

## U.S.-Mexico Hydrodiplomacy: Foundations, Change, and Future Challenges

By [Margaret O. Wilder](#), [Robert G. Varady](#), [Stephen P. Mumme](#), [Andrea K. Gerlak](#), [Nicolás Pineda Pablos](#), [Christopher A. Scott](#) - 12.23.2019

The year 2019 marked a significant milestone in U.S.-Mexico hydrodiplomacy: seventy-five years since the two countries adopted the Treaty of 1944, which apportioned between them the waters of the Rio Grande, Colorado River, and Tijuana River. Although the treaty is the countries' most notable and enduring act of hydrodiplomacy,<sup>[1]</sup> numerous cooperative agreements have followed over the past seven-plus decades. These arrangements have transformed transboundary water management in the region, in an arc away from conflict and toward greater cooperation and collaboration.

Water scarcity along the U.S.-Mexico border has intensified due to various effects of climate change, economic development, population growth, and increasing water demand,<sup>[2]</sup> resulting in a complex array of water-governance challenges.<sup>[3]</sup> But paradoxically, transboundary binational institutions between the United States and Mexico have become more adept—not less so—at devising innovative adaptations in water management. To some extent, this experience accords with study findings that show nations tend toward cooperation rather than conflict over water and that complexity need not be a deal breaker if water management institutions are robust.<sup>[4]</sup> This raises a crucial question to be addressed in this essay: how precisely have transboundary U.S.-Mexico relations evolved toward cooperation and collaboration?

### Hydrodiplomacy in Border Regions

The European Commission defines science diplomacy as “the use of science to prevent conflicts and crises, underpin policy making, and improve international relations in conflict areas where the universal language of science can open new channels of communication and build trust.”<sup>[5]</sup> It can likewise be thought of as “the use of scientific expertise to advance diplomacy.”<sup>[6]</sup> In essence, science diplomacy corresponds with the idea that “working together on research projects can build trust and networks between countries, improving their overall relations.”<sup>[7]</sup> Specifically, hydrodiplomacy can be understood as science diplomacy applied to transboundary waters. According to E. William Colglazier's 2018 review, in this journal, of the state of science diplomacy,<sup>[8]</sup> transboundary diplomacy over water may be one of the most consequential forms of future international scientific and political collaboration. Colglazier, citing a “future world” scenario of global warming challenges<sup>[9]</sup>—most of which revolve around water—notes an anticipated “rise in international tensions and conflict, especially in developing countries over water”<sup>[10]</sup> amid global warming conditions.

Hydrodiplomacy generally refers to international cooperation around water resources shared by two or more countries and varies according to the particular sets of power relations between those countries. Hydrodiplomatic initiatives may explicitly utilize scientific expertise to different degrees in various contexts, ranging, for example, from descriptive data to hydrological and water-resource models to decision-making support for alternative future scenarios. Lawrence Susskind and Shafiqul Islam note that successful hydrodiplomacy rests on moving away from zero-sum thinking that conceives of water as a fixed resource to more flexible understandings that allow space for cooperation between countries.<sup>[11]</sup>

We contend that effective hydrodiplomacy must be based on adaptive and collaborative transboundary water governance, defined as a form of collective decision making that is “formal, consensus-oriented, and deliberative,” where responsibility is shared among state and nonstate stakeholders working together to seek consensus.<sup>[12]</sup> Yet an important distinction in the U.S.-Mexico context is that not all stakeholders are coequals, given that the two countries' sections of the binational boundary water commission, as state actors, retain sovereign decision-making authority in carrying out their responsibilities under the 1944 treaty.



Fig. 1. U.S.-Mexico border, border states, and selected rivers. Source: Adapted by the authors from the International Boundary and Water Commission

#### ABOUT THE AUTHORS

*Margaret O. Wilder is associate professor in the School of Geography and Development and in the Center for Latin American Studies at the University of Arizona. She is an appointed member of the Good Neighbor Environmental Board, advisory to the president of the United States on U.S.-Mexico border environmental issues.*

*Robert G. Varady is a research professor of environmental policy and immediate past director of the Udall Center for Studies in Public Policy at the University of Arizona. His research centers on transboundary water governance in different international contexts.*

*Stephen P. Mumme is professor of Political Science at Colorado State University. His work centers on water and environmental management along the U.S.-Mexico border.*

*Andrea K. Gerlak is an associate professor in the School of Geography and Development and an associate research professor at the Udall Center for Studies in Public Policy at the University of Arizona. Her research focuses on institutions for governing water resources.*

*Nicolás Pineda Pablos is professor of public policy at the Colegio de Sonora, Hermosillo, Sonora, Mexico. His research focus is on water policy and urban water governance in Mexico and the U.S.-Mexico border region.*

*Christopher A. Scott is director of the Udall Center for Studies in Public Policy, professor in the School of Geography and Development, and director of the Consortium for Arizona-Mexico Arid Environments at the University of Arizona. He chairs the Consensus Study on U.S.-Mexico Drylands of the two countries' national academies of science.*

