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Sustaining Working Rangelands: Insights from Rancher Decision Making

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Authors

Roche, Leslie M
Schohr, Tracy K
Derner, Justin D
et al.

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Sustaining Multifunctional Working Rangelands: Social and Ecological Insights from Rancher Decision-Making

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). In the dialogue on rangeland conservation and sustainable use, there is a critical need to include the collective experiential knowledge and perceptions of ranchers and managers who live and work on these lands. Here, we surveyed 507 (33% response rate) California ranchers to gain insight into key factors shaping management outcomes within the context of a social-ecological framework for adaptive rangeland decision-making. The California Rangeland Decision-Making Survey provides three important insights into sustaining multifunctional working rangelands. First, survey results revealed diversity in ranch structure, management goals, and adaptive decision-making across the state's ranching community—which is potentially important to maintaining flexibility and capacity to support multiple economic and ecological services at both individual and system scales. Second, our results suggest that sustaining these working landscapes will require real partnerships built on mutual respect and trust, communication, and shared goals. Third, ranchers commonly identified environmental regulations and government policies—rather than environmental drivers—as major threats to the future of their operations. This work sheds light on the potential barriers to sustaining multifunctional working rangelands, and highlights the need for true collaborations among scientists, on-the-ground managers, and policy makers in defining sustainability strategies.

Key Words: agricultural economics, agricultural policy, biodiversity, coupled human and natural systems, ecosystem services, grazing management practices, sustainability.

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 (MA 2005; Havstad et al. 2007; FAO 2009). With the global population expected to reach 10.9 billion by 2100 (UN 2013), sustainably providing for our food needs will continue to be a fundamental challenge—especially under the mounting pressures of uncertain economic, social, and climate changes (FAO 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 (NRDC 2010; Briske 2011; FAO 2013).

Growing societal demand for sustainable food systems and expanding expectations for conservation is increasingly complicating management of rangelands (Boyd and Svejcar 2009; Briske 2011). 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 between land managers, conservationists, policy makers, and scientists (Daily et al. 2009; de Groot et al. 2010; Briske 2011; Bestelmeyer and Briske 2012; Briske 2012). In the dialogue on sustaining multifunctional

working rangelands, there is a critical need to include the ranching community's perceptions and collective experiential knowledge. Ranchers and land managers have unique knowledge, experiences, and values that influence their individual goal setting, decision-making, and adaptive management strategies (Kreuter et al. 2006; Knapp and Fernandez-Gimenez 2009; Sorice et al. 2012). They also have experiential insights into the impacts of these decisions on the economic and ecological sustainability of their agricultural enterprises (Berkes et al. 2000).

We examined results of a mail survey of California ranchers within the context of a social-ecological framework for adaptive decision-making (see Fig. 1 in Lubell et al. 2013). 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) (NationalAgriculturalStatisticsService(USDA NASS) 2012; CDFA 2013). These working lands also preserve open space, encompass highly valued ecosystems, and provide habitat for a diversity of common, threatened, and endangered species (GAO 1994; Maestas et al. 2003; Huntsinger et al. 2007; Brunson and Huntsinger 2008).

Long-term sustainability of working ranches lies within their abilities to cope with and adapt to changes in ways that maintain desired system functioning. These abilities are, at least in part, dependent upon resource options and capacity, individual goals and beliefs, and practice adoption (Walker et al. 2002; McAllister 2012; Lubell et al. 2013; Marshall and Smajgl 2013); and ranchers and land managers set and adapt these priorities based on their individual

perceptions of sustainability. In this context, we examined the structural features, management decision-making, and values and beliefs shaping California's 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 non-profit trade organization serving cattle ranchers, beef producers, and private owners of cattle-grazed properties across California. The survey included sections on operation and operator characteristics, individual goals, management practices, information sources, and social values and perspectives. Survey questions were informed from the literature and discussions with collaborating ranchers, and were then pilot tested. The final survey was administered via a multi-contact 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 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 1727 addresses.

Survey response rate was 33% (American Association of Public Opinion Research, Response Rate 4). There were 507 eligible surveys for this analysis; number of responses (n) per question ranged from 332 to 507 (Table S1; available online at [insert URL]), and is noted throughout. Survey respondents were from a diversity of bioregions across California—spanning 49 of the state's 58 counties (Fig. 1).

Data Collection and Analysis

To provide social and ecological insights into the key factors shaping ranch decision-making, we used descriptive statistics to characterize operator and operation demographics, management goals, practices, information sources, and basic social values. Detailed information on each survey question is provided in Supplementary Table S1.

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 animals (i.e., cow-calf pairs, stockers, dairy cattle, sheep, other) grazed.

