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Enabling sustainable pastoral landscapes: building social capital to restore natural capital

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Abstract. Sustaining pastoral landscapes is distinguished from stewardship of most other landscapes by the often far-reaching mobility of the large herbivores that have evolved with them. The scale of rangeland use is set by the cultural and animal adaptations needed for rangeland landscapes, and today, the connections needed for supplementary support of animals, households, communities, and government. The extent and inherent need for flexibility in pastoral systems clashes with the increasingly fragmented landscapes and hardening borders of today's world. Rangelands and pastoralism generally exist at the ecological, political, and economic margins, constrained by more profitable land uses on better lands. Regardless of their location, pastoral peoples and rangelands face growing political, economic, and climatic stresses that challenge their coupled resilience and ability to adapt. Focusing on the United States, in this paper I discuss at the landscape level key enablers for continued rangeland livestock production and the ecosystem services it provides, concluding with a discussion of how two grassroots groups in the United States have developed to help grazing communities have used innovation to maintain access to rangelands. Key enablers include having large grazing areas and connections among grazing areas needed at different times of year, a year round affordable forage and feed supply; tenure security; proximity or transportation to markets, processors, and employment; recognition and exploitation of the multi-functionality of rangelands; a "critical mass" of livestock producers in the area; and participation and leadership from a livestock-rearing community working and communicating across existing social, political, and physical boundaries.

Keywords. Rangelands – Grassroots groups – Mobility – Social-ecological systems – Pastoralism.

Favoriser la durabilité des paysages pastoraux : construction de capital social pour restaurer le capital naturel

Résumé. *Le maintien des paysages pastoraux se différencie de la gestion de la plupart des autres paysages par la mobilité, souvent sur de longues distances, des grands herbivores qui ont évolué avec eux. L'échelle d'utilisation des terres de parcours dépend des adaptations culturelles et animales nécessaires aux paysages de parcours, et de nos jours, des liaisons requises pour les besoins supplémentaires des animaux, des ménages, des communautés et par rapport au gouvernement. L'étendue et la nécessité inhérente de flexibilité dans les systèmes pastoraux se heurte à des paysages de plus en plus fragmentés et aux frontières plus strictes du monde d'aujourd'hui. Les parcours et le pastoralisme existent généralement de façon marginale dans le domaine écologique, politique, et économique, étant évincés par des utilisations plus profitables sur de meilleures terres. Où qu'ils se trouvent, les pastoralistes et les parcours affrontent des difficultés politiques, économiques et climatiques croissantes, qui mettent à l'épreuve à la fois leur résilience et leur aptitude à s'adapter. Concernant les États-Unis, dans cet article j'examine au niveau du paysage les éléments-clés favorables à la continuation de la production animale sur parcours et les services écosystémiques qui en découlent, pour conclure en examinant comment deux groupes locaux aux États-Unis se sont développés pour aider les communautés des pâturages, en utilisant l'innovation pour maintenir l'accès aux parcours. Parmi les éléments-clés favorables se trouvent le fait d'avoir de grandes surfaces de pâturages et des connexions entre les zones de pâturage nécessaires à différents moments de l'année, un approvisionnement en fourrage et concentré disponible sur toute l'année ; la sécurité de la tenure des terres ; la proximité ou le transport aux marchés, aux transformateurs, et à l'emploi ; la reconnaissance et l'exploitation de la multifonctionnalité des parcours ; une "masse critique" de producteurs de bétail dans la zone ; et la participation et le leadership d'une communauté d'éleveurs travaillant et communiquant à travers les frontières sociales, politiques, et physiques existantes.*

Mots-clés. *Parcours – Groupes locaux – Mobilité – Systèmes socio-écologiques – Pastoralisme.*

I – Introduction

Sustaining pastoral landscapes is distinguished from stewardship of most other landscapes by the often far-reaching mobility of the large herbivores that have evolved with them. The scale of rangeland use is set by the cultural and animal adaptations needed for rangeland landscapes, and today, the connections needed for supplementary support of animals, households, communities, and government. The extent and inherent flexibility of pastoral systems clashes with the increasingly fragmented landscapes and hardening borders of today's world.

The name, "rangeland" implies a land for ranging. For millions of years, the dependence of herbivores on rangelands for sustenance has meant the ability to move, sometimes over vast distances and across biomes, between elevations, to water, and away from drought or extreme cold. Pastoral societies, in turn, interact with social and political forces at multiple scales, including the costs of pasture access, the availablity of employment in local communities, urban and crop expansion into rangelands, and livestock prices worldwide.