Adapting terms from organizational management,[13] we offer straightforward working definitions of these key concepts aimed at clarifying important distinctions. *Conflict* in water governance is when two or more parties have different goals they view as mutually exclusive. *Cooperation* is when the parties share resources and information to help each achieve its own goal. And *collaboration* is when the parties work together toward achieving a shared goal. Yet this framework risks understating the complexity of these concepts in transboundary settings. Mark Zeitoun and Naho Mirumachi view conflict and cooperation as two essential faces of the same coin; rather than occupying opposite ends of a spectrum, they coexist and are in constant interaction with each other.[14] Claudia W. Sadoff and David Grey, in contrast, espouse a continuum theory that ranges from conflict to coordination to collaboration to joint action.[15] They assert that “collaboration results when national plans are adapted either to secure gains or to mitigate harm in another riparian country,” with joint action going even further and occurring when “riparians act as partners in the design, investment, and implementation” of the development of shared rivers.[16] In the U.S.-Mexico border region, intermittent episodes of conflict have largely been outweighed by an increasing spirit of cooperation over recent decades; thus, we argue that U.S.-Mexico hydrodiplomacy in general has moved away from conflict and toward cooperation and collaboration.

## The U.S.-Mexico Border Region

Recognized as a “hot spot” both for climate change and socioeconomic vulnerability,[17] the U.S.-Mexico border region presents an important test case for current and future hydrodiplomacy. The 1,956-mile (3,218 km) border between the two countries encompasses parts of ten states, four in the United States and six in Mexico (see figure 1).

### *Physical Geography*

The border’s climate ranges from hyperarid to semiarid to temperate, and its landscape is at once rugged and fragile. The border features a number of important protected areas, migratory bird corridors, and rich wildlife and vegetation in diverse ecological regions. By midcentury, average temperatures are projected to increase significantly in the region, with widespread drying, drought, and rising water stress.[18] Mean annual rainfall is highly variable across the region, but climate models project decreasing rainfall by midcentury.[19] There are a dozen transboundary rivers in the border region, including two major ones: the Rio Grande (known as the Río Bravo in Mexico), which demarcates the border from Texas and Chihuahua east to the Gulf of Mexico, and the Colorado River, which crosses the western border. Several transboundary groundwater aquifers underlie the border, further linking the hydrological systems of the two countries.[20]

### *Socioeconomic Characteristics*

Fourteen million people live in the region—in large, paired border cities, including San Diego/Tijuana and El Paso/Ciudad Juárez, and in smaller towns and rural settlements. Population growth is rapid, intensifying urbanization and encroachment on natural areas. In the United States, Sunbelt-oriented internal migration has resulted in the spread of housing subdivisions and commercial sprawl, while in Mexico unplanned colonias often lack basic services such as water, sanitation, and electricity.

Asymmetries of wealth, power, and influence are hallmarks of this border, where an advanced industrialized economy comes face-to-face with a developing economy. The two countries’ economies, cultures, and political systems all manifest unevenness, yet the past has seen cycles of conflict and accommodation over immigration, labor, trade, disaster management, narco-trafficking control, and—sometimes—water.[21]

The first decade of the twenty-first century witnessed two significant conflicts over water, yet the region’s robust transboundary institutions and relationships helped overcome them. Background for incident one dates to the 1990s, when severe precipitation deficits caused Mexico to declare an “extreme drought”—a term used but not defined in the 1944 treaty. This led to Mexico’s curtailment of water deliveries from its tributary rivers in the eastern Río Bravo to the United States, resulting in a massive water debt to Texas farmers. In 1999–2002, the issue became an international incident involving both countries’ presidents, resolved when wetter years allowed deliveries to resume.[22] The situation was also assuaged due to a mechanism that allows five-year average deliveries to meet Mexico’s treaty obligation. Some analysis indicates that the water shortage resulted from regional conflicts and mistrust between upstream and downstream irrigators, but that these groups also made common cause in demanding that their respective government representatives step in to resolve the crisis.[23] The dispute shed light on the need for bilateral cooperation to define shortage-sharing mechanisms. In 2016, Mexico fully paid off its water debt to the United States, and in 2017 the International Boundary and Water Commission (IBWC; in Spanish, *Comisión Internacional de Límites y Aguas*, CILA) created working groups to study a joint modeling system for the Rio Grande/Bravo. Yet Texas farmers

remain concerned that the fundamental issues underlying the water debt in drought periods are not fully resolved.

