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journal homepage: <http://www.elsevier.com/locate/rama>Landscape of North American Rangeland Social Science: Systematic Map[☆]Jasmine E. Bruno^{a,*}, Chantsalkham Jamsranjav^a, Kevin E. Jablonski^a, Elena G. Dosamantes^a, Hailey Wilmer^b, María E. Fernández-Giménez^a^a Department of Forest and Rangeland Stewardship, Colorado State University, Fort Collins, CO 80523-1472, USA^b US Department of Agriculture (USDA) Northern Plains Climate Hub, USDA–Agricultural Research Service Rangeland Resources and Systems Research Unit, Fort Collins, CO 80526, USA

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ABSTRACT

Rangeland scientists have made substantial progress in understanding ecological dynamics of rangelands, but the social factors have received less attention in North America. A body of North American rangeland social science has developed over the past 4 decades, with the number of studies increasing each decade. However, these works have not been systematically reviewed to assess the state of rangeland social science in North America or to identify research gaps. We developed a systematic map to characterize this literature by 1) the research objectives and questions; 2) who was studied; 3) where research was conducted; 4) which theories, methodologies, and methods were applied; and 5) how these research characteristics have changed from 1970 to 2017. We found that most (81%) North American rangeland social science has studied ranchers, farmers, and/or landowners, with limited consideration of other stakeholders (e.g., ranch workers, youth). Although age (43% of the studies) and education (40%) are often considered, other attributes/identities, such as gender (28%) and race or ethnicity (18%), are less frequently included. The most commonly used research method is surveys (52%), and much of rangeland social science does not make explicit connections to either specific methodological or theoretical frameworks. The limited application of theories, methodologies, and a lack of diverse methods has potentially constrained who and what have been studied in North America. The limited consideration of gender and race in rangeland social science is echoed in the limited number of studies that have accounted for the effects of social identities and power relationships on people's connection to and management of rangelands. This review highlights the need for more North American research that 1) is informed by social theory, 2) applies a diversity of methods, 3) considers a broader diversity of stakeholders, and 4) draws from multiple social science disciplinary traditions.

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Introduction

Rangelands are social and ecological landscapes that seemingly defy a singular, standard definition. The spatial extent of rangelands extends from a 40-acre ranch to 30–50% of Earth's ice-free land area (Sayre 2017). From the Sahelian Acacia savanna to the short-grass steppe, rangelands are all lands that are not forested, cropland, ice covered, or inhabited as cities (Sayre 2017). Rangelands are also cultural and social landscapes that often transcend ecological and political boundaries. The sociocultural extent of rangelands can

extend from one individual's source of recreation (e.g., Brunson & Gilbert 2003) to the central source of a community's livelihoods (e.g., Coles & Scott 2009). Researchers have advanced our understanding of these complex systems through the study of the ecological dynamics and management practices, but the equally complex social factors on North American rangelands have been historically understudied. As the rangeland science paradigm in North America shifts toward a complex systems and social-ecological focus (Briske 2017), there is an opportunity to fully integrate and centrally locate the social sciences into the more holistic study of rangelands as complex social and ecological landscapes (Sayre et al. 2012; Sherren & Darnhofer 2018).

The inception of rangeland science is intertwined with North America's colonial history and associated normative policies on rangeland assessment and use (Sayre 2017). While Indigenous peoples lived on and managed North American rangelands for thousands of years (McAdoo et al. 2003), with European colonization and

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migration came the rapid expansion of livestock production. As livestock and rangeland systems changed rapidly and significantly in the late 19th and early 20th centuries, land degradation emerged as a principal policy concern (Sayre et al. 2012). The policy and research responses to this land degradation, including the Taylor Grazing Act of 1934 and the Soil Conservation and Domestic Allotment Act of 1936, are often viewed as the inception of rangeland science (Ross 1984; Rasmussen 1985; Sayre 2017). This urgent need shaped an early production-oriented rangeland science paradigm into which social science was later integrated, often in an auxiliary role. These ecological findings and paradigms have been reviewed and synthesized in various papers (Milchunas & Lauenroth 1993; Fleischer 1994; Briske et al. 2003; Briske 2011).

Social science is the study of people and groups of people, such as households, societies, economies, and cultures (Bhattacharjee 2012). The unifying characteristic of the social sciences is the study of the social life of humans, and the diversity of social science includes the investigation of the individual to the study of society, including anthropology, political science, geography, sociology, economics, psychology, and a diversity of other disciplines and fields. Although anthropologists such as Evans-Pritchard (1940) studied global pastoralists (Dyson-Hudson & Dyson-Hudson 1980), there was comparatively less focus on social factors on North American rangelands in the early 20th century. Early social research on rangelands in North America, such as Smith and Martin (1972) and Buys (1975), came later in the 20th century, more intermittently, and explored social factors of behaviors and attitudes, often in the disciplinary context of ranch economics. In parallel with the broader emergence of interest in interconnected human-environment systems (UN General Assembly 1972; Ostrom 1990; Declaration on Environment and Development 1992; Zimmerman 1994; Scoones 1999), both social and ecological scientists began to recognize the importance of integrating the social sciences into the study of North American rangelands. With the development of social theories relevant to applied fields like agriculture, such as diffusion of innovation theory (Ryan & Gross 1943; Rogers 2003) and Fishbein and Ajzen's (1975) theory of reasoned action, rangeland researchers inquired about the motivations and perceptions of rangeland stakeholders in an effort to shape behaviors toward adoption of "best practices" and innovations (van Kooten et al. 2006; Martin et al. 2013; McClaran et al. 2015). The rise of fields such as political ecology (Escobar 1996), social-ecological systems (Ostrom 2009), and the study of pastoralism internationally (Dyson-Hudson & Dyson-Hudson 1980) offer new theories and methodological approaches to further diversify inquiry (Jeffrey 2003; Aboelela et al. 2007; Lang et al. 2012). Just as early advances in rangeland ecology contributed to assessment and management of rangelands, further advances in rangeland social science can and should contribute to more equitable development of and service delivery for individuals, communities, and societies who depend on rangelands. For example, a greater understanding of who does and does not have access to natural resources, and how access is gained, is foundational knowledge for the development of more equitable and sustainable systems of natural resource management (Ribot & Peluso 2009). The primary objectives of this paper are to systematically collect and analyze North American rangeland social science studies, map patterns across the literature, and identify gaps to inform future research (Arksey and O'Malley 2005; Colquhoun et al. 2014; Miake-Lye et al. 2016).