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; 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, non-governmental organizations, and independent sources (Table S1). We also asked about internet accessibility and preferred methods of accessing information resources.

Individual 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 five-point scale (1 = "fully disagree" to 5 = "fully agree").

To identify key challenges and risks to sustainability as perceived by ranchers, we used a qualitative content 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 (Neuman 2004; Knapp and Fernandez-Gimenez 2009). 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, 63% had an associate college degree or beyond and an additional 21% reported at least some college training (n = 496). Although first generation ranchers made up 19% of survey respondents, the majority of respondents were from multigenerational ranching families—71% were third or more generations (n = 493). Over 70% of respondents had a succession plan in place (45%; n = 456) or in progress (26%) that identified a strategy for keeping the land in ranching.

Nearly two-thirds of the respondents (64%; n = 487) identified ranching as a critical source of income. Median annual household income category—including on-ranch and off-ranch sources—was $100,000-149,999 (n = 463), with many survey respondents reporting diversified income sources. Almost one-third of respondents reported other agricultural production activities (e.g., timber, vineyards, row crops) within their operation. More than three-quarters of survey respondents (79%) reported some level of off-ranch employment (n = 479), and 56% of these respondents (n = 379) relied on off-ranch employment for more than half of their total household income.

Responding operations spanned a diversity of sizes and land ownership types (Table 1). Survey respondents (n = 494) represented 4.6 million hectares of rangeland, approximately 33% of California's grazed rangeland (CALFIRE-FRAP 2010). In terms of total ranch land resources, 75% of total rangeland area reported by all respondents (n = 494) was publicly leased (held by 19% of respondents), 14% was privately leased (held by 60% of respondents), and 11% was privately owned (held by 87% of respondents). Operation sizes (i.e., including all private and public rangeland utilized by a ranching operation) widely varied—ranging from one to more than two million hectares, with a median operation size of approximately 970 hectares.

Individual operation structure was approximately divided between those with a single ownership type (47% of respondents, n = 494) and those with two or more types of land ownership (53% of respondents, n = 494). Irrigated pastures played a role in half (50%) of operations represented (n = 494)—amounting to more than 70,000 ha (2% of the total land reported), which were primarily privately owned (60%) or privately leased (35%).

The majority of operations were cow-calf based, with a median cow-calf herd size of 145 (Table 1). Among survey respondents, 4% had < 20 cattle and calves; 27% had 20 to 99; 44% had 100 to 499; 18% had 500 to 2 499 and 8% had 2 500 or more. In contrast, the 2012 Census of Agriculture for the state of California (USDA NASS 2012) reported 59%, 20%, 11%, 7%, and 3% for the same size categories, respectively. Respondents reported more than 300,000 total head of livestock (beef and dairy cattle, sheep, horses, goats, etc.). Ninety-one percent of total livestock reported were beef cattle (evenly divided between cow-calf pairs and stockers (yearling cattle)); sheep represented less than 6% of total livestock reported, and less than 10% of the respondents grazed sheep. Nearly two-thirds of operations grazed only cow-calf pairs, one-third grazed both cow-calf pairs and stocker cattle, and less than 5% grazed only stocker cattle.

Management Goals, Practices, and Information Resources

Respondents (n = 488) rankings of goals fell into three observable tiers: 1) highest priority, agricultural production goals (livestock and forage production); 2) mid-level priority, conservation and environmental goals (weed management, water quality, soil health, riparian health, and wildlife); and 3) low-level priority, recreation and carbon sequestration (Fig. 2). The most highly rated key practices ("primary practices"; match calving to the environment, livestock water development, consult veterinarian on heard health plan, cross fencing,

supplemental feeding, match cattle genetics to environment; Fig. 3) clearly link to ranchers' highest priority goals, livestock and forage production. Across all practices, respondent interest in additional information to guide future use of practices ranged from 12 to 39% (Fig. 3).

Survey respondents' identified other ranchers and industry organizations (e.g., California Cattlemen's Association, California Farm Bureau Federation) (99% rated these combined resources as good or excellent; n = 502) as their most valued sources of information (Fig. 4). University of California Cooperative Extension and University information resources were rated second highest (80% rated these combined resources as good or excellent; n = 485), and USDA NRCS was rated third highest (56% rated quality as good or excellent; n = 470). Respondents (n = 500) reported using a diversity of methods to access these information resources. The top preferred source of communication was print publications (55%), followed by word-of-mouth and face-to-face interactions (42%), and e-mail and other electronic sources (25%). Eighty-two percent of respondents noted they had internet access—with 68% connecting via high-speed connections, 16% connecting via smartphones, and 14% connecting via dial-up connections. Twenty percent indicated a preference for a combination of information access options.

