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Collective action on the western range: coping with external and internal threats

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Abstract: Collaborative natural resource management institutions enable agents with diverse interests to come together to solve complex problems. These actors must overcome a series of collective action problems to create, maintain, and evolve these institutions. In addition to the challenge of heterogeneous actors, these commons social-ecological systems often face internal and external threats or disturbances. The institutional arrangements may be effective with problems that are internal to a social-ecological system – ones that they are designed to handle, but how do these arrangements cope with external disturbances, especially ones caused by large-scale political and economic decisions, events, and processes. Using ethnographic and archival data we conduct an institutional analysis outlining the existing and emerging collaboratives, the important actors, and ongoing efforts to cope with the five major challenges identified by rangeland actors. We trace the evolution of institutions on the western range with a focus on their ability to cope with challenges that are largely within the system – biodiversity, fire, and water management, and those that are driven externally by actors who are largely absent – border militarization and violence and exurbanization.

Keywords: Collaborative governance, collective action, disturbance, institutions, rangeland

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1. Introduction

> "Even when graziers recognized that there were too many cattle on the open range, they knew that reducing their herds would only invite others to increase theirs (Sheridan 2007, 125)."

Ranchers, government officials, and more recently environmentalists have struggled with the seemingly intractable problem of managing the range in the American West for over two centuries. In the late 1800s the institutional solution was closing up the range through government oversight and designated grazing allotments with specified stocking capacities. With shifting priorities, this early form of co-managed landscape has evolved to incorporate additional stakeholders and consideration of ecological issues, such as biodiversity loss, riparian restoration, and fire management. The struggle to bring together diverse interests to solve complex natural resource issues is a collective action problem where each individual may lack the incentive to contribute to the collective good. By building trust and common ground, collaboratives in southern Arizona have overcome the disincentives to cooperate on a commons that provides habitat for threatened and endangered species, location of numerous ecological hotspots, forage for cattle, and the landscape for an iconic rural lifestyle.

Complex and varied property rights are found throughout the West including portfolios of private parcels held in fee simple and allotments on Bureau of Land Management, United States Forest Service, and State Lands (Starrs 1998). Historically the western range was the site of conflict between homesteaders and ranchers and more recently environmentalists and ranchers. These conflicts represent different and sometimes competing interests over water use, land use, property rights and ownership, and environmental protection. These groups struggle to overcome complex problems such as water rights assignment (Libecap 1981a,b), water supply (Glennon 2009), preservation of biodiversity (Sayre 2005), and maintenance of ranching in the face of increasing exurbanization development pressure (White 2008). Until very recently, ranchers squared off with environmentalists and agency foresters and range conservationists (Starrs 1998; Sayre 2005; White 2008). But in the 1990s, groups of environmentalists and ranchers in isolated pockets throughout the west began to recognize common

ground, which allowed collaboration on issues of mutual concern, such as water, fire management, biodiversity, and open space protection (White 2008). In southeastern Arizona, the Malpai Borderlands Group was part of this revolution that was sparked by debate over fire management (Sayre 2005). Ranchers, The Nature Conservancy, and representatives from the United States Forest Service and Unites States Fish and Wildlife Service set aside differences and began to work on adaptive management strategies with formal and informal collaborative institutional arrangements. Scholars recognize the challenge of overcoming these types of collective action problems (Ostrom 1990), so how do we understand this ability to collaborate in volatile rangeland commons?

Collaborative natural resource management institutions enable diverse interests to come together to solve complex problems. These institutional arrangements may be effective with problems that are internal to a social-ecological system, but how do these arrangements cope with external disturbances, especially, external disturbances caused by large-scale political and economic decisions, events, and processes. As Anderies et al. (2004) point out, small homogenous groups managing social-ecological systems may be quite successful in coping with stable disturbances regimes that are largely internal to the system, but have difficulty coping with external disturbances. Janssen and Anderies (2007) demonstrate that long-enduring collective arrangements in social-ecological systems adapt over time to maintain system robustness in the face of these disturbances. However, even well-adapted systems may become vulnerable when confronted with new disturbances. In this case, a complex social-ecological system with heterogeneous actors, multiple interests and objectives, and several resources faces both internal disturbance, as well as emerging external disturbances that largely occur because of political and economic changes in the region and world. The purpose of this paper is to examine collaborative institutional arrangements on the rangeland of southeastern Arizona and explore the effectiveness of these institutions with regard to a set of complex internal and external challenges.

This undertaking has important implications for collaborative natural resource governance, and governance in general, such as the ability of institutions to cope with external change and disturbance. We also highlight the evolution of western range institutions from the period of the open range to today's co-management that incorporates ranch, government, and environmentalist concerns. The historical evolution helps us understand collaboratives' ability to deal with changing conditions and provides the context for existing institutional arrangements.