Methods

Systematic Map Methodology

Systematic methodologies to inform evidence-based decision making have been extensively applied in the health service sector, but the application of such research approaches has only recently

increased in the field of conservation and environmental management (Pullin & Stewart 2006; Berrang-Ford et al. 2015). Systematic approaches, such as systematic reviews and maps, apply rigorous, transparent, and objective processes to minimize bias (Colquhoun et al. 2014; Higgins and Green 2011). Unlike systematic reviews, systematic maps do not address specific questions but rather collate and synthesize diverse evidence on a high-level topic or area of study (Randall & James 2012; James et al. 2016; Miake-Lye et al. 2016). We chose to conduct a systematic map given that the rangeland social science literature had not been previously collated and synthesized, since the methodology can be applied across heterogeneous studies, and to identify specific questions for deeper review. To capture the breadth of the literature, we defined rangeland social science broadly, encompassing a range of literature from articles that integrate social science with biophysical research to work that is solely social science (Sherren & Darnhofer 2018). This definition allows for the inclusion of a diversity of academic fields that conduct social inquiry in relation to rangelands and recognizes the value of both integrated and stand-alone social science. In addition, areas of study such as history, feminist studies, and anthropology span the social sciences and humanities, but to create a comprehensive and systematic map of rangeland social science, we chose to include these fields. We offer this systematic map to not only acknowledge the contributions of rangeland social science to date but also offer a tool to inform future research. While we broadly and systematically examined the rangeland social science literature, in our analysis we chose to highlight the largest research gaps and those that we perceived to have the greatest impact on the advancement of the field.

Research Questions, Protocol Development, and Inclusion Criteria

The overarching goal of this systematic map is to describe the state of social science research on North American rangelands. More specifically, we aimed to determine what kinds of social science research questions have been asked, how these questions have been researched, and the major and impactful research gaps. Following standards for systematic methods, we first developed the review protocol (Fig. 1). The objective of an a priori protocol is to enhance rigor, reduce bias, and create a transparent process that can be both tracked and scrutinized by the reader (James et al. 2016).

In the protocol we outlined the research objectives and detailed methods, and we used the protocol to guide the research process. In addition, we established the following criteria for the inclusion of research: 1) a geographic focus on North America, 2) a social science component, 3) focus on rangeland or ranching systems, and 4) a scientific article published in a peer-reviewed journal from 1970 to 2017 in English or Spanish. These criteria were applied to determine the inclusion of research throughout the review process and are subsequently referred to as the *inclusion criteria*.

Article Search and Expert Review

In the systematic map protocol, we included a list of search terms developed to identify all relevant information while maintaining a necessary level of specificity (Table 1) (Pullin & Stewart 2006). To identify potential articles, we searched all permutations of the *Primary* and *Secondary* key word terms joined with the Boolean operator *AND* in the Web of Science database (see Table 1). For example, we searched ("Grass* landowner" AND Survey) and (Grass* landowner" AND Interview). To identify the initial search terms, we reviewed the key words listed in major rangeland social science publications and continued to add key words until the results yielded only redundancies, indicating data saturation (Saunders et al. 2018). Three of the authors (E. D., J. B., K. J.) screened the

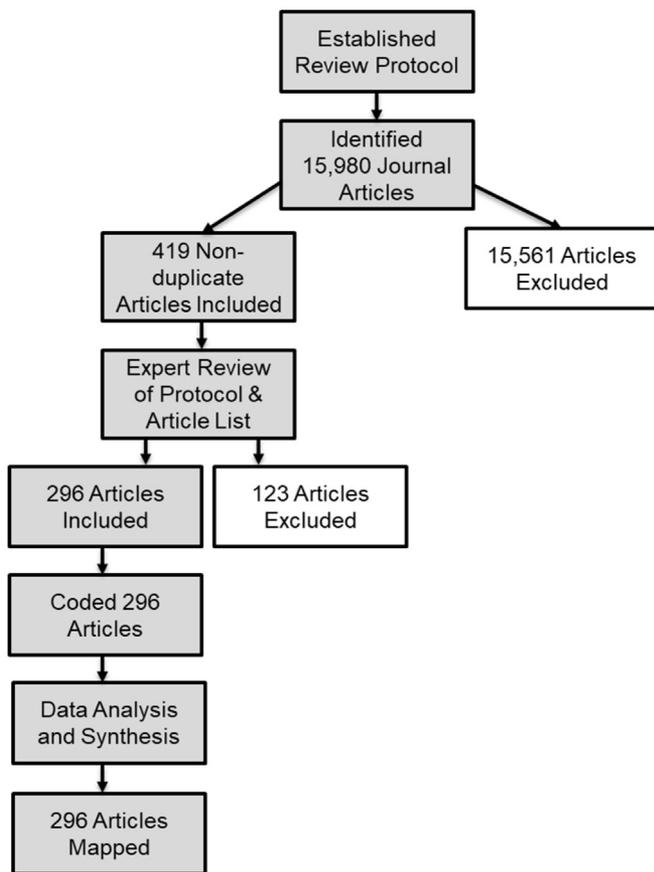


Figure 1. Overview of review process from protocol development to synthesis executed from September 2017 to November 2018.

abstracts and titles of the resulting articles against the inclusion criteria.