Operator Values and Beliefs

The majority (63%; n = 486) of respondents agreed that the ranching lifestyle was more important than economic return, suggesting profit as a secondary motivation among many ranchers. Ninety-seven percent of survey respondents (n = 490) agreed with the statement *"Whenever possible, I try to conserve natural resources"*. If confronted with conflict between economic viability and environmental protection, 68% (n = 484) agreed that it would be most important to protect economic viability. However, nearly half (47%) of respondents (n = 481)

disagreed with the statement *"My landowner rights allow me the absolute right to do whatever I want with my land"* (29% agree; 31% neutral).

Trust in government involvement in conservation was divided among respondents. Thirty-six percent of respondents (n = 484) agreed and 33% disagreed with the statement *"Government involvement in conservation has helped ranchers"* (31% neutral). Thirty-five percent of respondents (n = 470) agreed and 36% disagreed with the statement *"In the future, government incentives will be the best way to improve voluntary conservation on actively ranched lands"* (29% neutral). The vast majority of respondents (90%; n = 488) viewed the most important role of government was upholding the private property rights of individual citizens.

In response to the open-ended question, "*What is your biggest concern for the future of your operation?*", respondents (n = 415) primarily identified socio-economic threats (Fig. 5), encompassing 3 main themes: 1) government regulations and environmental policies (50%); 2) economic viability (43%), with 25% of these respondents voicing concerns for continued funding of the Williamson Act (i.e., California Land Conservation Act of 1965)—a widely used program in California (Lubell et al. 2013) that enables the preservation of open space by providing reduced property tax rates for landowners maintaining land in agricultural or related uses (DOC 2013); and 3) succession planning (21%), with 49% of these respondents specifically noting estate taxes as a challenge. The only commonly emerging biophysical concern was security of water supply (21%), for which respondents also identified interrelated policy and weather issues.

DISCUSSION

The Rangeland Decision-Making Survey provides three important insights into sustaining multifunctional working rangelands. First, our results highlight the diversity in ranch structure, management goals, and adaptive decision-making across California's ranching operations—which has also been reflected in other grazed rangelands (Rowan and White 1994; Coppock and Birkenfeld 1999; Coppock 2011; Kachergis et al. 2013; Marshall and Smajgl 2013; Sayre et al. 2013). This landscape-level heterogeneity potentially accommodates the breadth of opportunities necessary to provide the continuum of food, water, and habitat goals increasingly demanded by society. Furthermore, ranch-level diversification in resources and response options enhances individual abilities to cope with and adapt to economic and ecological variability and uncertainty (Walker et al. 2002; Folke et al. 2005; McAllister et al. 2006; Fazey et al. 2010; Brunson 2012; Sayre et al. 2012; Lubell et al. 2013; Kachergis et al. 2014). Therefore, programs and initiatives supporting a spectrum of infrastructure and management options are key to enhancing flexibility and capacity to achieve multiple agricultural production and conservation outcomes at multiple scales (Figs. 2 and 3).

Second, sustaining multifunctional working rangelands—and mainstreaming conservation programs in general—will require real partnerships built on mutual respect, communication, and shared goals. Working within local social networks and connecting with recognized opinion leaders and "boundary organizations" is key to building trust among diverse stakeholders (Briske 2012; Lubell et al. 2013). Indeed, ranchers seek out local, trusted information sources, recognized opinion leaders, and other peers as resources in their decision-making (Fig. 4) (Rowan et al. 1994; Lubell 2007; Ferranto et al. 2011; Kachergis et al. 2013; Lubell et al. 2013). Reaching and connecting with a diverse audience like the ranching community requires

strategically targeted messaging via multiple media approaches, including face-to-face interactions, print publications, and new communication technologies (e.g., social media, mobile phone applications, online portals).

To enhance adoption, conservation outreach and education efforts should be adapted and demonstrated to meet ranchers' key needs and goals, particularly focusing on joint solutions for agricultural production and conservation outcomes. We found that most ranchers do see value in many ecological services (Fig. 2) and express a strong land stewardship ethic, which have been shown to be motivating factors in conservation practice adoption by ranchers and land owners, and collaborative approaches in general (Smith and Martin 1972; Liffmann et al. 2000; Didier and Brunson 2004; Fernandez-Gimenez et al. 2005; Conley et al. 2007; Ferranto et al. 2011; Oviedo et al. 2012). Conservation organizations looking to broaden their audience to include, or increase, rancher participation can build on these shared goals and identify opportunities to integrate their conservation messages into outreach and education programs focused on agricultural production.

