

# udall center

for studies in public policy

environmental policy working papers

no. 2

## **Transboundary Ecosystem Services**

### **A New Vision for Managing the Shared Environment of the U.S. and Mexico**

Laura López-Hoffman







# Transboundary Ecosystem Services

**A New Vision for Managing the Shared Environment  
of the U.S. and Mexico**

Laura López-Hoffman, Ph.D.<sup>1</sup>

Udall Center for Studies in Public Policy  
The University of Arizona

Environmental Policy Working Papers  
July 2010

Support for Udall Center  
Publications is provided by  
the Morris K. Udall and  
Stewart L. Udall Foundation.  
**[www.udall.gov](http://www.udall.gov)**

<sup>1</sup> Assistant professor, School of  
Natural Resources and  
the Environment, and assistant  
research professor of environmental  
policy, Udall Center for Studies in  
Public Policy, University  
of Arizona



---

## About the Author

**Laura López-Hoffman** is an assistant professor in the School of Natural Resources and the Environment, and an assistant research professor of environmental policy at the Udall Center for Studies in Public Policy at the University of Arizona. She obtained her Ph.D. from Stanford University in biological sciences and her B.A. from Princeton University. Prior to coming to the University of Arizona, she was an NSF post-doctoral fellow at the Universidad Nacional Autónoma de México (UNAM).

López-Hoffman studies the linkages between the environment and human society. The objective of her research is to contribute to the development of policies and institutions that protect ecosystems while sustaining their contributions to human well-being. She uses interdisciplinary and comparative research approaches to integrate science and policy, in particular the concept of ecosystem services. The Millennium Ecosystem Assessment serves as her conceptual framework for evaluating the complex interactions between ecosystems and species, the services they provide, and human well-being.

---

### **Transboundary Ecosystem Services: A New Vision for Managing the Shared Environment of the U.S. and Mexico**

By Laura López-Hoffman

Edited by Robert Merideth

Designed by Chrysantha Gakopoulos

Published by the Udall Center for Studies in Public Policy at the University of Arizona

Copyright © 2010 by the Arizona Board of Regents

All rights reserved

Udall Center for Studies in Public Policy

The University of Arizona

803 E. First St. Tucson, AZ 85719

(520) 626-4393

***udallcenter.arizona.edu/ucpubs***

Cover photo: aerial photograph, All American Canal, by Karl W. Flessa

Support for Udall Center Publications is provided by the Morris K. Udall and Stewart L. Udall Foundation.

---

## Introduction

Recently, much attention has been given to the binational challenges facing the United States and Mexico; most of the discussion has focused on economics, border security, and immigration. In addition to these issues, the countries face another common problem, one that has the potential to fundamentally alter the well-being of people in both nations. The challenge is to conserve the natural resources shared by the United States and Mexico in the face of environmental change—drought, land-use change, intensive water use, deforestation, urbanization, habitat fragmentation, and climate change—and to protect their shared environment’s ability to support the well-being of people in both countries (Liverman et al. 1999).

This working paper suggests a novel approach to the management of the U.S.-Mexico transboundary environment. It proposes framing the conservation of the natural resources shared by the countries in terms of shared ecosystem services. The United Nations-sponsored Millennium Ecosystem Assessment can be used as a framework for designing transboundary policies to protect ecosystem services across borders.

The concept of ecosystem services is an emerging, innovative policy tool currently being implemented in domestic environmental policy in both countries and could be used to frame a binational policy approach for U.S.-Mexico transboundary conservation.<sup>1</sup>

Three cases that exemplify important transboundary services are outlined in the appendices. The cases demonstrate how drivers of environmental change in one country can affect ecosystem services in the other country—and how drivers in the border region can impact services far removed from the border (and vice versa). The examples of shared services span the entire U.S.-Mexico border, from services shared by people in California and Baja California, to services shared between Texas and Mexican states as far south as Jalisco.

Case-specific strategies to protect transboundary ecosystem services discussed in the appendix have been offered elsewhere (López-Hoffman et al. 2009). The goal of this working paper is to argue for a broad platform to protect against the unintended impacts of actions and policies in one country on ecosystem services in another country.

<sup>1</sup> For example, in the United States, the 2008 Farm Bill has provisions to protect ecosystem services in agricultural areas. In Mexico, CONANP has been using a “payment for ecosystem services” approach to induce landowners to conserve forest to prevent erosion, maintain water quality, and sequester carbon.