Pastoralism and pastoralists have been defined many ways (Huntsinger *et al*., 2010). Globally, rangelands and pastoralism generally exist at the ecological, political, and economic margins, constrained by more profitable land uses on better lands (Sayre *et al*., 2013). Regardless of their location, pastoral peoples and rangelands face growing political, economic, and climatic stresses that challenge their coupled resilience and ability to adapt (Reid *et al*., 2014). For the purposes of sustaining pastoral landscapes, there is considerable overlap between the needs of modernized, market-driven livestock production and traditional, subsistence pastoralism. Here we use the term pastoralist loosely to mean people with a mode of life centered on livestock rearing on rangelands.

Based on a meta-analysis of stated preference studies on European agrarian landscapes, Van Zanten *et al.* (2014) concluded that landscape attributes that include livestock presence, a mosaic of land cover, or historic buildings generally receive the highest stated preferences across 345 studies in diverse European landscapes. Unique cultures may be rooted in interactions with livestock and rangelands. Ecologically, because cultural practices and the behavior of grazing animals have created and maintained many rangelands, landscape conservation may be linked to continued grazing or cultural activities. Biodiversity may be enhanced by grazing, and domesticates can be used to manipulate habitat and enhance ecosystem service at the behest of the manager (Huntsinger and Oviedo, 2014). Depending on the particular circumstances, herbivory can create moderate disturbance that stimulates diversity (Perevolotsky and Seligman, 1998); helps to control invasive species (Germano *et al*, 2012), and prevents or reduces conversion to woody vegetation (McBride and Heady, 1968; Rowntree, 1994; Johnson and Cushman, 2007). On the other hand, again depending on circumstances, large herbivore grazing can reduce biodiversity through changes in vegetation composition and structure, increase erosion through trampling and reduction of ground cover, facilitate woody plant invasion, and reduce habitat and food for other fauna. Pastoral landscape stewardship at the landscape level is about managing the spatial configuration of resources to make possible environmentally positive outcomes for rangelands and the people using them.

Rangeland fragmentation and loss of access may be the most serious problem facing the world's pastoralists. This includes fragmented landownerships, vegetation types, travel corridors, support networks, and infrastructure. Rangelands in the United States today are a mosaic of ownerships. Privately held croplands and pastures may be interspersed with government rangelands, forests, and residential developments. Herds need connectivity between different topographies and vegetation types, and pastoralists need connections to markets, employment, government, and other pastoralists. The constellation of land types and facilities that support rangeland production must be considered and often linked if pastoralism is to continue on rangelands.

Focusing on the United States, in this paper I discuss key enablers for continued rangeland livestock production and the ecosystem services it provides, concluding with a discussion of how two

grassroots groups in the United States have developed to help grazing communities overcome some of their problems in order to maintain access to the rangelands they need. Key enablers include having enough and the right types of grazing lands, providing a year round affordable forage and feed supply; tenure security; access to markets, processors, and employment; recognition and exploitation of the multi-functionality of rangelands; a "critical mass" of livestock producers in the area; and government recognition and appropriate policy. In the end, however, the real "key enablers" must be the pastoralists themselves.

II – Large areas to graze: the imperative of mobility

Among mammals, the most characteristic evolutionary adaptation to rangeland is the ability to use rangeland plants of low and even hostile nutritional quality. Large grazers, including ruminants such as cows, sheep, caribou, deer, yaks, and other herbivores like horses and camels, have evolutionary adaptations that enable them to flourish on a low protein diet, one that is often loaded with silica, indigestible fiber, and toxins. Rangeland herbivore adaptations include the ability to digest a lot of fiber, including cellulose, the ability to run swiftly and travel long distances, digestive systems that can defuse many toxins, and teeth that can stand up to silica and a life of eating tough plants. Migration, or mobility of various sorts, is an adaptation by large grazers to an environment where nutrient sources are spread over a large area and may differ in quality by species or locality, and where forage production is heterogeneous in time and space. Movement may be regular and seasonal, or may be opportunist to escape drought or cold, or to find the best forage at any given time within a particular set of conditions.

