fronterizas

Dallen J. Timothy

Resumen

A pesar de su función tradicional como barreras de la interacción humana, las fronteras internacionales se han convertido en líneas de contacto en estos últimos años y se ha reducido, en términos relativos, su función como barreras de separación. Las naciones soberanas comienzan a comprender la importancia de los esfuerzos cooperativos transfronterizos y su valor en la promoción del desarrollo económico y la sustentabilidad cultural y ecológica. Esto es de importancia especial en las zonas donde el turismo representa uno de los rubros de interés primario.

Entre muchas de las ventajas de la cooperación transfronteriza en el turismo se encuentra la capacidad de promover el equilibrio e integridad de la cultura y del medio ambiente. También puede ayudar a estandarizar políticas de uso y de conservación en ambos lados de la frontera, permitiendo que el manejo de las zonas recreativas valiosas se realice de manera más integral y sustentable. A pesar de todas las ventajas, sin embargo, existen algunos obstáculos sustanciales de orden económico, político y sociocultural que típicamente impiden la realización completa de los esfuerzos de cooperación.

Dentro de este contexto, en este documento se examina el papel del turismo en las regiones fronterizas y la importancia de la colaboración transfronteriza, especialmente en el ámbito del turismo y de

la conservación. También se presentan muchas de los razonamientos económicos para la conservación relacionada con el turismo en las zonas fronterizas y sugiere varios métodos para financiar las actividades de turismo y conservación del patrimonio cultural y de la naturaleza.

Introduction

Borderlands are dynamic and constantly changing. They rarely coincide with the spatial, economic, and social norms of individual nations. In some cases, border zones are seen as sub-nations – figuratively distinguishable from the countries to which they belong. According to Pan-American scholars, the U.S.-Mexican border is no exception (Brown 1997; Herzog 1986, 1990, and 1991; Kearney and Knopp 1995; Martinez 1988). In fact, most observers agree that the U.S.-Mexican border and its adjacent territories function as a distinct region, pulling both sides into a contiguous and interdependent province that rarely resembles Mexico or the United States in economic, social, political, or ecological terms.

Despite this integrative pattern and the symbiotic relationships that often develop between border communities – which is especially apparent in twin cities like El Paso, Tex.-Ciudad Juárez, Chih.; San Diego, Calif.-Tijuana, B.C.; and Nogales, Ariz.-Nogales, Son. – political boundaries have traditionally functioned as significant barriers to cooperation, regional growth, and conservation management. Nonetheless, political and economic changes have occurred in recent years resulting in improved international relations, increased efforts at crossborder planning, and more integrated forms of communications and development. Various emerging forms of supranationalism (such as the North American Free Trade Agreement [NAFTA], the European Union [EU], and the Association of Southeast Asian Nations [ASEAN]) and bilateral agreements are examples of these changes.

Tourism is the world's largest industry and one of the most noteworthy foci of crossborder cooperation today. Moreover, most places in the world have targeted tourism as a medium for economic development. In many borderlands, tourism is an important economic

activity and the most typical types of tourism are shopping, drinking, gambling, and prostitution, which develop as a result of divergent rules of law, distribution systems, and taxation on opposite sides of a border (Timothy 2001, 2002). In addition, because borders are situated in national peripheries, they are routinely located in pristine natural areas. As a result, nature-based tourism is common in border regions. Rain forests along the Costa Rica-Panama and Uganda-Democratic Republic of Congo borders, for example, are acclaimed areas for ecotourism and various other forms of nature travel (Timothy 2001), and there are several similar places along the U.S.-Mexican border. 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; similar proposals have been made for the demilitarized zone between North and South Korea (Young and Rabb 1992).

This chapter examines the several roles of borders as venues for tourism and cultural and natural resource protection, and includes an examination of funding opportunities. It then highlights the importance of crossborder cooperation in tourism development and conservation, examines various social and political constraints to bilateral collaboration, and applies these insights along the U.S.-Mexican border region.

Borderland Resources and Crossborder Cooperation

In their discussions about sustainability, scholars have emphasized a form of tourism development and planning that advocates the long-term integrity of natural and cultural resources so that they may be maintained for continuous future use (Butler 1999). Several goals of sustainable tourism development have been identified over the years, including the protection of ecological processes and biodiversity. The human element has received additional attention in recent years, however, as development specialists have promoted development principles such as community involvement, holistic planning, harmony, equity, efficiency, balance, cultural integrity, and integration (Bramwell and Lane 1993; Hall and Lew 1998; Milne 1998; Timothy 1999).

Within the context of border regions, these principles can best be supported through crossborder cooperation. For example, in many border areas where natural and cultural heritage abound, international parks have been established, several of which have become important tourist destinations. Most international parks have been designated international because two or more national parks or other protected areas meet at an international border, although some are designated as international because they may lie adjacent to a border but only on one side. Transborder cooperation is crucial to the sustainability of parks and other protected areas in border regions.

Cooperation for Conservation

During the past 30 years or so, Western societies have become obsessed with conservation and its various forms and manifestations in both natural and cultural spheres. There are several reasons for this social phenomenon. First, industrialization and high-tech development have brought about a greater sense of urgency to conserve rurality, traditions, and natural environments. Second, environments are seen as having considerable scientific and conservation value because they can provide valuable information in many areas of research (Pearson and Sullivan 1995). The educative role of conservation has also importantly influenced the growth of conservation in recent years. Third, people value the aesthetic aspect of historic communities and natural landscapes, which may be esteemed because they are old or have an otherwise high "scarcity value" (Lynch 1972). Fourth, there is value to preserving ecological and cultural diversity. In its broadest sense, environment refers to both human and natural elements. Environmental diversity and sustainability are crucial considerations in conservation, particularly since built heritage and many forms of natural heritage are nonrenewable resources. Once sites of historical value are gone, they cannot be reintroduced or regenerated, and even if replicas are created, they cannot replace the originals in scientific, aesthetic, or educational terms (Timothy and Boyd 2003). Fifth, nature and culture also have a functional value. It is common for old buildings, for example, to be renovated and used for purposes other than their

original operation. Some good examples of this are old factories that have been transformed into office buildings, jailhouses that have been transformed into restaurants, and railway stations that have been transformed into souvenir shops.

Another important reason for conservation's growth in popularity, and perhaps one of the most important reasons in the realm of tourism, is that conservation is good economics. In places where tourism is based on natural and cultural resources, the economic impact of conservation efforts can be profound. According to Timothy and Boyd (2003), as tourism has grown, destination leaders and residents have begun to realize the potential value it has for local economies in terms of job creation, increased tax revenues, additional regional income, and the stimulation of entrepreneurial activity. Often, then, economics becomes the basis for conserving environments and developing tourism.

Because most cultural and natural tourism resources are not bound by human-created political borders, most conservation problems cannot be solved without the joint involvement of administrators in adjacent countries. Crossborder cooperation in ecosystems management can help facilitate the standardization of conservation controls on both sides of a border. This has the potential to contribute to the protection of migratory species, water bodies, and scenic landscapes that cross international boundaries. It may also reduce the risk of fire and air pollution, and it allows fuller and easier enjoyment of recreational amenities and experiences (MacNeil 1990). Crossborder collaboration may also reduce the over-exploitation of resources on one side of a border – something that all too commonly results in severe conservancy problems in neighboring regions (Ingram, et al. 1994; Johnstone 1995). Crossborder cooperation might also enhance tolerance and understanding between personnel and entrepreneurs (Tenhiälä 1994). This tolerance and understanding is important where natural resources are concerned, as disputes commonly erupt over partisan uses of internationally shared resources.

Funding through Cooperation

As previously noted, economics is a major force behind conservation efforts and it especially motivates decisions to develop tourism. Crossborder cooperation can be an important tool for funding tourism and conservation in frontier areas. However, regardless of whether true cooperation is achieved or not, funding is an otherwise crucial part of development. The following paragraphs describe various funding sources that can be tapped for tourism in frontier regions.

Despite its economic potential, conservation is not cheap. Most conservation bodies throughout the world have faced severe budget cuts in recent years as public monies have dried up, and management has had to devise new ways to fund conservation. In most cases, tourism has been targeted as a key economic activity and a method of funding various forms of conservation. The source of funding for the maintenance of natural and cultural areas has sparked considerable debate in both private and public circles, and various observers have identified a range of options for generating additional funding.

User fees, such as entrance and admission fees, are the first, and perhaps most widely accepted source of revenue. Cossons (1989) and Prentice (1989) have argued that to make up for lost public funding, it becomes imperative for users to pay for their experiences, and research shows that in most cases, tourist use of cultural and natural resources is price-inelastic, meaning that requiring payment for use does not generally result in lower levels of use. In most cases, visitors are willing to pay for the upkeep and conservation of the sources of their recreational experiences. Interpretation is similar to user fees, which can also be used as a revenue source. The most typical methods for this include audio tape rentals, purchasable maps and guidebooks, and inexpensive group tours.

A second revenue source – special events such as festivals, art shows, sporting competitions, and other exhibitions – can also offset conservation costs. Participants in special events can be charged rental, utility, and other service fees, or they may be required to pay a certain percentage of their earnings to the hosting agency or attraction. Although planned events have the potential to bring in

significant quantities of revenue, it is critical for managers to bear in mind that they must not let these occasions detract from the primary aims and objectives of the site.

Retailing, the third major revenue stream, may be used for conservation purposes. Research demonstrates that people have an unusually high propensity for spending money while they travel and engage in recreational activities. This tendency to spend can have important economic implications for tourist destinations, especially in small communities and rural areas. With the realization of its economic potential, many park and historic site managers have begun to expand their services into the retail sector (Butcher-Younghans 1993). With careful planning, the development of tourism in areas of historic and natural importance can play an important role in providing not only funding for conservation and daily operations, but jobs and increased community income and standard of living, as well (Timothy and Boyd 2003).

Although they require more capital investment, lodging and catering for tourists can also be useful for funding conservation. If new buildings are required, it is important that site managers ensure they do not divert from the goals of conservation or trivialize the significance of the place in question. In many instances, existing homes and historic structures may be used as accommodations and food services areas. The extent to which this can be done will usually depend on extant land use plans and zoning regulations. In rural areas, some of the most successful and aesthetically sound lodging establishments are bed and breakfasts, cabins, farmhouses, campsites, and cottages.

Grants provide yet another source of funding. When no direct line of government funding exists, agencies, organizations, and communities can submit grant proposals to various public agencies and philanthropic associations. Sometimes, agencies with an interest in education and conservation are able to provide one-time gifts to private, public, and nonprofit areas, and there are several agencies that have distinct interests in funding borderland development projects. For example, several high-profile philanthropic organizations (including the Kellogg Foundation and the Rockefeller Foundation) give regular grants for communities in border areas, including Mexico, to assist in community development. These grants are usu-

ally awarded on a competitive basis and solid justifications have to be made for why the individual site is most deserving of the money. Many of the largest philanthropic organizations have programs for both domestic and international work and tend to focus on development-oriented projects. In these cases, a one-time gift is usually offered.

Sponsorship, an increasingly popular revenue source for conservation areas, entails a form of in-kind exchange, whereby some sort of service is provided in exchange for another service, or money. An example might be a regional newspaper that offers advertising space to an historic fort in exchange for admission passes, which it uses as prizes or gifts. It may also be possible for organizations to sponsor special events, which allows a great deal of exposure for their products.

Donations are one of the most common sources of conservation funding for natural and cultural sites. Unlike sponsorships, these typically do not have in-kind exchanges attached to them. Instead, they are gifts that are not expected to be repaid in any way. Donations may come from individuals or organizations. To elicit small-scale and personal donations, managers often place donation boxes near entrances and exits to motivate people to donate spare change or more to the site's conservation fund. This practice is commonplace at many attractions, even where entrance fees are required. In some instances, a donation may be considered an adequate admission fee at locations where official user fees are not levied. Larger gifts from estates, philanthropic individuals, and corporations are also important.

In spite of the source of funding, managers and conservationists must understand the funding processes and how environments can support their own conservation and interpretation. Not every funding source may be appropriate for every situation, and managers need to be aware of the best ways for money to be used and for resources to be tapped.

Constraints on Crossborder Cooperation

Despite increasing efforts toward cross-national partnerships throughout the world, true cooperation is difficult to achieve. While cultural and natural resources in border areas face the same types of problems other protected areas face (such as law enforcement, funding, research, staff issues, illegal hunting, and unsustainable agricultural practices nearby), their location creates a set of rather unique obstacles that most protected areas do not typically encounter (Timothy 2000).

Cultural and social values on opposite sides of a border have a tendency to create chasms between neighbors that are difficult to bridge. Of course, the size of this chasm depends on the degree of difference and the willingness of each side to work at cooperation. Collaborative efforts are much easier to facilitate when symmetrical interests, values, languages, and social practices exist between each side of a border (Blatter 1997). Saint-Germain (1995) found language and cultural traditions to be significant barriers to crossborder communications along the U.S.-Mexican border. Differences in administrative practices can raise insoluble barriers to international collaboration. When agencies in each nation, whose responsibilities include environmental protection and/or tourism development, have contrasting mandates and opposing views of natural resources, it is difficult to realize common goals in borderland areas. For example, in the United States and Canada, park and forest management agencies have traditionally been at odds with each other. In the United States, "the Park Service strives to preserve the natural environment while allowing recreational activities, and the Forest Service seeks to balance multiple uses of the land with recreation. In [Canada], the agencies are more polarized. While [Parks Canada] functions much like the U.S. Park Service, the Forest Ministry operates solely for the purpose of resource extraction" (Weingrod 1994).

