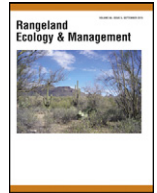




Contents lists available at ScienceDirect

# Rangeland Ecology & Management

journal homepage: <http://www.elsevier.com/locate/rama>

## Sustaining Working Rangelands: Insights from Rancher Decision Making<sup>☆</sup>



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### ARTICLE INFO

#### Article history:

Received 1 October 2014

Accepted 24 June 2015

#### Key Words:

agricultural policy  
biodiversity  
coupled human and natural systems  
ecosystem services  
sustainability science  
working landscapes

### ABSTRACT

Grazed rangeland ecosystems encompass diverse global land resources and are complex social-ecological systems from which society demands both goods (e.g., livestock and forage production) and services (e.g., abundant and high-quality water). Including the ranching community's perceptions, knowledge, and decision-making is essential to advancing the ongoing dialogue to define sustainable working rangelands. We surveyed 507 (33% response rate) California ranchers to gain insight into key factors shaping their decision-making, perspectives on effective management practices and ranching information sources, as well as their concerns. First, we found that variation in ranch structure, management goals, and decision making across California's ranching operations aligns with the call from sustainability science to maintain flexibility at multiple scales to support the suite of economic and ecological services they can provide. The diversity in ranching operations highlights why single-policy and management "panaceas" often fail. Second, the information resources ranchers rely on suggest that sustaining working rangelands will require collaborative, trust-based partnerships focused on achieving both economic and ecological goals. Third, ranchers perceive environmental regulations and government policies—rather than environmental drivers—as the major threats to the future of their operations.

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### Introduction

Rangelands are biologically diverse working landscapes that include complex ecosystems ranging from arid deserts and shrublands to mesic grasslands and woodlands. Covering approximately 50% of the world's terrestrial surface (Lund, 2007), rangelands support nearly one-third of the world's population and provide multiple ecosystem goods and services—including food and fiber production, water resource protection, and biodiversity (Havstad et al., 2007; MA, 2005; Neely et al., 2009). With the global population expected to reach 10.9 billion by 2100 (United Nations [UN], 2013), providing these goods and services into the future will continue to be a fundamental challenge—especially under the mounting pressures of uncertain economic, social, and climate changes (FAO et al., 2013; Sayre et al., 2013; UN, 2013). The

long-term sustainability and stewardship of rangeland systems around the globe has been the subject of increasing public debate (Briske, 2011; FAO et al., 2013; NRDC, 2010; Sayre et al., 2013; UN, 2013).

Growing societal demand for sustainable food production and expanding expectations for land conservation (e.g., Briske, 2011) are increasingly complicating management of rangelands (Boyd and Svejcar, 2009). In answer to the growing challenges for these and other social-ecological systems, recent reviews on landscape planning, natural resource management, and policy decision making have highlighted needs for enhanced partnerships and communication among land managers, conservationists, policy makers, and scientists (Ban et al., 2013; Bestelmeyer and Briske, 2012; Briske, 2011, 2012; Daily et al., 2009; de Groot et al., 2010). There is a critical need to include the ranching community in this dialogue on sustaining multifunctional working rangelands. Ranchers have unique knowledge, experiences, perceptions, and values that influence their individual goal setting, decision making, and adaptive management strategies (Kachergis et al., 2013, 2014; Knapp and Fernandez-Gimenez, 2009; Kreuter et al., 2006; Sorice et al., 2012). They also have insights into the impacts of these decisions on economic and ecological aspects of their agricultural enterprises

<sup>☆</sup> Research was funded by the US Dept Agriculture's National Institute of Food and Agriculture, Rangeland Research Program, Grant 2009-38415-20265.

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(Berkes et al., 2000). Finally, ranchers are the actors expected to participate in policy partnerships and comply with regulations, so it is crucial to understand how they view the policy and regulatory landscape.

We examined results of a mail survey of California ranchers within the context of a social-ecological framework for adaptive decision making (Fig. S1; available online at [<http://dx.doi.org/10.2111/REM-D-13-00025.1>]). The framework provides a conceptual approach that integrates existing decision-making theories to address challenges and opportunities in complex agro-ecological systems (e.g., California's working rangelands [Lubell et al., 2013]). Grazed rangelands in California cover approximately 13.8 million hectares (CALFIRE-FRAP, 2010) and support cattle production—the state's fourth leading commodity (3.2 billion U.S. dollars for cattle and calves) (CDFA, 2013; USDA NASS, 2012). These lands also preserve open space, encompass highly valued ecosystems, and provide habitat for a diversity of common, threatened, and endangered species (Brunson and Huntsinger, 2008; Ferranto et al., 2013; GAO, 1994; Huntsinger and Oviedo, 2014; Huntsinger et al., 2007; Maestas et al., 2003; Plieninger et al., 2012).