A second conflict occurred in 2005–7, when the United States unilaterally decided to line with concrete a twenty-three-mile section of the earthen All-American Canal (AAC),<sup>[24]</sup> over objections and court challenges by a coalition of environmental organizations, communities, and the Mexican government.<sup>[25]</sup> The AAC is an 80-mile (128 km) aqueduct in southeastern California that conveys Colorado River water west to Imperial Valley farms and nine cities. Considerable political pressure in favor of the canal lining was exerted by the U.S. cities' water utility corporations and the rural irrigation districts. Plans for the lining extended back to 1983, when the United States, again unilaterally, declared ownership of the seepage water from the earthen canal; in 1988, the U.S. Congress directed the Department of the Interior to develop specific plans for the lining. Nearly two decades later, in 2005, eight claims were brought against the canal-lining project in the U.S. Ninth Circuit Court of Appeals. But the United States prevailed in these court cases, and subsequent appeals in 2006 and 2007, based on the claim that the lining achieved loss prevention for water perceived as belonging to the U.S. allocation. Mexico, for its part, viewed the lining as essentially a "taking" of cross-border seepage water used by farmers in the Mexicali area for more than sixty years.<sup>[26]</sup> The canal lining was completed in 2009.<sup>[27]</sup> Scholars note that once the conflict became a legal matter, the IBWC/CILA—as well as U.S. and Mexican federal agencies—was sidelined and thereafter had limited involvement in resolving the case.<sup>[28]</sup> In 2010, an earthquake damaged Mexicali and prevented Mexico from accepting Colorado River water deliveries, engendering a humanitarian response by the United States.<sup>[29]</sup> This led to Minute 319 (discussed later) and set the stage for a new era of binational collaboration.

### Evolution of U.S.-Mexico Hydrodiplomacy

Despite periods of conflict, with remnants persisting today, the United States and Mexico, as already noted, have tended to cooperate over the management of transboundary water resources, an impulse that has only gained strength in the last three decades. This is the case even though the two neighbors have sometimes clashed over immigration, narco-trafficking, trade, and other issues of geopolitical significance.

Bilateral efforts to develop institutions to manage the border date back 130 years, to 1889, when the countries entered into the U.S.-Mexico Convention, whose signal creation was the joint International Boundary Commission. In 1944, this commission was renamed the International Boundary and Water Commission (Comisión Internacional de Límites y Aguas), reformulated under a mandate to manage shared water resources. The Treaty of 1944, monitored and enforced by the IBWC/CILA, allocated the waters of border rivers—the Colorado, Rio Grande/Río Bravo, and Tijuana—and established a method of "minutes" (i.e., treaty extensions or applications) that would permit modifications to the treaty over time.

Thus, in 1973, the IBWC/CILA adopted Minute 242 to address water quality in response to Mexico's demands to reduce the salinity of Colorado River water delivered by the United States.<sup>[30]</sup> Minute 242 guaranteed a minimum level of water quality and vindicated a national U.S. interest over the narrower interests of the seven U.S. Colorado River basin states.<sup>[31]</sup>

In 1983, the La Paz Agreement became the first bilateral framework agreement to address the environment. Mexico and the United States agreed to "protect, conserve, and improve the environment" of the border region,<sup>[32]</sup> and committed to a procedure for discussing border environmental issues and sharing related data and information. La Paz led to official recognition of a broad group of stakeholders, including states, *municipios* (in Mexico), and county and local administrations (in the United States), as well as environmental nongovernmental organizations.<sup>[33]</sup>

The 1994 North American Free Trade Agreement (NAFTA), signed by Mexico, the United States, and Canada, was accompanied by NGO and interest-group concerns about the potential environmental impacts the agreement would wreak in terms of pollution and toxic waste dumping, especially in Mexico. NAFTA thus became a unique trade deal that pioneered an environmental side agreement resulting in the creation of the trilateral Commission for Environmental Cooperation (CEC), headquartered in Montreal. Separately, the U.S.-Mexico Border Environment Cooperation Commission (BECC) and the North American Development Bank (NADB) were established at the same time. In 2018, the BECC was subsumed by the NADB, which along with the CEC marked twenty-five years in 2019.

The 2006 establishment of the Transboundary Aquifer Assessment Program (TAAP) committed the United States—via its network of U.S. Geological Survey offices and university-based water resources research centers—to hydrogeologic assessment and data collection on selected transboundary groundwater aquifers in Arizona, New Mexico, and Texas. Mexico, although not a signatory, has participated in scientific research

and information sharing via its national water authority, the Comisión Nacional del Agua (CONAGUA), CILA, state governments, and regional universities. Until the creation of TAAP, the IBWC had paid little to no attention to transboundary groundwater resources, and the program helped highlight the importance of data sharing around transboundary aquifers.

## Major Turning Points

The 1944 treaty and the subsequent Minutes 319 and 323 represent significant inflection points in the evolution of U.S.-Mexico hydrodiplomacy. The components of the first major turning point, the treaty and creation of the IBWC/CILA, have proven durable yet flexible foundations for the subsequent seventy-five years of hydrodiplomacy. The treaty's complexity, coupled with its political malleability through the "minutes" process for operationalizing and extending provisions, contributes to its durability. With specific agreements concerning the management of three named rivers, as well as a mandate to manage transboundary sanitation and administer all existing bilateral boundary agreements, the treaty serves numerous and varied stakeholders, helping widen its utility and political support.