Problems also arise when dissimilar levels of government responsible for various aspects of planning and conservation meet at international frontiers. In Mexico, for example, states, and not the federal government, usually administer parks and preserves. In most cases, U.S. borderlands are administered by states and federal agen-

cies that do not always agree. U.S. Fish and Wildlife Service, National Parks Service, Department of Homeland Security, U.S. Customs, Bureau of Reclamation, and Bureau of Land Management, as well as the states of Sonora, Chihuahua, and Coahuila all have an interest in what takes place along the border (Steffens 1994). Therefore, a situation is created where many "individuals, groups, and agencies involved in all kinds of activities have an interest in the [U.S.-Mexican] border region. Yet many of them seem to operate in almost total ignorance of the others. They duplicate each other's efforts, and their interests overlap" (Kjos 1986).

Political practices in most places have mandated that all levels of international negotiations are the responsibilities and rights of national governments (Gaines 1995). This has typically precluded local governments from getting involved in crossborder negotiations. In most cases, local authorities have no rights to enter into agreements with their crossborder neighbors unless they have received prior authorization from the national government (Hansen 1983). This is an unfortunate situation, for in many cases, the implementation of conservation and tourism policies and programs usually works best on a local level, where the people and administrators are more familiar with their crossborder neighbors (Gaines 1995; Hansen 1983; Timothy 2000). This is certainly the case in most crossborder communities in the United States and Mexico. The twin cities of Douglas, Ariz., and Agua Prieta, Son.; Nogales, Ariz., and Nogales, Son.; and Yuma, Ariz., and San Luis Río Colorado, Son., for example, commonly work together in areas of environmental care, fire control, and tourism (Ingram, et al. 1994; Johnstone 1995).

Sovereignty is typically viewed as the absolute control of national space and territory. True forms of cooperation are hard to establish because it means the parties involved would have to give up some minute degree of autonomy in the name of collaboration, and thereby diminish absolute territorial sovereignty (MacKinnon 1993). This notion is usually most visible at international borders, where economies and political systems meet. Arduous border-crossing formalities are a manifestation of sovereign control and may keep people from visiting another country. They may also avert the free flow of goods and services between sides. These restrictions

hamper staff and visitor exchanges, which are particularly important in building understanding, conducting research, and in carrying out interpretive programs. Border-related issues usually take precedence over conservation needs in borderlands. Most national governments are more interested in preventing undocumented migration and in controlling the flow of goods than they are in protecting the environment and in establishing cooperative relations. As one U.S. park official noted:

> For every agency that wants to encourage the greater flow of wildlife, another agency wants to build 14-foot walls to keep immigrants and drugs out. All of our conservation problems are affected by social problems: drugs, illegal immigration, the language barriers ... If we don't make progress with illegal immigration and drug traffic – which will continue to be difficult to resolve – we won't make progress on conservation issues (quoted in Steffens 1994).

Because of sovereignty constraints, it is difficult to achieve truly integrated cross-national cooperation; both polities understand that they will have to give up some level of control in the name of collaboration. In the context of the U.S.-Mexican border, Herzog (1986) notes:

> By the beginning of the present decade the political implications of the growing symbiosis between San Diego and Tijuana began to emerge more clearly. Although citizens, bureaucrats, scholars, and elected officials on both sides of the border recognized the need for local coordination, the principle of national sovereignty continued to impede the formation of any truly binational form of boundary governance. Thus, decisions would persist within the framework of separate jurisdictions of San Diego and Tijuana.

The physical structure of the border also influences conservation efforts. Barbed wire fences, minefields, and guard towers are obvious barriers to human interaction, cooperation, and conservation in some parts of the world. However, even in less-stringent situations,

such as on the U.S.-Canadian border, a seven-meter wide cleared vista extends along the entire border, cutting through agricultural landscapes and protected areas such as the Waterton-Glacier International Peace Park, marking ecological integrity and true binational cooperation in conservation (Timothy 2000). The vista, which is cleared with herbicides and bulldozers, is an eyesore to many conservationists and it reflects non-cooperative conditions rather than crossborder cooperation. Along the U.S.-Mexican border – where the U.S. has erected high walls and fences and in some places where the U.S. has dug anti-vehicular trenches just inside the border near crossing points – the border infrastructure is also an impediment to conservation. Even in less urbanized areas, the smaller border fences divide nature preserves and historic sites, which affects species migrations. Illegal mass migration (by foot and vehicle) into the United States also endangers many of the plant and animal species that inhabit the borderlands.

Marginality is another influential variable to cooperation. In the 1960s, the Mexican government invested millions of dollars in the northern frontier zone for economic and infrastructure development, urban renewal, and cultural preservation. Mexico, however, is outside the norm in this respect. Central authorities normally view frontier zones as marginal and unimportant to their modernization and economic development efforts. Usually, they favor the more populated and industrious interior. This leads to a lack of funding and administrative support for border regions (Blake 1993; Korona 1995). During policy development, peripherality also typically results in the marginalization of border residents' concerns. Thus, as Ingram, et al. (1994) note, it is not surprising that national and state policies often differ from the needs and priorities of communities and places along the border.

Finally, contrasts on opposite sides of a border are especially visible when the developed world meets the developing world. When it comes to tourism and conservation, varying levels of development are difficult to balance, because in less-developed countries it is often hard to provoke widespread enthusiasm for conservation when governments and most of the population are primarily concerned with basic survival (Norton 1989). In these cases, binational cooperation is difficult because most less-developed countries are more

concerned with domestic problems such as poverty, health care, and unemployment than they are with crossborder issues (Timothy 2000). Additionally, imbalance exists when one country has knowledge about and the resources to devote to conservation and management, but its crossborder neighbor does not. In the words of Parent (1990):

> Like Mexico itself, the Mexican park system is still developing. Mexico does not have the resources to staff and manage its parks as intensively as in the United States. Unlike the United States, Mexico cannot give such strong emphasis to environmental preservation. Instead, it must compromise more with economic development for the local people.

Differing levels of development may also result in varying degrees of environmental protection on opposite sides of a border. Where pollution is uncontrolled on one side of a border, conservation efforts and tourism development are necessarily influenced on the other side (Steffens 1994). In the U.S.-Mexican borderlands, for instance, "polluted surface runoff, unimpeded by the border, threatens the health of residents on both sides" (Ingram, et al. 1994), and Pacific Ocean pollutants from Tijuana, which the current carries northward, make many of the beaches south of San Diego unusable for recreational purposes (Timothy 2000).

Conclusion

Crossborder cooperation is of paramount importance to sustainable development and to the development of equitable relationships on both sides of the border. Crossborder cooperation can promote community empowerment, it can promote the sustainable development of natural and cultural resources, and it can strengthen local economies. In addition to sound infrastructure development, human resource advances, and ecological conservation, binational collaboration may enhance funding. Many sources of funding exist for tourism development, and while most of these are not specific to border regions, they may be adequately applied to communities and areas located on or near the international boundary.

Border areas are often important tourist destinations, and in some cases, because of their typically peripheral location, they are prime laboratories for ecological and cultural conservation. While the border and its effects (such as peripheral location, marginality of residents, and opposing levels of development, among others) usually function as barriers to cross-national networks, methods need to be explored to overcome these obstacles. Because true crossborder cooperation is a rather new paradigm (with a few exceptions in Europe) it is still too early to understand the gravity and breadth of its repercussions. Nonetheless, nascent evidence suggests that cross-border cooperation provides many opportunities for community enhancements on both sides of the border.

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IX

A Potential Riparian Protected Area: The Trinational Kumiai Corridor

Katherine Comer[1]

Abstract

The Kumiai Corridor concept is a blueprint for a trinational riparian protected area that aims to enhance the hydrological, ecological, and cultural resources of the Campo Indian Reservation in San Diego County, Calif., the County of San Diego, and the Municipality of Tecate, B.C. On one end of the Campo Creek-Tecate River corridor, the Campo Indian Reservation already boasts community-led riparian protection programs. Thirty-five kilometers downstream, at the other end, an ecological easement was recently created on sacred Kumiai lands at Rancho Cuchumá. Those Mexican lands were joined with public Bureau of Land Management lands in the United States to form a transborder protected zone called Servidumbre Cuchumá. Plans for an urban river park in Tecate have been developed. These existing projects would serve as anchors for an approximately 100-meter wide biodiverse riparian ribbon through urban Tecate and through rural lands in San Diego County.

The Kumiai Corridor blueprint uses two phases. In phase one, lands could be protected within national boundaries through a variety of land protection instruments. Phase two would "weld" the protected areas across national boundaries. A seamless corridor might

help bring greater attention, protection, and funding for the area. Long-term goals for the region include the incorporation of lands adjacent to the corridor and the incorporation of lands beyond the anchors. Stakeholders hope the riparian protected area will one day stretch from the Laguna Mountains to the Tijuana Estuary on the Pacific Ocean.

Un Zona Ribereña Potencialmente Protegida: El Corredor Kumiai Trinacional

Katherine Comer[1]

Resumen

El concepto del Corredor Kumiai es un plan de un corredor ribereño trinacional protegido con el propósito de enriquecer los recursos hidrológicos, ecológicos y culturales de la Reserva India de Campo dentro del condado de San Diego, California, el Condado de San Diego y el Municipio de Tecate, Baja California. Por un extremo del corredor del Arroyo Campo-Río Tecate, la Reserva India de Campo ya cuenta con programas de protección ribereña dirigidos por la comunidad; y, por el otro extremo, a 35 kilómetros río abajo, en fecha reciente se estableció una servidumbre ecológica en las tierras sagradas de los Kumiai en el Rancho Cuchumá. En este proyecto se juntaron las tierras mexicanas con tierras públicas del Bureau of Land Management de los Estados Unidos para formar una zona protegida transfronteriza llamada Servidumbre Cuchumá. Ya se trazaron proyectos para el establecimiento de un parque ribereño en la zona urbana de Tecate. Los proyectos existentes actuarán como puntos de

anclaje de una franja de unos 100 metros de ancho de biodiversidad ribereña a través de la zona urbana de Tecate y de tierras rurales del Condado de San Diego.

El proyecto del Corredor Kumiai consiste en dos fases. En la primera, las tierras se podrían proteger dentro de los límites nacionales mediante una serie de instrumentos de protección de las tierras. En la segunda fase, se "fusionarían" las zonas protegidas de ambos lados de los límites nacionales. Un corredor continuo podría ayudar a generar más atención, protección y recursos financieros a esta zona. Las metas a largo plazo de la región incluyen la incorporación de tierras adyacentes al corredor y las tierras más allá de los puntos de anclaje. Las partes interesadas esperan que algún día la zona ribereña protegida abarque desde las Montañas Laguna hasta el Estuario de Tijuana en el Océano Pacífico.

Introduction

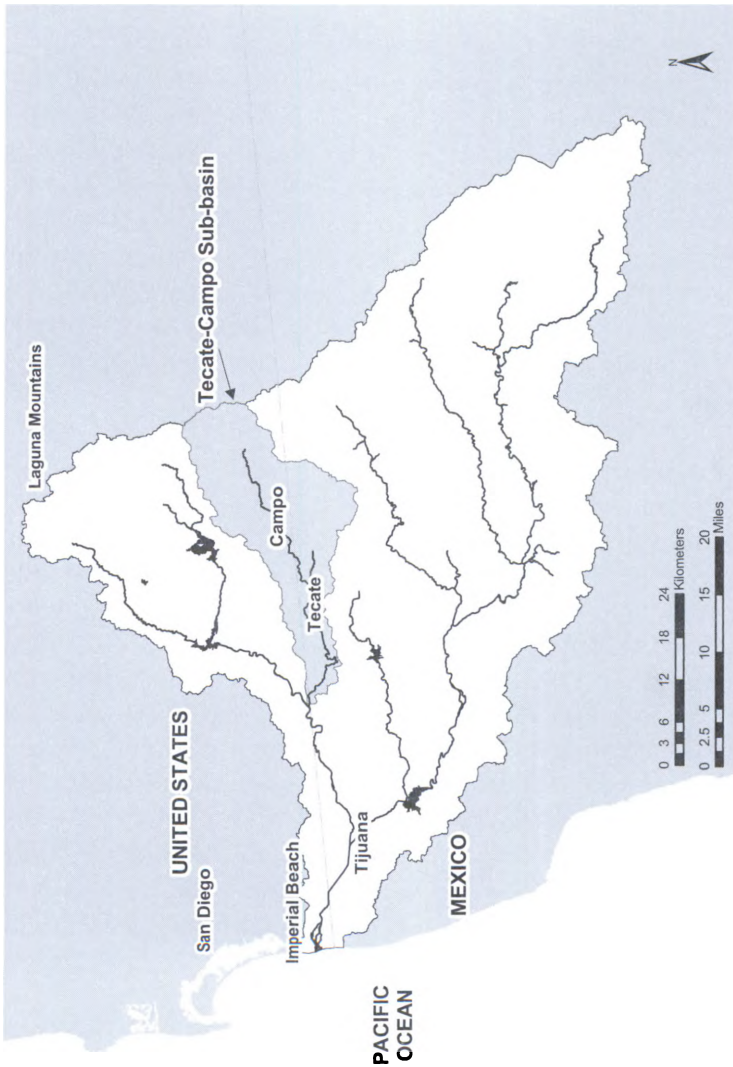
In contrast to site-based approaches, regional planning tools are some of the most effective conservation tools for maintaining ecosystems (Noss and Harris 1986). Ecosystems that operate within geographic boundaries such as biomes, watersheds, and migratory routes do not generally coincide with political boundaries, such as the boundaries of counties and countries (Zbicz 1999; CEC 2000). The coordination of all actors, laws, administrations, and cultures is challenging for conservationists. However, such challenges must be overcome to manage regional-scale ecosystems properly. This chapter focuses on regional land conservation techniques and tools.