Beginning around 13,000 years ago, as the domestication of large herbivores began, people used them to make use of lands where, by and large, cultivation was impractical. Juliet Clutton-Brock, who has written extensively on domestication and pastoralism, refers to domesticated grazers as a "walking larder" (1989), food "on the hoof." By domesticating and herding, humans earned an assured supply of meat, dairy foods, skins, and numerous other goods, produced by livestock from low-protein and widely dispersed vegetation that is mostly indigestible and sometimes toxic to humans. Livestock are able and eager to move around and find the food they need for themselves on landscapes where food and water is, per unit area, scarce. A fundamental aspect of herding cultures, then, has always been facilitating the ability of the animals to express their great capacity for mobility and using unarable land. As a result, livestock herding peoples have developed cultural traditions and practices that support and facilitate the mobility of grazing animals over the large areas of land they need to acquire sufficient sustenance (Fernandez and LeFebre, 2006). For modern ranchers, this means having access to rangelands for as much of the year as possible, because they are generally the least costly source of food for the animals.

There is a complex web of social relations and institutions that have enabled cultures to adapt to mobility and highly variable rangeland productivity, and U.S. pastoralists are no exception (Ellickson 1986; Ellis 2003). "Reciprocity," a common characteristic of pastoral societies, facilitates shared responsibility for widely dispersed livestock, and in the U.S., neighbor trusts neighbor to return wandering animals (Ellickson, 1986). Traditions for sharing forage resources, as well as labor and equipment, are often present within a ranching community (Bennett, 1968).

Landscape stewardship for rangelands, whether they are used for livestock production or not, must be rooted in an understanding of the need for mobility, and along with it, contiguity and extent. Mobility of grazing animals means that they must be able to get from one place to another, often to use multiple types of vegetation occurring at different elevations. For stewardship of rangelands, this means assessing the different types of rangelands available for grazing, and the corridors and connections among them. The ability of the people and cultures rearing livestock on rangelands to manage and facilitate mobility is crucial. This may mean access to distant pastures, use of mo-

torized vehicles, or ability to hire workers with the needed skills. For domestic animals, this can also include sustitutes for mobility such as harvested forages and feeds, which may increase monetary and environmental costs, but which can also be mutually beneficial. Livestock can consume by-products and provide fertilizing manure.

As an example of an integrated landscape of croplands and rangelands, the nineteenth century community land grants of the Mexican government in New Mexico, USA, included small private parcels near water sources titled to individual households for growing crops, while the surrounding much larger areas of rangeland were held in community ownership, facilitating animal mobility, labor savings, and forms of transhumance. In another example, Alpine farmers often keep their stock in a barn or in privately held paddocks for much of the winter, consuming meadow hay, feeds, and crop residue until they are sent up to mountain meadows to graze community-owned or municipal summer pasture. The forms of ownership were made null when the United States government acquired the southwest.

III – Tenure security and fragmentation

Tenure security is often weak when it comes to the rangelands used by pastoralists. The scale of pastoralism rarely conforms to political, ownership, and land use boundaries, and there is strong competition from alterative uses. Because of mobility, and the semi-natural appearance of grazing lands, the land can look unoccupied. As returns from grazing are not high per unit area, a broad array of competing land uses impinge on rangelands globally. Crop production, mining, urbanization, and recreation successfully annex rangelands. Pastoralists lose range to grazing exclusion for recreation, tree-planting, and environmental or wildlife protection. Protection of predators or feral grazers like wild horses can reduce the utility of rangelands for pastoralism. Yet security of access to large grazing areas, and key resources like water, are needed by pastoralists (Fernandez-Gimenez and Le Febre, 2006).

Traditional herding peoples have generally managed a significant part of their rangeland resources as a commons with community management, or in an open access condition where animal numbers are limited by periodic droughts, winters of exceptional cold, or other factors (Fernandez-Gimenez and Le Febre, 2006). Grazing animals together and sharing rangelands maximizes the amount of land and the diversity of habitats, elevations, water sources and so on available to each animal. Sharing a large landscape also makes it more likely that livestock can access different types of vegetation in different seasons, including transhumance from mountain meadows in summer to lowland grasslands in winter. In North America, pre-U.S. hispanic institutions and nineteenth century emerging institutions for grazing management were cut short by the inability of local communities, in part restrained by governmental stricture, to control massive speculative introductions of stock onto the unsettled public domain of the western U.S. late in the century (Nelson, 1995). The result, due to the consequences of an open-access condition, was transfer of most arid and montane public domain rangeland to the government for management.