2. Extant literature

2.1. Collective action

Sometimes individuals' self-interested action results in suboptimal outcomes for society as a whole, otherwise known as collective action dilemmas. Olson (1965) posited that no one individual or group will cooperate to provide a common good unless there is a privileged group or hegemon willing to create the public good of a common set of institutional arrangements. However, empirical research has shown many examples of

cooperation without externally imposed rules (Ostrom 1990; Baland and Platteau 1996). Instead of Hobbes' ([1651] 1988) "war of all against all", groups of people self-organize into collaborative institutions to resolve collective action dilemmas. Studies show that at the local level of communities and households, groups of people self-organize to resolve social dilemmas without the external imposition of rules (Ostrom and Change 2002). In fact, locally crafted rules often outperform rules created at higher levels of government for several reasons, including attention to place-specific contexts, local monitoring and enforcement, and community support for the institutional arrangements (Ostrom 2008). Collaborative institutions increase levels of cooperation by building social capital (Marshall 2005) leading to more collective action, as individuals gain trust and experience reduced transaction costs (Lubell and Scholz 2001; Ostrom 2005). In contrast, some argue that a multiplicity of collaborative institutions in the same policy arena may reduce overall levels of collaboration (Lubell et al. 2010) because the ecology of games allows individuals to take hard line positions in one forum or foster animosity between institutions (Long 1958). This situation may be particularly problematic when actors are involved in parallel games, such as those we find in Arizona: maintenance of rural livelihoods, preservation of biodiversity, and improving watersheds and reducing water overdraft, as well as managing or slowing exurbanization and reducing border violence and impacts of border militarization.

2.2. The range as a commons

Throughout the world pastoral and ranching systems on grasslands persist and many of these systems can be described as a commons, or aspects of the resources provided by the system are common pool resources (Bromley and Feeny 1992). The western range social-ecological system provides many resources including forage, habitat, and open space (Robbins et al. 2009), as well as regional or global public goods, such as the landscape for the preservation of an iconic rural way of life (Brunson and Steel 1996). In the case of the southwestern range, a large portion of land held under federal control was *de jure* open range until the Taylor Grazing Act of 1934 (Libecap 1981a,b). As ranching moved west across the Great Plains, cattlemen could legally purchase land at $1.25 an acre or homestead up to 160 acres, but these legal means to obtain property title were cost prohibitive or too small to support a ranching operation (Dennen 1976); thus ranchers began to illegally enclose land (Libecap 1981a,b) and overgraze land (Dennen 1976) to protect their use rights. In order to reduce overgrazing and restrict entry, ranchers formed cattlemen's associations to formalize institutions. To reduce overstocking, the cattlemen's associations sometimes restricted stocking rates to a rancher's water rights with the punishment for overstocking being expelled from the cattlemen's association and the joint roundup; expulsion from the roundup significantly increased the costs and difficulty of running cattle on the range (Dennen 1976).

With growing concern about the state of public lands, beginning with the General Land Law Revision Act in 1891, the President could set aside public land under the General Land Office's administration for forest reserves (Hadley 2005).

A comprehensive grazing policy for these reserves was established in 1902 that restricted the number of animals, included federal oversight on management practices, and secured use rights to a particular ranch; cattlemen associations were actively involved in granting leases by determining prior usage of particular lands (Rowley 1985). The growing forest reserves covered a fraction of the public land held by the General Land Office resulting in overgrazing on most federal land until the Taylor Grazing Act established allotments of up to 10 years with a preference for local livestock operators and those with secure water rights (Libecap 1981a,b). The act led to formalized use rights, but also increased the scrutiny and political debate regarding appropriate usage of federal lands and federal oversight of individual ranchers' practices (Libecap 2007). With the growing strength of the conservation, sportsmen, and environmental movements over the last century, the rancher's management of the publicly held range came under increasingly public scrutiny that culminated in the 1990s with efforts to be "Cattle free by '93" (Starrs 1998) and environmental legal scholarship arguing that the use rights of ranchers can and should be eliminated (Donahue 1999). Sheridan (2007) points out that many ranchers consider their public land grazing rights to be prescriptive rights because these permits are bought and sold with the private ranch land, but the federal government instead views these as restricted rights with stocking rates that may be reduced or revoked, as has occurred in cases of drought. The conflicting definitions about "ownership" of allotment rights further exacerbate the relationships between the ranchers, government, and the public. Surprisingly, in the context of these ongoing conflicts, ranchers and environmentalists have partnered with the federal and state agencies to co-manage the rangeland in many communities throughout the west (White 2008).

3. Methods

In 2009–2010, we conducted 98 semi-structured interviews with 78 individuals and conducted participant observation in Cochise County, Arizona. We selected prominent landowners, leaders of collaborative organizations, nongovernmental natural resource or environmental organizations, agency personnel involved in collaborations, and local government officials. Participant observation provides an opportunity to gather data on more subtle themes and nuances and to gain rapport within the local community (Bernard 2006). Establishing high levels of trust with community members is particularly important given the political volatility in the region. In addition to joining ranchers, land use managers and border patrol agents in their typical work environments, we attended public meetings and events in 2010 and conducted participant observation with individual ranchers, agency field officers, and NGO representatives'; activities included riding with ranchers on their property, watching agency consultations with landowners, helping with basic maintenance of buildings, and observation of board meetings and local public hearings.

Managers craft institutions – rules, norms, and shared strategies (Ostrom 2005) – when creating and changing collaboratives – these collaboratives attempt to solve a diverse array of natural resource management issues (Wondolleck and

Yaffee 2000). Prior work has demonstrated the importance of institutions in shaping the incentives for natural resource managers (York et al. 2006; Schoon 2008) and their ability to work across jurisdictional or property ownership boundaries (Schoon and York 2011). Using an institutional analysis approach, we identify the relevant actors, issues, and collaborative institutions (Ostrom 2005); we focus on how these institutions and the natural resource managers respond to internal and external disturbances to the social-ecological system (Ostrom 2009).