Land conservation involves the use of legal mechanisms and economic incentives to encourage sustainable use or the recovery of the ecosystem services in an area (Terra Peninsular 2001; Gutiérrez Lacayo, et al. 2002). This chapter discusses current attempts at land conservation along the California-Baja California border that may serve as models for other areas along the U.S.-Mexican border. It also suggests mechanisms for protecting a trinational riparian Kumiai Corridor that stretches from the Campo Indian Reservation in the United States, through San Diego County, Calif., to Tecate, B.C., in Mexico.

The Kumiai Corridor blueprint is a conceptual plan for protecting an ecologically, hydrologically, economically, and culturally important area along the U.S.-Mexican border. The trinational riparian protected area would start at Campo Creek on the Campo Indian Reservation in the United States, continue through San Diego County lands to the U.S.-Mexican border where it turns into the Tecate River, include parts of Joe Bill Canyon in Mexico, the proposed Tecate Urban River Park through the City of Tecate,[2] and end at the binational ecological easement at Rancho Cuchumá, which is property of Rancho La Puerta, A.C.[3] (Figure 1). The Kumiai Corridor would encompass approximately 35 kilometers (km) of the river's length with a 50-meter (m) buffer on both sides of the river channel. Width would vary depending on hydrology and land ownership. Ideally, the corridor would provide the following services:

- U.S., Mexican, and indigenous cultural preservation
- Links between protected areas in southern San Diego County and critical ecological areas in northern Baja California
- Wildlife movement corridors and contiguous aquatic habitat
- Recovery of riparian vegetation to help recharge the aquifers, protect surface waters, trap sediments, and provide flood control
- Associated economic benefits of a clean environment and natural flood control
- Enhancement of cooperation between nations, governmental agencies, and non-governmental organizations (NGOs)
- Restoration and enhancement of the ecological and hydrological function of the larger Tecate-Campo sub-basin and the Tijuana River Watershed
- Recreational, educational, and research opportunities

Figure 1. The Tijuana River Watershed



Source: Author; data from SDSU and COLEF 1994

Background

United States and Mexican Land Acquisition Mechanisms

The United States has more land designated for conservation than Mexico does, mainly due to historic public land allotments and economic incentives, such as tax breaks that encourage individuals and companies to designate protected areas. At the same time, Mexico has developed innovative approaches for creating and managing protected areas that incorporate human needs and activities. Table 1 provides a partial list of the tools that are available to entities that want to acquire additional land for conservation in Mexico and the United States. The table also provides a short description of some of the incentives associated with each tool.

A Regional Context

Watersheds are appropriate geographic units for analyzing the regional natural and human processes that affect the Kumiai Corridor (Dunn and Leopold 1978; Montgomery, et al. 1995; GNEB 2000). The Tecate-Campo sub-basin is situated within the Tijuana River Watershed (Figure 1). This binational sub-basin straddles the U.S.-Mexican border, encompasses 430 km^2, and is characterized by steep, hilly terrain and a Mediterranean climate. It is dominated by chaparral and coastal sage scrub, wetlands (including vernal pools), and riparian zones with oaks, cottonwoods, and willows (Delgadillo 2000). The sub-basin is predominantly rural and, in 1994, was 88% non-developed. Protection of the riparian corridor would serve as an international model for other transboundary watersheds.

Challenges in the Tecate-Campo Sub-Basin

The Kumiai Corridor plan addresses many concerns in the Tecate-Campo sub-basin, including the increasing population pressure, human economic needs, diminishing groundwater, contaminated surface water, poor air quality, threatened ecosystems, and threat-

Table 1. Land Acquisition Mechanisms

Tool	United States	Mexico
Land donation	Can be stipulated in wills, land gifts by corporations, and living proprietors. The government offers estate tax breaks and charitable tax deductions.	Not common due to lack of incentives; the donor pays for the transfer of title and development rights, and the receiver pays property taxes.
Land purchase	Land trusts or governments buy or transfer lands.	Has recently been exercised by U.S. and Mexican NGO teams (in Coahuila, for example). Costs of property taxes and management of the donated land are high for land trusts. There are limits on how much land can be owned.
Easement donation	Landowners can donate conservation easements that for a stipulated time period (usually perpetuity) restrict some specific uses but maintain title to the land. Charitable deductions and estate tax breaks apply.	Must be signed between two plots of land (dominant and servient). The dominant can determine the NGO that receives a gift of land (1 ha) as a gift from the landowner. For an "easement in gross" there is only one landowner. In general, there are insignificant tax incentives. An NGO can be a third party overseer with legal power to defend the land, a more economic option.
Easement purchase	Same as above, with monetary compensation for the development rights.	Most highly recommended by Pronatura. Economic compensation or other assistance is the immediate incentive, but management and title of the land stay in the hands of locals (Bahia de los Angeles is a good example).

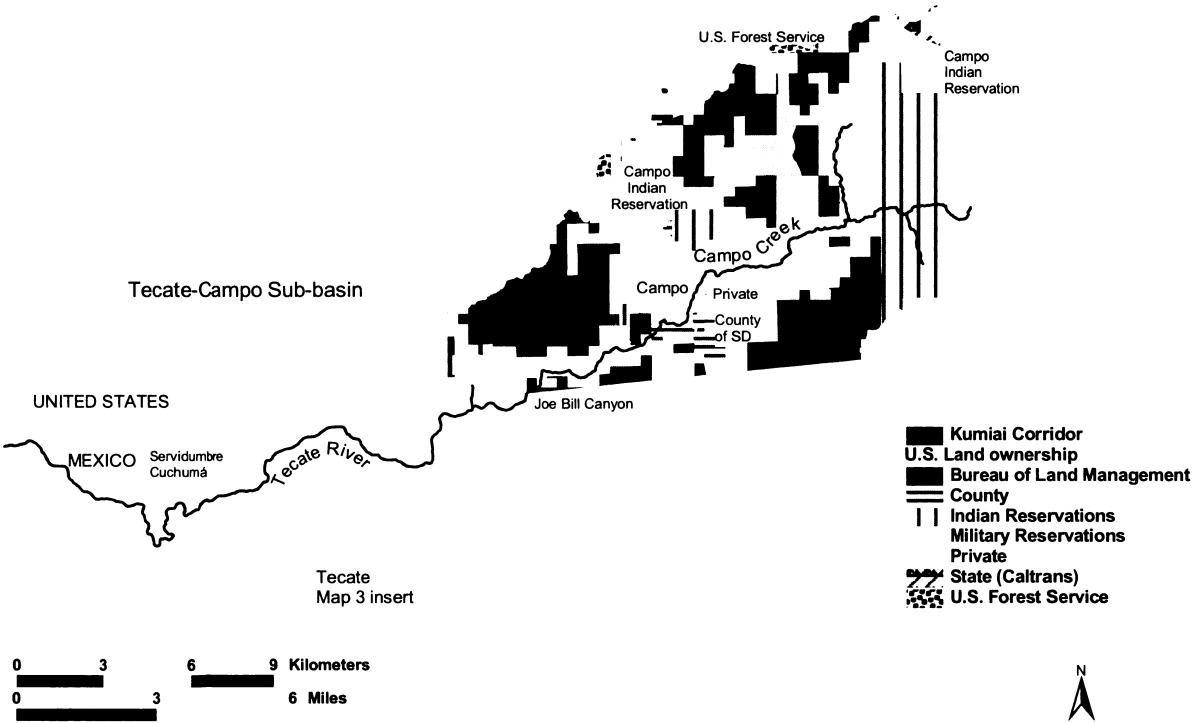
Sources: U.C. Davis 1998; Corcuera, et al. 2000; Gutiérrez Lacayo, et al. 2002; Ochoa 2004; Vargas Téllez 2004

Table 1. continued

Tool	United States	Mexico
Land transfers	Land trusts are intermediaries for the government organizations while they work on acquiring the land. Incentives are that trusts avoid monitoring and enforcement costs, and free up monies to purchase other land, and it is a faster process in emergency situations."	Land could be incorporated by the Instituto Nacional de Ecología (INE), Comisión Nacional de Áreas Protegias (CONAP), or similar government institutions. Political swings cause this to be risky. Also, laws allow "compatible development" in biosphere reserves. Attempts are being made to incorporate private lands into reserves. Generate transfer fees and taxes for the holder.
Transferable development rights, *derechos transferibles de desarrollo*	Owner sells the development rights in a sensitive area in exchange for development rights in a more biologically appropriate site, termed a "receiving area."	A government agency offers land owners a parcel of equal monetary value in a more appropriate site. Zoning laws are weak and therefore there are few incentives. Has been used in Mexico City for historic preservation.
Usufructo	Not applicable in the United States.	"Life estate," which includes the rights to use and enjoy land or resources, are sold to an NGO. The previous owners are given a parcel on which to live and work, and the contract expires with the landowner's death.
Fideicomiso	Similar to a conservancy's ability to manage funds and land.	A contract on rights of use is drawn and land/money can be donated and sold via a financial institution (usually a bank). The terms of the contract are monitored.
Bequest	Donation after death. Avoids estate taxes.	Donation after death.

Sources: U.C. Davis 1998; Corcuera, et al. 2000; Gutiérrez Lacayo, et al. 2002; Ochoa 2004; Vargas Téllez 2004

Figure 2. Land Ownership in the Campo Section of the Kumiai Corridor, 2004



Source: Author; data from SANDAG 2003

ened cultural resources. Tecate's population is expected to double by 2025 (Ganster, et al. 2002) and the demand for potable water has steadily increased. Well water now serves only 30% of Tecate, down from 100% in the early 1990s (Ramírez 2004). Well water is used less today because of low precipitation, well overdraft, and diminished water quality. Low water tables have caused the sediments, salts, and contaminants in some wells to become so concentrated that humans can no longer drink the water. Imported Colorado River water supplements well water in Tecate, but it is expensive to purchase and treat, and the construction of dams and diversions upstream have made the flow inconsistent. If managed properly, restored riparian areas of the region could help recharge the aquifer.

Hydrology, stream geomorphology, biological systems, and recreational activities in riparian areas have suffered from urbanization and sprawl (Pronatura 2002). Loss of riparian habitat in the region has led to loss of connectivity for migratory animals, erosion of the banks, scouring of the streambed, increased flooding, and sedimentation in downstream areas, such as the Tijuana Estuary. In addition, recovery of riparian vegetation could reduce evaporation of surface water, the invasion of exotic species, the loss of biodiversity, and it could increase the river's aquatic health (Michel and Graizbord 2002; Ponce 2003). Physically, the loss of riparian habitat in Tecate has given illegal sand miners, vehicular traffic, and squatters access to streambeds. The Tecate River rarely flows. However, where there is surface flow, the high levels of contamination from industrial and non-point source urban runoff make recreation unsafe (Gersberg, et al. 2000). Criminal activity also makes the riverbed unsafe for recreation in some areas. Increased impervious areas (such as roads and buildings) have slowed rain-fed recharge of the groundwater systems that underlie the channel and feed the river.

Indigenous Kumiai communities in the area that could benefit from cultural links across national boundaries include the Campo Band of Kumeyaay (spelled Kumiai in Spanish) Indians in the United States, and the Mexican communities of San José de la Zorra, San José Tecate, Juntas de Nejí, and San Antonio Necua. Land use changes and globalizing economies threaten traditional indigenous ways of life and valuable indigenous knowledge bases

such as language, ecological management, arts, and medicinal practices (Wilken-Robertson 2002). Archeological sites near the Kumiai Corridor, such as Cuchumá, Bosque de los Encinos, Rancho Pérez, Casa Orendain, and San José Tecate (Pronatura 2002) could become part of the Kumiai Corridor.

Previous Research

Previous work in the region called for the protection of this riparian corridor. Researchers identified the riparian zone of the Campo Creek and the Tecate River as important biological corridors and potential transboundary protected areas (Ganster, et al. 2002; Michel and Graizbord 2002). Recent studies have classified the U.S. section of the Kumiai Corridor as conservation category "Gap 4," which is unprotected under the law (CBI 2003). On the Mexican side of the corridor, the Servidumbre Cuchumá is the only legally protected area. Researchers have identified Joe Bill Canyon as a Conservation Priority I (a high priority) and as an established recreational area (Pronatura 2002).