Today, 50% of the land area of the 11 western states is in federal ownership, with grazing and other uses largely controlled by land management agencies (Huntsinger and Starrs, 2006). A livestock producer on U.S. rangelands may summer on montane lands managed by the United States Forest Service, winter on desert lands managed by the Bureau of Land Management, and spend the times in between on privately owned irrigated pasture, crop stubble, or meadow land near the house (Fig. 1). Hay or other feed is used when forage is not available, sometimes grown on the small but comparatively well-watered private property of the ranch. Private lands may also be rented. A significant problem for transhumance is the loss of trailing routes to highways and urban sprawl. In a recent survey of ranchers in California, those practicing transhumance were significantly more likely than other nearby ranchers to be affected by vegetation change on government land, largely due to fire suppression, and conversion of private land (Huntsinger *et al*., 2010). To create a landscape that offers the security of tenure ideal for sustainable rangeland stewardship, coordination among multiple forms of ownership and governance may be required.

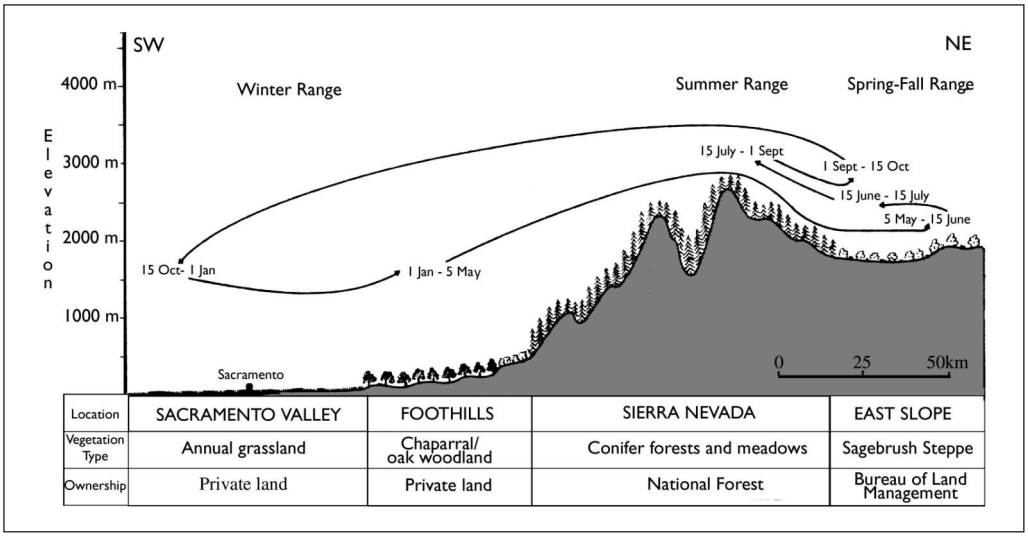

Fig. 1. In transhumance, livestock travel among vegetation types, topographies, and land ownerships in California's western Sierra Nevada (adapted from Rinshede, 1984).

1. Maintaining critical mass

Veterinary services, packing facilities, and local markets rely on what has been termed a "critical mass" of livestock producers (Hart, 1991; Liffmann, 2000). Once that is lost, the loss of infrastructure, neighbors, and rangelands augments the departure of rangeland producers, and in scenic or peri-metropolitan areas, increases land conversion (Fig. 2). A socio-ecological feedback loop has been described for private ranches in the United States (Huntsinger, 2009). When one ranch is developed and converted, the overall rangeland available to livestock husbandry gets smaller, as does the local labor pool, the size and political influence of the grazing community, and the support for markets, feed stores, veterinary services, and slaughterhouses. The urban-agricultural "edge" expands, leading to greater conflicts between agricultural practices and new, amenity-seeking residents, and potentially increasing the land price of the remaining ranches. These pressures increase the probability that more ranches will sell.