# Transboundary Ecosystem Services

Laura López-Hoffman

## Background

### Millennium Ecosystem Assessment and transboundary ecosystem services

Ecosystem services are the ways in which ecosystems, and the species they comprise, sustain and fulfill human life. The well-being of human society depends on the services of ecosystems, including the air we breathe, the water we drink, the food that nourishes us, and the aesthetic experiences that inspire our cultures and fulfill our lives (Millennium Ecosystem Assessment 2005; Daily 1997).

Because the U.S. and Mexico share ecosystems, and the species that range across or fly over their borders, they share the services provided by those species and ecosystems as well (López-Hoffman et al. 2010). Since the countries share services, management actions and policies in one nation can affect the delivery and quality of ecosystem services in the other country, and in turn, the well being of people in the second country (López-Hoffman et al. 2009).

The Millennium Ecosystem Assessment (MA) is an international effort to assess the status of the world's ecosystems and the ability of ecosystems to support human well-being through ecosystem services. As part of the effort, the MA developed a framework to understand the relationship between ecosystems, the services they provide, and societal welfare (Millennium Ecosystem Assessment 2003).

In a transboundary setting, the MA framework can be used to (1) elucidate how drivers of environmental change in one country can affect the delivery of ecosystem services and human welfare in another country (or in both countries), and (2) develop cross-border collaborations to protect shared ecosystem services (López-Hoffman et al. 2009).

As developed by the MA, the notion of societal interest is inherent in the concept of ecosystem services and would frame cross-border negotiations over natural resources in terms of mutual interests between countries. Actions taken in the mutual interests of two nations create incentives to work together, rather than against one another.

If conservation efforts are framed as the protection of shared ecosystem services, the discussion could be transformed into one organized around pro-

tecting the mutual interests of the countries (López-Hoffman et al. 2009). In cases where the countries' interests do not naturally align, the MA framework can be used to identify innovative approaches, such as cross-border payments for ecosystem services, to overcome differences and find common ground.

### Climate change threats to transboundary ecosystem services

Western North America, including much of Mexico and the U.S. Southwest, is experiencing a trend towards a warmer, more arid climate. This climatic shift will have serious implications for the U.S.-Mexico borderland ecosystem services that are supported by water resources, as well as for services provided by migratory species.

The Intergovernmental Panel on Climate Change (IPCC) predicts that average annual temperature in the U.S.-Mexico borderlands, in addition to much of western North America and Central America, likely will increase by about 1.5°C by 2030 to more than 2.5°C by 2100 (IPCC 2007). In combination with this warming trend, annual precipitation is projected to decrease across the region. Hot, dry weather is expected to be more prevalent during the winter months, with a 10-15 percent reduction in winter rains by 2050 (Seidel et al. 2008).

Summer precipitation, however, will likely remain static or slightly increase due to higher ocean temperatures. Winter snow pack in the headwaters of the Colorado and Rio Grande/ Río Bravo will be reduced, leading to decreased spring runoff. Due to lower mean annual precipitation and reduced snow pack, less water may be available to fill reservoirs (Barnett and Pierce 2009). This in turn will mean less water availability for the in-stream flows necessary to support functioning ecosystems and ecosystem services in the region (Stewart 2009).

Shifts in the timing of life cycle events (phenology) between migratory species and the plants they depend on (e.g. flowering or seed production timing for food) may be disrupted by climate change. Wildlife may fall out of sync with the timing of critical plant resources they need during their migration (Batalden et al. 2007). In turn, this likely will impact the ecosystem services provided by migratory species, such as the pollination and cultural services of long-nosed bats and monarch butterflies, respectively (see Appendix).

## Transboundary Ecosystem Services

Laura López-Hoffman

### Policy Options

Given the vital importance of transboundary ecosystem services to people in both countries and the imposing threat of climate change, mechanisms are needed to protect cross-border services. In addition to tools for protecting specific types of services, a broad platform is needed to protect ecosystem services in one country against the unintended impacts of actions and policies in another country. Here are some examples:

#### Migratory species

*New treaties and efforts to protect migratory species should consider the ecosystem services they provide.*

For example, an effort is currently underway to establish the North American Bat Conservation Alliance (NABCA). NABCA should monitor the transboundary ecosystem services provided by migratory bats and document their value. A treaty to protect migratory bats should be developed; and the value of bat cross-border services should be used to demonstrate that the U.S. and Mexico have a mutual interest in supporting the treaty.