4. Background

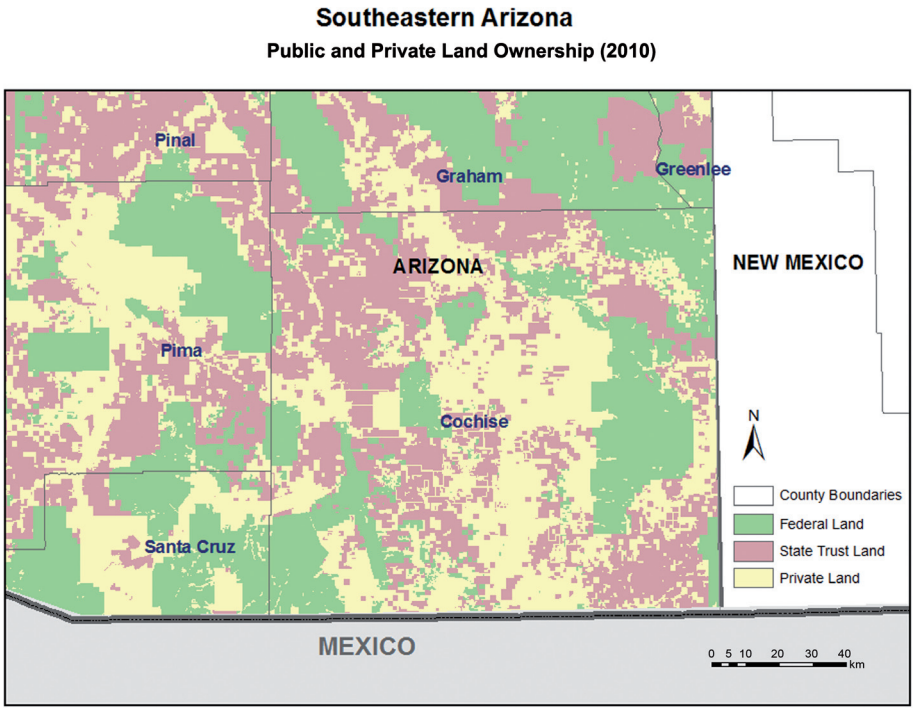
Spanish ranchers began running cattle in what is now Arizona in the 1700s with the epicenter being in the Santa Cruz Valley in modern Santa Cruz County, adjacent to Cochise County. Frequent Apache raids largely prevented movement out of the valley (Sheridan 1995). After Mexican independence, the Mexican government granted numerous land grants along the San Pedro Valley in what is now Cochise County, but Apache attacks resulted in abandonment of many of these grants (Sheridan 1995). In the late 1800s, following the forced removal of the Chiricahua Apaches (Hayes 1999), Anglo settlers moved into the eastern portion of the county supplying the growing demands of the federal government for beef. The federal government increased its military presence in the southern portion of the Arizona territory dealing with ongoing raids from the San Carlos Apaches, who were still roaming through the region (Hayes 1999). With the Desert Land Act of 1877 these ranchers could patent up to 640 acres through homesteading and ranchers concentrated these patents around creeks, springs, and cienegas, wetlands in the desert, throughout Cochise County. As the range filled up ranchers began to create institutions governing access to the range, principally those with water rights controlled the rangeland (Sheridan 1995). During the cattle boom of the 1880s, with the influx of capital and cattle spurred by speculation and completion of the Southern Pacific Railroad, cattlemen began to recognize the degradation of the range due to overstocking. Two Cochise County cattlemen's associations, the Tres Alamos Association and the Tombstone Stock Growers Association concluded that the range was beyond capacity without more water or grass, in 1885 and 1886, respectively (Sheridan 1995). Because of insecure rights, most cattlemen refused to reduce stocking resulting in between 50% and 75% of cattle dying during a period of drought (Sheridan 1995). Through the 1890s and into the early 1900s drought followed by heavy El Niño rains led to denuded hillsides, top soils washing away, and deep arroyos (Tellman and Hadley 2006).

The backdrop of ecological and economic disaster on the open range furthered the calls for public administration of grazing land throughout the west. In 1902 forest reserves were established in Cochise County that were consolidated in 1917 under management by the Coronado National Forest (Bahre 1991). As described earlier, the Forest Service limited grazing on forest reserves, but overgrazing on other federal lands continued until the Taylor

Grazing Act of 1934 (Bahre 1991). Unlike other areas of the west (Libecap 1981a,b), most of Cochise County remained unfenced into the 1930s with the public lands being the center of overstocking on the open range (Bahre 1991). In 1917, an early range inspector noted that there were 191,000 cattle, 28,000 goats, and 11,800 sheep in the county, while today there are less than 60,000 cattle and very few sheep or goats (Tellman and Hadley 2006). The degradation of the Cochise County range was so extreme that David Griffiths, an early range conservationist, noted that "things are far different in Southern Arizona. Here unused pastures are rare, cultivated fields are fewer in number, and the destruction is so complete" (Griffiths 1901, 9). Griffiths (1901) goes on to explain that the particular ecology coupled with mismanagement led to one of the worst cases of range degradation in the American West.

Cochise County is a mix of Chihuahuan Desertscrub, semi-desert and plains grassland, evergreen woodland, and Ponderosa Pine and Mixed-Conifer Forest (Bahre 1991). Much of the grassland is now a mix of grass-shrubland that most likely resulted from woody encroachment following the cattle boom's overgrazing (Bahre 1991). The local ecology was also altered through efforts by the early Anglo settlers and the General Land Office to suppress wildfires (Bahre 1991). The overgrazing resulted in arroyos cutting through the riparian areas changing stream flow and water infiltration (Bahre 1991; Hadley 2005). Recently the jaguar, *Panthera onca*, has been spotted after an absence of almost half a century (Brown and Gonzalez 2000). Predators like the elusive jaguar, and more commonly wolves and coyotes, were targets of extermination campaigns by ranchers and the government agencies (Rowley 1985; Donahue 1999). Cochise County is part of an ecological hotspot, the Sky Islands (Spector 2002) that is home to over half the bird species found in North America (Felger and Wilson 1994) and the greatest diversity of mammals north of Mexico (Warshall 1995). Quite simply, it is an important region ecologically with a diversity of habitats and species with the challenge of recovering from an extreme case of range mismanagement in the late 1800s.