After the completion of the first phase of key word searches, we consulted multiple rangeland social science experts on the review protocol and the identified citations (Pullin & Steward 2006). These materials were physically and electronically disseminated at the *Rangeland Social Science Gathering 2018*, a meeting of rangeland social scientists during the 2018 Society for Range Management Annual Meeting in Sparks, Nevada. The approximately 20–25 attendees were recruited for expert debrief of the key word terms, the identified literature body, and the overall review protocol. Attendees identified omissions related to concepts of collaboration and Indigenous peoples, and due to this feedback, we included additional terms in a second round of key word searches that resulted in the inclusion of additional articles. This process improved the content and construct validity of the systematic map (Sampson et al. 2009).

The complete key word search identified 15 980 articles. We applied the inclusion criteria at the title and abstract level and identified 2 016 articles. Lastly, we eliminated duplicates, identifying 419 articles for full-text review. We retrieved and downloaded, as pdfs, 419 articles through open-access means or university subscription services. We used a Google Form (Appendix A) for data extraction and coding, creating the systematic map database in *Microsoft Excel* (version 1808). We tested our coding protocol with a sample of 10 articles to train all reviewers, confirm the inclusion and exclusion criteria, and finalize the data collection tool. Questions with a low level of agreement between reviewers were either discarded or reworded and/or labeled with further clarification.

Table 1

Key word terms searched with all permutations of the *Primary* and *Secondary* terms joined with the Boolean operator *AND* (e.g., “Grass* landowner” AND Survey) in Web of Science from ≈ October 2017 to February 2018. The use of an asterisk (*) with the root of a search term returns all forms of the word (e.g., range* returns range, ranges, rangeland, and rangelands).

Primary	Secondary
“Grass* landowner”	Survey
Rangeland	“Focus group”
Livestock producer	Interview
Permittee	Extension
Landowner	Decision*
Rancher	Motivation
Range* manager	“Native American”
Agency employee*	“American Indian”
Ranch*	“African American”
Range* operator	“Asian American”
	Race
	Ethnicity
	Value*
	Perception
	Attitude*
	Planning
	Behavior
	Policy
	Knowledge
	Gender
	Hispanic
	Innovation*
	Adoption
	Collaboration ¹
	Indigenous ¹

¹ Indicates that the term was added in a second round of key word searches based on stakeholder feedback.

Full-Text Review and Coding

The first four authors of this paper (C. J., E. D., J. B., K. J.) completed the full-text review of the articles and were trained to exclude articles conservatively and indicate papers that required a second review, which was completed by a different reviewer. If there were discrepancies between the two reviewers, the third reviewer was engaged in the final inclusion decision. During full-text review we excluded an additional 123 articles based on the inclusion criteria, and coded and analyzed data from the remaining 296 papers. The identified articles are available as [Supplemental Materials](#).

In the systematic map database, each item has a unique record including basic article characteristics such as author, title, and year of publication. We extracted the authors’ stated research questions, objectives, and hypotheses and indicated whether they were implicit or explicitly stated. We coded for geographic area studied, academic field and journals, study populations and unit of analysis, data collection and analysis methods, integration of collaborative and participatory approaches, theoretical and methodological frameworks, and how these research elements have changed over time. We defined methodology as the researchers’ choice, integrating philosophical and fundamental assumptions, of how to apply their selected methods (Gay & Weaver 2011; Sprague 2016). We coded a binary response for methodology, selecting yes only if the authors were explicit about the application of a methodology. Otherwise, we did not attempt to deduce the methodology and, rather, indicated that it was not explicit. We followed an identical coding scheme for theoretical frameworks and applied Strauss and Corbin’s (1998) definition of theory as “a set of well-developed concepts related through statements of relationship, which together constitute an integrated framework that can be used to explain or predict phenomena.” The dominant academic field was first determined by the nature of the journal. If the academic field of

the journal was not explicit, the theories applied in the research, the literature cited, and the first author's department were used to identify the dominant academic field, and if no single field could be discerned as dominant, the reviewers selected *interdisciplinary*. When relevant, we identified an applied field, such as range science or human dimensions of natural resources. Otherwise, we coded for a discipline such as *ecology* or *anthropology*. Throughout this paper, we generally refer to both applied fields and disciplines as *academic fields*.

We also had an a priori interest in which populations are engaged as research participants or subjects and the degree to which rangeland social science addresses questions related to individual or intersecting social identities and power relationships (Crenshaw 1989, 1997; Nash 2008). Thus, we coded if and how the research considered the individual attributes/identities of gender, race or ethnicity, age, and education, and ranch operation characteristics of income and operational scale. If one but only one of the identities or characteristics listed earlier (e.g., gender) was considered, we coded the paper as *considers attributes/identities or operation characteristics as singular and stand-alone*. Next, if two or more attributes/identities or characteristics were considered, we coded papers as *considering attributes/identities or operation characteristics as multiple, simultaneous, and intersecting or multiple, intersecting, and marginalizing within structures of power*. By identity we mean the self-categorization of an individual's role in society, such as one's gender, occupation, and race (Stets & Burke 2000; Stryker & Burke 2000). Social location denotes how a person's identities define their position in history and society, such as the historical influence of gender on women's engagement in labor markets (Anthias 2012). In total, we extracted 48 data fields, with 27 close-ended categories and 21 open-ended fields. The data are publicly available in Mountain Scholar: <https://doi.org/10.25675/10217/195227>.

Analysis

After data cleaning, we analyzed and visualized the qualitative data in R 3.5.1 using the *ggplot2* and *RColorBrewer* packages (R Core Team 2013; Neuwirth 2014; Wickham 2016). First, we calculated descriptive statistics (frequencies) on all closed-ended categorical data items (e.g., studied population, research method). Second, to assess changes over time in studied populations and research methods, we compared the relative frequency of response types by decade. Third, to understand and display the geographical locations of social science research over time, we used Python with packages *Matplotlib*, *NumPy*, and *Pandas* to conduct a spatial-temporal analysis and produce maps (Oliphant 2007; Hunter 2007; McKinney 2010).