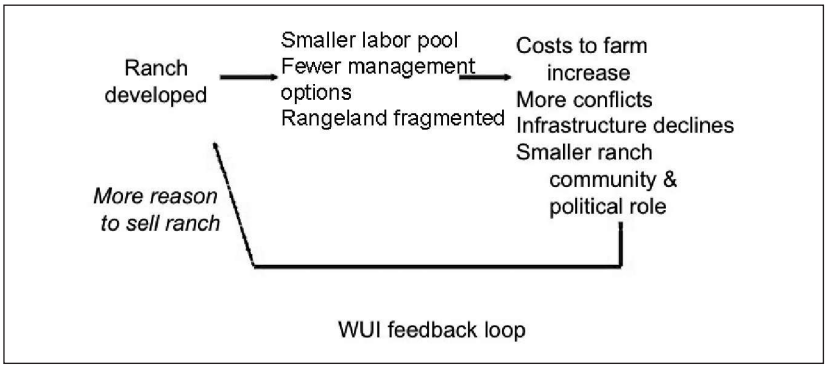

Fig. 2. The loss of one ranch to urbanization feeds back to the community in a way that leads to more losses of ranches (adapted from Huntsinger, 2009).

2. Recognition of multi-functionality

Recognition that alternative land uses can take place concurrently with livestock production, and can even at times be synergistic with other uses, can help increase the rangelands available for grazing. A wide number of species depend on and make use of rangelands, some benefiting from livestock grazing (Huntsinger and Oviedo, 2014). Hunting, trekking, camping, birdwatching, mushroom and herb collection, firewood and wood production, some or all of these things typically occur on grazed rangelands. Species important to crop pollination may find refugia on nearby rangelands (Chaplin-Kramer *et al*., 2011). Rangelands are often scenically attractive and culturally resonant.

Because livestock production from rangelands is generally not enough to support ranchers, there is considerable interest in finding ways to gain income from non-livestock uses, yet payments for ecosystem services programs are rare in the United States. Even though many were unfamiliar with the specific term ‘‘ecosystem services,’’ more than two-thirds of ranchers surveyed in California were receptive to the idea of being rewarded monetarily ‘‘to improve the quantity and/or quality of environmental benefits that their land provides to society” (Cheatum *et al*., 2011). The length of time they would have to commit to an activity, and the size of the payment, were important factors in rancher willingness to participate in such ecosystem services production programs, with ranchers preferring shorter contracts and higher payments. Who would offer the payments was also important to prospective sellers, with non-profit organizations or private firms strongly preferred over governmental agencies (Cheatum *et al*., 2011). Perhaps because self-motivation and education still remain the primary motivators for more conservation-minded behaviors (de Snoo *et al*., 2013), U.S. ranchers making such changes usually have strong ideas about why they chose to make changes, and why they are important.

Forestry may conflict with grazing, or provide opportunities. Livestock and other large herbivores may graze the understory of orchards, savannas, woodlands, and even forests, as well as forest meadows and clearings as part of “agroforestry,” or more specifically, “silvo-pastoralism.”The interactions between large herbivores, forest growth, and fire are complex and depend on site environmental conditions, the pattern of grazing, the species of grazer, and the relative palatability of forest species. By reducing fuels livestock grazing can reduce the severity of fires, acting as a substitute and more selective alternative to natural fire regimes or prescribed burning (Tsiouvaras *et al*., 1989; Blackmore and Vitousek, 2000). In U.S. pine plantations livestock grazing has been found a cost-effective way of controlling understory vegetation (Allen and Bartolome, 1989). Coordination and communication between herders and foresters is needed. However, despite calls for policy reform in U.S. forest management, including the use of deliberate burning to reduce fuels (North *et al*., 2015), there remains a strong predjudice against the use of livestock grazing for forest management in the United States.

Tree planting has become one of the most well-publicized methods of combating climate change. This has led to the planting of trees in grasslands and meadows, often to the detriment of biodiversity (Veldman *et al*., 2015), and evidently often without benefit for carbon sequestration (Naudts *et al*., 2016). Planting more open forests that still provide forage for grazing animals and consist of more deciduous and broad leaved vegetation may help. In the United States, huge fires have left a blank slate for forest regrowth, and there is deep concern among many of us that they will be restored at densities that facilitate re-burning, especially given warming conditions. Livestock should be part of mediating regrowth to create clumped and less dense patterns of tree growth that resist fire. Particularly in climates with dry seasons and fires, rangeland soils may be the most secure way to store carbon for the long run (Booker *et al*., 2013). Payments for the ecosystem service of carbon sequestration are sought by rangeland owners in the U.S., but so far opportunities have been minor, in part because of the difficulties and costs of demonstrating additionality.