The principal challenge to the treaty's legitimacy, a dispute over U.S. responsibility to control the salinity of the Colorado River, was resolved by Minute 242 in 1973, further consolidating binational support for the agreement. With Minute 242, the United States effectively conceded to Mexico's argument that the treaty guaranteed a minimum threshold of water quality to co-riparians. Six years later, in 1979, Minute 261 extended the treaty's application to transboundary sanitation, enabling the IBWC/CILA to address water-quality problems.

Over the past two decades, the treaty's capacity to resolve water-shortage disputes and address ecological conservation has been tested on both the Rio Grande/Bravo and the Colorado River. On the Rio Grande/Bravo, Article 4's shortage-sharing provisions have led to binational investments in water conservation infrastructure in the watershed of Mexico's Río Conchos (a Río Bravo tributary), though binational differences over treaty interpretation persist. In contrast, the Colorado River, thought by the treaty's negotiators to present the most vexing shortage problems, has seen unprecedented advances in shortage sharing and ecosystem conservation (Minutes 319, 323). Two institutional features contributing to the functionality of the IBWC/CILA are (1) its operation outside the political-electoral arena in both countries and (2) the professionalization of its commissioners and personnel. At least in the case of Mexico, where most public offices are granted to insiders and political appointees whose service overlaps with presidential terms, the CILA commissioners have stayed in office much longer than the six-year presidential terms, including one commissioner who remained thirty-one years in office. A U.S. commissioner held the post for twenty years. The commissioners, engineers by profession with a few exceptions, have traditionally kept a low political profile, playing a mostly technical role.

A second inflection point came in 2012 with Minute 319, which authorized environmental flows of water to the Colorado River Delta (located entirely within Mexico), marking the first time the two nations had delivered water to the delta to promote ecosystem restoration.<sup>[34]</sup> Minute 319 is one of the "most significant agreements" signed to date, given the diversity of issues and cooperation measures embraced and its long-term collaboration on Colorado River basin management.<sup>[35]</sup> Following issuance of the minute, parties successfully negotiated in March 2014 a pulse-flow release meant to mimic the ecologically vital spring floods that historically inundated the delta. For the first time in fifty years, the pulse-flow release reconnected the Colorado River with the Sea of Cortez. Environmental NGOs helped raise the necessary funding to meet the water and restoration commitments. In the larger picture, Minute 319 helped launch a binational stakeholder process under the IBWC/CILA that brings together agency representatives, university researchers, and environmental NGO representatives to conduct research and monitoring.<sup>[36]</sup> Building from this experience, the successor, Minute 323 (2017), required both countries to provide water and funding for habitat restoration and scientific work in the Colorado River Delta for the subsequent decade,<sup>[37]</sup> set forth voluntary cutbacks in times of drought, and allowed Mexico to continue to store water in Lake Mead, located upstream on the Colorado River between the states of Arizona and Nevada.

Minutes 319 and 323, and the successful negotiation of a pulse-flow release to begin restoration of the delta's wetlands, demonstrate the significance of the Treaty of 1944 and the IBWC/CILA as bedrock institutions, and underscore the argument that strong binational institutions are critical for managing complexity in transboundary basins.<sup>[38]</sup> Furthermore, the case illuminates the emerging role of environmental networks led by natural and social scientists, policy scholars, and environmental NGOs that has altered the hydrodiplomacy landscape and helped reshape IBWC/CILA activities.<sup>[39]</sup>

A weakness in the 1944 treaty, however, is its inclusion only of the United States and Mexico as official parties and the lack of a requirement for consultation with affected sovereign tribal nations.<sup>[40]</sup> Despite Minute 319 being generally regarded as a success, legal scholar Madeleine J. Lewis notes that the Cocopah Indian Tribe and other delta stakeholders “have not received due representation during the negotiations of past environmental flow programs.”<sup>[41]</sup> She argues that the absence of a requirement for input from the Cocopah tribe “is a major failure of the entire Minute process to date.”<sup>[42]</sup> Nevertheless, Lewis also points out that Cocopah tribal members and other delta stakeholders were among those most overjoyed to witness the water flowing during the 2014 release, with the majority observing this for the first time in living memory.

Hydrodiplomacy has benefited from sustained scientific leadership on one hand, and strong political and institutional foundations on the other. Leadership by scientists in the United States and Mexico to devise and implement innovative solutions (e.g., pulse-flow release) and monitor project impacts (e.g., ecological recovery and societal benefits), as well as internal scientific leadership within the binational network, has lent enduring stability and credibility to the longtime efforts to protect the delta’s delicate wetlands.<sup>[43]</sup> Political leadership demonstrated by IBWC/CILA authorities has been crucial to hydrodiplomatic successes, just as environmental NGO representatives have been instrumental in providing scientific support and financial resources,<sup>[44]</sup> alongside challenging the IBWC/CILA to provide a more open and participatory stakeholder process.<sup>[45]</sup> Finally, the treaty is the terra firma upon which the rest of the transboundary cooperative apparatus rests. Lewis,<sup>[46]</sup> like Stephen P. Mumme, the political scientist,<sup>[47]</sup> argues for the essential importance of the treaty as an orchestrator of all transboundary water relationships. Without a treaty, “the likelihood of contriving an equitable and sustainable water-sharing agreement between the two nations was improbable.”<sup>[48]</sup>