The Kumiai Corridor concept fits in well with stakeholder recommendations. In 2003, five stakeholder workshops were held for the Binational Vision for the Tijuana River Watershed Project.[4] Stakeholders' desired actions and activities were documented through small group activities and prioritized through an individual voting process. At a meeting in Campo, Calif., many of the participants voted for the construction of wildlife corridors, specifically in rural San Diego County lands, the La Posta Corridor (see CBI 2003), La Gloria Canyon, Smith Canyon, Joe Bill Canyon, and from La Rumorosa to the Cuyamaca Mountains. At the Tecate stakeholder meeting, two of the most suggested actions were watershed-wide recognition and respect for the Kumiai people. Participants also suggested that deforested areas, sand mines, and areas with hydrological problems be identified.

The Kumiai Corridor plan follows general conservation recommendations from the Las Californias Binational Conservation Initiative (CBI, et al. 2004). The objectives of the project are to:

- Protect the border region's unique biogeography
- Link existing protected areas

- Identify gaps in protected areas and targets for conservation
- Promote a binational park system

Landowners and Stakeholders

The owners of the land traversed by the corridor are, from east to west: Campo Indian Reservation, U.S. private landowners, Bureau of Land Management (BLM), the County of San Diego (Figure 2), private ranchers in Mexico, Comisión Nacional del Agua (CNA), and Rancho La Puerta, A.C. (Figure 1). Some of the potential stakeholders are listed in Appendix I.

Phase One of the Kumiai Corridor Plan: Small Steps

The Campo Reservation Section

The Campo Indian Reservation is the northernmost section of the Kumiai Corridor blueprint. The Campo Band is one of 12 U.S. bands of Kumeyaay and five *ejidos* of Kumiai in Mexico totaling nearly 5,000 people (Connolly 2004). The Campo Indian Reservation, approximately 100 km east of the City of San Diego, measures approximately 65 km^2 and contains two disconnected sections with a combined population of approximately 350 residents. The area is threatened by cattle grazing outside the reservation, which causes erosion and downstream sedimentation; groundwater contamination from septic systems; illegal dumping; hazardous waste from drug labs; and invasion by salt cedar (or Tamarisk) and other exotic species (Green 2003a).

The Campo section of the corridor is already protected and under restoration by tribal authorities. A no-grazing program has been implemented and community-based riparian restoration projects are under way at a number of locations on the reservation. The restoration projects use weirs, or "rock drops," which slow water flow, control erosion and undercutting of banks during storm events, recharge groundwater, and help create wetlands (Green 2004b). Sediments are trapped in the standing water and behind the weirs,

thus protecting downstream areas from scoured banks, infill, and the pollutants mixed into the sediments. The projects can serve as models for downstream communities in the Kumiai Corridor.

The tribal government communally owns and oversees all the land on the reservation. Therefore, there is no need to create a conservation easement. However, the establishment of a long-term management program would continue to set a good example for upstream and downstream neighbors, and it could lead to many real benefits for the reservation. For example, the Tribal Council could pass a protected area ordinance or program, which would allow sustainable use of the riparian area while protecting Campo Creek from waste dumping, over-harvesting of riparian vegetation, over-development, channelization, and so forth. Activities such as sustainable reed harvesting, traditional basket making and sales, a native plant nursery, medicinal plant harvesting, food harvesting, and ecotourism present the potential to generate income and foster cultural values for the residents (Green 2004a). By participating in the trinational Kumiai Corridor, the reservation would maintain control of their lands and open up a dialogue on the best ways to promote sustainable development and foster riparian and cultural enhancement in the subbasin. The Campo Reservation could serve as a cultural hub, or anchor, for the Kumiai Corridor.

The Cuchumá Ecological Easement Section

Tecate Peak, or Cuchumá, sits at the other extreme of the Kumiai Corridor, (see Figure 1), and it is a place of significant cultural, historical, and ecological value, and could symbolically serve as one anchor for the Kumiai Corridor. Cuchumá is a sacred mountain for the Kumiai people. "The young played at its feet as their elders hunted the slopes for wild game...it was the mystic mountain where their spirits joined the spirits of their ancestors when they died" (Summers 1972). In addition, the area is biologically rich, containing endangered flora and fauna. In 2003, Pronatura helped negotiate an easement of Rancho La Puerta Mexican lands with BLM lands on the U.S. side of the border. Pronatura acts as a third party for the easement contract and monitors and defends the terms of the easement (which include no development or activities harmful to the

environment). Interestingly, BLM was the "dominant" party receiving the ecological benefits (see Table 1 for further explanation), and was an important, although not a required, player in the contract (Ochoa 2004; Vargas Téllez 2004). This type of transborder agreement could serve as a model for other areas along the border.

The San Diego County Section

The northern middle section, mostly San Diego County lands, could be protected in two phases, starting with immediate legal protection of the riparian lands and continuing with the development of a river conservancy that would acquire additional land and manage the land (see, for example, the San Diego Conservancy Law 2002). In the first phase, the San Diego County section could create a conservation easement approximately 15 km in length, starting at the southern border of the larger Campo Reservation parcel and extending to the international border at Joe Bill Canyon (see Figure 2). It would be necessary to develop separate easement contracts between each landowner and a local and willing land trust that has the necessary staff and resources to monitor and protect the easement terms (perhaps TNC, Backcountry Land Trust, the San Diego Land Conservancy, or BLM). In addition to the 50 m riparian buffer zone, other activities are possible and suggested. For example, in some cases entire parcels could be incorporated through an easement donation (such as from San Diego County and BLM) or with compensation (such as from private landowners, see Table 2). Each easement contract may stipulate conditions of use that, for example, may allow low-impact grazing and agriculture where appropriate, but prohibit channelization, high-density development, or sand extraction.

Table 2. Suggested Organizations and Actions for the County of San Diego Section

Bureau of Land Management	BLM could contribute to conservation by easing its properties along Campo Creek. The BLM lands along the border are part of the Border Mountains area, which is administered as a Special Recreation Management Area (SRMA). Changes to the permissible activities might involve prohibiting off-highway vehicles in the easement (BLM 1994). BLM also has the ability to ease adjacent lands into its own and become the holder of eased lands (CBI 2003).
County of San Diego	The county could ease its land into the Kumiai corridor along the riparian corridor by SR-94. The County could contribute to regional conservation of the easement by zoning the areas outside the easement for low densities in the General Plan 2020 and any insuring that any wetland activities require state and federal permits. Community groups and indigenous groups should work with the County Department of Planning and Land Use on these issues (CBI 2003).
Private Ranchers and Owners	Low impact grazing and agriculture can be compatible with conservation objectives, and some citizens may donate or ease land within and beyond the 50 meter riparian buffer.
Border Patrol	A written memorandum of understanding between the easement holder and the Border Patrol may help reduce vehicular impacts from Border Patrol activities. Remote sensing techniques have been studied at SDSU for the purpose of protecting sensitive habitats (Lina Masters 2002). Training for agents on where sensitive habitats are is essential.

Sources: Author and CBI 2003

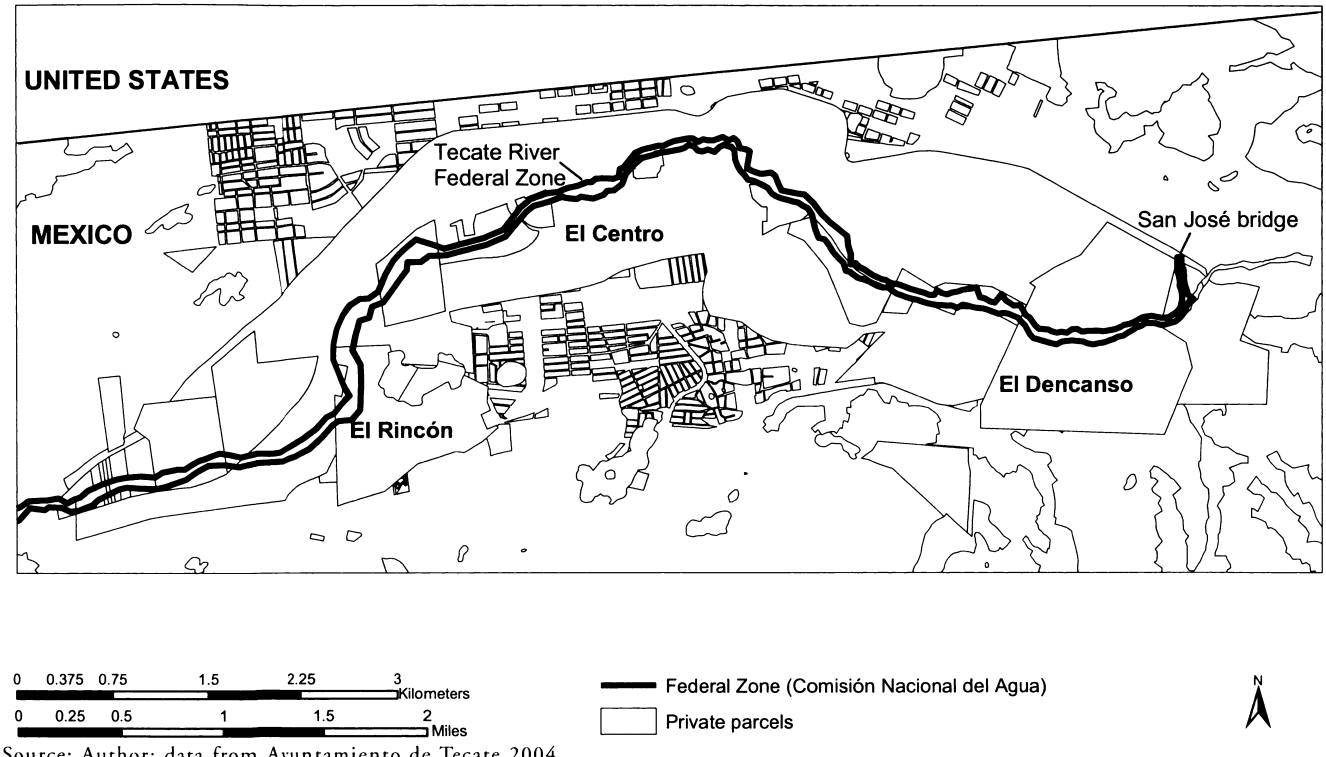
The Tecate Section

The southern middle section, the city of Tecate, is in the advanced stages of planning for an urban river park. The Kumiai Corridor would include the 10-km stretch of the Tecate River (Figure 3) that is proposed for the park and would eventually incorporate less-developed areas upstream and downstream, with the goal of creating a contiguous protected riparian zone. This is consistent with long-term goals of stakeholders, which include a series of connected river parks from Tijuana to Tecate, and even over the international border into the Laguna Mountains (United States) and into the Pacific Ocean at Imperial Beach (United States).

The idea of a Tecate river park has existed for several years and has prompted research at several universities.[5] The Centro de Estudios Urbanos developed the *programa parcial* (master plan)[6] for the Tecate Urban River Park in 2004. The proposed park extends from the San José bridge in east Tecate to the Rincón district in the west (see Figure 3). The master plan for the river park includes the concession of administrative rights to the riverbed from CNA to the municipality of Tecate (Ayuntamiento de Tecate 2004). Under the master plan, the 10-year flood zone would have a "no use" zoning while the 1,000-year flood zone would have mixed use zoning with recreational areas and permeable surfaces. The regular settlements (with services) and irregular settlements (squatters) that have been built in the CNA owned federal zone (approximately 50 m on either side of the river channel) would pose major obstacles to this proposed zoning.

The master plan also calls for the use of "ecotechnology," such as sediment traps to slow erosion, reduce water velocity, and build up the riverbanks. Permeable "geoscreens" on the banks would be used instead of concrete flood control structures because they allow groundwater recharge and can host riparian native vegetation (Espinoza 2004). Studies that have investigated the feasibility of pumping treated water from the Wastewater Treatment Plant to the San Jose bridge in the Descanso district show that the wastewater may be useful for irrigating the river park and partially recharging nearby wells (Ponce 2004).