Lastly, identifying the most salient challenges perceived by ranchers can aid translation between science, policy, and management in establishing common goals, identifying barriers to effective partnerships, and finding win-win solutions for sustainable management and conservation of working rangelands. More than a century of rangeland science has focused on the ecological complexity and biophysical threats to rangeland ecosystems (as reviewed in DiTomaso 2000; Herrick et al. 2010; Briske 2011; Sheley et al. 2011; Ash et al. 2012; Belnap et al. 2012). Contrary to this ecological focus, the dominant concerns for sustainability among ranchers are socio-economic (Fig. 5). Most notably, ranchers commonly identified environmental regulations and government policies—rather than environmental drivers—as

major threats to the future of their operations, a sentiment that has been echoed in other agricultural communities (Smith and Martin 1972; Liffmann et al. 2000; Conley et al. 2007; Niles et al. 2013). Although respondents were divided on trust in government involvement in conservation, a considerable fraction of respondents perceived some government agencies as barriers to their flexibility and management capacity—rather than as facilitators and partners in sustaining multifunctional rangelands.

IMPLICATIONS

The California Rangeland Decision-Making Survey revealed great diversity in ranch structure, management goals, and adaptive decision-making across the state's ranching community. California's working rangelands are at the nexus of wildland, agricultural, and urban landscapes—and, as a result, serve as a case study at the frontier of increasing social and regulatory pressures to define sustainable management on rangelands around the globe. As population growth continues, so will expansion of urban corridors, land use change, and agricultural intensification—resulting in increased social and ecological pressures on the long-term viability of ranching operations and the many benefits rangelands provide.

Addressing these challenges will require a multidisciplinary problem solving approach, including true partnerships among scientists, policy makers, and on-the-ground managers. Creating "translational science partnerships" (Briske 2012), which can help build trust and enhance communication among diverse communities, are also central to finding "win-win-win" opportunities for agricultural production, ecological sustainability, and human well-being. Additionally, using a "bottom-up" approach promotes mutual learning, and enhances effectiveness and adoption of conservation programs and sustainability initiatives. Lastly, given the complexity and variability

of rangeland systems, these efforts must also address these high priority issues at scales (e.g., human, pasture, ranch enterprise, watershed) most relevant to linked ecological and economic systems (Briske 2011; Roche et al. *In Review*).

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LIST OF FIGURES

TABLES

Table 1. General operation characteristics for surveyed California ranches.

	Mean	**Median**	**Range**
Total area[1] (ha)	9405	971	0 – 2,059,852
Private owned[1] (ha)	1075	251	0 – 16,187
Private leased[1] (ha)	1306	101	0 – 40,469
Public leased[1] (ha)	7001	0	0 – 2,023,430
Irrigated lands[1] (ha)	144	1	0 – 4,856
Total livestock[2]	643	200	4 – 22,000
Cow/Calf pairs[2]	288	145	0 – 8000
Stockers[2]	295	0	0 – 15,000
Sheep[2]	181	0	0 – 8,200

[1]n = 494.
[2]n = 492.

FIGURES

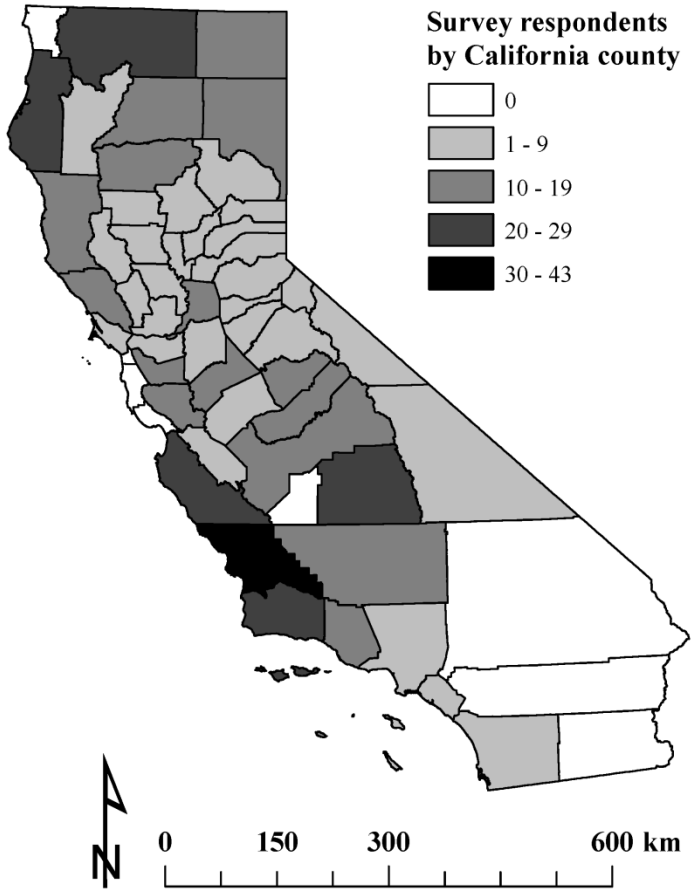

Fig. 1.