### **Anticipating Hydrodiplomacy Challenges at Midcentury**

The evolution of transboundary relations over shared water resources has been dynamic and responsive to newly arising challenges. Although the U.S.-Mexico relationship has experienced significant instances of conflict, precipitated by drought or infrastructure problems, the overarching direction has been toward cooperation and even collaboration. The Treaty of 1944 has been a stabilizing influence on bilateral water relations, cushioning political oscillations. Indeed, for the past seventy-five years, the two countries’ water relations have been remarkably insulated from geopolitical nuances and differences, responding more directly to local and watershed concerns and to the perpetual need to accommodate and respond to development asymmetries along and beyond the international boundary.

Minutes 319 and 323, which allowed water flows into Mexico’s Colorado River Delta, demonstrated fresh capacities for innovation, cooperation, and collaboration. After decades of relationship building among scientists, environmental NGO and government agency representatives, and IBWC/CILA officials, the two countries defined a shared goal of restoring some environmental flows to the delta’s stressed wetlands. The United States and Mexico collaborated to allow the peak flow release and an ongoing mechanism for identifying and purchasing other water allocations, followed by sustained scientific monitoring of the restoration effort. One key participant indicated that the “binational collaboration, bolstered by the heavy advocacy by non-governmental organizations from both countries, was a necessary force in negotiating commitments to delta flows.”<sup>[49]</sup> As part of the same agreement, the two countries cooperated to achieve Mexico’s goal of securing water storage capacity, when needed, in U.S. reservoirs and the United States’ goal of identifying a formal means of sharing Colorado River shortages with Mexico. These actions fulfill Sadoff and Grey’s concept of collaboration and even joint action.

Lewis emphasizes both the durability of working relationships over long periods and the role of successive treaty minutes in building layer upon layer of institutional architecture that ultimately resulted in the “remarkable” Minute 323.<sup>[50]</sup> Amendments stretching back to Minute 306—which was adopted in 2000 and dedicated the two countries to a “conceptual framework” to protect the delta’s wetlands—attest to the “IBWC’s growing but hesitant commitment to the environmental health of the Colorado River, and of the delta in particular.”<sup>[51]</sup> Such institutional partnerships are not created overnight. The monumental strides in binational collaboration to secure dedicated environmental flows in this water-stressed landscape were the work of decades, not mere months or years, and of a strong coalition—with an engaged IBWC/CILA at its center—that likewise developed over many years and remained solidly guided by both science and a commitment to restoring essential, environmental flows. At the same time, in working toward Minutes 319 and 323, both the United States and Mexico were pursuing their own national goals and interests.

As we look toward the future, many potential obstacles lie in the path of successful U.S.-Mexico hydrodiplomacy. In the last decade, scientists have recognized that the assumption of stationarity—that

“natural systems fluctuate within an unchanging envelope of variability” [52]—no longer holds for water resources, given that “anthropogenic change of Earth’s climate is altering the means and extremes of precipitation, evapotranspiration, and rates of discharge of rivers.” [53] Hydrological nonstationarity requires that the region rely on continued binational commitment and robust transboundary governance—an institutional stationarity of sorts—to build resilience against future challenges.

Much of the challenge transcends climate change and fluctuation. Along the border, as noted earlier, the sociopolitical environment creates conditions of increasing complexity—including uneven economic development, rapid population growth, and chronic water scarcity. These changes are placing increased demands on the treaty and IBWC/CILA for ever-more nimble institutional responses. Moving toward midcentury, hydrodiplomacy initiatives must continue to engage these challenges creatively and, most important, binationally. While little evidence suggests that shifting geopolitical relations have affected binational environmental relations, they could at some point hamper, halt, or even set back hydrodiplomacy, should national interests on either side favor such a course. This is arguably a somewhat more acute concern under the Trump administration, which has given dangerous credence to antiscientific rhetoric—namely, denying the science behind the anthropogenic causes of climate change—with the potential to affect U.S.-Mexico geopolitical relations. In essence, the U.S. leadership has sparked the opposite of science diplomacy in its desire to declare a “crisis” at the U.S.-Mexico border. Such an approach is at odds with the cooperative hydrodiplomatic initiatives in the transboundary region for three-quarters of a century.

The history of effective U.S.-Mexico hydrodiplomacy carries implications for other global transboundary regions under stress, pointing to the fundamental value of strength, flexibility, and, above all, trust in the foundational instruments and management institutions governing the relationship. Dynamic transboundary regions require adept institutions and scientific and political leadership to face the challenges that inevitably confront them—not as instances for prevailing in conflict but as opportunities to further cooperation and collaboration toward serving the individual interests of each country while also advancing their shared goals.