Within this historical and ecological context natural resource managers established more than twenty formal collaborations and numerous informal arrangements across a checkerboard of public and private ownership (Map 1). Such forms of collaboration are increasing throughout the western USA (Wondolleck and Yaffee 2000; White 2008). Managers traditionally deal with these problems on their own, but as one Arizona forester indicated to us during an interview, "fires don't read parcel maps." We characterize these problems as largely internal to the social-ecological system, although extremely complex. Do rangeland collaboratives continue to manage complex environmental issues such as biodiversity, fire management, and water management in the face of these pressing external disturbances? How do collaboratives cope with other emerging external threats, such as militarization along the US-Mexico border and increasing urbanization?



Map 1: Land ownership in Southeastern Arizona.

4.1. Actors

Today, many public agencies, including the United States Forest Service, Bureau Land Management, State Land Department, State Parks Department, Department of Defense, the National Park Service, and United States Fish and Wildlife Service manage vast stretches of land throughout Cochise County. Private landowners lease some of the public land for grazing and farming and own parcels interspersed with public lands. Nongovernmental Organizations like The Nature Conservancy and Audubon Society directly manage conservation lands, and both also collaborate on projects with private and public land managers. Some groups, such as the Malpai Borderlands Group, do not manage land directly, rather members come together to discuss and coordinate management issues, such as fire management and biodiversity conservation. The Natural Resource Conservation Service aids farmers and ranchers in their conservation plans-focusing on water conservation, best management practices, and restoration of the range. Associated with Natural Resource Conservation Service are the Natural Resource Conservation Districts, government units governed by cooperating landowners who determine priority issues within a district. The Natural Resource Conservation Service and Natural Resource Conservation Districts are an important collaboration between private

landowners and federal policy and management programs, such as the United States Department of Agriculture's cost-share program, Environmental Quality Incentives Program.

The following organizations are actively involved in environmental, water, and land management collaborations in Cochise County (see Table 1):

Several organizations and public agencies in Mexico are also involved in collaborations that cross the international border, in particular the NGOs Biodiversidad y Desarrollo Armónico and Naturalia.

5. Collective action on the range

Ranchers are actively involved in collaborative natural resource governance institutions, most notably the Malpai Borderlands Group, but also ranch-level agreements, such as Safe Harbor Agreements for endangered cactus, fish, and amphibians. These collaborative institutions are linked together creating a complex, multi-level governance network with ties between government and private actors, public and private land, and across biota, water, and fire that span management boundaries. These collaborations grow out of the historic context of southeastern Arizona and the particular rangeland institutions that govern land management.

Within the county, well established and well studied collaborative groups and projects include the Malpai Borderlands Group and the Upper San Pedro Partnership. The Huachuca Firescape is one of a handful of newer partnerships that is growing rapidly. Other proposed projects include the Gila-Yaqui Corridor that would bring together landowners and agencies in Sonora and Arizona. Some projects are much smaller in area and scope, involving one or two landowners, an NGO, or a public agency, i.e. riparian restoration projects or Safe Harbor Agreements. Here are some of the existing, emerging, or proposed projects and

Table 1: Organizations in collaborative governance in Cochise County

Federal Government Agencies	**State Government Agencies**
United States Forest Service	Arizona Parks Department
Bureau of Land Management	Arizona Game and Fish
Department of Defense	Arizona Land Department
Natural Resource Conservation Service	**Non-Governmental Organizations**
United States Fish and Wildlife Service	Malpai Borderlands Group
United States National Park Service	The Nature Conservancy
United States Geological Society	Sky Island Alliance
Bureau of Reclamation	Audubon Society
Department of Homeland Security/Border Patrol	Cuenca Los Ojos
Local Government Agencies	Community Watershed Alliance
City of Benson Government	Cascabel Hermitage Association
City of Bisbee Government	International Pollinators Association
City of Sierra Vista Government	Defenders of Wildlife
Cochise County Government	

collaborations identified by land managers that involve multiple land managers and organizations (Table 2):

All of these collaborative institutions affect ranching either directly or indirectly. The Chiricahua Firescape includes ranchers surrounding the Chiricahua Mountains. They participate in fire planning with foresters and range conservation officers from the US Forest Service, park biologists from National Park Service, and officers with the State Land Department. The Northern Jaguar Project includes several ranchers who are interested in protecting open space and maintaining wildlife corridors essential for the elusive and rare jaguar. The Gila-Yaqui Partnership is currently in planning stages, but is led by ranchers who are concerned about riparian restoration. Based on our discussions with managers several major challenges repeatedly emerged, which the collaboratives directly address: fire, competing water demands and the need for riparian restoration, and threats to biodiversity.