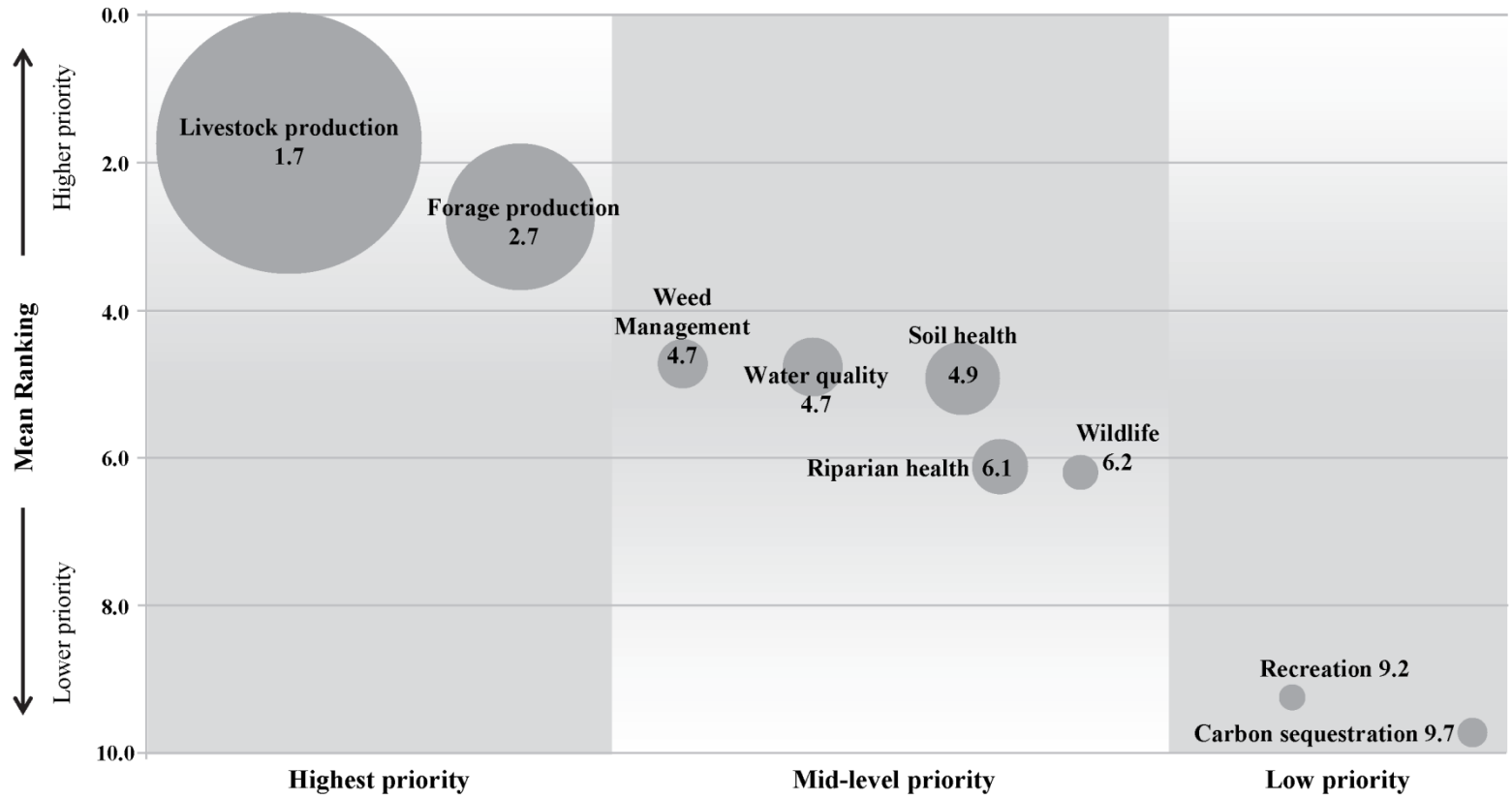
Mean Ranking
Higher priority
Lower priority
0.0
2.0
4.0
6.0
8.0
10.0
Livestock production
1.7
Forage production
2.7
Weed
Management
4.7
Water quality
4.7
Soil health
4.9
Riparian health 6.1
Wildlife
6.2
Recreation 9.2
Carbon sequestration 9.7
Highest priority
Mid-level priority
Low priority

Fig. 2.