## Acknowledgments

The authors gratefully acknowledge the contributions of Adriana A. Zuñiga, Sharon B. Megdal, and Karl W. Flessa to a 2018 conference presentation on which this essay was partially based: R. G. Varady, S. Mumme, A. K. Gerlak, S. B. Megdal, M. O. Wilder, N. Pineda Pablos, C. A. Scott, K. W. Flessa, and A. Zuñiga, “Seventy-Five Years of Hydrodiplomacy on the U.S.-Mexico Border,” presented at the “Empowering Hydro-diplomacy Conference,” The Hague, Netherlands, October 5, 2018.

The work that resulted in this essay was undertaken as part of the International Water Security Network, a project funded by Lloyd’s Register Foundation, an organization that helps protect life and property by supporting engineering-related education, public engagement, and the application of research. We further acknowledge the Inter-American Institute for Global Change Research for Project CRN3056, which is supported by the U.S. National Science Foundation (grant no. GEO-1128040) and NSF grant no. DEB-1010495. The paper also benefited from support from the Morris K. Udall and Stewart L. Udall Foundation, in Tucson, Arizona.

## About the Authors

*Margaret O. Wilder is associate professor in the School of Geography and Development and in the Center for Latin American Studies at the University of Arizona. She is an appointed member of the Good Neighbor Environmental Board, advisory to the president of the United States on U.S.-Mexico border environmental issues.*

*Robert G. Varady is research professor of environmental policy and immediate past director of the Udall Center for Studies in Public Policy at the University of Arizona. His research centers on transboundary water governance in different international contexts.*

*Stephen P. Mumme is professor of Political Science at Colorado State University. His work centers on water and environmental management along the U.S.-Mexico border.*

*Andrea K. Gerlak is an associate professor in the School of Geography and Development and an associate research professor at the Udall Center for Studies in Public Policy at the University of Arizona. Her research focuses on institutions for governing water resources.*

*Nicolás Pineda Pablos is professor of public policy at the Colegio de Sonora, Hermosillo, Sonora, Mexico. His research focus is on water policy and urban water governance in Mexico and the U.S.-Mexico border region.*

Christopher A. Scott is director of the Udall Center for Studies in Public Policy, professor in the School of Geography and Development, and director of the Consortium for Arizona-Mexico Arid Environments at the University of Arizona. He chairs the Consensus Study on U.S.-Mexico Drylands of the two countries' national academies of science.

- 
- [1] Stephen P. Mumme, *The 1944 Water Treaty as a Constitutional Document* (Houston: Rice University's Baker Institute for Public Policy, 2019), <https://www.bakerinstitute.org/media/files/files/fb5668a4/mex-pub-watertreaty-031419.pdf>.
- [2] Gregg Garfin et al., eds., *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment* (Washington, DC: Island Press, 2013), <https://www.swcarr.arizona.edu/content/about-report>.
- [3] Margaret Wilder et al., "Climate Change and U.S.-Mexico Border Communities," in *Assessment of Climate Change in the Southwest United States*, ed. Gregg Garfin et al. (Washington, DC: Island Press, 2013): 340–84, <https://www.swcarr.arizona.edu/chapter/16>.
- [4] Aaron T. Wolf et al., "Managing Water Conflict and Cooperation," chap. 5 in *State of the World 2005: Redefining Global Security*, ed. Erik Assadourian et al. (Washington, DC: Worldwatch Institute, 2005): 80–208.
- [5] Jan Marco Müller and Maurizio Bona, "Past, Present, and Future of Science Diplomacy in Europe," *Science & Diplomacy* 7, no. 3 (September 2018), <http://sciencediplomacy.org/perspective/2018/past-present-and-future-science-diplomacy-in-europe>.
- [6] E. William Colglazier, "Science Diplomacy and Future Worlds," *Science & Diplomacy* 7, no. 3 (2018), <http://www.sciencediplomacy.org/editorial/2018/science-diplomacy-and-future-worlds>.
- [7] David Matthews, "Can Science Diplomacy Work?" *Inside Higher Education*, June 6, 2019, <https://www.insidehighered.com/news/2019/06/06/advocates-science-diplomacy-see-great-need-era-world-divisions>.
- [8] Colglazier, "Science Diplomacy," <http://www.sciencediplomacy.org/editorial/2018/science-diplomacy-and-future-worlds>.
- [9] Joshua Busby, "Warming World," *Foreign Affairs* (July/August 2018): 49–55, <https://www.foreignaffairs.com/articles/2018-06-14/warming-world>.
- [10] Colglazier, "Science Diplomacy," <http://www.sciencediplomacy.org/editorial/2018/science-diplomacy-and-future-worlds>.
- [11] Lawrence Susskind and Shafiqul Islam, "Water Diplomacy: Creating Value and Building Trust in Transboundary Water Negotiations," *Science & Diplomacy* 1, no. 3 (September 2012), <http://www.sciencediplomacy.org/perspective/2012/water-diplomacy>.
- [12] Chris Ansell and Alison Gash, "Collaborative Governance in Theory and Practice," *Journal of Public Administration Research and Theory* 18, no. 4 (October 2008): 543–72. See also Barbara Cosens and Alexander Fremier, "Assessing System Resilience and Ecosystems Services in Large River Basins: A Case Study of the Columbia River Basin," *Idaho Law Review* 51, no. 1 (2015), <https://digitalcommons.law.uidaho.edu/idaho-law-review/vol51/iss1/3>.
- [13] Seapoint Center for Collaborative Leadership, <https://seapointcenter.com/cooperation-teamwork-and-collaboration/>.
- [14] Mark Zeitoun and Naho Mirumachi, "Transboundary Water Interaction I: Reconsidering Conflict and Cooperation," *International Environmental Agreements*, vol. 8 (2008): 297–316, <https://doi.org/10.1007/s10784-008-9083-5>.
- [15] Claudia W. Sadoff and David Grey, "Cooperation on International Rivers: A Continuum for Securing and Sharing Benefits," International Water Resources Association, *Water International* 30, no. 4 (2009): 420–27,

