Applying Ostrom's Social-Ecological Framework to manage user conflicts around public grazeland management

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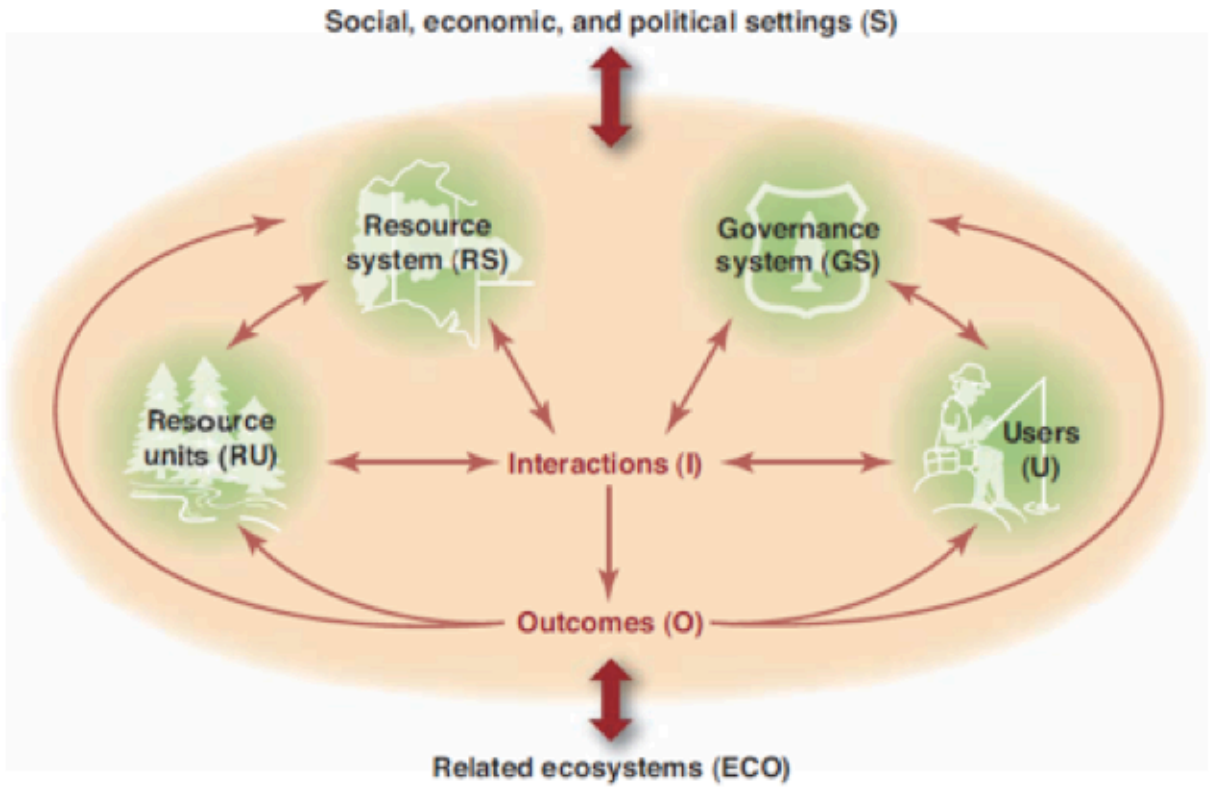


Fig. 1. The core subsystems in a framework for analyzing social-ecological systems.

Abstract

Of Idaho's total land mass, approximately 68% is publicly owned – over 35 million acres – and about 48% is used for grazing (Roselle et al., 2009). Multiple users, organizations and governing bodies must interact to make decisions about land use and conservation. Because of the importance of agriculture, recreation and tourism to Idaho's economy, mitigating user conflicts of interest is critical for successful public lands management. To address this concern, we use Ostrom's framework (Table 1) to analyze existing interactions and processes, and highlight the gaps in communication and knowledge between the users (U), governance system (GS), resource systems (RS) and units (RU). This analysis can provide insights for improvement

and ways to incorporate multiple perspectives to develop comprehensive public land management practices in the future.