Fourth, to identify trends in research objectives across our sample and over time, we conducted a content analysis on the research objectives text (Elo & Kyngäs 2008). If no research objective was identified, we analyzed text describing the research question. We used content analysis because this method considers spatial and temporal trends and is both systematic and replicable (Stemler 2001). We coded text describing research objectives using a combination of a priori codes, or codes predetermined before examining the data, and emergent codes, codes that were identified from and through the reading of the data (Denzin & Lincoln 2008). Given our familiarity with the rangeland social science literature, we were aware of the prevalence, both explicit and implicit, of innovation theory (i.e., adoption or diffusion of innovations). Therefore, we created the following a priori codes to allow a more nuanced understanding of studied predictors or drivers of adoption of innovations: *attributes as predictors/drivers of adoption*, *perceptions and attitudes as predictors/drivers of adoption*, and *social dynamics/power as predictors/drivers of adoption*; we recoded all

articles related to adoption into these categories (Rogers 2003). We also coded the text of research objectives for all papers using emergent codes and grouped these codes into categories: *adoption*, *conservation*, *collaboration*, *management behavior*, *project/program design and evaluation*, *history of ranching and rangelands*, *adaptation and decision making*, *economics and agribusiness*, *identity*, and *social context*.

Lastly, we used VOSviewer (van Eck & Waltman 2009) to conduct a bibliometric citation analysis to explore the network patterns among journals that have published rangeland social science literature. In the selected analysis, VOSviewer represented each journal with a circle sized relative to the number of articles published in the journal. We used VOSviewer to determine the relatedness of journals by the number of times they cite each other, and VOSviewer visualized these cross-journal citations through clusters and links, with tightly clustered and linked journals indicating a high number of relative citations (van Eck & Waltman 2009).

Results

Spatial and Temporal Trends in North American Rangeland Social Science

The literature review process resulted in a total of 296 rangeland social science journal articles published between 1970 and 2017. With three articles published between 1970 and 1979, three articles from 1980 to 1989, 46 articles from 1990 to 1999, 86 articles from 2000 to 2009, and 158 articles published between 2010 and 2017, there is an upward trend of published rangeland social science literature in North America from 1970 to 2017 (Fig. 2).

The literature body spans 21 academic fields across the social sciences, biological sciences, and humanities with rangeland science (34%) and human dimensions of natural resources (12%) contributing the most articles (Table 2). Accompanied by the trend of increased publications over time is a geographic expansion of the study location. For a full 3 decades, early rangeland social science publications were based on populations and topics based in the United States with research focused on Canada and Mexico not emerging until the 2000s (Fig. 3).

Citation and Journal Trends

The bibliometric citation analysis by source examined the relatedness of journals by the number of times they cite each other

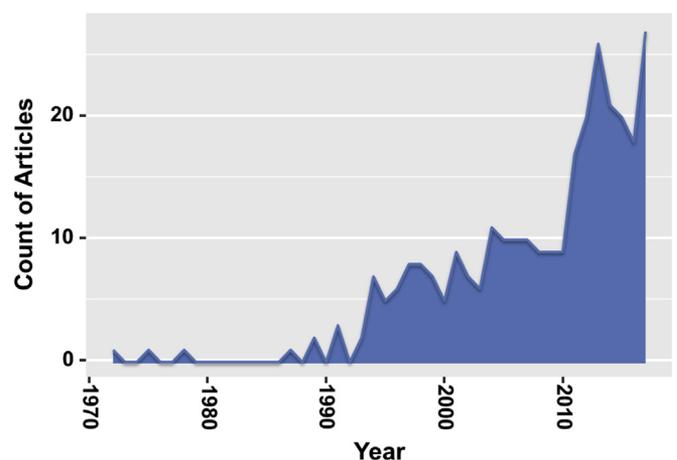


Figure 2. Plot of count of North American rangeland social science journal articles by year published from 1970 to 2017 ($n = 296$ articles).

Table 2

Academic fields represented in the article sample with the academic field identified first by the journal and, if unclear, the disciplinary approach, literature cited, and first author's department.

Academic field	No. of articles	% Of articles
Rangeland science	100	34
Human dimensions of natural resources	35	12
Economics	30	10
Ecology (social focus)	25	8
Agriculture/Animal science	24	8
History	15	5
Geography	13	4
Anthropology/Ethnobotany	10	3
Sociology	5	2
Education and extension	5	2
Ethics and philosophy	5	2
Wildlife	5	2
Social psychology	4	1
Interdisciplinary	4	1
Conservation	4	1
Organizational science	3	1
Veterinary medicine	3	1
Public health/Human development	3	1
Political science	1	< 1
Engineering	1	< 1
Humanities-English	1	< 1

(van Eck & Waltman 2009). The citation links, indicated by lines between circles, represent citations between journals. With 71 out of the 296 journal articles in *Rangeland Ecology & Management* (REM), it is the most prominent journal in our rangeland social science literature sample with 1 121 citation links to a wide diversity of 121 other journals in the literature body. *Society & Natural Resources* and *Wildlife Society Bulletin* are the second most prominent journals, each publishing 15 articles with a total of 333 citations and 345 citations, respectively. The size of the circles in Figure 4 represents the relative count of the articles, showing the prominence of REM, even though only 25% of articles were published here. Of the 121 journals, 64 journals are clustered on the basis of the high number of citations across journals. Relatedness was calculated on the basis of citation occurrence using the association strength similarity measure (Van Eck & Waltman 2007). Fifty-seven journals are external to the central clusters. The full list of journals are in Appendix B disaggregated by external and internal to the citation clusters, accompanied by the associated number of articles and citations by journal.

Study Populations and Research Methods

In the 296 papers that met our criteria, we found that 81% of rangeland social science papers were centered on ranchers (66%), farmers (22%), or landowners (22%). Less consideration has been given to land managers (14%), rangeland organizations (e.g., grazing associations) (11%), the general public (10%), Indigenous communities (3%), scientists/researchers (3%), stakeholders such as youth (2%), other resource users such as hunters (2%), and Extension professionals (1%) (Table 3).