Figure 3. Land Ownership in the Tecate Section of the Kumiai Corridor, 2004



Source: Author; data from Ayuntamiento de Tecate 2004

At a meeting at Rancho La Puerta in 2004 on the institutional concerns for the proposed Tecate Urban River Park, stakeholders and Pronatura representatives recommended a "road map" to creating the park, some of which had already been completed (indicated with *):

- Convene stakeholders, landowners, and government officials*
- Agree on the objectives for the river park*
- Organize a media campaign to involve the public
- Establish the functions of the different actors
- Create a realistic timeline and budget*
- Map out the legal issues
- Gain concession of the administrative title of the federal zone from CNA to the municipality of Tecate
- Transfer administrative control of the federal zone to a *paramunicipal* (see definition in Table 3)

The *paramunicipal* would develop plans, zoning laws, and issue development permits, among other administrative duties. Some river park stakeholders have developed a working draft of a Río Parque Tecate Paramunicipal, called the Comisión Municipal para la Administración del Río Tecate (Municipal Commission for the Administration of the Tecate River, in Spanish COMART).[7]
In addition to the above steps, two additional steps should be taken to ensure the long-term conservation of the river:

1. Create a *servidumbre pública*, or easement, between the CNA-owned federal zone and another parcel, with third-party NGO oversight. An ecological easement (see Table 1 for further explanation) would ensure the perpetual protection of the riverbed. It would be protected from potential political swings, and overseen by a third-party NGO with the legal mechanisms to uphold the easement contract. An easement contract between CNA and another landowner (such as Rancho La Puerta) could be created with terms of use that follow the stakeholder-defined objectives of the river park (e.g., prohibiting concrete channelization). The landowner would be the dominant party (receivers of environmental benefits), while CNA land would be subservient (provider of environmental benefits).

2. Create additional easements between CNA and adjacent landowners beyond the 50-meter wide CNA-owned river channel. To expand the park, a "public mixed easement" would be created between the CNA federal zone and each plot that shares a boundary with the federal zone. If the owners of the parcels are willing, the Tecate Urban River Park fideicomiso (see Table 3) could accept land donations or purchase land. In this case, the CNA-owned federal zone would be the dominant parcel, while the private parcels would be subservient. Separate contracts for each owner would lay out land use terms, which could include low-impact land use such as recreation, agriculture, or low-impact grazing. Again, a third-party NGO would monitor the terms of the easement contracts and defend the lands against violations.

In Mexico, there is currently no legal mechanism that combines all the duties and powers of a "river park conservancy" as in the United States (see San Diego River Conservancy Law 2002). What the Tecate Urban River Park stakeholders need to accomplish their goals is a combination of actions, or a "conservation cocktail" (Guitiérrez Lacayo 2004) (Table 3).

Definitions of terms in Table 3 are as follows: A *fideicomiso* operates under the *Ley de Operaciones de Crédito* (Law of Operations and Credit). A contract on rights of use is drawn and land and/or money is given to a *fiduciaria* (usually a bank). The fideicomitente is the person giving the land or money to the fiduciaria. *Fideicomisarios* are responsible for receiving the money and executing the objectives set forth in the internal rules of the *fideicomiso*. The *comité técnic*o (technical committee) is the decision-making organization that oversees the process (Pronatura 2002). A *paramunicipal* is a decentralized public entity that operates within the municipal government (or state or federal government) with a specific purpose (for example, the gas company Pemex is a *paraestatal* of the Mexican federal government). The Secretaría de Infraestructura y Desarrollos Urbano del Estado (State Secretary of Infrastructure and Urban Development, in Spanish SIDUE) would serve on the *paramunicipal* and would continue to oversee the protection of urban infrastructure, or any man-made structures such as bridges, within the federal

Table 3. Proposed Objectives and Actors in the Tecate Urban River Park

Objective	Organizations
Establish priorities for the Park	Stakeholders
Create recreational areas and open green space	*Paramunicipal*
Approve management and conservation plans	*Paramunicipal* uses the *plan de ordenamiento de territorial*
Design and execute a development plan for the river zone	*Paramunicipal*
Establish development restrictions with legal backing. Protect the recharge zones for the aquifer	*Paramunicipal* zones river park land and issues development permits
Charge for services provided by the river park	Costs are decided by the *paramunicipal* (who serves as the comité técnico of the *fideicomiso*) and carried out and administered by the *fideicomisarios*
Acquire land through exchange or purchase; receive lands or other goods in the form of donations	*Fideicomiso*
Rehabilitate flora and fauna through restoration projects	*Paramunicipal* approves a project and hires workers through the *fideicomiso*
Maintain the streams and drainages in a natural state, avoid concrete channelization, and protect the slopes. Provide protection against erosion and flooding using natural materials that integrate into the environment	The *paramunicipal* advises on "ecotechnology" alternatives to concrete structures; CNA and SIDUE maintain oversight and both agencies are part of the *paramunicipal* advisory board
Contract personnel to monitor the park	*Paramunicipal* and *fideicomiso*

Sources: Author and Gutiérrez Lacayo 2004

zone. CNA and the Comisión Estatal del Agua (State Water Commission, in Spanish CEA) would continue to oversee water rights, concessions, and discharge into national waters. CNA would continue to own the federal zone land under the river, although the administrative title would be conceded to the Municipality of Tecate.

Phase Two of the Kumiai Corridor Plan: "Welding" the Four Sections

Phase two involves merging the four sections – Campo, County of San Diego, Tecate, and Cuchumá. In phase one, the challenge was to merge management objectives among agencies, private parties, NGOs, and other stakeholders. Phase two is admittedly more difficult because it involves land acquisition, as well as protection and management, across international borders.[8]

Because of the success of the Servidumbre Cuchumá, that ecological easement should be expanded through Rancho La Puerta and other private lands so it reaches and joins the Tecate Urban River Park. In those easements, low-impact development or grazing densities could be negotiated. On the east side of the river park, from the San José Bridge to Joe Bill Canyon, similar ecological easements between the CNA federal zone and private landowners could be created. At the border, CNA lands could be eased with BLM lands in the United States the way Rancho Cuchumá was eased with BLM lands for the Servidumbre Cuchumá.

One drawback to developing multiple easements with a "conservation cocktail," is that if each parcel uses different easement terms, the overall conservation objectives for a contiguous, integrated Kumiai Corridor may not be met. To help increase the contiguity of conservation objectives, a trinational NGO could be created to bring upstream and downstream landowners and stakeholders to the table. The NGO could create a memorandum of understanding (MOU) or similar agreement to define the overall conservation objectives for the Kumiai Corridor and formalize the partnerships among the actors. The NGO could also provide the third-party oversight for easement contracts in Mexico.

Long-Term Administration and Funding for the Corridor

On the Campo Reservation, the Campo Environmental Protection Agency (Campo EPA) and the Tribal Council administer natural resources and the Tribal Council has the power to enforce the decisions made for the protected area. Financial support for conservation projects that improve the land may be available through the U.S. Department of the Interior, the U.S. Department of Agriculture, or the Tribal Lands Initiative. Ecotourism, workshops, performances, and sales of cultural products (such as baskets made from riparian reeds) could provide income for residents.

San Diego County conservation easements would be legally binding and the land trust that holds the land would be responsible for monitoring the easement terms. Maintenance for trails and picnic areas, for example, could come from user fees, Campo Creek River Conservancy memberships and donations, San Diego County funds, or BLM, for example.

For the Tecate section, with approval from the *paramunicipal*, the *fideicomiso* could hire a salaried employee to enforce the rules of the Tecate Urban River Park. Educational programs would inform citizens and industries of park rules. If there were insufficient funds, then community residents would be the caretakers in the park. Construction of recreational trails would allow easy passage for the resident caretakers; this form of "community watch" can be successful. Trails and interpretive signs could serve as demarcations for the river park boundaries; other protected areas stress demarcation as an important and necessary enforcement tool (Breymeyer and Noble 1996; Gutiérrez Lacayo, et al. 2002). A telephone hotline would allow residents to report violations anonymously. Fines collected from violators would go toward cleanup of the illegal activity or toward mitigation projects in other parts of the river park. With the proper management, the Tecate Urban River Park *fideicomiso* could act as a land mitigation bank, receiving fines from violators of municipal and river park laws and purchasing additional land for the Kumiai Corridor.

After formal protection is established, a United Nations Educational, Scientific, and Cultural Organization (UNESCO) Man and the Biosphere Reserve or World Heritage site could be developed to draw international attention, protection, or funds for the Kumiai Corridor. Biosphere reserves are areas where the coastal or terrestrial ecosystems serve conservation, human development, and research functions (UNESCO 2004a). UNESCO's "Cultural Heritage" status can provide a monument, a group of buildings, or the site of historical, aesthetic, archaeological, scientific, ethnological, or anthropological value. "Natural Heritage" status emphasizes physical, biological, and geological features (UNESCO 2004b). The Kumiai Corridor does contain threatened species of universal value and places of universal cultural value (Pronatura 2003). Both the United States and Mexico would have to submit a separate application for inscription on the World Heritage List, along with a detailed management plan. UNESCO economic assistance is available for the preparation of management plans and for the maintenance of sites (UNESCO 2004b).

Entrepreneurial opportunities for all three nations include ecotourism (cabins, hiking, horses, bird watching, fishing), produce and artisan markets, and wilderness pass sales. Trinational cooperation could lead to U.S. funding (perhaps through private foundations, such as the International Community Foundation) for the construction of structures, such as a Kumiai community center, a *transfronterizo* cultural center, museums, a research laboratory, a water-testing laboratory, river park offices, trails, or camping/hiking rest stops.

Once implemented, it is important to measure the success of the Kumiai Corridor plan quantitatively and qualitatively (TNC 2000). Suggestions include calculating:

- Number of hectares protected
- Change in aquifer levels
- Change in well production
- Change in sediment loading
- Change in leaf area index (foliage)
- Number of jobs created
- Revenue attracted
- Revenue of the "land mitigation bank"

- Number of donors
- Number of stakeholders involved in the NGO

Binational environmental indicators are needed to quantify other environmental impacts such as changes in air quality, water quality, biological integrity, and so forth.

Conclusions

The proposed trinational corridor would bring many services to its residents and neighbors – clean water and air, wildlife, cultural heritage, green open space, recreation, and economic opportunities. This chapter outlines the challenge of identifying the optimal tools for conservation in each political and administrative unit. The blueprint offered here presents a few options for land conservation, but promotes perpetual ecological easements as the long-term regional planning tool with a vision for the future.

Theoretically, phase one follows the approach of TNC, seeking small, simple, and "do-able" strategies within national boundaries (TNC 2000). Phase two – welding protected areas across international boundaries – is obviously more complex. However, in Mexico, for example, mixing approaches and organizations (such as the *paramunicipal*, *fideicomiso*, easements, and a trinational NGO) offers a robust solution that may withstand political and economic swings. In other words, long-lasting political support for Kumiai Corridor protection could be greater with numerous vested entities and with a variety of tools, or a "conservation cocktail." An important benefit of cooperatively managing human, economic, and natural resources among three nations is the long-term cooperative bonds that result. This blueprint may guide other areas of the U.S.-Mexican border, as it provides options and strategies for bridging political and administrative boundaries.

Endnotes

[1] This chapter contains valuable contributions from: Miguel Ángel Vargas Téllez, Fernando Ochoa, and Martín Guitiérrez Lacayo, Pronatura, A.C.; Mike Connolly and Phil Green, Campo EPA;

Patricia Ramírez, CESPTE; Ana Espinoza, CEUSS; Bertha Hernández, IRSC-SDSU; Michael Wilken-Robertson, CUNA; Mario Salzman, Fundación La Puerta, A.C.; and Anne McAnaney, International Community Foundation.

[2] The proposed park involves ecological rehabilitation and recreational enhancement of the urban Tecate River riparian zone (see "The Tecate Section" for details).

[3] A foundation with an environmental/cultural focus.

[4] Funded by the State Water Resources Control Board, County of San Diego, Institute for Regional Studies of the Californias, and the Geography Department at San Diego State University.

[5] For example, the Institute for Regional Studies of the Californias at SDSU (see Ganster, et al. 2002; Michel and Graizbord 2002), California State Polytechnic University, Pomona, Studio 606, Department of Landscape Architecture, and Arizona State University's School of Planning and Landscape Architecture.

[6] With funding from Fundación la Puerta.

[7] From a presentation by Mario Salzman in Tecate in April 2004.

[8] An example of how difficult this welding process is can be seen from efforts to simply merge GIS data across the California-Baja California border (Wright and Griffin 1993).