Introduction

Agriculture is culturally important and economically valuable to Idaho. In 2012, agriculture generated 20% of Idaho's total economic output, or $25.1 billion dollars in sales. Of this, $4 billion was contributed by livestock and dairy production (University of Idaho, 2014). Livestock is raised on both public and private land. Today, livestock grazes on more than 220,000 acres of private land, and over 11,500,000 acres of public land. In Idaho, BLM-managed lands alone generated $416 million in 2016 from grazing - the highest economic output of all BLM states (BLM, 2018). Blaine county, has experienced a 16% decrease in farm operations from 1997-2012 (USDA 2012). This is due, in part, to an increase in growth and development in recent years (Hubbard 2017). As one of the fastest growing cities in the US, Boise has felt significant development pressure in recent years. The 3.1% population growth in 2017 (Sharf 2018) has created opportunities as well as cultural shifts and pressures on the natural landscape around the capital. As the population increases, development is expected to continue to grow and increase pressures on agricultural land to convert to profitable development (Hubbard 2017). Behind agriculture and technology, tourism is Idaho's third largest industry (Runyan 2015). More people are taking advantage of the recreational opportunities Idaho has to offer and moving to or simply traveling for recreation in the area to bike, kayak, hunt and fish. World-class recreation exists at the heart of the grazelands Idaho ranches depend on. For example, Sun Valley, ID is an upscale resort town catered to skiing and snowboarding, with a significant proportion of real estate dedicated to vacation and second homes with a surrounding landscape of grazeland. Here, a unique landscape mosaic made of private ranchland, natural areas, growing urban sprawl and public lands makes the balancing act between local communities' values, tourism attraction and rancher needs a challenging one. Currently, there is an abundance of research on grazeland ecology, yet very little covers the interaction of users taking place on those grazelands. We attempt to highlight such knowledge gap with careful analysis of the interactions and communication streams between users and governance systems.

Methods

To perform our analysis, we contacted several individuals that represented different aspects of the system to better understand the needs of the public grazeland system as well as current perspectives. In order to gain more knowledge of these systems we completed research using government documents, university published literature and scientific literature. We conducted

phone interviews with Kathleen Bean of Lava Lake Ranch, Jenny Gonyer of Salmon Valley Stewardship as well as Bray Beltran of the Heart of the Rockies Initiative. We also facilitated a discussion with a Boise State University Environmental Ethics (PHIL 327) class taught by Brian Ertz, a environmental lawyer who has worked with environmental groups such as Sierra Club to bring lawsuits against government agencies in Idaho.

Results: System Components

For each system component, we highlighted the most central aspects to need to be considered for understanding the contentious issue of public land used for multiple purposes.

Resource System

The resource system is the grazing allotment. The productivity of this system is directly affected by grazing. Grazing leads to resource depletion and from resource depletion the resource system can either continue to be grazed or it can begin the re-growth process. If there is enough palatable vegetation the system will be productive and continue to provide sustenance for the livestock. However, if the livestock stay in one area for too long that area may see a decline in the palatable vegetation. Overgrazing is a primary contributor to desertification because it converts a productive arable piece of land into unproductive land (Causes Effects and Solutions of Overgrazing, 2016). The loss of productivity directly results in the loss of food available for consumption (Causes Effects and Solutions of Overgrazing, 2016). In this ecosystem overgrazing can cause a loss of vegetation which leads to soil erosion in that area (Causes Effects and Solutions of Overgrazing, 2016). Grazing allotments are systems that are constantly changing and undergoing changes such as grazing and re-growth. Like all ecosystems grazing allotments have an equilibrium at which they thrive. The equilibrium ensures a balanced ecosystem and without balance the ecosystem may fail.

Resource Unit

The resource unit is palatable vegetation within grazing allotments. The amount of available palatable vegetation has an effect on the value of the Animal Unit Month (AUM). The AUM is an indicator of how much vegetation is required for one animal unit to graze for one month (Animal Unit, 2018). If there is a high amount of palatable vegetation then the AUM's value is higher, likewise if there are a lot of weeds or non-palatable vegetation then the AUM's value will be lower. The presence of non-palatable vegetation decreases the amount of palatable vegetation that is available decreasing the nutrient availability within the grazing allotment. Non-palatable vegetation such as Lupin is toxic to cows and if consumed will have negative health impacts.