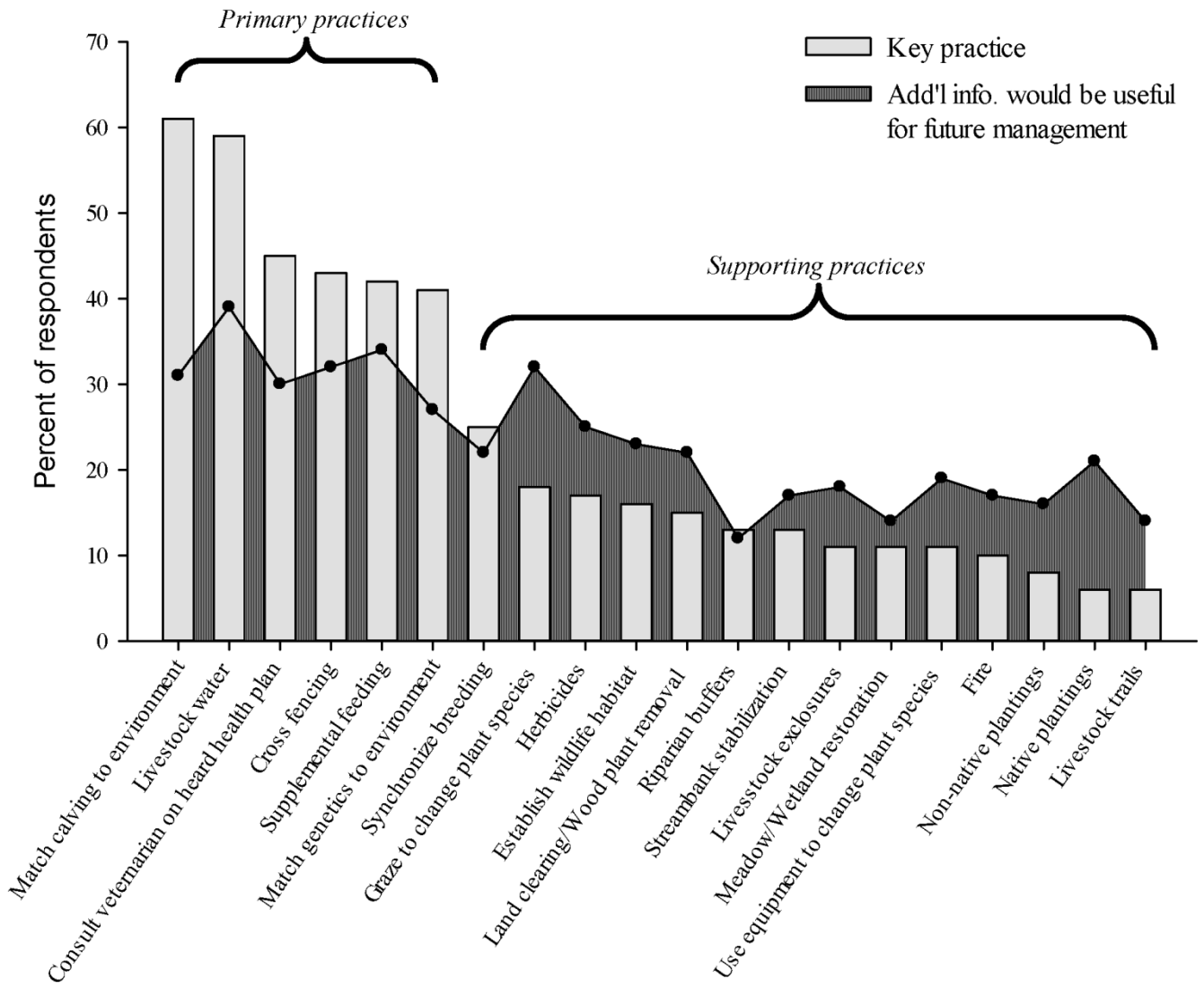
Primary practices
Supporting practices
Key practice
Add'l info. would be useful for future management
Percent of respondents
70
60
50
40
30
20
10
0
Match calving to environment
Livestock water
Consult veternarian on heard health plan
Cross fencing
Supplemental feeding
Match genetics to environment
Synchronize breeding
Graze to change plant species
Herbicides
Establish wildlife habitat
Land clearing/Wood plant removal
Riparian buffers
Streambank stabilization
Livesstock exclosures
Meadow/Wetland restoration
Use equipment to change plant species
Fire
Non-native plantings
Native plantings
Livestock trails

Fig. 3.