When disaggregated by decade, the trend of ranchers as the dominant study population persists (Fig. 5). The literature body remains skewed toward the study of ranchers, but the diversity and abundance of populations increases through time with six populations studied between 1970 and 1989 and 13 populations considered between 2010 and 2017.

The most frequently used research methods are surveys (52%) and interviews (33%; Fig. 6). The category totals for data collection methods are noncumulative with some articles coding to multiple categories. For example, if a survey of predetermined questions was administered but it was preceded by exploratory interviews or had

a standalone structured interview section, the article would be coded for both *survey* and *interview*. When temporally disaggregated, the dominance of survey and interview research remains consistent through the decades, but like with the study population, there is a greater diversity of data collection methods over time. Moreover, only 34% of the rangeland social science literature has been presented as grounded in a theoretical framework (Table 4). Forty-two percent of the selected articles explicitly named a collaborative partner, but only 8% of articles include a participatory element.

Content Analysis of Research Objectives and Questions

A content analysis of the research objectives highlights the prevalence in the literature of concepts related to adoption of technologies or conservation/management (53%). Within the subset of the literature on adoption, many papers consider management behavior (40%). The research in the adoption subset is often focused on attributes of sampled individuals or operations (63%), such as rancher attributes/identities (e.g. age, education) and operation characteristics (e.g., operational type and scale), which are associated with or predict adoption of innovations. While 38% of articles researched perceptions and attitudes regarding a technology or practice, only 17% considered factors additional to attributes and perceptions, such as power, politics, and historical context. In addition to adoption, conservation (21%) and collaboration (13%) emerge as prevalent concepts, with the first paper coded to collaboration appearing in 1991.

Attributes and Identity

Both the content analysis of the research objectives and the close-ended coding applied to the full-text identified operation characteristics, such as operational scale and income, and their relationship to rancher attitudes or practices as the dominant focus of the literature (Table 5; Fig. 5). In contrast, race or ethnicity (not mentioned in 82% of articles) and gender (not mentioned in 72% of articles) are the least considered attributes/identities. In addition, only 5% of the articles consider power dynamics or marginalized social locations (e.g., women, racial or ethnic minorities, youth) in the rangeland social science literature. The evidence gap map displays attribute/identity or operation characteristics on the x-axis and the dimensions for how attributes/identities or operation characteristics are considered on the y-axis (Fig. 7). Figure 7 graphically highlights gaps where few articles exist and where there is a concentration of research. For instance, while a relatively high number of articles consider age (128 articles), only five papers examine how age intersects with other attributes/identities to marginalize individuals (e.g., succession challenges of older, low-income producers).

Discussion

Although rangeland science conceptually acknowledges the connection between environmental concerns and social processes (Stoddart 1965; Watson 2005; Ostrom 2009; Brunson 2012; Hruska et al. 2017), the volume of rangeland social science literature in North America remains relatively small when compared with the associated rangeland ecology literature. For example, Sherren and Darnhofer (2018) analyzed REM and found that 1 of 61 published papers in 2016 was social science and 5 of 77 papers published in 2011 were social science. Furthermore, our results indicate that rangeland social science has focused predominately on ranchers, with limited consideration of gender, race, or ethnic identities. While a diversity of 121 journals published studies in the literature body, the majority was survey research from applied natural