Long-term sustainability of individual ranches, and thus working rangeland ecosystems, lies within ranchers' abilities and desires to make adaptive management decisions to cope with changes in ways that attain agricultural goals and conserve essential ecosystem functions (Fig. S1; available online at [<http://dx.doi.org/10.2111/REM-D-13-00025.1>]). Sustaining working rangelands is thus, in part, dependent on ranchers' social values, management goals and resource options and capacity, and management strategy and practice adoption (Lubell et al., 2013; Marshall and Smajgl, 2013; McAllister, 2012; Walker et al., 2002). In this context, the goal of this paper is to document and report 1) operator and operation demographics; 2) management goals, practices, and information resources; and 3) operator values and beliefs across California's working rangelands. We argue that including the ranching community's perceptions, experiential knowledge, and decision-making is essential to advancing the ongoing dialogue to define sustainable working rangelands.

## Methods

### Survey Design and Sampling

We developed a mail survey of ranchers using the membership list of the California Cattlemen's Association (CCA). CCA is a nonprofit trade organization serving cattle ranchers, beef producers, and private owners of cattle-grazed properties across California. The survey included sections on operator and operation demographics, management goals, practices, information resources, and operator values and beliefs. Survey questions were informed from the literature and discussions with collaborating ranchers and were then pilot tested. The final survey was administered via a multicontact approach, including both print and online advertisements endorsed by local agricultural organizations (Dillman, 2007). Producer members of CCA received four waves of contact from March to June 2011: the initial mail survey and return envelope, a reminder letter including the option to refuse the survey or note ineligibility, a second mail survey packet, and a final reminder card. The survey was delivered to 1 727 addresses.

Survey response rate was 33% (American Association of Public Opinion Research, Response Rate 4), with little indication of nonresponse bias across successive response waves of the survey (Lubell et al., 2013). There were 507 eligible surveys for this analysis; the number of responses ( $n$ ) per question ranged from 332–507 (Table S1; available online at [<http://dx.doi.org/10.1016/j.rama.2015.07.006>]) and is noted throughout.

### Data Collection and Analysis

To provide social and ecological insights into the key factors shaping ranch decision making, we used descriptive statistics to characterize key components adapted from the rangeland decision-making framework

(Fig. S1; available online at [<http://dx.doi.org/10.2111/REM-D-13-00025.1>]); operator and operation demographics; management goals, practices, and information resources; and individual social values. Detailed information on each survey question is provided in Supplementary Table S1 (available online at [<http://dx.doi.org/10.1016/j.rama.2015.07.006>]).

### Operator and Operation Demographics

We asked survey respondents about a number of operator characteristics and structural features of the operation, including age, gender, education, number of generations ranching, income, financial dependence on ranch, state of succession planning, other agricultural production activities, land base of ranching operation (owned by individual, private leased, public leased, paid to graze), total acres, and number of grazing animals (i.e., cow-calf pairs, stockers, dairy cattle, sheep, other).

### Management Goals, Practices, and Information Resources

We provided respondents with a list of nine potential agricultural and natural resource management goals (livestock production, forage production, carbon sequestration, invasive weed management, recreation, riparian/meadow health, soil health, water quality, and wildlife) and asked them to rank (1–9) each goal as it related to the priorities of their operation. We assigned a rank of “10” to goals that were not ranked by each individual respondent and therefore not identified as a priority. For common rangeland and ranch management practices, we asked respondents about their experience with, and perceived effectiveness of, ranch facilities and infrastructure, herd management, vegetation management, and landscape enhancements; in particular, we focused on management practices prominent in conservation planning and incentive programs (see Table S1; available online at [<http://dx.doi.org/10.1016/j.rama.2015.07.006>]; Briske, 2011). For each practice, we asked 1) if the practice had been used in the past 5 years; 2) whether the practice was key, helpful, or not effective in moving toward management goals; and 3) if additional information on the practice would be useful to future management decisions.

For information needs and networks, we asked respondents to rank (1 = “Never Use,” 2 = “I use this, and the quality is poor,” 3 = “I use this, and the quality is good,” 4 = “I use this, and the quality is excellent”) the quality of information they received from local government agencies, nongovernmental organizations, and independent sources (Table S1; available online at [<http://dx.doi.org/10.1016/j.rama.2015.07.006>]). We also asked about Internet accessibility and preferred methods of accessing information resources.

### Operator Values and Beliefs

We posed statements on basic social values, including views on private property rights, natural resource conservation, environmental protection, ranching lifestyle, and the role of government in rangeland conservation. Respondents were asked the extent to which they agreed or disagreed with each statement using a 5-point scale (1 = “fully disagree” to 5 = “fully agree”).

To identify key challenges and risks to sustainability as perceived by ranchers, we used word cloud analysis (Cidell, 2010) of the open-ended question, “What is your biggest concern for the future of your operation?” Content clouds, or word clouds, assess the relative frequency of words used in analyzed text. We also coded individual response text using an iterative coding process of summarizing and organizing text passages (Knapp and Fernandez-Gimenez, 2009; Neuman, 2004). We then computed the number of individually coded responses under each theme and the number of survey respondents addressing each theme.

## Results

### Operator and Operation Demographics

Median respondent age was 62 (range 25–93;  $n = 491$ ), and most respondents were male (83%;  $n = 494$ ). In terms of formal education,

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