5.1. Fire

Southeastern Arizona has some of the highest incidences of lightening fires in the country (Bahre 1991); the fire ecology has changed significantly in the region since the 1880s (Barton 1999). Now the intensity and extent of fires is quite different than before the cattle boom; as Budd (2002) writes "fed by years of suppression, fire is a furious storm that takes all in its path (119)." Cooperation surrounding fire has a long history in Cochise County and much of the west, although the relatively recent shift toward managed burns was initially controversial and fraught with conflict. Historically the emphasis was on cooperative fire suppression and it was federal policy to purposely overgraze under timber stands to create fire breaks (Rowley 1985; Bahre 1991), but over the past few decades, ranchers, agencies, and environmentalists have come to appreciate the regenerative importance of fire to the ecological system (Sheridan 2007). There are three formal collaborative projects that work on fire management issues in Cochise County – the Malpai Borderlands Group, the Huachuca Firescape Plan, and the Chiricahua Firescape Plan.

Malpai Borderlands Group involves federal, state, NGOs, and private ranchers in developing burn plans for southeastern Cochise County and southwestern Hidalgo County, New Mexico. The impetus for the creation of the Malpai organization began over conflict surrounding fire management between ranchers and public officials in the 1990s (Sayre 2005). In 1991 a fire started in

Table 2: Collaborative environmental governance groups

Upper San Pedro Partnership	Upper San Pedro Water District
Middle San Pedro Partnership/Community Watershed Alliance	Gila-Yaqui Partnership
Huachuca Firescape	Malpai Borderlands Group
Chiricahua Firescape	Northern Jaguar Project
Wildlands Network Conservation Plan	Arizona Partners for Fish and Wildlife
Cascabel Working Group	International Pollinators Initiative

the far southeastern corner of Cochise County; the rancher had recently cleared the parcel of brush and was confident that the fire was not a threat to any human developments, so he requested that the blaze be allowed to burn naturally to maintain the newly reestablished grassland (Sayre 2005). Because of federal policy the Forest Service refused to allow the fire to burn and suppressed it, which created a maelstrom in the local ranching community resulting in heated exchanges at local public hearings over outdated fire suppression policies. Through the efforts of a local rancher with ties to the environmental community, the local community came together first in an informal group and then formally as a nonprofit organization. Their collective efforts resulted in changes to the federal fire policies, as well as changing the borders of the local district for the Natural Resource Conservation Service to better serve the Malpai Borderlands Group whose territory includes rangeland in New Mexico and Arizona. These changes enabled the land managers to pursue fire management planning across the entire region and sparked collective action on biodiversity and water issues. According to a forester with Forest Service the Malpai Borderlands Group fire plan revolutionized fire management in the region creating a new approach incorporating multiple stakeholders and management objectives in a single, flexible document.

Over the past few years western Cochise County has borrowed ideas from the Malpai Borderlands Group in the Huachuca Firescape Plan. This group is a newer collaboration with agreements between a smaller number of larger landholders including Audubon, The Nature Conservancy, Forest Service, National Park Service, and Fort Huachuca, a military base in western Cochise County. Building upon the Huachuca Firescape and the Malpai Borderlands Group, the Chiricahua Firescape Plan brings together Bureau of Land Management, Forest Service, National Park Service, State Land, and private ranchers in the Chiricahua Mountains in eastern Cochise County. Both of these firescapes include prescribed burns, as well as strategies for controlled burns that begin naturally. The efforts to bridge environmental and ranching goals have become more difficult with the increased exurbanization that reduces managers' ability to conduct prescribed burns that would improve the ecosystem because of the increased threat to private property in these newly developed rural areas.

5.2. Water

In Cochise County, access to water historically was a development constraint. Settlement largely centered on rivers such as the San Pedro until technology allowed construction of deep agricultural and domestic wells. Prior to the invention and widespread use of the centrifugal pump in the 1870s (Wood et al. 2005), ranching was largely limited to riparian areas (Sheridan 1995). Water rights were linked to informal stocking rights on the open range, with monitoring by the local cattlemen's associations (Wagoner 1952), although this effort was not effective (Griffiths 1901). These existing use rights were used to establish

initial allotments by the Forest Service and the Bureau of Land Management in the region. The scarcity of water and its role in the local ecology have long been recognized, but in the past half century there has been increased recognition of the direct connection between surface and groundwater, particularly the impact of groundwater pumping on stream flow. County rivers continue to provide irrigation water, as well as vital habitat for wildlife. The San Pedro is an important ecological hotspot serving as a major thoroughfare for numerous migratory bird species. It is also home to the endangered Huachuca Water Umbel, which resulted in great controversy and then collaboration, through the Upper San Pedro Partnership, to reduce groundwater overdraft and maintain in-stream flows. The Upper San Pedro Partnership brings together a diverse group of private and public entities, at all levels of government, to manage the river and help maintain adequate water levels. The Upper San Pedro Partnership also has cooperative water monitoring agreements with Mexican NGOs and government agencies. The efforts on the San Pedro directly affect ranching in adjacent Santa Cruz County – numerous, critical easements were purchased on the famous Babacomari Ranch just west of the Huachucas to protect the region from further residential development and groundwater pumping and improve instream flows on the Babacomari River, a tributary of the San Pedro. Although the Upper San Pedro Partnership is an important collaborative group in the county, perhaps the largest and most diverse group, it is not the only collaborative working on water issues. In Benson, several efforts are underway to form a similar alliance to manage the Middle San Pedro led by the Community Watershed Alliance. Ranchers are integral members of this new effort on the Middle San Pedro concerned with riparian restoration and improvement of the range ecosystem, as well as reducing exurbanization and the increasing demand for rural residential groundwater pumping.