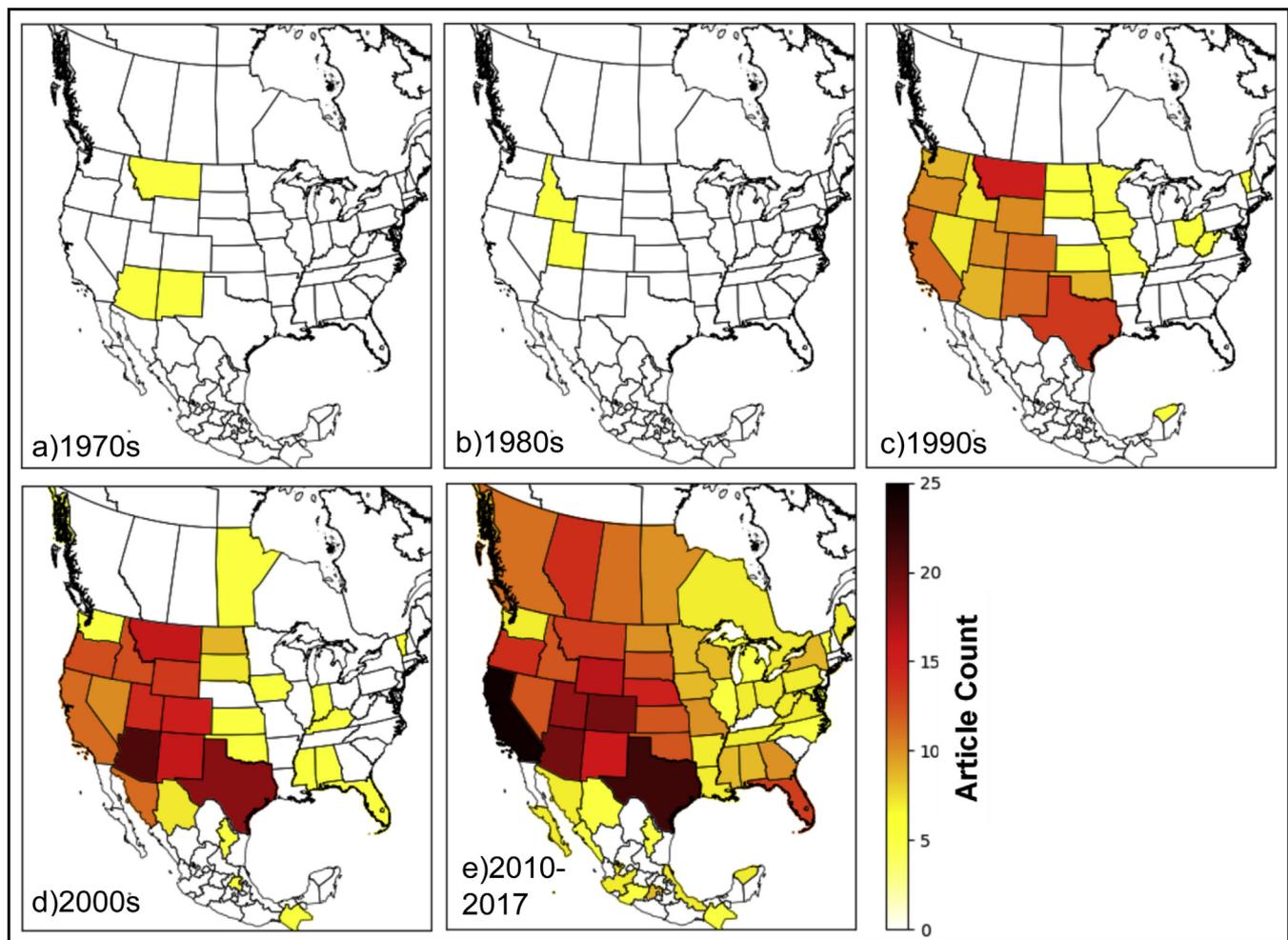


Figure 3. The count of the geographic location of the people and topics studied in the rangeland social science literature by state or province in the a, 1970s, b, 1980s, c, 1990s, d, 2000s, and e, 2010–2017.

resource fields. In view of this relatively untapped potential, we focus our discussion of the preceding results on how rangeland social science can evolve to more equitably and effectively address pressing topics, rather than a critical appraisal of specific articles or questions.

Reaching Beyond Ranchers in Rangeland Social Science

The majority of the articles study ranchers, with less frequent investigation of other rangeland stakeholders such as natural resource management agency employees, ranch workers including guest workers, and the general public, for example. While ranchers are a critical population to engage as they have made and continue to make significant contributions to rangelands, there exists an opportunity to diversify the study populations engaged in our research. This research gap may link to knowledge gaps of how diverse rangeland stakeholders perceive new technologies, how they make decisions, and what their attitudes are toward rangelands. While many populations remain understudied, Barry's (2014) research on the public's perception of rangelands on social media and Plunkett et al.'s (1999) gender-disaggregated research of farm and ranch adolescents undergoing family transition both begin the work of integrating a diversity of voices and viewpoints into rangeland science. To understand the diversity of management decisions on rangelands, we recommend more comprehensive

consideration of all rangeland stakeholders. Research methods and methodologies such as stakeholder mapping (Bryson 2004) could support rangeland decision makers, researchers, and Extension agents to better understand the varied social and economic systems of North American rangelands. Stakeholder mapping is used to identify participants in a system and understand factors such as their needs, level of engagement, and interests. In North American rangeland systems, we propose that stakeholder mapping could support our understanding of the diversity of people engaged in rangeland systems, their needs, and how they could be effectively engaged in future research.

Social Identities and Dynamics on Rangelands

The existing rangeland social science literature has contributed significant knowledge related to adoption of innovations but seldom considers how gender, race, or ethnic identities influence such decisions. In addition, our results indicate that few studies consider class, or the intersection of multiple social identities (e.g., Indigenous women), and how these factors may affect an individual's access to and management of resources. The content analysis of the research objectives and questions revealed that adoption of innovation and management behavior are the most frequently studied concepts in the North American rangeland social science literature. While operation characteristics (e.g., operation

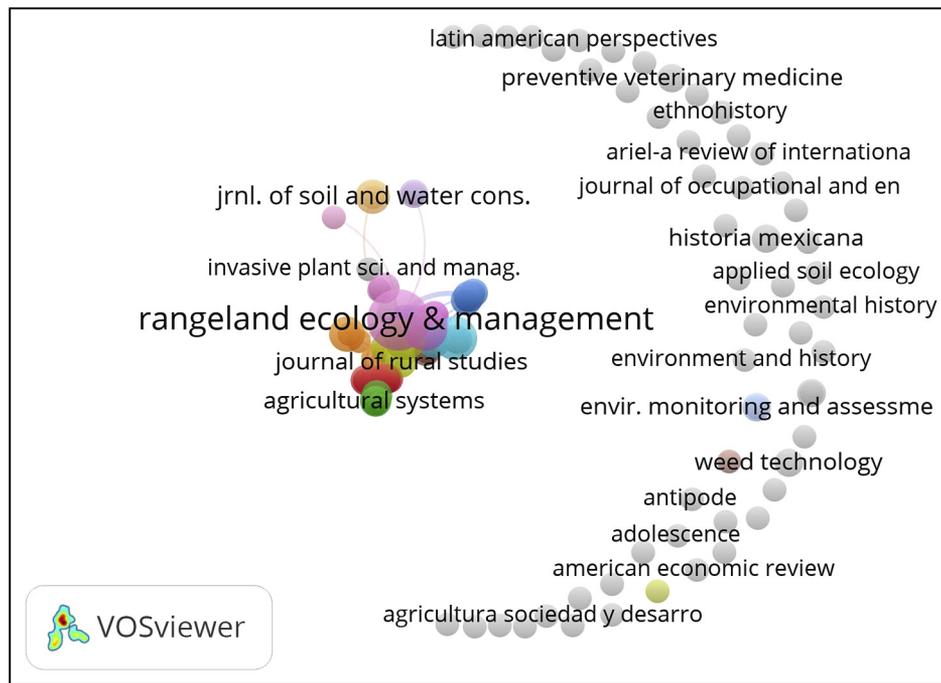


Figure 4. Citation network map by journal. The central rangeland social science clusters, determined by citations across sources, present high relatedness across 64 journals (Appendix B). The crescent of unconnected nodes displays 57 journals with low relatedness by citation to the central clusters. The sizes of the circles represent the relative count of the articles, showing the prominence of *Rangeland Ecology & Management* (largest, central circle).

type or scale) and specific individual attributes/identities (e.g., age, education, income) are linked to concepts of adoption (Parente & Prescott 1994; El-Osta & Morehart 1999; Fernandez-Cornejo et al. 2007), the lack of research on topics such as gender, class, race, or ethnicity limit the research and Extension communities' understanding of diverse needs in rangeland communities. Moreover, an

individual's relationship to the research process often affects his or her level of influence or perceived credibility, and the exclusion of people of color, women, youth, and groups of lower socioeconomic status as research subjects or coresearchers can reinforce existing power dynamics (Harding 2006). While there is limited research that considers gender, ethnicity, or race, McCurdy and Kwan's

Table 3

Data collection method, data analysis method, study population, and unit of analysis for the selected 296 articles. Category totals are noncumulative with some articles classified into multiple nonexclusive categories.