<https://doi.org/10.1080/02508060508691886>.

[16] Ibid.

[17] Climate Central, “American Warming: The Fastest-Warming Cities and States in the U.S.,” (2018), <https://www.climatecentral.org/news/report-american-warming-us-heats-up-earth-day> Margaret O. Wilder, Gregg M. Garfin et al. (2013) *ibid*.

[18] Wilder et al., “Climate Change,” <https://www.swcarr.arizona.edu/chapter/16>; Jonathan Overpeck et al., “Summary for Decision Makers,” in *Assessment of Climate Change in the Southwest United States*, ed. Gregg M. Garfin et al. (Washington, DC: Island Press, 2013): 1–20, <https://www.swcarr.arizona.edu/chapter/one>.

[19] *Ibid*.; Christopher A. Scott, “The Water-Energy-Climate Nexus: Resources and Policy Outlook for Aquifers in Mexico,” *Water Resources Research* 47 (2011), <https://doi:10.1029/2011WR010805>.

[20] Rosario Sanchez, Victoria Lopez, and Gabriel Eckstein, “Identifying and Characterizing Transboundary Aquifers along the Mexico-U.S. Border: An Initial Assessment,” *Journal of Hydrology* 535 (2016): 101–19.

[21] Roberto Sánchez-Rodríguez and Stephen P. Mumme, “Environmental Protection and Natural Resources,” in *Mexico and the United States: Confronting the Twenty-First Century*, working paper series (San Diego: University of California, 2010), [https://scholar.google.com/scholar?hl=en&as\\_sdt=0%2C3&q=sanchez-rodriguez+and+mumme&btnG=](https://scholar.google.com/scholar?hl=en&as_sdt=0%2C3&q=sanchez-rodriguez+and+mumme&btnG=); Paul Ganster and David Lorey, *The U.S.-Mexican Border into the 21st Century*, 2nd ed. (New York: Rowman & Littlefield, 2008); María García-Acevedo and Helen M. Ingram, “Conflict in the Borderlands: Report on Water,” *NACLA Report on the Americas* 38, no. 1 (July / August 2004): 19–41, <https://nacla.org/article/conflict-borderlands.1>

[22] Stephen R. Viña, *The United States–Mexico Dispute over the Waters of the Lower Rio Grande River* (Washington, DC: Congressional Research Service, 2005), [https://www.everycrsreport.com/files/20050321\\_RS22085\\_90ee6592ed31594967978e6d8af28409d5d13b16.pdf](https://www.everycrsreport.com/files/20050321_RS22085_90ee6592ed31594967978e6d8af28409d5d13b16.pdf); and Texas House of Representatives, 2002, “Mexico’s Water Debt: Behind the U.S.-Mexico Water Treaty Dispute,” House Research Organization 77-7 (April 30, 2002).

[23] Casey Walsh, “*Aguas Broncas*: The Regional Political Ecology of Water Conflict in the Mexico-U.S. Borderlands,” *Journal of Political Ecology* 11 (2004): 43–58.

[24] Imperial Irrigation District, <https://www.iid.com/water/water-transportation-system/colorado-river-facilities/all-american-canal>.

[25] Alfonso A. Cortez-Lara, Megan K. Donovan, and Scott Whiteford, “The All-American Canal Lining Dispute: An American Resolution over Mexican Groundwater Rights?” *Frontera Norte* 21, no. 41 (June 2009), [http://www.scielo.org.mx/scielo.php?script=sci\\_arttext&pid=S0187-73722009000100006](http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0187-73722009000100006).

[26] *Ibid*.

[27] Imperial Irrigation District, <https://www.iid.com/water/water-transportation-system/colorado-river-facilities/all-american-canal>.

[28] Cortez-Lara, Donovan, and Whiteford, “The All-American Canal,” [http://www.scielo.org.mx/scielo.php?script=sci\\_arttext&pid=S0187-73722009000100006](http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0187-73722009000100006); Carlos de la Parra Rentería, “The All-American Canal: An Issue of Contexts,” in *The U.S.-Mexican Border Environment: Lining the All-American Canal; Competition or Cooperation for Water in the U.S.-Mexican Border?* ed. V. Sánchez Munguía, SCERP Monograph Series 13 (San Diego: SDSU/SCERP/El Colef, 2006).