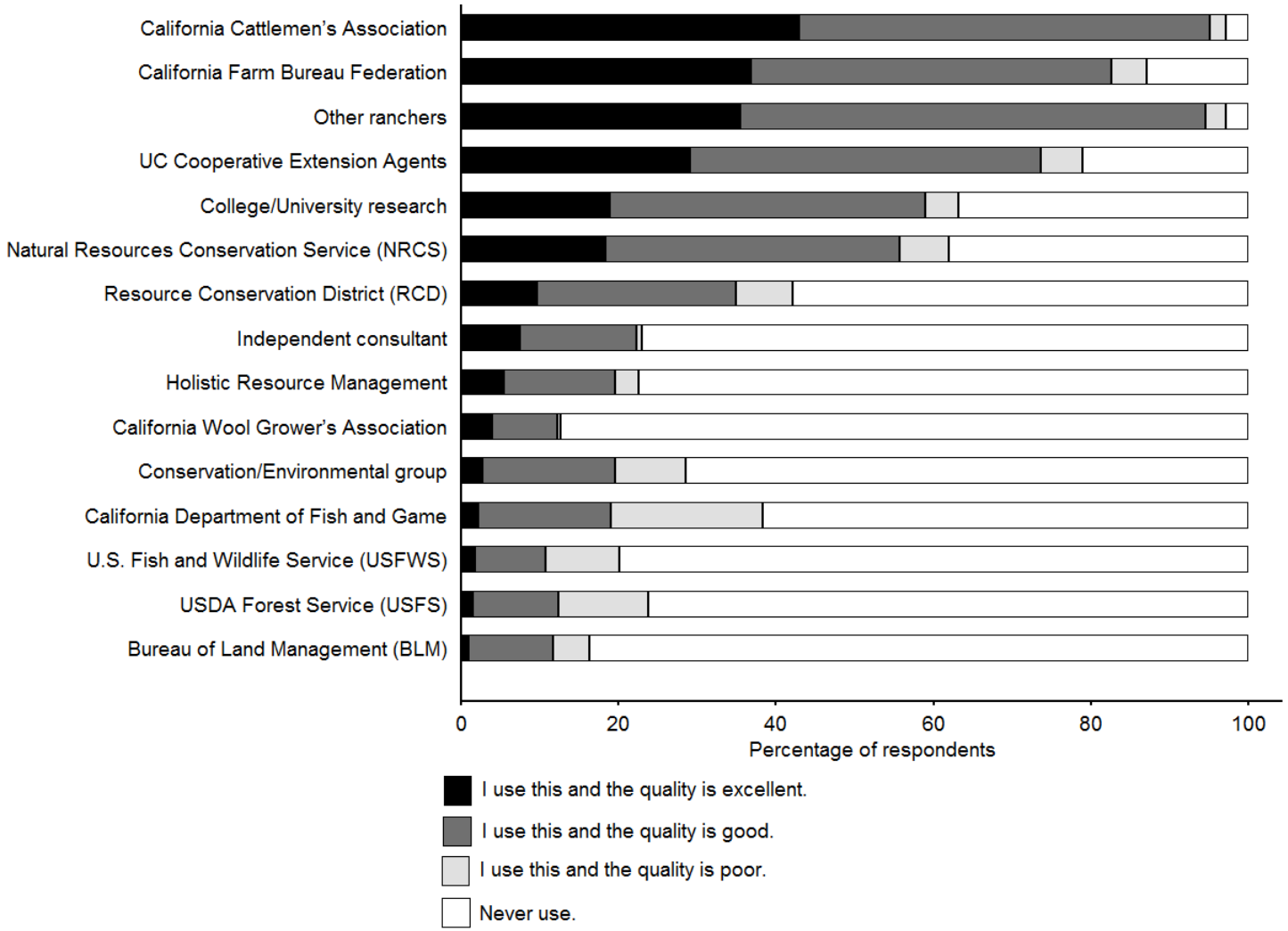
California Cattlemen's Association
California Farm Bureau Federation
Other ranchers
UC Cooperative Extension Agents
College/University research
Natural Resources Conservation Service (NRCS)
Resource Conservation District (RCD)
Independent consultant
Holistic Resource Management
California Wool Grower's Association
Conservation/Environmental group
California Department of Fish and Game
U.S. Fish and Wildlife Service (USFWS)
USDA Forest Service (USFS)
Bureau of Land Management (BLM)
0
20
40
60
80
100
Percentage of respondents
I use this and the quality is excellent.
I use this and the quality is good.
I use this and the quality is poor.
Never use.

Fig. 4.


EstateTax
Development
Concern
Environmental
Water
Family
Taxes
Lease
State
Lands
Loss
Generation
Ranch
Public
Cattle
Business
Production
Enough
Private
Operation
DepartmentofFishandGame
Control
Future
Federal
Regulations
Cost
County
Ranching
Grazing
California
Able
Property
Costs
Government
Biggest
Income
Agencies
InheritanceTax
Quality
High
WilliamsonAct
Rights
Restrictions

1

2 **Fig. 5.**

SUPPLEMENTARY MATERIAL

Supplementary Table S1. Descriptions, response rates, and values of questions used from the California Rangeland Decision-Making Survey delivered to 1727 members of the California Cattlemen's Association between March and June 2011.