Such an effort will require a multi-step process: researchers and NGOs in the U.S. and Mexico need to conduct more thorough valuations of bat ecosystem services; concomitantly, researchers and NGOs should work with local stakeholders in both countries to urge their state wildlife agencies, and in turn the Departments of the Interior and State, Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT), and Secretaría de Relaciones Exteriores to develop a new treaty; in addition, the Border Governors, as well as governors in non-border states like Jalisco, can advocate for stakeholders under their jurisdiction.

#### Ecosystem services supported by transboundary groundwater

*A binational groundwater treaty is needed.*

U.S. and Mexico would be wise to honor their commitment under Minute 242 of the 1944 Water Treaty and develop a mechanism for equitably resolving groundwater disputes along the border. The Bellagio Draft Treaty on Transboundary Groundwater—developed in 1987 by experienced groundwater managers and scientists from around the world—would provide such a mechanism. The Border Governors Conference, in tandem with the Inter-



national Boundary and Water Commission (IBWC) and Comisión Internacional de Límites y Aguas (CILA), the Comisión Nacional del Agua (CONAGUA) and local water districts in the U.S., should urge the U.S. and Mexican federal governments to develop a border-wide groundwater treaty.

*Implementation of the “Transboundary Aquifer Assessment Act” needs to be accelerated.*

As a possible first step toward establishing a groundwater treaty, in 2006 the U.S. Congress enacted the United States-Mexico Transboundary Aquifer Assessment Act. The act promotes cooperation between appropriate entities in the two countries in “conducting a hydrogeologic characterization, mapping, and modeling program for priority transboundary aquifers” in the border region (House bill 469, Senate bill 214, 109th Congress). The Border Governors Conference should urge the U.S. Geological Survey and the Water Resources Research Centers, the U.S. entities charged with executing the Act, to hasten its implementation.

*“Payments for Ecosystem Services” can be used to align interests in protecting shared ecosystem services.*

In many situations involving water, the interests of the U.S. and Mexico might not naturally align, as efforts to increase water on one side of the border necessitate a decrease on the other. In such situations, the innovative approach of “payments for ecosystem services” can be used to find common ground.

For example, in the All-American Canal case (see Appendix), U.S. and Mexican stakeholders concerned about the loss of Mexico’s Andrade Mesa wetlands could buy existing Colorado River water rights in Mexico, and dedicate the water to wetland protection. This would not only protect the wetlands in Mexico (and stakeholders in Mexico), but benefit stakeholders in the U.S. by insuring the wetlands’ continued function as “stop-over” for birds migrating to the U.S.<sup>2</sup>

Mexico’s national water law was recently amended to allow for “environmental use”; notably, U.S. water law does not allow for such uses. Two NGOs, the U.S.-based Sonoran Institute and Mexico’s Pronatura Noroeste, have been exploring a similar approach to secure water for restoring the Colorado River delta.

<sup>2</sup> In this example, the wetlands are providing supporting services for wildlife and biodiversity.

## Transboundary Ecosystem Services

Laura López-Hoffman

### Broad mechanisms to protect against unintended cross-border impacts on ecosystem services

*The Commission for Environmental Cooperation (CEC) should develop programs to protect transboundary ecosystem services.*

Of all the binational arrangements for transboundary conservation, the CEC is the only institution with a geographic mandate broad enough to address the vast ecological linkages between the countries (as exemplified by the ecosystem services provided by monarch butterflies and long-nosed bats; see Appendix). Transboundary ecosystem services should be developed as one of the CEC's areas of concern.

Since the CEC's creation in 1994, the U.S. and Mexico have generally supported its mission. Nevertheless, the organization has been seen as underfunded and weak. Because it has lacked the resources and thus the "teeth" to identify problems, investigate them, and enforce corrective measures, the commission has yet to fully realize its promising mandate. For CEC to be effective, it requires two critical changes: (1) a redesign to make it more inclusive of affected communities and other stakeholder groups, and (2) far greater and longer-term financial commitment by the participating countries.