Data collection method	No. articles	% of articles	Unit of analysis	No. articles	% of articles
Survey	154	52	Individual	202	68
Interview	99	33	Group	76	26
Literature review	49	17	Household/Operation	63	21
Archival/Document	28	9	Community	33	11
Focus group	15	5	Agency/Org.	16	5
Participant observation	15	5	Ecological unit	12	4
Ecological/Ag.	15	5	Literature/Doc.	5	2
Workshop	9	3	Project	3	1
Social media	2	1	Other	4	1
Other	10	3	Unclear	10	3
Unclear	8	3			
Data analysis method	No. articles	% Of articles	Study population	No. articles	% Of articles
Descriptive statistics	182	61	Ranchers	196	66
Inferential statistics	132	45	Farmers	64	22
Multivariate statistics	28	9	Landowners	64	22
Noncomp. case study	27	9	Land managers	40	14
Economic model	26	9	Org(s)/Group(s)	33	11
Doc/Archival analysis	18	6	General public	31	10
Thematic/Content	16	5	Indigenous peoples	10	3
Grounded theory	13	4	Ecological/Ag.	10	3
Literature review	13	4	Literature or project	9	3
Comp. case study	8	3	Scientific community	9	3
Model	7	2	Resource users	7	2
Simulation model	5	2	Cattle producers	6	2
Narrative analysis	4	1	Youth	6	2
Policy	1	<1	Extension	3	1
Other	23	8	Other	12	4
Unclear	4	1			

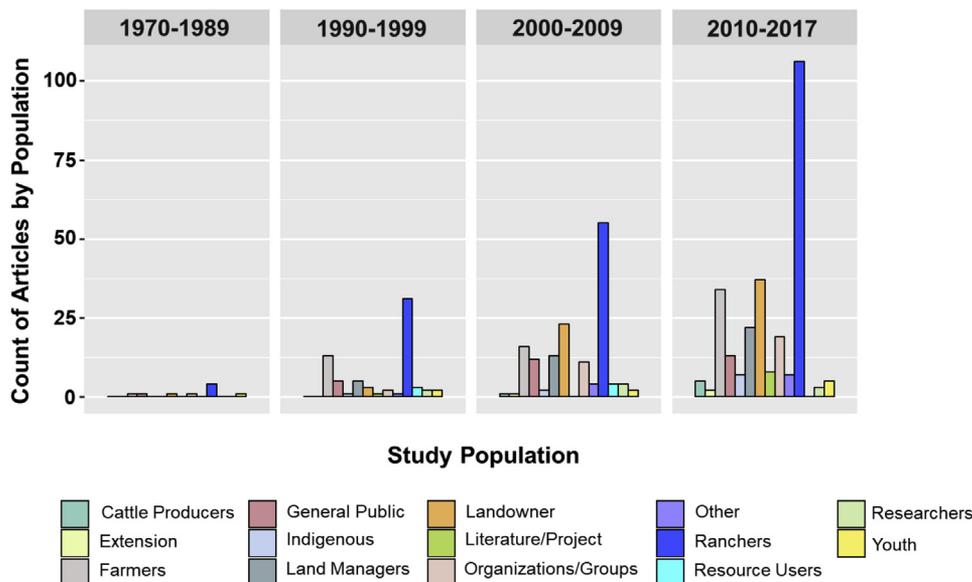


Figure 5. Article counts by decade with the bar color indicating the human population studied (ecological/agricultural populations not included). Category totals are noncumulative with some articles classified into multiple nonexclusive categories.

(2012) study of ethnic and gender differences in rural youth and Arnold and Fernández-Giménez’s (2007) grounded theory approach to collaboration on tribal rangelands serve as examples of works that consider these factors.

Beyond the inclusion of concepts of race, class, gender, and ethnicity, there is a need to consider how these identities interrelate. Rangelands as social-ecological systems exist within complex cross-scale political, ecological, economic, and social systems (Huntsinger & Oviedo 2014; Hruska et al. 2017; Sayre 2017). Gender, class, and race relate to dynamics of power within such systems, and rangeland social science’s minimal consideration of these dynamics limits our understanding of how diverse stakeholders make decisions on the landscape. While Sayre et al.’s research (2013) serves as an example that considers concepts of

power, there remains an opportunity for rangeland social scientists to more broadly and deeply address how diverse identities, social locations, and power shape rangeland management and its outcomes. This gap could be addressed by engaging diverse researchers, such as feminist scholars, who focus on issues of inequity of gender, race, ethnicity, and class (Sprague 2016). For example, intersectionality is a feminist theory that considers the interactions among marginalized identities such as race, gender, and class (Crenshaw 1990, 2018; Davis 2008; Nash 2008; Sprague 2016). Rangeland literature has explored the experiences of women (e.g., Wilmer & Fernández-Giménez 2016) and Indigenous communities (e.g., Garcia-Bernal 1994) on rangelands, but an intersectional framework would consider the unique experience of being an Indigenous woman, for example. In addition, as the