IV – Proximity to employment and markets

To create a sustainable pastoral landscape, proximity and access to towns and cities, and the markets and employment they provide, is important and becoming more so.

The large areas of rangelands needed to support livestock, low productivity per unit area, and competition from modern agriculture, including the use of crops to feed livestock, means that in the developed world and even in many less developed countries, to achieve a reasonable standard of living as a participant in the market economy, livestock rearing households need additional income streams, beyond that from their stock. In the western United States, study after study has confirmed that significant income for ranching households comes from non-livestock sources including wage labor, and that rangeland real estate prices are not justified by their production value. As early as 1969, Smith and Martin (1972) found that ranchers in Arizona depended on outside income, and that local towns were part of their support network by providing wage jobs and business opportunities. The largest ranch in the United States, the King Ranch in Texas, hosts numerous industries designed to supplement their livestock production income, including marketing branded trucks and hosting paying hunters. U.S. ranches also enjoy tax reductions and other financial benefits from the federal and state government. In California only 25% of livestock producers earned most of the income from livestock in 2005 (Huntsinger and Bartolome, 2014).

V – Governance and the grassroots

As we have seen, stewardship for rangelands that intends to foster rangeland cultures, protect rangeland wildlife, and assure healthy vegetation and environment must consider diverse ecosystems and their drivers, agricultural practices, forage and feed sources, land uses, individual and community tenure and governance systems, sources of employment and relationships with proximate land uses, and the spatial or social arrangements among them. Because of their changing and semi-natural character, and the ways that ecological, economic, and social change are deeply interwoven, they can be characterized as co-evolving social-ecological systems (Olsson *et al*. 2004; Liu, 2007). It is also important to consider vertical scale. For rangeland landscapes, politics, climate change and the global economy are obvious drivers from higher levels. At lower levels, whether or not herbivory is well-managed in a pasture, the individual decisions of landowners and their heirs, and even the economic well-being of livestock producing families will have feed back to the capacity for landscape stewardship (Huntsinger and Oviedo, 2014).

Ranchers often consider themselves to have a distinct culture from those engaged in other forms of agriculture, or than the dominant culture, and feel that understanding of rangelands and their imperatives is weak. The most innovative efforts at “collaborative and adaptive approaches” for landscape stewardship these days seem to be evolving from rangeland livestock producers themselves, in what ironically are termed “grassroots” efforts. Grassroots stewardship may be conceived of as community governance that arises organically in response to complex and shifting demands from society and the ecosystem. In the United States, grassroots alliances of ranchers have emerged to protect access to rangelands (Huntsinger *et al*., 2014). Contrasting two different organizations in two different regions, and the innovations they have made, provides insight into how each alliance reflects their unique political and ecological landscape.

1. Malpai Borderlands Group (http://www.malpaiborderlandsgroup.org)

The Malpai Borderlands Group (MBG) is a self organized group of Arizona ranchers that began collaborating to facilitate controlled, deliberate burning of their brush-invaded rangelands. Ownership of the semi-arid rangelands in the area is 59% private, 18% federal, and 23% state (Arizona and New Mexico). Ranchers may need to use lands in all of these ownerships as they seek to ful-

fill their annual forage needs. The group developed connections to state and federal representatives of the land management agencies that control much of the grazing lands in their geographic locale, including some 800,000 acres of relatively unfragmented rangelands in southeastern Arizona and southwestern New Mexico (http://www.malpaiborderlandsgroup.org/). They worked with the agencies to create a first of its kind coordinated, trans-ownership burn plan to help fire-fighters to allow some areas to burn safely on interdigitated private and government lands.

Eventually the group also became concerned about the growing demand for residential real estate parcels that was driving the fragmentation of private rangelands and conflicts on government range. The group's goals grew to include resisting rangeland fragmentation by using "conservation easements," a legal tool that restricts development rights on private land by changing the property title. Conservation easements are established voluntarily between a conservation organization or government agency and a landowner. To motivate participating ranchers to set up conservation easements, access additional grazing land during drought was provided to those with an easement. These became known as «grassbanks», another example of conservation innovation by the group (Gripne, 2005; White and Conley, 2007). For the MBG, it is a nearby ranch and wildlife reserve, owned by an NGO, that is only grazed when needed.