*The CEC's Transboundary Environmental Impact Assessment (TEIA) mechanism could be used to protect the ecosystem services of one country against unintended impacts of actions and policies in the other country.<sup>3</sup>*

For example, were TEIA to encompass ecosystem services, the Canadian government would have to consider the transboundary impacts of its noxious weed policies on butterfly populations in the U.S. and Mexico.

In the All-American Canal situation (see Appendix), under TEIA, the U.S. Bureau of Reclamation would have had to consider the cross-border impacts of lining the canal on the wetlands in Mexico. The existence of a TEIA mechanism might not have stopped the Bureau from lining the canal, but it would have provided Mexican stakeholders with a tool to more forcefully argue for wetland restoration and mitigation in Mexico.

After 15 years of non-action, the two federal governments should negotiate and implement a workable and forceful TEIA agreement for conserving the U.S. and Mexico's shared ecosystem services. The Border Governors could add immediate support by urging the federal governments to implement TEIA.

<sup>3</sup> TEIA was envisioned in the North American Agreement for Environmental Cooperation (NAAEC) enabling document. NAAEC is the environmental side agreement to NAFTA.

---

## Conclusion

Mexico and the U.S. would be well-served by framing natural resources conservation in terms of shared ecosystem services as outlined by the UN's Millennium Ecosystem Assessment. The ecosystem service concept can be used to organize transboundary conservation as being in the countries' mutual interests.

In particular, the payments-for-ecosystem-services approach can be used to find common ground in situations where the countries' interests do not align naturally. Because the sharing of ecosystem services links the well-being of people in both nations, it is in the interest of both the U.S. and Mexico to work together to protect the ecosystems and ecosystem services that support the welfare of their citizens.

## Transboundary Ecosystem Services

Laura López-Hoffman

### Appendix: Cases of Transboundary Ecosystem Services<sup>4</sup>

#### Water and the All-American Canal

The All-American Canal was constructed in the 1940s to carry Colorado River water to farms in California's Imperial Valley and to San Diego. Millions of cubic meters of water seep annually from the unlined dirt canal, filtering into the aquifer under the Mexicali Valley in Mexico. The high-quality leaked water accounts for 10-12 percent of the aquifer's annual recharge, enhancing its water quality. The seeped water is an inadvertent addition to Mexico's official allotment from the Colorado River under the 1944 Water Treaty.

Since 1942, the leaked water has been a source of irrigation and drinking water—provisioning services—for the residents of the Mexicali Valley. In addition, water seepage from the canal has created new wetland habitats in the Andrade Mesa—2,500 ha in the U.S. and 3,500 in Mexico—providing supporting services for protected and rare migratory birds.

For years, California water users have pressured the U.S. Bureau of Reclamation to reduce the seepage of water to Mexico. In response, in mid-2007 the Bureau began to line sections of the canal with cement in order to prevent 83.5 million cubic meters of seepage yearly. In 2005, a group of Mexican business and civic leaders and two California-based environmental NGOs sued the Bureau in U.S. district court asserting that the canal-lining would make the Mexicali aquifer “completely unusable” for the 1.3 million people of the Mexicali Valley, hurt the local economy, and destroy wildlife and wetlands in Mexico.

The lawsuit noted that while the Bureau's 1994 and 2006 Environmental Impact Assessments considered the lining's potential effect on wetlands in Mexico, they suggested wetland mitigation only for the U.S.

The lawsuit was dismissed in July 2006. The court declared that the U.S. Constitution's Fifth Amendment due process protections do not apply to people outside U.S. territory. A 2006 waiver from the U.S. Congress prevented the court from considering whether the loss of wetland habitat in Mexico would constitute violations of the U.S. Endangered Species and National Environmental Policy Acts and the Migratory Bird Treaty.

---

### The pollination connection between long-nosed bats and tequila

Bats provide the regulating service of pollinating agave, which is critical to tequila production in central Mexico, particularly the state of Jalisco. Two species of long-nosed bats are the principal pollinators of the blue agave plant—providing a regulating service.

Mexican corporate producers clone agave—rather than allowing natural reproduction—since agave hearts, which are cooked and distilled, have higher sugar content if the plants are prevented from flowering. As a result, most large plantations in Mexico consist of only one or two genetic varieties. The consequences of low genetic diversity have been severe: in the late 1980s, and again in 1996 and 1997, the homogenous crops were devastated by pathogens, resulting in sizeable economic losses.