Livestock have a negative interaction with palatable vegetation due to grazing. Once grazed the palatable vegetation has an opportunity to undergo regrowth. Weeds and other non-palatable vegetation compete with palatable vegetation during re-growth. The re-growth of grazed plants requires energy from sunlight and the use of stored reserves (University of Idaho, p.41). In grasses energy reserves are stored in above ground stems, while for tap rooted legumes energy reserves are stored primarily below ground (University of Idaho, p.41). Pasture re-growth rates depend on the season, with peak productivity occurring in late spring to early summer (University of Idaho, p.41). Nutrients in the soil need to be absorbed equally otherwise some plants will outlive others.

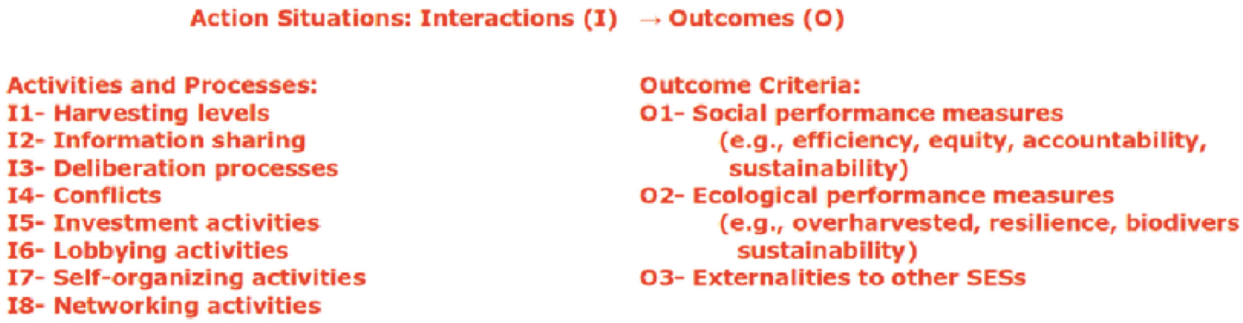
Governance System

Ranches partner with Natural Resources Conservation Service, U.S. Fish and Wildlife Service and the Idaho Department of Fish and Game to implement good grazing practices and wildlife management on their land holdings. These partnerships also operate within the jurisdiction of agencies such as BLM, USFS, NPS and Idaho Department of Lands (IDL, 2018), which also make decisions about land use in Idaho. Many conservation organizations collaborate to manage large landscapes of public and private land. For example, the Idaho Coalition of Land Trusts is a group of 19 land trusts and two local and state government programs to conserve land throughout the state of Idaho.The group also works to collectively achieve policy and communication goals (Idaho Coalition of Land Trusts, 2017). There have also been instances of conflict between governing agencies and conservation organizations. In 2015, a conservation group called the Western Watersheds Project filed a lawsuit contending that governing bodies did not act appropriately to protect the grazeland from degradation (O1, O2) (AP, 2016). The lawsuit was eventually dismissed, but such conflicts may sour public perception of grazing on public lands (I4) which can impact the livelihood of ranchers (O1). Regional cooperative and associations play a big role in bringing different user groups together. For example, the Idaho Cattle Association, Eastern Idaho Grazing Association, Owyhee Cattlemen's Association, Idaho Wildlife Federation and Idaho Water Users Association are just a few of the pertinent associations that work in the state.

Users

Grazeland provides resources for much of the ecosystem and the economy in the Treasure Valley. There are many direct and indirect users of this resource, and the most obvious would be the ranchers themselves. The livestock provides livelihood to the ranchers, including meat and fiber that are consumed locally and shipped to consumers around the country. Other users

include hundreds of thousands of recreationists that fish, hunt, hike and bike on grazeland annually. In 2016, over 6 million visitors used BLM lands for recreation in Idaho. BLM administered over 26,000 permits and passes in the same year (BLM, 2016). Because of the co-mingling of public and private land, many ranchers and landowners voluntarily allow recreation on their land. However, there have been recent instances where new residents have closed property boundaries to recreationists, sparking tension (Barker, 2017). Development has also changed the landscape to users, particularly as farmers have been forced to sell land. For example, over the course of ten years, Ada County lost 36% of the total farm acreage and a 13% agricultural operations loss (Hubbard, 2017). These changes will inevitably impact public land use and quality. The abundance of users in this system makes it particularly contentious and important. From the ranchers using the grazeland to supply forage to their livestock, to hikers using the region for recreational experiences, many users enjoy the grazeland for very different reasons.