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Appendix A

Back Country Land Trust
California Environmental Protection Agency (Cal EPA)
Campo Environmental Protection Agency (Campo EPA)
Colegio de la Frontera Norte (College of the Northern Border) (COLEF)
Comisión Estatal de Agua (State Water Commission) (CEA)
Comisión Estatal de Servicios Públicos (State Commission of Public Services of Tecate) (CESPTE)
Comisión Nacional de Agua (National Water Commission) (CNA)
Comisión Nacional de Áreas Naturales Protegidas (National Commission for Protected Areas) (CONAP)
County of San Diego
Dirección General de Ecología (State Secretary of Ecology) (DGE)
Fundación la Puerta, A.C. (La Puerta Foundation, A.C.)
Instituto de Culturas Nativas (Native Cultures Institute) (CUNA)
International Boundary and Water Commission-Comisión Internacional de Límites y Aguas (IBWC-CILA)
International Community Foundation (ICF)
Kumeyaay Indian communities: Campo Band of Kumayaay Indians, San José de la Zorra, San José Tecate, Juntas de Neji, and San Antonio Nécua
Mountain Empire Resources Information Taskforce (MERIT)
Municipalidad de Tecate (Municipality of Tecate)
Pronatura, A.C.
Proyecto Bioregional de Educación Ambiental (Bio-regional Environmental Education Project) (PROBEA)
San Diego State University (SDSU)
Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food) (SAGARPA)
Secretaría de Infraestructura y Desarrollo Urbano del Estado (State Secretary of Infrastructure and Urban Development) (SIDUE)

Secretaría del Medio Ambiente y Recursos Naturales (Secretary of the Environment and Natural Resources) (SEMARNAT)
Terra Peninsular, A.C.
The Nature Conservancy (TNC)
U.S. Environmental Protection Agency (EPA)
Universidad Autónoma de Baja California (Autonomous University of Baja California) (UABC)
University of California at San Diego (UCSD)

X

The Role of State Sovereignty in U.S.-Mexican Treaty Law on Transboundary Water and Wildlife

Kelly Hoffman

Abstract

Do environmental resources that are shared among international governments pose a challenge to state sovereignty? (Herein state is defined as, "A body politic, especially one constituting a nation" [American Heritage Dictionary 2000]). How are these challenges to sovereignty mitigated by international law? This chapter examines the treaty law that governs two natural resources that freely cross the U.S.-Mexican border – freshwater and wildlife. Both the United States and Mexico have turned to international law, most commonly in the form of major international treaties, to protect their interests in these resources. The chapter examines U.S.-Mexican treaties that concern transboundary wildlife and shared rivers, and this chapter shows that even while signing cooperative treaties, the states have gone to great lengths to protect and safeguard their sovereignty. The language of these treaties is oriented only to a limited extent to establishing cooperative regimes for resource management. More often, the treaty is dedicated to reinforcing national boundaries, protecting state sovereignty, and minimizing the influences of the neighboring country on domestic territory and national decision-

making. These findings provide insight into larger debates over the breakdown of state sovereignty in the face of globalization. Rather than being a symptom of the breakdown of national borders, international treaties, ironically, serve to reinforce state sovereignty.

La Función de la Soberanía del Estado en el Derecho de los Tratados entre Estados Unidos y México sobre el Agua y Especies Silvestres de la Zona Transfronteriza

Kelly Hoffman

Resumen

¿Representan los recursos ambientales compartidos entre gobiernos internacionales un desafío a la soberanía de los estados? (De aquí en adelante, se define el concepto de estado como "una entidad política, especialmente una que constituye una nación" según la edición 2000 del American Heritage Dictionary.) ¿Cómo se mitigan estos desafíos a la soberanía mediante el derecho internacional? En esta ponencia se analiza el derecho de los tratados que rige sobre dos recursos naturales que cruzan libremente la frontera entre los Estados Unidos y México – el agua dulce y la vida silvestre. Los Estados Unidos y México se han apoyado en el derecho internacional, más comúnmente por medio de los tratados internacionales, para proteger sus intereses en estos recursos. Esta ponencia analiza los tratados entre los Estados Unidos y México con respecto a la vida silvestre y los ríos compartidos de la zona transfronteriza y demuestra que, a pesar de la firma de tratados de cooperación, los estados han hecho todo lo posible por proteger y salvaguardar su soberanía.

La redacción de estos tratados se orienta solamente de manera limitada al establecimiento de regímenes de cooperación para el manejo de los recursos. A menudo, un tratado se dedica a reforzar las fronteras nacionales, proteger la soberanía de los estados y reducir las afectaciones del país vecino sobre el territorio nacional y la toma de decisiones a nivel nacional. Los hallazgos del documento brindan un panorama de información hacia deliberaciones más profundas sobre la desintegración de la soberanía del estado ante la globalización. En lugar de ser un síntoma de la desintegración de las fronteras nacionales, los tratados internacionales, irónicamente, constituyen un recurso para reforzar la soberanía del estado.

Introduction

State sovereignty is one of the organizing principles of modern international law. The independence of nation-states and the freedom of national governments to act within their borders create a critical foundation of the state system. Despite sovereignty's solid place in international law, it remains a highly contested principle. Developing states defend their rights to sovereignty in an effort to prevent the intervention and imposition of authority from more powerful states, while wealthy states resist efforts of international organizations to limit their control over their domestic and economic affairs. At the same time, globalization scholars argue that the concept of sovereignty may be anachronistic because international trade, networks, and legal regimes are limiting the ability of independent states to manage their own affairs without international and external influence. The natural environment and transborder resources are frequently cited as threats to state sovereignty, while the legal principles of sovereignty are believed to hinder effective management and protection of transborder resources. This chapter explores the principle of sovereignty in U.S.-Mexican treaty law and how it affects shared natural resources, particularly freshwater and wildlife. How is sovereignty addressed in these treaties? Is state sovereignty weakened or reduced by international cooperation? Or do the terms of the treaty reconfigure but essentially strengthen sovereignty?

An examination of U.S.-Mexico water and wildlife treaties reveals that sovereignty plays out very differently in each case. In terms of shared freshwater resources, the majority of the law that governs the shared U.S.-Mexican rivers comes in the form of bilateral treaties. In these treaties, there is a progression from a strict interpretation of sovereignty and territorial rights to a more nuanced view of sovereignty and a greater flexibility towards seeing the river basins in question as unified wholes. Importantly, a binational governing agency – the International Boundary and Water Commission (IBWC) – was established to deal with the implications of sovereignty. The role of IBWC and the nature of its authority both limit and strengthen sovereignty in different ways.

In the case of wildlife, only one bilateral treaty between the United States and Mexico explicitly governs transboundary wildlife. Either regional or major global treaties constitute the remainder of the treaties signed by both countries. In contrast to the water treaties, wildlife treaties mention sovereignty less explicitly and establish a more cooperative spirit from the beginning. However, the treaties do not establish binational or supranational governing agencies and they allow both countries to retain control over the governance of the resource and the laws they create to implement the treaty terms. In the case of the United States and Mexico, the U.S. Fish and Wildlife Service has authority over U.S. wildlife and even transboundary wildlife shared with Mexico. In Mexico, the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) has similar powers over Mexican wildlife.

Sovereignty and Transboundary Natural Resources

The concept of sovereignty involves both external and internal rights (Liftin 1998). External sovereignty is the formal equality of all nations in international law. Each nation is sovereign in that it has an equal say in the formation of treaties and when they participate in international governing agencies, such as the United Nations. Article 2 of the Charter of the United Nations makes this point clearly: "The Organization is based on the principle of the sovereign equality of all its Members." Sovereign nations are allowed

to act independently and to defend their interests in the international arena. There is no supranational governing agency above nations, and one of the basic rights of treaty law provides that no country can be subject to an international law without its consent (Birnie and Boyle 2002).

Internally, states have sovereign authority over their domestic affairs. The state is the only legitimate authority within its territory and has the right to govern; use force; introduce economic and development policies; and to establish education, infrastructure, and postal services pursuant to its own interests. Importantly for this discussion, internal sovereignty also includes the right to exploit the natural resources within a state's territory and to adopt its own environmental policy. Although both internal and external sovereignty are carefully guarded rights, it is important to note that the concept of sovereignty is in no way absolute, particularly within the modern realities of international law. Human rights laws, trade, war crimes, and international environmental laws all put pressure on and reduce the absolute right of a country to do whatever it chooses within its borders.

Despite the importance of sovereignty both in international law and to the states themselves, modern global problems increasingly seem to conflict with state sovereignty. Recent writings on globalization argue that the "state," as an organizing unit of the international system, is losing ground, gradually being replaced by supranational governing agencies, networks of multinational corporations, and non-governmental agencies (Slaughter 2004). Furthermore, some argue that globalization is reducing the importance of borders because telecommunication, culture, media, ideas, trade, people, and environmental effects freely move across borders. "Global values," (Meyer, et al. 1997) such as human rights, the elimination of nuclear weapons, free trade, and environmental protection, require privileging world cultural goals over a state's right to follow its own domestic policies.

Because of the transboundary nature of environmental problems, they are particularly viewed as a threat to sovereignty. Most environmental problems do not recognize state boundaries and states cannot prevent the effects of how another state influences the quality of its own land, water, and air. Borders are political demarcations

that human actors draw, enforce, and give meaning to (Liftin 1998). Before the 16th century, borders between nations were more likely to take the form of frontiers – often difficult or rugged terrain or large bodies of water that people could not easily cross. As the world became more populated and power became concentrated in the hands of local monarchs, political borders began to replace frontiers as the demarcation between countries. During this same time period, political power came to mean control over a specific territory and borders came to mark the limits of the authority of one political unit *vis a vis* its neighbors. While Western Europe became organized into separate nation-states by the end of the 18th century, this model was not transferred to the rest of the world until the middle of the 20th century. With the end of World War II and with the decline of colonialism, the former colonies were also divided into political units separated by borders (Kratochwil 1986).

International law began to emerge along with political borders near the end of the medieval period. Natural resources were among the first issues addressed in international law. The natural environment and natural resources do not obey borders; in most cases, transboundary resources flow freely across borders. As countries try to secure a constant and consistent supply of a given resource to industrialize or to provide for growing populations, the rights of neighboring countries to access a given transboundary resource can create conflicts (Haas and Sundgren 1993). Economic development and population density caused natural resources to become increasingly scarce, increasing competition between neighboring countries over shared resources.

In terms of sovereignty, this conflict over shared resources is depicted as a battle between the territorial sovereignty of one country and the territorial integrity of its neighbors (Berber 1959). Territorial sovereignty implies the right to complete control over the land within a country's borders. Territorial integrity is the right of any given country to an unaltered environment, or to a natural environment that has not been damaged by the actions of neighboring countries. Territorial integrity is also the right to not have internal supplies of land, water, or air damaged by the actions of neighboring countries. In its early formulations, territorial sovereignty was used to argue for complete authority and control over everything

within a state's boundaries, from land to populations. The first official articulation of this right appears in the 1895 Harmon Doctrine, in which the U.S. Attorney General asserts the extent of the rights of the United States to the waters of the Rio Grande:

> The fact that the Rio Grande lacks sufficient water to permit its use by the inhabitants of both countries does not entitle Mexico to impose restrictions on the United States which would hamper the development of the latter's territory or deprive its inhabitants of an advantage with which nature had endowed it and which is situated entirely within its territory. To admit such a principle would be completely contrary to the principle that the United States exercises full sovereignty over its national territory (21 Ops. Attorney General [1895] 274, 283).

In the Harmon Doctrine, the Attorney General asserts a claim to absolute territorial sovereignty and discounts restrictions on the freedom of the United States to use its territory and resources in any way it sees fit. These assertions of territorial sovereignty come into conflict with the complementary right of neighboring states to territorial integrity. If both of these rights are considered absolute, there can be no resolution of most transboundary resource conflicts.

Despite early claims to absolute territorial sovereignty, such as the Harmon Doctrine, throughout the 20th century states have shown a great willingness to compromise and work with neighboring states to develop equitable rights to shared resources. One solution that has emerged to resolve the inherent tensions between territorial sovereignty and territorial integrity is an understanding of "rights" and "responsibilities" (Wapner 1998). In most of the international law that governs the environment, states are given the right to exploit their domestic resources as they choose, but have the responsibility not to cause harm to neighboring states. This balance between rights and responsibilities is made clear in the 1972 Stockholm Declaration, the first major global treaty on the environment.

In Principle 21, the Stockholm Declaration says "states have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own

resources pursuant to their own environmental policies." The assertion of the sovereign right to exploit resources is a clear statement of the right to territorial sovereignty. But Principle 21 goes on to declare, "and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction." This second half of Principle 21 limits sovereignty at the point of causing harm to neighboring states. The United Nations' principles clearly assert the balance between rights to sovereign control of a territory and the responsibility not to harm the territory of other states. This principle has become so institutionalized in international environmental law that 20 years later, the Rio de Janeiro Declaration restated it almost verbatim, and this balance of rights and responsibilities appears throughout the water and wildlife treaties between the United States and Mexico.

Many authors that write on sovereignty and the environment have approached this from a different perspective – that of environmental protection (Liftin 1998; Wapner 1998; Haas and Sundgren 1993). These authors argue that while transboundary resources threaten sovereignty, the right to sovereignty also threatens transboundary resources. In the case of water resources, the optimal use of a river often does not correspond to the sum of the interests of all the countries involved. Geologists, environmentalists, and recently even economists have argued that the optimal use of a river can only be achieved by looking at the entire basin as an integrated whole, rather than by dividing the river basin by political boundaries. In terms of migratory wildlife, a species can only be protected if all of the countries along its flight or migration path agree to work for its conservation. Strict hunting and capture laws in the country where a species spends its winters will be relatively powerless if the country where the species spends its summers does not adopt similar protection measures.

Despite apparent contractions of state sovereignty because of global problems, the natural environment, and the principles of rights and responsibilities in international law, the principle of state sovereignty remains a central component in international law. Sovereignty is reinforced and reconstructed through the examples of cooperation apparent in international environmental law. For

instance, even the process of signing an environmental treaty reinforces state sovereignty in many ways. Externally, the process emphasizes that states, and only states, are the legal players in the international community. Only states can be parties to treaties, and other bodies (such as non-governmental organizations [NGOs] and individuals) must move through state channels to assert their demands on the international field. Furthermore, state sovereignty is even reinforced within the content of the environmental treaties, because while states will agree to certain restrictions and limits on what they or their populations can do within their territories, the state often asserts itself as the primary governing agency responsible for treaty compliance. Even when international governing institutions are created, states will either ensure that these bodies do not have authority over them without explicit agreement, or the states will have a central administrative role in these governing institutions.