Description of question/statement from the California Rangeland Decision-Making Survey	Value	N
Operator and Operation Demographics		
Age	Years	491
Gender	Male/Female	494
What is the highest level of education you completed?	Scale 1-7[1]	496
Not including the generations after you, how many generations of ranchers have there been in your family?	Scale 1-7[2]	493
What is your approximate yearly household income, including all ranch and off-ranch incomes?	Scale 1-7[3]	463
Approximately what proportion of your total household income comes from off-ranch employment?	Scale 1-7[4]	479
I am dependent on the ranch as a source of income.	Scale 1-5[5]	487
Do you have a succession plan for your ranch that identifies a strategy for keeping land in ranching in the future?	Yes, No, In progress	456
Does your ranching operation include other agricultural production activities that affect land management?	Yes/No	507
Acres managed for grazing, by ownership (owned, private leased, public leased, hired to graze)	0-5,090,000	494
Irrigated acres managed for grazing, by ownership (owned, private leased, public leased, hired to graze)	0-12,000	494
In a typical year, how many head of cow-calf/stockers/dairy cattle/sheep/other typically graze on land you own or lease?	4-22,000	492
Management Goals, Practices, and Information Resources		
Rank of the goals related to agricultural and natural resource management.		
Livestock production	1(highest) to 9(lowest)	483
Forage production		459
Carbon sequestration		332
Invasive weed management		450
Recreation		352
Riparian/Meadow health		383
Soil health		440
Water quality		445
Wildlife		429
Have you used this practice in the past 5 years?/Would additional information be useful to future management decisions?		
Facilities	No, Yes/Key, Yes/Helpful, Yes/Not	
Cross fencing to create more small pastures		457

Livestock drinking water development	effective	461
Livestock trail development		427
Livestock exclosure development		419
Land clearing - remove all woody species		434
Herd Management		
Consult a veterinarian to create an optimal herd health plan		444
Match genetics to local conditions		441
Match calving season to local conditions		441
Synchronize breeding		428
Supplemental feeding plan		440
Vegetation Management		
Graze livestock to change plant species		435
Use equipment to change plant species		436
Use herbicides to change plant species		438
Use fire to change plant species		438
Plant native plant species		427
Plant non-native plant species		424
Landscape Enhancements		
Create riparian buffer		422
Stabilize streambeds		423
Restore meadows and wetlands		412
Establish wildlife habitat		426
Ranking of the information sources about ranching.		
Bureau of Land Management (BLM)	Scale 1-5[6]	453
California Cattlemen's Association		494
California Department of Fish and Game		457
California Wool Growers Association		460
Conservation/Environmental group		449
California Farm Bureau Federation		487
Holistic Resource Management		456
Independent consultant		457
Natural Resources Conservation Service (NRCS)		470
Resource Conservation District (RCD)		456
Other ranchers		479
USDA Forest Service (USFS)		459

U.S. Fish and Wildlife Service (USFWS)		458
UC Cooperative Extension agents		479
College/University research (excluding extension)		461
Participating in formal organizations related to ranching is important.	Scale 1-5[5]	487
What is your preferred method for communicating about ranching?		
Email and electronic sources		500
Word of mouth or face-to-face	Choice	500
Print publications		500
How do you access the internet?		
Dial-up connection		500
Smartphone	Choice	500
High speed connection		500
I do not use the internet		500
Individual Values and Beliefs		
The ranching lifestyle is more important to me than economic returns.	Scale 1-5[5]	486
Whenever possible, I try to conserve natural resources.	Scale 1-5[5]	490
In situations where there are conflicts between economic viability and environmental protection, it is more important to protect economic viability.	Scale 1-5[5]	484
My landowner rights allow me the absolute right to do whatever I want with my land.	Scale 1-5[5]	481
Government involvement in conservation has helped ranchers.	Scale 1-5[5]	484
In the future, government incentives will be the best way to improve voluntary conservation on actively ranched lands.	Scale 1-5[5]	470
Upholding the private property rights of individual citizens is the most important role of government.	Scale 1-5[5]	488
What is your biggest concern for the future of your operation?	Open ended	415

[1]Scale ranges from 1 = "did not graduate high school" to 7 = "advanced degree".

[2]Scale ranges from 1= 1st generation rancher to 6= 6th generation rancher.

[3]Scale ranges from 1= "Less than $49,999" to 7= "More than $300,000".

[4]Scale ranges from 1= "0%" to 6= "100%".

[5]Likert-scale ranging from 1 = "fully disagree" to 5 = "fully agree".

[6]Ranking: 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".