Results: Interactions

Ostrom's framework contains eight interaction variables (I) (Table 2). Incorporating the different components Ostrom's framework may generate insights about interactions, gaps and potential outcomes for Idaho's public grazelands. From the perspective of users, there are many interactions that are critical in Idaho's public grazelands. Harvesting (I1), information sharing (I2) and conflicts (I4) are all contributing factors to the maintenance of 'working lands' and conservation of natural resources. Interactions between the Resource Unit and ranchers is very common. All users: land managers, ranchers and recreationalists 'harvest' (consume resources) palatable grazeland and share information about this resource. Both the BLM (part of the Governance System) and ranchers interact with the Resource System. As a result conflicts about management techniques and use inevitably occur. Our analysis highlights first, how governance systems and social systems can change how users interact with the resource

system and second, how users impact the resources and resource system. To see the complete interactions between the systems refer to appendix item A.

External Interaction on the Resource System

With a warming climate, (O3) vegetation begins to grow earlier in the spring. Earlier growth can actually lead to less total plant growth (A Warmer, 2018). This may be due to increased transpiration and the demand for water, as a result the soil moisture content is decreased which results in insufficient water availability for plants later in the year (A Warmer, 2018). This is not beneficial for the resource system as there would be less vegetation growth and therefore be able to support fewer livestock. A warming climate has a negative effect on the resource system.

Resource System & Resource Unit Interaction

When the resource system has grazing occur this leads to a depletion of the resource's availability. If the resource system is overgrazed then the productivity of the grazing allotment will decrease (Causes Effects and Solutions of Overgrazing, 2016). With a lower productivity the value of the AUM within the Resource Unit will be decreased. Due to lower land productivity there is less food available for livestock consumption (Causes Effects and Solutions of Overgrazing, 2016). This is a negative interaction between the Resource System and Resource Unit dimensions of Ostrom's framework.

Governance on the Resource System

Government agencies such as the BLM manage the public lands and issue permits that allow ranchers to use those lands for grazing. The BLM issues permits to any US citizen or business that has control of private property known as "base property" (Programs: Natural Resources, 2018). Conditions and stipulations such as forage use and season of use are set within the permits and leases issued by the BLM (Programs: Natural Resources, 2018). These stipulations are the rules that ranchers need to follow in order to maintain their permit to graze on public land. The BLM's standards of grazeland health were developed in the 1990s and describe specific conditions such as the presence of streambank vegetation and adequate canopy and ground cover (Programs: Natural Resources, 2018). This interaction between the Governance System and the Resource System is positive because it is the BLM's goal to maintain the health and productivity of public grazelands for use by current and future generations (Programs: Natural Resources, 2018).

User to Resource System

The rancher manages his livestock which have an effect on the palatable vegetation within a grazing allotment. The manager also works to reduce the amount of weeds within a grazing allotment. Spring is the best time to conduct chemical spraying of areas infected with weeds (Knapp, 1996). A backpack sprayer works for spot invasions but in order to deal with extensive weed invasions a sprayer attached to a vehicle may be necessary (Knapp, 1996). The rancher interacts with these components of the resource unit in order to maintain the grazing allotment. Without proper management of livestock overgrazing could occur which leads to less land productivity (Causes Effects and Solutions of Overgrazing, 2016).

Economic, Political and Social Settings to Government System to Users

Resource consumption is also driven by market forces. To capitalize on demand, Lava Lake to become a founding member of the Mountain States Lamb Cooperative, consisting of 125 sheep producers in the west as well as the controlling owner of Mountain State Rosen, a national lamb distributor. This cooperative fostered information sharing (I2) between producers and collectively established premiums and stabilized the market to maximize niche marketing techniques for premium all-natural lamb (Stevens, 2014). Ranchers can participate in the Idaho Preferred program run by the Idaho State Department of Agriculture, which works to identify and promote local food and agriculture products. Through these associations, ranches can market to 'locovore' and 'foodie' movements, which has motivated consumers to pay a premium for local food from businesses that invest in improved animal welfare, reduced synthetic inputs and active conservation efforts. A feedback loop between national marketing and resource consumption helps drive sustainability and efficiency.