However, asserting the idea that sovereignty continues to be a powerful and principle right that is not reduced by international environmental treaties does not necessarily imply that states are independent sovereign bodies unconnected from other states, or that the international field is anarchic, despite the absence of a supranational governing body. The world is witnessing the rise of a global community, with states as the primary actors. In addition to globalization through trade and communications, the beliefs and values of the world community penetrate state lines and influence both the people and the state itself (Meyer, et al. 1997; Frank, et al. 2000a; Goodman and Jinks 2003). Furthermore, states have long followed rules and norms of international diplomacy and law, and compliance with treaties is surprisingly high (Chayes and Chayes 1995). Nevertheless, states continue to protect their rights to sovereignty carefully, even when cooperating with other states on one of the most stateless forces – the natural environment.

Cases: Transboundary Water and Wildlife

This chapter focuses on a comparative analysis of the treaty law that governs two transboundary natural resources that the United States and Mexico share. Transboundary resources are those natural resources that cross one or more national borders, such as freshwater, wildlife, clean air, and atmosphere. Freshwater supplies and wildlife are the transboundary resources that are examined in this discussion. Freshwater supplies include lakes, rivers, and aquifers, although in the U.S.-Mexican case, transboundary rivers are the primary shared water supply. Transboundary rivers are defined as any river in which any part of its entire flow is located in more than one country. These rivers include boundary rivers that form part of an international border, such as the Rio Grande/Río Bravo, and transboundary rivers that cross an international border, such as the Colorado River. The major and most-contested shared freshwater resources between the United States and Mexico include three rivers: the Tijuana River in southern California and northern Baja California; the Colorado River, which runs from Colorado through Arizona and into the Gulf of California between Sonora and Baja California; and the Rio Grande/Río Bravo, which runs from northern New Mexico to the Gulf of Mexico, forming the U.S.-Mexican border along its path between Texas and the four Mexican states of Chihuahua, Coahuila, Nuevo León, and Tamaulipas. The major treaties that govern these freshwater supplies were signed in 1889, 1906, 1933, 1944, and 1973. The IBWC has also established more than 300 smaller agreements, but only the major binational river treaties will be addressed here.

The joint management of these freshwater resources can be compared to the joint management of another transboundary resource – transboundary wildlife. Transboundary wildlife includes both migratory and border wildlife. Migratory wildlife consists of those birds, terrestrial animals, and marine animals that reside in two or more countries during any point in their migratory route or lifecycle. Border wildlife concerns animals that live along the border itself and cross the border freely, but do not necessarily migrate. There are hundreds of transboundary species between the United States and

Mexico, but treaty law primarily governs migratory birds (particularly waterfowl), large game animals, and endangered species. The major wildlife treaties that deal with transboundary wildlife include a 1936 bilateral treaty, the 1940 Western Hemisphere Convention, the 1971 Ramsar Convention, and the 1973 Convention on International Trade in Endangered Species.

Although freshwater and wildlife are different resources in significant respects, their management poses similar challenges to state sovereignty. Sovereignty is challenged first by the nature of the two resources, and then by the cooperative regimes that are formed to manage the sharing of the resources. In the cases of both rivers and wildlife, the resources flow freely across the border and neither state can guarantee that the actions of its neighbor will not negatively affect the quality and quantity of its own portion of the joint resource without establishing some form of cooperative agreement. The cooperative agreements themselves can threaten state sovereignty, as well, by establishing supranational governance or by setting restrictions on the exploitation of the resource within domestic territory.

Treaties Governing Transboundary Freshwater Resources

Transboundary water law within the U.S.-Mexican border region progresses from early treaties that follow a strict reading of sovereignty to a more cooperative understanding of rights and responsibilities in later treaties. The earliest treaties define sovereignty as territorial sovereignty, a definition that often privileges the United States as the upstream country and limits Mexico's claims to the shared river resources. The first U.S.-Mexican river treaty created a binational governing agency, the International Boundary Commission (IBC) (the name was later changed to the International Boundary and Water Commission). The creation of such an agency threatens sovereignty to a certain extent, but the terms of the treaty clearly limit the authority of IBWC and ensure that neither state will be subject to new decisions without its explicit consent. Treaties signed in the early to mid-20th century focus on joint construction projects of major canals and dams. While these projects showcase

cooperation and partnership along the border, the treaties again divide authority over the completed projects. While the dams and canals were jointly built, in the end, they did not become truly "international." Finally, in the most recent major river treaty between the United States and Mexico, there is much greater recognition of Mexico as a downstream neighbor with rights to an undamaged supply of freshwater. Although the treaty again lays out strict reservations on the rights granted to Mexico, it is nonetheless a greater acknowledgment of downstream rights than is apparent in the earlier treaties.

1889 Convention on Boundary Waters

The 1889 treaty that created IBC was the first river treaty signed between the United States and Mexico. IBC was the world's first binational governing agency to govern a river. Its role was to first monitor and resolve conflicts over the precise location of the border, particularly in the region of the Rio Grande, because the river would often shift over time, and second to act as a governing agency for any other disputes that may have arisen between the United States and Mexico over their rights to the Rio Grande.

The 1889 treaty makes it clear that while IBC was a binational governing body in many ways, it did not have true authority over either the United States or Mexico. The treaty states that the "International Boundary Commission shall have exclusive jurisdiction in the case of said differences or questions." However, both states retained the right to reject the decisions of IBC in Article VII. "If both Commissioners shall agree to a decision, their judgment shall be considered binding upon both Governments, unless one of them shall disapprove it within one month reckoned from the day on which it shall have been pronounced." The formation of a binational governing agency reduces sovereignty to some extent, and yet each country's assertion of their right to approve and disapprove the binational governing agency's rulings reinforces sovereignty. This treaty is extended by conventions in 1895, 1896, 1897, 1898, 1899, and 1900; the nature and name of IBC is changed in a 1944 treaty.

1906 Convention Between Mexico and the United States for the Distribution of Waters of the Rio Grande

The next water treaty between the United States and Mexico was in 1906. In this treaty, the United States does allocate a specific amount of water to Mexico. The treaty lays out specific amounts of water that the U.S. guarantees to deliver to Mexico every year through the Rio Grande. In addition to establishing a guaranteed amount of water that the downstream country shall receive, the treaty establishes an annual delivery schedule of how much water will be flowing downstream every month.

However, while the treaty acknowledges Mexico's water rights to the extent that it guarantees some flow every year, the treaty is equally explicit in its pronouncement that Mexico does not have legitimate rights or claims to the water. In Article IV, the treaty states:

> The delivery of water as herein provided is not to be construed as a recognition by the United States of any claim on the part of Mexico to the said waters; and it is agreed that in consideration of such delivery of water, Mexico waives any and all claims to the waters of the Rio Grande for any purpose... and also declares fully settled and disposed of, and hereby waives, all claims heretofore asserted or existing, or that may hereafter arise, or be asserted, against the United States on account of any damages alleged to have been sustained by the owners of the land in Mexico, by reason of the diversion by citizens of the United States of waters in the Rio Grande.

Downstream rights are recognized only to the extent of guaranteeing a certain amount of water, but only if Mexico waives any further claim to the water, as well as any rights to prevention of damage on the part of the United States. This point is reiterated in other sections of the treaty, as well. In the 1906 treaty, sovereignty is made explicit, and the upstream country (the United States) is outspoken in resisting any limitations on its sovereignty and rights to exploit its river as it sees fit.

1933 Convention Between the United States of America and the United Mexican States for the Rectification of the Rio Grande

In 1933, Mexico and the United States signed their first joint construction treaty. This treaty, while relatively minor, is significant in certain respects. The main goal of the treaty is to build a permanent canal for the Rio Grande both to relieve flooding problems and to stabilize the border between the two countries. The canal was to be constructed jointly, in one of the first major joint building projects along a U.S.-Mexican river. However, despite the joint, bilateral nature of the project, the treaty once again explicitly defines the specific rights and jurisdictions of each country *vis a vis* the canal. Article 8 makes this point clearly: "The construction of works shall not confer on the contracting parties any property rights in or any jurisdiction over the territory of the other. The completed work shall constitute part of the territory and shall be the property of the country within which it lies." As Article 8 outlines, although the countries will collaborate in building the canal, the canal itself will not be under binational control once completed. Rather, each country will have full jurisdiction over its half of the canal. That is not to say, however, that the treaty does not establish at least partial joint governance. Indeed, IBC is given authority over the canal, although this governance does not go so far as to constitute truly binational governance. Each country retains the right to approve the decisions of IBC, thereby protecting their sovereignty and their rights to control their domestic territory.

1944 Treaty Between the United States of America and Mexico Relating to the Waters of the Colorado and Tijuana Rivers, and of the Rio Grande (from Ft. Quitman, Texas, to the Gulf of Mexico)

The next major water treaty between the United States and Mexico, and arguably the most important natural resource treaty signed between the two countries, was established in 1944. This treaty was intended to "fix and delimit the rights of the two countries" regard-

ing all three major rivers that cross the U.S.-Mexican border: the Tijuana, Colorado, and Rio Grande. While the treaty itself is similar in nature to the 1906 treaty in that it is primarily an allocation treaty, there are important differences. The 1944 treaty is significantly more cooperative in spirit and the nature of sovereignty is subtler and less focused on strict water rights. In the 1944 water treaty, sovereignty is not treated as explicitly as it is in the 1906 treaty. The nature of sovereign rights has also softened somewhat, although domestic claims to a state's rightful share of a river are still given priority over internationally shared demands. Both the upstream country (the United States) and the downstream country (Mexico) are accorded rights to the waters, and neither country is prioritized.

In light of earlier agreements, even the preamble to the treaty begins with a remarkable spirit of cooperation. It begins, "The Government of the United States of America and the Government of the United Mexican States: animated by the sincere spirit of cordiality and friendly cooperation which happily governs the relations between them... have resolved to conclude a treaty..." This spirit of "friendly cooperation" and happy governance stands in contrast to the preamble of the 1906 treaty, which states the goal is "to remove all causes of controversy between them in respect thereto, and being moved by considerations of comity, have resolved to conclude a Convention." At least on paper, by 1944, the United States and Mexico had moved from a position of reducing contention to one of encouraging binational cooperation.

In content, the 1944 treaty first changes the role (as well as the name) of IBC. Now known as the International Boundary and Water Commission, IBWC is charged with the "settlement of all disputes" that arise regarding this treaty, and "shall in all respects have the status of an international body." While IBWC is given supranational authority to a significant extent, each country retains true authority over its own half of the commission, and the commission does not have enforceable authority over either state. Rather, the governments of both nations must approve the commission's decisions. Much like the early structure of IBC, the establishment of a bina-

tional commission reduces sovereignty, and yet the states reassert authority and independence from the decisions of the commission by requiring government approval of all IBWC decisions.

The treaty then goes on to reinforce the provisions of the 1933 treaty by providing for the joint construction of two dams and by guaranteeing each state jurisdiction over the constructed works in their territories, despite being jointly constructed:

> The works constructed, acquired or used in fulfillment of the provisions of this Treaty and located wholly within the territorial limits of either country, although these works may be international in character, shall remain, except as herein otherwise specifically provided, under the exclusive jurisdiction and control of the Section of the Commission in whose country the works may be situated.

As in the 1933 treaty, although the dams constructed by the provisions of the 1944 treaty are joint projects between the United States and Mexico, each country retains complete sovereign control over its own territory, including the international dams located within national boundaries.

Importantly, conceptualizing the rivers as complete systems and considering how best to manage the rivers binationally is introduced as are the interests of both nations for the first time. In article 8, the treaty also recognizes dual interests:

> The two Governments recognize that both countries have a common interest in the conservation and storage of waters in the international reservoirs and in the maximum use of these structures for the purpose of obtaining the most beneficial, regular and constant use of the waters belonging to them.

While the acknowledgement of common interest does not equal the recognition of a dual goal of long-term conservation or environmental protection, it is nevertheless a significant change that the United States and Mexico are asserting common interests in their water management and that they are striving to address these issues in a binational and cooperative fashion.

Finally, rights and responsibilities are introduced as a way of balancing the sovereignty interests of both states. Concerning the authority of IBWC, the treaty states that "the Commission shall have the power to authorize either country to divert and use water not belonging entirely to such country, when the water belonging to the other country can be diverted and used without injury to the latter and can be replaced at some other point on the river." However, the text of the treaty then goes on to clarify that allowing one country to divert water does not confer upon that country *rights* to the water. Furthermore, like the 1906 treaty, the 1944 treaty is explicit at various points in the limits of the water rights granted to Mexico.

The right of state sovereignty is still a dominant feature in the 1944 treaty, although these rights are constructed and asserted in several different ways. First, while IBWC is granted the status of an international governing body, the commission itself is divided equally between representatives of the two countries who will represent and defend the interests of their respective nations. Second, while the treaty provides for the joint construction of new major infrastructural projects (specifically dams), these works will, like the earlier canal, be the exclusive property of the country in which they reside. Finally, rights and responsibilities are developed as a way to balance the competing claims of both countries to the shared rivers.