A large effort is also underway to create an international partnership to manage the Gila-Yaqui watershed including landowners, ranchers, NGOs, and government agencies (particularly Mexican federal environmental agencies), although institutional arrangements have not yet been formalized. On a smaller scale, there are numerous collaborative efforts to restore streambeds and riparian areas throughout the county. Cuenca Los Ojos, an organization led by ranchers, is the most committed and active group that works on riparian restoration as a means to protect the environment and improve the range for cattle. In these water collaboratives, some individuals expressed frustration with government involvement, either mandates such as those associated with the San Pedro, or inflexibility of state regulatory agencies when landowners attempt to restore riparian areas, whereas, others want stronger government involvement, particularly regarding domestic well construction. There is no single collaborative solution for water management in Cochise County; rather managers have created a diverse array of collaborations to deal with different aspects of the issues from riparian restoration that directly improves range conditions and groundwater recharge to efforts to decrease groundwater pumping and improve instream flows. Given the reliance of ranching on groundwater for stock tanks and riparian restoration for

improved stream flows and range conditions, ranchers are actively involved in leading many of these initiatives throughout the county.

5.3. Threats to biodiversity

The ecological hotspots found throughout Cochise County create numerous opportunities and challenges for area natural resource managers. Historically ranchers focused on eradicating predators, but now managers attempt to maintain habitat for wildlife and access to water, even once despised predators. Safe Harbor agreements for endangered frogs, bats, fish, and plants bring together state and federal agencies on particular landowners' property. In historically unusual fashion, several ranchers not only sought agreements on their properties, but also made the United States Fish and Wildlife Service aware of the existence of endangered and threatened species on their properties. The most likely explanation for this behavior is the sense of trust developed through other collaborative projects. Audubon Society and The Nature Conservancy are also involved in numerous biodiversity efforts on private property owned by the NGOs or individual landowners. Some of the larger collaboratives, such as Malpai Borderlands Group and the Upper San Pedro Partnership, also include biodiversity goals and projects within their activities. The Northern Jaguar Project works to maintain habitat for the jaguar on public and private land, as well as to provide education to the community. United States Fish and Wildlife Service partners with NGOs and private landholders to protect the Chiricahua leopard frog, Sonoran tiger salamander, and other endangered species.

The Sky Island Alliance through the Wildlands Network Project has proposed extensive wildlife corridors overlaying public and private lands in an effort to establish priorities for agencies and communities, as well as areas to target biodiversity projects. The rich biodiversity of the region is well recognized by all managers, yet there are disagreements about the most successful means to reduce threats to the biodiversity. Some private landowners are concerned about projects that may restrict their ability to maintain livelihoods, given past perceptions of United States Fish and Wildlife Service endangered species habitat requirements. While a minority perspective, NGOs are concerned about the effectiveness of cooperative agreements on private lands. Regardless of these differences in viewpoints, all managers are concerned about loss of biodiversity, especially as it interfaced with exurbanization and fragmentation of habitat.

Within the ranching community, there are mixed views about biodiversity protection, particularly the potential restrictions associated with the Endangered Species Act, yet numerous ranchers have become involved and even led collaborative efforts to protect biodiversity. For some a belief about protecting the wildness of the western range and all its biota, even in the face of losses from predators or restrictions from the government, was central to their perspective as stewards of the land. Other ranchers were skeptical of the motivations of environmental organizations involved in biodiversity protection, although the long-term commitment of mainstream

groups, such as The Nature Conservancy, and building trust with the United States Fish and Wildlife Service field officers has increased willingness of many ranchers to enter biodiversity collaborative institutions. Additionally numerous federal and state grants or cost-share programs prioritize projects that incorporate biodiversity goals, such as stock tanks that provide water for endangered, threatened, or game species. One rancher showed us a tank that was partially funded by Department of Agriculture monies that supports deer in addition to cattle, while walking by the water we found the skeletal remains of wildlife with evidence of a mountain lion attack. The rancher was proud of her efforts to protect biodiversity and the environment in ways that maintained her family's ranch. When asked about her concern about predation of cattle, she indicated that these events are rare and federal funds that support ranching and the environment reduces the burden on individual families.

Whether the ranchers are leading efforts, participating, or affected by the outcomes, their role as stewards and mangers of vast tracts of land was recognized by everyone we spoke with. Beginning in the last few decades, ranchers have created and joined collaborative institutions that strive to deal with fire, water, and biodiversity. Most managers, agencies, environmentalists, and ranchers, recognize the multiple resources provided by the range. Over the past two decades these individuals have overcome almost two centuries of conflict to solve collective action problems. Their efforts maintain the range, but now these individuals and organizations encounter two new challenges that are largely external-exurbanization and the border, but have large, local impacts on the social-ecological system.

6. External threats

6.1. Exurbanization

One of the chief threats identified by respondents was exurbanization and associated land fragmentation. The concern about fragmentation of the range is not new. In the late 1800s, frequent conflicts erupted between ranchers and homesteaders, "nesters," who carved up the range; many of the nesters attempted dry-farming using a new approach to planting developed in the Great Plains (Benton-Cohen 2009). Most of these homesteaders failed and much of the land was acquired by ranchers, or returned to the public domain (Sheridan 1995). It is on many of the old homesteads, whether those of nesters or original ranch homesteads, that much of the exurbanization is occurring in Cochise County. This increasing exurbanization has caused concern regarding fragmentation of habitat, breaking up the range, increased water demand with more domestic wells, and increased traffic on county roads.