If corporate producers used natural bat pollination, the resulting genetically diverse crops would be less susceptible to diseases. In contrast to the corporate producers, artisanal tequila producers depend on bat pollination, and use many genetic varieties of blue agave as well as other agave species. Further, these small producers are collaborating with conservation biologists to protect bats.

The ecosystem services provided by bats are clearly critical to tequila production. However, the pollinator's future is uncertain; long-nosed bats are listed as endangered in both the U.S. and Mexico. Their habitat is threatened in both countries, particularly in the over-wintering caves of the U.S.-Mexico borderlands.

On both sides of the border, millions of bats have been burned, dynamited, or barred from their roosts by ranchers and cattlemen who mistake them for vampire bats. Bat caves have also been destroyed by urban development.

## Transboundary Ecosystem Services

Laura López-Hoffman

### The monarch butterfly and aesthetic fulfillment

People from Canada to Mexico experience wonder and a sense of aesthetic fulfillment—a cultural service—when they witness the extraordinary migration of the monarch butterfly. Every fall, more than 100 million monarch butterflies migrate from Canada and the U.S. to ten small mountaintops in central Mexico. The spectacular sight of trees laden with butterflies draws eco-tourists to the “Monarch sanctuary,” boosting the economy of local villages. Monarch butterflies are in jeopardy throughout their range. In Mexico, illegal logging is threatening the butterflies’ winter ground. In the monarch’s U.S. and Canada summer grounds, corn pollen transgenically engineered to express insecticides may be harming them.

In Canada, milkweed, the monarch’s primary summer host plant and food source, is eradicated as a noxious weed. In the U.S., intensive agricultural practices have resulted in the loss of the milkweed plants the monarchs depend on for their fall migration to Mexico.

Until recently, most significant butterfly conservation efforts have focused on Mexico. In 1986, the Mexican government proclaimed the winter sites a Biosphere Reserve and off-limits to logging. In addition, international NGOs have been paying local people to abstain from logging in the oyamel forests. Nonetheless, rates of deforestation seem to be increasing in the reserve.

A recently begun CEC-lead effort is now focusing on preventing monarch decline in the U.S. and Canada.

<sup>4</sup> The cases are adapted from: López-Hoffman, et al. 2009.

## References

Barnett, T, and D Pierce. 2009. Sustainable water deliveries from the Colorado River in a changing climate. *Proceedings of the National Academy of Sciences of the USA* 106: 7334–7338.

Batalden, RV, K Oberhauser, and AT Peterson. 2007. Ecological niches in sequential generations of eastern North American monarch butterflies (Lepidoptera: Danaidae): The ecology of migration and likely climate change implications. *Environmental Entomology* 36(6): 1365–1373.

Daily, GC, ed. 1997. *Nature's Services: Societal Dependence on Natural Ecosystems*. Washington DC: Island Press.

IPCC (Intergovernmental Panel on Climate Change). 2007. *Climate Change 2007: The Physical Science Basis: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.

Liverman, DM, RG Varady, O Chávez, and R Sánchez. 1999. Environmental issues along the United States-Mexico border: Drivers of change and responses of citizens and institutions. *Annual Review of Energy and the Environment* 24: 607–643.

López-Hoffman, L, RG Varady, and P Balvanera. 2009. Finding mutual interest in shared ecosystem services: New approaches to transboundary conservation. In *Conservation of Shared Environments: Learning from the United States and Mexico*, eds. L López-Hoffman, E McGovern, RG Varady, KW Flessa. Tucson: University of Arizona Press.

López-Hoffman, L, RG Varady, and P Balvanera. 2010. Ecosystem services across borders: A framework for transboundary conservation policy. *Frontiers in Ecology and the Environment* 8(2): 84–91, doi:10.1890/070216.

Millennium Ecosystem Assessment. 2003. *Ecosystems and Human Well-Being: A Framework for Assessment*. 2003, Washington, DC: Island Press.

Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Our Human Planet*. Washington, DC: Island Press.

Seidel, D, Q Fu, WJ Randel, and TJ Reichler. 2008. Widening of the tropical belt in a changing climate. *Nature Geoscience* 1: 21–24.

Stewart, IT. 2009. Changes in snowpack and snowmelt runoff for key mountain regions. *Hydrological Processes* 23(1): 78–94.