Governance system to users

Resource use by ranchers is regulated by governing agencies. US Forest Service adopted a grazing permit system and the Taylor Grazing Act in 1942, which established grazing allotments to individual operators who were dependent on public land. These actions reduced competition between ranchers and ensured they would have rights to the land they were permitted for. The IDL managed approximately 1,138 leases, contributing 258,428 AUM of forage in 2017 (IDL, 2018). The Natural Resource Conservation Service, the USFS and the BLM work to evaluate the condition of the rangeland (Borman, 1999). This management strategy is routinely adjusted for best financial and environmental returns by meeting with industry, government and other stakeholders (IDL, 2018).

Resource system to users

Grazeland users have different impacts on grazeland resources, whether users are ranchers, or tourists who recreate on the public grazelands. Consumer demand for meat products can drive an increase in livestock stocking rates, which can lead to overgrazing. Overgrazing is detrimental to ecosystem goods and services such as recreational opportunities and water production. Depletion of palatable vegetation can reduce productivity for future livestock, limit food and habitat availability for wildlife, and result in soil erosion, compaction and decreased water filtration (Roselle et al., 2009). We anticipate that overgrazing may also damage the aesthetics of the landscape, which may be of particular concern in areas where there are tourist attractions, such as in the Sun Valley region. Fishing in the valley's streams and rivers is one of the main attractions in the area. Recently, the volume of fish found in these waterways have been noticeably reduced by sedimentation and pollution, which is thought to be the result of overgrazing by livestock (Moore, 2017). Though there can be negative impacts of grazing on the resource system, many users have economic incentives to protect these natural resources. Conservation organizations work with land owners and agencies to provide conservation easements which can work to both provide tax benefits to ranchers and habitat improvements to benefit wildlife and livestock health.

Gaps

We identified multiple areas of future research, the following are knowledge gaps that Ostrom's framework helped identify. The first gap, was our knowledge regarding climate change and how it might impact resource units. Another gap we identified between the GS and Users was how can dialogue between ranchers and agencies be facilitated in a more effective manner? Many ranchers feel underrepresented when it comes to their ideas being heard. Another gap we identified was how the public perceives grazing on public lands. Finally we identified multiple gaps in our knowledge surrounding the recreationist. We lacked knowledge about the interactions between ranchers and recreationists as well as what the impact of recreationists is upon palatable vegetation when using public lands. These gaps are areas that need to be researched further.

Conclusions

Identification of knowledge gaps in the system revealed where communication linkages should be forged for better management outcomes. Public lands will continue to debates with many different interests at play but there are several key findings from our analysis. First, we identified a disconnect between the scale that a rancher operates on, and the scale at which the landscape management policies are implemented. When this scale mismatch occurs, some

individuals may be at more of a disadvantage than others, due to operational costs and location. Second, we identify a role redundancy of governing agencies and conservation organizations in which both monitor and protect grazeland. Conflict occurs when conservation organizations identify government agencies in violation of their governing responsibilities. This can act as a check and balance, but also can create a tense polarization with ranchers in the crossfire. We suggest that communication strategies be improved such that problem areas can be identified and responded to proactively, thereby improving relations and conservation outcomes. Third, we conclude that rancher management practices also are based on norms and values, which may be based on cultural distinctions that differ from that of other users, including those that make management policy decisions. Importantly, individual ranchers should be included in conversations in the Government System: between conversation groups, governing organizations and regional cooperative and associations, to feel that their values are represented in the decision-making process. These problem areas demonstrate that adaptive co-management may be a promising strategy to incorporate different user interests and resolve conflict over what will continue to be a contentious topic in the western US.