Fragmentation and exurbanization are also shifting the social fabric of the county. In Cochise County, like most rural areas in the USA, collaboration was a part of life; you worked with neighbors to provide public services, construct roads, maintain schools, and manage responses to natural events such as flooding and fire. Informal neighborliness continues, although exurbanites moving into rural western landscapes have different

priorities and sense of what being a good neighbor entails, i.e. not allowing cattle to get on to their "lawn." Numerous respondents, especially local officials, were frustrated by ranchette owners who purchase 20 acres in remote locations and then expect city services. Through lobbying, or becoming the "squeaky wheel," these landowners obtain services like road improvements with the cost borne either by the entire jurisdiction or imposed on the neighboring landowners.

Exurbanization also leads to increased water demand, fragmentation of wildlife habitat, and loss of farm and rangeland (Curtin et al. 2002). Exurbanization on former ranch and farmland is difficult to address, particularly as farmers and ranchers face narrow profit margins, while land values for development are high. Additionally, the next generation of farmers and ranchers frequently cannot afford to purchase a farm or ranch because of land prices based on development potential. Because of the economic downturn exurbanization has slowed, but it remains a concern in the county. Conservation easements are one of the tools used to reduce exurbanization, and numerous groups hold easements in Cochise County. Malpai Borderlands Group and The Nature Conservancy have worked to establish priority areas for reduction of fragmentation and range loss seeking funds to establish easements on vulnerable lands. Easements are not the only institutions used to deal with exurbanization; we learned about two other efforts in northwestern Cochise. Individuals came together to lobby against a road improvement project near Cascabel and subdivision development near Benson. These groups attempted to manage exurbanization through access, in the case of the Cascabel road, and directly through denial of subdivision and home construction permits near Benson. Near the base of the Chiricahuas one of the first ranch families, the Riggs family, continues to hold a large spread of beautiful, and increasingly valuable land. Over the past few years the Riggs have been talking with the Cochise County Planning Department about creating an overlay district that would restrict development over much of the historic property, but enable clustered development near the Chiricahua National Monument. So far the discussion has not led to the creation of any new institutions, but this effort represents a new type of co-management in the county. Exurbanization is a difficult issue without a simple solution because of demand for ranchettes for retirees, commuters to regional cities, vacation homes and the narrow margins for agriculture in the region (Travis 2007), yet in Cochise County most mangers expressed concern about fragmentation and a desire to maintain open spaces, wildlife habitat, and preserve traditional livelihoods. They also expressed concern that exurbanization is something their grassroots efforts within the local system might not be able to solve.

6.2. Borderlands challenge

The border presents another problem that managers felt was overwhelming and one that they largely could not control. These managers' lives, livelihoods, and family histories are intimately interwoven with the region as a borderlands. This historic relationship began to change in the 1990s when the Clinton administration militarized urban areas to shift migration traffic to

rural areas (Nevins 2002). The basic concept was immigration would slow once immigrants faced the harsh desert high country of Arizona and New Mexico, but migratory traffic maintained pre-militarization levels and may have even increased. As a result, the number of deaths in the desert began to sky rocket (Doty 2009). Migration has always been a part of life in the region, but the increased migration through rural Cochise County and the associated militarization causes ecological damage on the fragile range. Many of the rangeland collaboratives have received federal monies, especially through the Bureau of Land Management, to pick up trash along migration trails, although thankful for some assistance in cleaning up the range, most managers expressed frustration over the futility of the efforts. With a growing concern over security on the border, George W. Bush's administration waived environmental policies, known as the Chertoff Waiver, to enable the expedient construction of a border road and wall/fence resulting in ecological damage without environmental impact assessments (Sayre and Knight 2010), as well as decreased trust between the federal management agencies and the Border Patrol. The Department of Homeland Security has provided some money to the Forest Service for brush clearance; in doing so Border Patrol increases their ability to monitor the borderlands and Forest Service is able to meet some of their fire management objectives, yet most of these projects are fairly small and monies are only available for parcels with strategic security objectives.

Federal security and militarization efforts and increased migration are not the only border issues on the Cochise County range. In recent years, Mexican gangs and cartels have increased their control over human immigration corridors coupling this with their drug smuggling efforts. The violence on the Mexican side of the border has threatened to spill over into the US causing distress and concern among all managers. Most relevant to the local ranching community was the murder of rancher Robert Krentz in April 2010 that many suspect was a result of Krentz happening across the path of a smuggler (Steller 2010); this violence led to President Obama sending in the National Guard (Kelly 2010). This tragic death has led to increased concern about smuggling violence coupled with concern about the ecological costs of the militarization, as well as frustration about the inability of the federal government to reduce the threat of violence on the rural range.

7. Overcoming collective action problems on the range

Collective action within the local social-ecological system cannot solve the challenging issues of exurbanization and the border in the same ways as fire, water, and biodiversity protection. These external threats to the local system are more difficult to solve even among small groups of homogenous resource users (Anderies et al. 2004). In this study, a hetereogenous group of natural resource managers works diligently to maintain collective action on the internal threats, but express frustration over the futility of working on these external disturbances at the local level.