A third important innovation by the group is that conservation easements can be voided if federal or state grazing leases are lost by the rancher, because this would most likely make the ranch no longer economically viable. The enables a rancher to sell the land for development after all. As local land management agencies also find fragmentation and urban sprawl to be a problem for management and fire control, and large undeveloped ranches create a buffer between protected government lands and urban sprawl (Sulak and Huntsinger, 2007; Talbert *et al*., 2007), the group now has a point of leverage in negotiation over possible changes in grazing policy.

2. California Rangeland Conservation Coalition (http://carangeland.org)

The statewide grassroots California Rangeland Conservation Coalition (CRCC) is more of community of interest than of a specific geographic locale. In California the challenges ranchers face in accessing rangelands are shaped by a different land tenure configuration and a higher level of fragmentation. They manage a complex portfolio of owned and leased lands, leasing from government agencies, but also from private landowners who have retired from ranching, own land for investment, or own land for non-ranching purposes. Land trusts, utilities, and municipalities also lease grazing land. A rancher in the Sierran foothills, for example, reported use of 14 different leases (Sulak and Huntsinger, 2007), while another told us in 2012 that he had 33 small leases scattered throughout his local area, some grazed by only small groups of cattle (Huntsinger and Bartolome, 2014). Competition for leases is fierce, and it is not uncommon for ranchers to submit bids for leases that require a substantial commitment to stewarding and improving the range. Leasing from owners of such diverse interests can be overwhelming. In addition, there is great public scrutiny of rangelands, as rangelands often are interspersed with urban and suburban development. And with more land lost to development in this high-value area, ranchers are more reliant on lands that are not privately owned. The Coalition helps them negotiate and communicate with those who control the rangeland.

After a history of polarization over the impacts of livestock grazing, the innovative California Rangeland Conservation Coalition began in 2005, leveraging the notion that much habitat would be lost, as frustrated ranchers sold out to developers, if the ranching and environmental communities did not work together. In this region, livestock can be important to conservation of a variety of endangered species (Huntsinger and Oviedo, 2014). An important goal for the Coalition is to inform the public, environmental consultants, managers, and agencies that ranching is not only a preferred land use compared to development, but also is an essential resource management tool and can be used to benefit wildlife. They produced the unprecedented "Rangeland Resolution" signed by over 100 agricultural organizations,

environmental groups, and state and federal agencies. New signatories continue to sign on. The signatories have pledged to work together to preserve and enhance California's rangeland for species of special concern, while supporting the long-term viability of the ranching industry.

The CRCC is closely linked to and had a role in creating an innovative land trust, the California Rangeland Trust, run by ranchers themselves (http://www.rangelandtrust.org/). They partner with ranchers willing to establish a conservation easement. The group worked with an NGO to create an innovative, collaborative map of what they believe are the most important targets for establishing conservation easements within their scope of coverage in California (Huntsinger *et al*., 2013). To help preserve access to rangelands, the CRCC also promotes and supports research on the environmental benefits of grazing, and holds workshops and an annual summit each year.

VI – Conclusions

Rangeland stewardship calls for adaptive governance at diverse environmental and ecological scales. While top down governance and development programs have only had limited success, there is evidence that in the complex rangeland context, bottom up processes characterised by collaboration and communication with other stakeholders and NGOs have been more effective and innovative in finding ways to adapt pastoralism to a changing context.

Pastoralists are united in their need for extensive rangeland that is often threatened by land conversion and alternate uses, in their ability to cope forage production that is highly variable in space and time, and in the importance of access to markets and supplementary income and feed sources. Yet each ranching household has a unique configuration of available resources and constraints, depending on the types of land they have access to and who owns it, the amount of family labor available, the condition of the resources they use, their sources of outside income and capital, their relations and shared culture with other pastoralists, and so forth. Given this complexity, innovative institutional arrangements that facilitate new forms of mobility, help to retain rangeland, and connect pastoralists to larger scale processes are needed. In our grassroots examples, NGOs played important roles in facilitating rancher organization and acquisition of resources, and helping them communcate with the public and government. U.S. advisory and outreach organizations, such as University Agricultural Extension services and the Natural Resources Conservation Service, also helped groups to communicate with scientists, the public, and government representatives, and to learn the scientific reasons behind desired practices. In both cases, the groups wound up supporting research to share the impacts of their good stewardship, and to learn how to improve stewardship. By working together as a group, ranchers developed negotiating power with the government regulators and agencies that influence their range use, and benefited such agencies by providing a conduit to communication with large numbers of ranchers.

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