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Appendix

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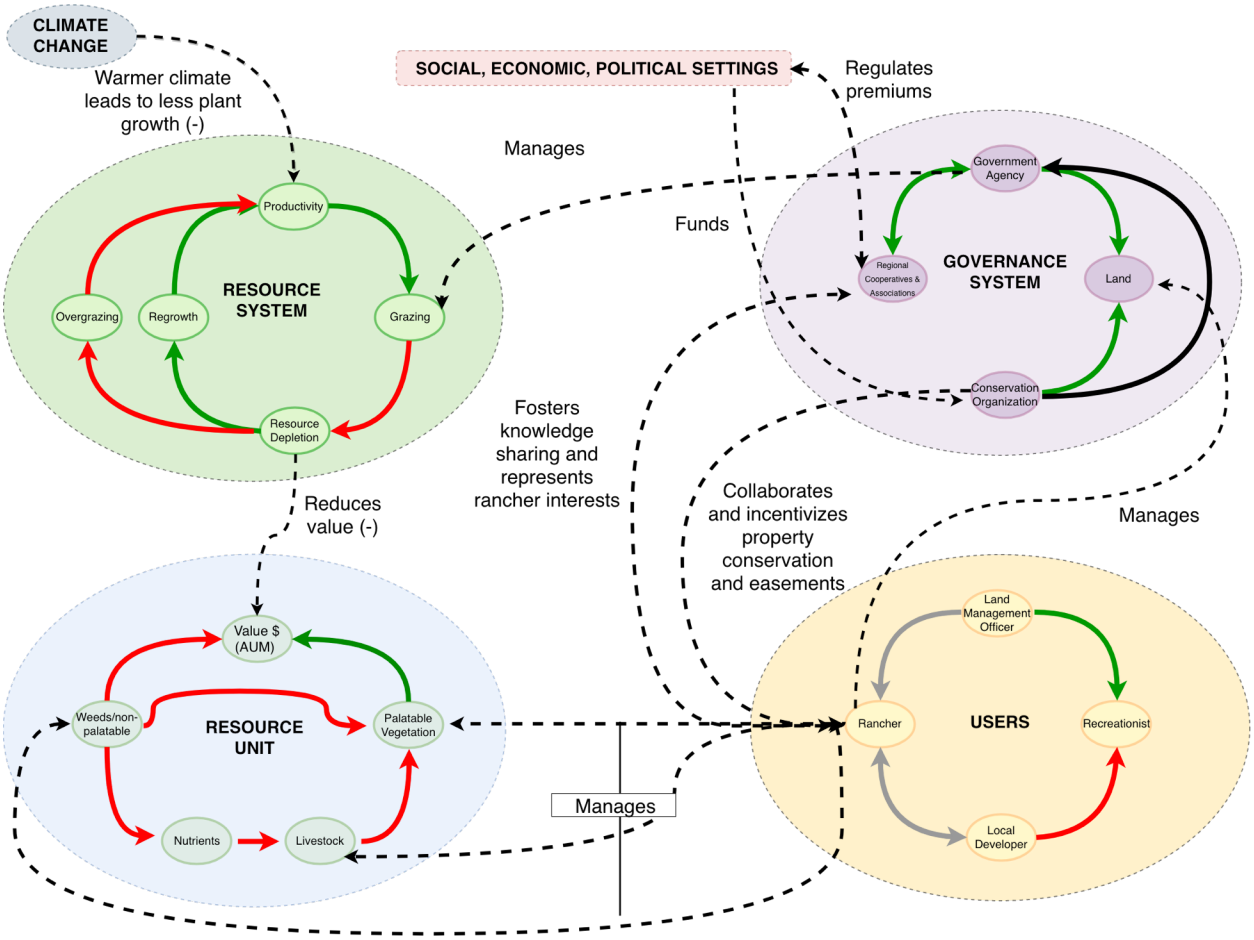
CLIMATE CHANGE
Warmer climate leads to less plant growth (-)
SOCIAL, ECONOMIC, POLITICAL SETTINGS
Regulates premiums
Manages
Funds
Productivity
RESOURCE SYSTEM
Overgrazing
Regrowth
Grazing
Resource Depletion
Government Agency
Regional Cooperatives & Associations
GOVERNANCE SYSTEM
Land
Conservation Organization
Fosters knowledge sharing and represents rancher interests
Collaborates and incentivizes property conservation and easements
Manages
Reduces value (-)
Value $ (AUM)
Weeds/non-palatable
RESOURCE UNIT
Palatable Vegetation
Nutrients
Livestock
Land Management Officer
Rancher
USERS
Recreationist
Local Developer
Manages