The actors involved in these collaboratives recognize a complex and interconnected world. In order to internalize some of the costs and benefits, as well as incorporate diverse interests, many of the collaboratives cast a wide net including ranchers, environmentalists, and public and private actors. These efforts have enabled the collaboratives to directly address many complex issues such as biodiversity, fire, and water, yet they have struggled to address the border concerns and exurbanization. Part of this difficulty is associated with the externality of most decisions, such as the federal government's decisions about militarization and fence building, and the large-scale processes that lead to human migration, drug trafficking, and settlement decisions in the rural west. Ranchers and United States Fish and Wildlife Service field officers have attempted to affect federal decisions about the border through Congressional testimony, but most thought their local knowledge fell on deaf ears. Over the past few years, ranchers, environmentalists, and government officials expressed concern with increased traffic over ecologically sensitive landscapes, the increased militarization of border patrol and backlash from smuggler cartels, a fragile sense of community for local residents, and tense relationships between governmental agencies, environmental organizations, and community members over border policy. So far, the rangeland collaboratives have not been able to solve or mitigate the impacts of the border on the range, although efforts such as resource sharing for brush clearance may pave the way for increased collaboration between Border Patrol and other federal agencies in the future.

On perhaps a somewhat smaller scale than the international border crisis, the local community also struggles to cope with exurbanization. The county could regulate land use to reduce exurbanization to some extent, but the state of Arizona allows landowners to subdivide large rural lots over thirty-six acres without local government approval; these subdivided parcels may by subdivided several times over resulting in a highly fragmented rural landscape. Many of the collaborative actors were troubled by the state and county policies on rural subdivision, although some were also concerned that a change in policy would reduce the value of land. We were unaware of any activity by the collaboratives to lobby to change these policies. As Travis (2007) has illustrated, southeastern Arizona is facing the same exurbanization trend as much of the rural American west. Americans are attracted to the rural mystique and desire to own a "ranchette." Collaboratives cannot alter these shifting preferences, but through conservation easements on the most fragile and vulnerable properties these groups are attempting to limit the impact of land fragmentation on the range.

Large scale, external processes such as climate change are affecting what we have termed internal challenges with forecasts of reduced precipitation, increased temperatures, and shifts of the desert ecology throughout the Sky Islands region (Archer and Predick 2008). Although some managers recognize changing weather patterns, they typically did not focus on climate change when asked about ongoing challenges. Some ranchers in the region may be more vulnerable to these climate changes because of more limited access to capital and government resources (Vásquez-León et al. 2003) and like their predecessors on the open range these

individuals may overgraze because of this vulnerability. But most of the large-scale commercial ranchers in the area are working with scientists, environmentalists, and agencies to manage their herds in a sustainable manner to cope with drought and changing rainfall patterns and some are even beginning to talk about preparations for climate change. The institutions incorporate biodiversity, fire, and water management goals, but small-scale collaborations will not be able to adequately with the impacts of shifting ecologies. We anticipate that climate change will emerge as an important external challenge in the eyes of the managers in the years to come, but at this point it is not central to their collaborative activities.

Armitage (2005) argues community-based resource management strategies are better able to withstand change or disturbance because adaptive capacity is created in part through self-organization and flexibility of many local institutional arrangements. In this study, we illustrate how co-management through collaborative institutions is better able to cope with disturbances that are internal to system. Rangeland managers attempt to deal with aspects of the border and exurbanization, but believe that their efforts are futile compared to the large-scale decision-making and economic processes occurring outside the local system. But with internal disturbances extremely divergent interest groups, ranchers, agencies, and environmentalists, are able to overcome a collective action problem and develop a plethora of collaborative institutions. In the cases with well-established relationships and trust, ties have strengthened during this period of increased stress. In contrast, relationships between diverse interests that are newly established seem to be more tenuous in the face of the crisis.

8. Conclusion

Land, environmental, and water managers have created an impressive range of collaborations to deal with important natural resource management issues in Cochise County. Range issues and ranchers are central to these collaborative activities. Although we met managers with diverse backgrounds, missions, and resources, we found a remarkable degree of agreement surrounding definition of "the problems" in the county and a remarkable capacity for collaboration across the commons regardless of property ownership. In order to understand the responses of the governance network of a rangeland commons to external threats, we need to systematically gather data about the actors and structure of the network. Our future work will build upon this institutional analysis using social network analysis to explore how the adaptive capacity of a social-ecological system is partially dependent on the underlying social relationships and the social network structure, particularly leadership, information flow through a network, and trust.

Exploring the diverse and unique collaborations of Cochise County helps us understand how to overcome collective action problems to solve pressing social and ecological problems. Rangeland collaboration on natural resource management issues will surely persist in the face of the border crisis, yet it is clear that ongoing militarization, smuggling, and migration may alter the institutional arrangements and the ability of ranchers, environmentalists, and government agencies to collectively

act. The community also struggles to deal with the ongoing issue of exurbanization and land fragmentation; in contrast to the border, there are more attempts to collectively act through purchase of conservation easements, establishment of overlay conservation districts, and lobbying for denial of subdivision applications or road improvements, but many of the drivers and institutions remain external to the system. It is this tension between internal and external disturbances that communities throughout the world face when attempting to manage commons; they struggle to collectively act in the face of climate change, globalization, and migration, processes that are largely external to local social-ecological systems, while maintaining collective action that copes with internal disturbances.

On the western range, natural resource managers come together in several issue arenas: water, fire, and threats to biodiversity, but managers recognize that collective action is costly and difficult in communities and organizations with diverse interests, missions, and mandates. In order to solve many pressing natural resource management concerns at a scale broader than any single land manager, cross-border solutions and collaborative management arrangements are required. Society has struggled to understand when and why people work together when the costs and risks of collaboration are high, while rewards may not come for generations. Yet even in the cauldron of western lands issues, we find government officials, private land owners, and environmental and conservation groups that collectively act, pushing aside aspects of their agendas to manage the range.

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