1973 Mexico-U.S. Agreement on the Permanent and Definitive Solution to the Salinity of the Colorado River Basin (IBWC Minute No. 242)

The 1973 agreement on salinity in the Colorado River is the final major freshwater treaty between the United States and Mexico. In the late 1960s and early 1970s, the United States and Mexico recognized that the quality of the water in the Colorado that was reaching Mexico was a serious problem. Agricultural run-off, industry, and increasing domestic consumption in growing U.S. cities had caused the river's salt level to rise. The salinity problem was one of the first major examples of U.S. actions creating serious negative consequences on the downstream reaches in Mexico. Resolving this

problem required a balance of the rights of the United States to use the water, and recognition of its responsibility to prevent harm to its downstream neighbor.

After a series of agreements by IBWC, the solution to the salinity problem was definitively agreed upon in 1973. The solution was that the United States guarantee a specific amount of water at a maximum level of salinity, thus securing the quality of water being delivered to Mexico in the Colorado. This solution is significant because downstream riparian rights are being extensively recognized. The agreement states:

> With the objective of avoiding future problems, the United States and Mexico shall consult with each other prior to undertaking any new development of either the surface or the groundwater resources, or undertaking substantial modifications of present developments, in its own territory in the border area that might adversely affect the other country.

The agreement recognizes that the United States has the responsibility to guarantee that its downstream neighbor is unharmed by U.S. domestic activities. The requirement to prevent harm is acted upon in this treaty. Furthermore, the spirit of this agreement is clearly cooperative, and it addresses rivers as indivisible units more so than earlier treaties do.

The water treaties began with an understanding of the United States' absolute sovereignty over the upstream waters of the Rio Grande, Colorado, and Tijuana Rivers. In the mid-20th century, the joint construction projects, while international in nature, are ultimately reassigned to the authority of the country in which they are located. Similarly, while IBWC is in many ways a binational governing agency, the authority of the agency rests within the governments of each country and their representatives. Finally, as seen in this last treaty, by the late 20th century, Mexico's rights as a downstream riparian state are increasingly recognized, and the right of the United States to absolute territorial sovereignty is limited in that it cannot cause significant harm to its downstream neighbor.

Treaties Governing Transboundary Wildlife Resources

The governance structure developed in the treaties concerning transboundary wildlife in the United States and Mexico is significantly different than that of fresh water. First, the treaties have a much greater spirit of cooperation, and significantly less emphasis on sovereign rights over wildlife resources. Second, no binational governing agency is created to mirror IBWC. Instead, the U.S. Fish and Wildlife Service retains authority over U.S. wildlife and SEMARNAT retains authority over Mexican wildlife, even though these wildlife resources are migratory and transboundary. Third, there is only one binational treaty. The rest of the treaties are multinational and either regional or global. This is interesting because wildlife management is less a binational cooperative venture on the part of the United States and Mexico. Rather, each country is acting more or less independently in its decisions to enter multilateral treaties. This is partially due to the type of governance needed for the effective management of wildlife, as will be discussed later. Finally, the wildlife treaties in the early 20th century are similar to water treaties in that they list specific species to be protected and they focus on conserving the resource itself. By the late 20th century, there is a much greater emphasis on major environmental protection, particularly habitat protection.

1936 Convention for the Protection of Migratory Birds and Game Mammals

The 1936 Convention for the Protection of Migratory Birds and Game Mammals between the United States and Mexico was one of the first treaties in the world to establish governance over migratory species that travel between two or more countries. The treaty first lays out a spirit of cooperation between the two countries and then outlines specific limits on the hunting and capture of specific species. Unlike the early water treaties, this first migratory bird treaty does not explicitly lay out rights to territorial sovereignty or rights to control domestic resources. It doesn't even provide balances between sovereign rights and the responsibility to prevent

harm. Instead, this convention begins with a spirit of cooperation and sustainable use of migratory species. "It is right and proper to protect the said migratory birds, whatever may be their origin, in the United States of America and the United Mexican States, in order that the species may not be exterminated," it reads. The treaty then lays out the limits on hunting and capture that will protect and conserve migratory species, and concludes with a list of migratory species covered by the treaty. Importantly, the treaty makes no mention of sovereignty or rights to exploit the resource as each country sees fit. It doesn't even mention prevention of harm. Protection of ecosystems and habitat conservation are also not addressed. The only way sovereignty comes into question is that the terms of the treaty are to be implemented by domestic laws, written and concluded by both countries independently. As well, no supranational governing agency is established. Instead, the terms are to be implemented independently and both countries are invited to present amendments in the future. In this treaty, sovereignty is neither expressly protected nor expressly threatened. State rights to exploit their natural resources as they see fit are not made explicit, but at the same time, no binational agency is given authority over the governance and management of migratory wildlife.

Surprisingly, given the many treaties that govern freshwater supplies, the 1936 treaty is the only binational migratory wildlife treaty between the United States and Mexico. All the other treaties that concern wildlife in both countries are either regional or global treaties that both countries signed unilaterally. The first of these treaties is the 1942 Western Hemisphere Convention.

1942 Western Hemisphere Convention

The 1942 Western Hemisphere Convention is a significant treaty for several reasons. In terms of wildlife conservation, environmentalists have argued that widespread treaties that govern the entire habitat of the migratory cycle of a species are the best way to conserve and protect the species. In addition to being the first treaty of its kind, the Western Hemisphere Convention achieves widespread habitat preservation by bringing countries throughout the Americas together for the common goal of wildlife conservation. In content,

the Western Hemisphere Convention is similar to the 1936 treaty between the United States and Mexico. It begins on a note of cooperation:

> The governments of the American Republics, wishing to protect and preserve in their natural habitat representatives of all species and genera of their native flora and fauna, including migratory birds, in sufficient numbers and over areas extensive enough to assure them from becoming extinct through any agency within man's control...

Like the 1936 treaty, the Western Hemisphere Convention begins with an assertion that the countries have come together in a spirit of cooperation for the sake of conservation of wildlife, a goal they cannot achieve unilaterally. The remainder of the treaty is devoted to the creation of natural parks, nature and wilderness reserves, and limitations on hunting, especially of certain species outlined in the treaty's appendix. In terms of sovereignty, the treaty is again similar to the 1936 migratory birds treaty. The treaty does not create a supranational governing authority, but instead relies on domestic law-makers to create laws to implement the terms in each of their respective countries. The countries themselves are charged with the implementation of the treaty terms within their domestic laws. While sovereignty is not explicitly protected in treaty terms, the treaty does not create a supranational governing agency that would threaten sovereignty.

The remainder of the wildlife treaties signed by the United States and Mexico are major global treaties. Like the 1936 treaty and the Western Hemisphere Convention, these treaties all begin with a clear spirit of cooperation and do not create supranational governing agencies. Instead, countries are charged with the responsibility of managing their own wildlife and wildlife habitat according to the terms of the treaty.

1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention)

The first of these major global treaties is the 1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (known as the Ramsar Convention for the city in Iran where it was signed). The main action taken by the Ramsar Convention is the creation of a list of wetlands that are particularly important as waterfowl habitat. Each party to the treaty is responsible for first submitting a list of its important wetlands to be included on the main convention list, and each party is then responsible for the conservation and management of the wetlands it included on the list.

The Ramsar Convention also includes explicit safeguards of each country's sovereignty. In Article 2.3, sovereign rights are protected outright: "The inclusion of a wetland in the List does not prejudice the exclusive sovereign rights of the Contracting Party in whose territory the wetland is situated." Here, the convention is explicit that assigning a wetland to the list does not take that wetland out of the sovereign control of that country. Instead, the country remains responsible for domestic enforcement of the treaty terms, specifically for the conservation and protection of that wetland. Like the other wildlife treaties, Ramsar does not establish a supranational governing agency. At this point, 138 countries have signed the Ramsar Convention, including Mexico in 1986 and the United States in 1987.

1973 Convention on International Trade in Endangered Species

The final global treaty for managing wildlife signed by both the United States and Mexico is the 1973 Convention on International Trade in Endangered Species (CITIES). The goal of this treaty was to protect endangered species. Endangered species pose a unique threat to sovereignty because the species themselves are not always transboundary. Protecting endangered species often requires international pressure on one or two countries that control the entire population of a species. Developed and developing countries also

often clash over the protection of endangered species, many of which are located in Africa and South America. Although CITES does not explicitly concern U.S.-Mexican transboundary wildlife, it is significant for this discussion because it affects domestic exploitation of wildlife in both countries.

Like the Ramsar Convention, CITES establishes national governance in the spirit of international cooperation. "People and States should be the best protectors of their own wild fauna and flora..." and furthermore, "international cooperation is essential for the protection of certain species against overexploitation through international trade." This convention, like the earlier wildlife treaties, manages sovereignty by allowing states to retain control over their own resources while pushing for international cooperation. There are currently 164 parties to this treaty. Mexico signed in 1991 and the United States signed in 1974.

As these treaties illustrate, wildlife is managed in a significantly different manner than water resources are managed along the U.S.-Mexican border. The wildlife treaties exhibit a much greater emphasis on cooperation, which might suggest that countries are less guarded about their sovereign interests. But at the same time, these treaties do not create binational or supranational governing agencies, which are arguably the greatest threat to state sovereignty. While the water treaties demonstrate a greater defense of sovereignty, they also establish a governing agency that, to some extent, takes power away from the national governments.

The nature of both water and wildlife resources needs to be examined to account for the different treatment of sovereignty in the water and wildlife treaties. The vital nature of water resources may be what makes countries more cautious and guarded about their rights to water than they are about their rights to control wildlife. In addition to vital domestic consumption of freshwater, the exploitation of water resources is necessary for developmental and economic activity, while the hunting and capture of wild birds are primarily social and recreational activities. Another reason for the cooperative spirit of the bird treaties may be that unlike water, there is no upstream-downstream dimension to wildlife. On the other hand, no one country controls primary access to the resource, as an upstream country does in a river situation. The species migrate back

and forth between the two countries, and therefore any one country wanting to preserve its migratory wildlife needs the cooperation of all the other countries along the migration route.

Conclusion

The transboundary freshwater treaties signed between the United States and Mexico are more careful to protect sovereign rights than wildlife treaties are, but they do allow for the establishment of a binational governing authority. Wildlife treaties, on the other hand, involve both a spirit of cooperation and reliance upon national governance of shared resources. As these treaties demonstrate, the international, cooperative management of these resources involves a reduction of sovereignty through the recognition of downstream rights, binational governance, and through international cooperation. At the same time, however, sovereign rights are made explicit at many points throughout the treaties and these rights are ultimately reinforced.

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Index

The SCERP Mission

The Southwest Consortium for Environmental Research and Policy (SCERP) was established by the U.S. Congress in October 1990 to "initiate a comprehensive analysis of possible solutions to the acute air, water quality, and hazardous waste problems that plague the United States-Mexico border region." SCERP is a consortium of five U.S. universities (Arizona State University, New Mexico State University, San Diego State University, University of Texas at El Paso, and University of Utah) and five Mexican universities (El Colegio de la Frontera Norte, Instituto Tecnológico de Ciudad Juárez, Instituto Tecnológico y de Estudios Superiores de Monterrey, Universidad Autónoma de Baja California, and Universidad Autónoma de Ciudad Juárez). SCERP carries out its mission through a cooperative agreement with the U.S. Environmental Protection Agency. A permanent administration office is maintained by the consortium in San Diego.

Environmental Problems of the U.S.-Mexican Border Region

The border region lies 100 kilometers, or 60 miles, on each side of the U.S.-Mexican political boundary and encompasses parts of four states in the United States—Texas, New Mexico, Arizona, and California—and six Mexican states—Baja California, Sonora, Chihuahua, Coahuila, Nuevo León, and Tamaulipas. Approximately 13 million people live in the U.S. counties and Mexican *municipios* on the border. The high density of people and increased industrialization since the passage of the North American Free Trade Agreement (NAFTA) have placed an even greater burden on the inadequate infrastructure and environmental resources of the region. Exacerbating the problem is the fact that many U.S. counties along the border are categorized as "economically distressed," and few communities possess the resources needed to address their environmental concerns. Some of the critical border environmental issues include:

- Rapid urbanization and lack of adequate infrastructure
- Air pollution from open burning, vehicle emissions, and industrial operations
- Contamination of surface water and groundwater from open sewers and industrial waste
- Overuse of aquifers and surface streams
- Transportation and illegal dumping of hazardous wastes
- Destruction of natural resources

The SCERP Solution

SCERP uses a broad, integrated, multidisciplinary approach to address the issues of the border. SCERP researchers collaborate with the U.S. Environmental Protection Agency (EPA) and Mexico's Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT), as well as local and state governments, tribal nations, business and industry, non-governmental organizations, and communities of the border region. SCERP organizes research, outreach, and training programs devoted to improving environmental conditions and building capacity in the border region for resolving critical environmental problems. SCERP is pioneering a model of binational cooperation that brings U.S. and Mexican researchers together and introduces new skills and perspectives in binational environmental problem solving.

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