[29] U.S. Department of the Interior, “Salazar, Elvira Announce Water Agreement to Support Response to Mexicali Valley Earthquake,” December 20, 2010, <https://www.doi.gov/news/pressreleases/Salazar-Elvira-Announce-Water-Agreement-to-Support-Response-to-Mexicali-Valley-Earthquake>.

[30] Stephen P. Mumme, “Constructing Equity during the Salinity Crisis, 1961–1973: Mexico, the United States, and the Politics of Sharing on the Colorado River,” *Journal of the Southwest* 59, no. 1–2 (2017): 133–83, <https://doi.org/10.1353/jsw.2017.0009>.

[31] Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming.

- [32] The agreement addressed water, air, hazardous, and [solid waste](#) pollution prevention; contingency planning and emergency response; and cooperative enforcement and compliance. See “Agreement between the United States of America and Mexico Signed at La Paz, August 14, 1983” (Washington, DC: U.S. Government Printing Office).
- [33] Robert G. Varady, “The North American Free Trade Agreement (NAFTA) and Environment in the U.S.-Mexico Border Region,” *Encyclopedia of Environment and Society*, vol. 5, ed. P. Robbins (Thousand Oaks, CA: Sage Publications, 2009); Stephen P. Mumme and Kimberly Collins, “The La Paz Agreement 30 Years On,” *Journal of Environment & Development* 23, no. 3 (2014): 303–30.
- [34] International Boundary and Water Commission, “Colorado River Reconnects with the Sea following Historic Release of Water for the Environment,” May 16, 2014, [http://www.ibwc.gov/Files/Press\\_Release\\_051614.pdf](http://www.ibwc.gov/Files/Press_Release_051614.pdf).
- [35] Vicente Sánchez and Alfonso A. Cortez-Lara, “Minute 319 of the International Boundary and Water Commission between the U.S. and Mexico: Colorado River Binational Water Management Implications,” *International Journal of Water Resources Development* 31, no. 1 (2015): 17–27, <https://doi.org/10.1080/07900627.2014.922465>.
- [36] Karl Flessa, Eloise Kendy, and Karen Schlatter, eds., *Minute 319: Colorado River Limitrophe and Delta; Environmental Flows Monitoring*, interim report (El Paso: International Boundary and Water Commission, 2016), [https://www.ibwc.gov/Files/Minutes%20319/2016\\_EFM\\_InterimReport\\_Min319.pdf](https://www.ibwc.gov/Files/Minutes%20319/2016_EFM_InterimReport_Min319.pdf).
- [37] International Boundary and Water Commission: United States and Mexico, “Minute No. 323: Extension of Cooperative Measures and Adoption of a Binational Water Scarcity Contingency Plan in the Colorado River Basin,” September 21, 2017, <https://www.ibwc.gov/Files/Minutes/Min323.pdf>.
- [38] Wolf et al., “Managing Water Conflict.”
- [39] Andrea K. Gerlak, “Resistance and Reform: Transboundary Water Governance in the Colorado River Delta,” *Review of Policy Research* 32, no. 1 (2015): 100–23.
- [40] Madeleine J. Lewis, “Minute by Minute: An Assessment of the Environmental Flows Program for Restoration of the Colorado River Delta,” *Wyoming Law Review* 19, no. 1 (2019): 255, ft. 206.
- [41] *Ibid.*, 255.
- [42] *Ibid.*, 256.
- [43] Jennifer Pitt and Eloise Kendy, “Shaping the 2014 Colorado River Delta Pulse Flow: Rapid Environmental Flow Design for Ecological Outcomes and Scientific Learning,” *Ecological Engineering* 106, Part B (September 2017): 704–14, <https://doi.org/10.1016/j.ecoleng.2016.12.002>.
- [44] Some of the major environmental NGOs involved include the Sonoran Institute, Environmental Defense Fund, and ProNatura Noroeste.
- [45] Andrea K. Gerlak, “Regional Water Institutions and Participation in Water Governance: The Colorado River Delta as an Exception to the Rule?” *Journal of the Southwest* 59, no. 1–2 (2017): 184–203.
- [46] Lewis, “Minute by Minute,” 231–57.
- [47] Stephen P. Mumme, “Revising the 1944 Water Treaty: Reflections on the Rio Grande Drought Crises and Other Matters,” *Journal of the Southwest* 45, no. 4 (Winter 2003): 649–671.
- [48] Lewis, “Minute by Minute,” 234.
- [49] Quoted in Lewis, “Minute by Minute,” 239.
- [50] *Ibid.*, 237.
- [51] *Ibid.*

[52] P. C. D. Milly et al., "Stationarity Is Dead: Whither Water Management?" *Science* 319, no. 5863 (2008): 573–74, doi:10.1126/science.1151915.

[53] Ibid.

**Regions:** [Americas](#)

---

**Source URL:** <http://www.sciencediplomacy.org/article/2019/us-mexico-hydrodiplomacy-foundations-change-and-future-challenges>