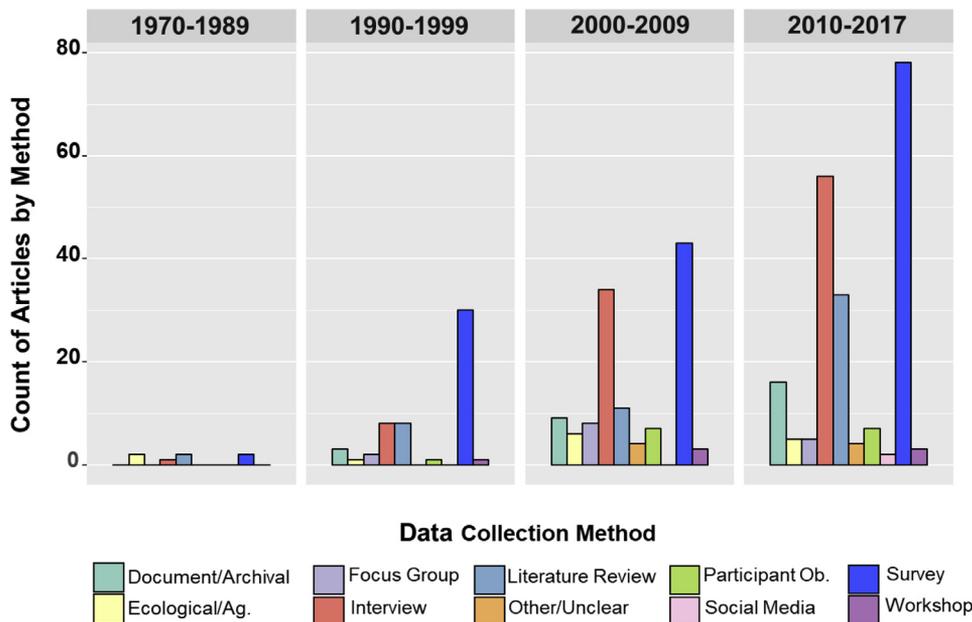


Figure 6. Article counts by decade with the bar color indicating the data collection method used. Ecological/Ag. serves as an overarching category to account for any biophysical data collection method (e.g., soil samples, precipitation measures) used in studies with both ecological and social research. Category totals are noncumulative with some articles classified into multiple nonexclusive categories.

Table 4

Percent of selected articles that state a research objective, question, hypothesis, and collaborative partner and percent of articles that employ a theoretical framework, methodological framework, and participatory methods. For all questions, 296 articles were coded and responses were dichotomous with either *yes* or *no*.

	No. articles	% Of articles (yes)
Research objective stated	289	98
Research question stated	80	27
Research hypothesis stated	207	70
Methodological framework considered	48	16
Theoretical framework considered	102	34
Collaborative partner explicitly mentioned	123	42
Participatory research component	23	8

average age of manager populations increases, rangeland social science could build a better understanding of the experiences and challenges of range managers and ranchers throughout decision makers' lifetimes and through various levels of physical ability that address issues of ranch succession. For example, [Fischer and Burton \(2014\)](#) documented endogenous cycles of farm succession in Scotland, describing the cocreation of a "succeedable" farm and a successor over time to better explain barriers to farm succession. We encourage rangeland social scientists to identify such knowledge gaps related to identity and power in rangeland systems. However, to address such gaps, the rangeland research community must also deepen collaborations with researchers from other fields, such as feminist and critical race studies. Just as economists and human dimensions researchers contributed to early rangeland

Table 5

Level of consideration of individual attributes/identities (e.g., gender, race or ethnicity), operation characteristics (e.g., operational scale), and dynamics of power and social location. For all questions, 296 articles were coded and responses were dichotomous with either *yes* or *no*.

	No. articles	% Of articles (yes)
Consideration of gender		
Used in analysis	38	13
Sample described	35	12
Mentioned	11	4
Not mentioned	212	72
Consideration of race or ethnicity		
Used in analysis	31	10
Sample described	7	2
Mentioned	15	5
Not mentioned	243	82
Consideration of age		
Used in analysis	64	22
Sample described	49	17
Mentioned	15	5
Not mentioned	168	57
Consideration of education		
Used in analysis	54	18
Sample described	41	14
Mentioned	23	8
Not mentioned	178	60
Consideration of class, socioeconomic status, or income		
Used in analysis	93	31
Sample described	44	15
Mentioned	38	13
Not mentioned	121	41
Consideration of operational scale		
Used in analysis	96	32
Sample described	54	18
Mentioned	47	16
Not mentioned	99	33
Consideration of power and identity		
Power and intersecting marginalized social identities	16	5
Simultaneity of interacting social identities	47	16
No consideration	233	79

social science, scholars from other social science fields and the humanities have the potential to contribute quality research that deeply explores and critically analyzes the social complexity and diversity of North American rangelands.

Diverse Social Sciences on Rangelands

Rangeland science (34% of the 296 articles) and human dimensions of natural resources (12%) represent the two most common academic fields in the sample, reflecting the prominence of integrated natural and social science research ([Sherren & Darnhofer 2018](#)). Specific to the social sciences, the following academic fields contribute three or more articles to the sample: economics (10% of the 296 articles), history (5%), geography (4%), anthropology and ethnobotany (3%), sociology (2%), education and extension (2%), social psychology (1%), and organizational sciences (1%). Social science is an overarching category of academic disciplines, and there are several prominent social science disciplines or fields that are either underrepresented or not found in our sample. The lack of prominent areas of study such as ethnic studies, communications, women's studies, and community development is notable. Research by rangeland scientists reviewed in this paper have popularized social inquiry on rangelands, such as the study of livelihoods (e.g., [Coles & Scott 2009](#)), social-ecological services (e.g., [Huntsinger & Oviedo 2014](#)), and cultural resilience (e.g., [Wilmer & Fernández-Giménez 2016](#)). But, as rangeland demographics change ([Sheridan 2001](#); [Sagoff 2003](#)), recreation continues to expand on public lands ([Miller et al. 2001](#); [Taylor & Knight 2003](#)), and social and political change affects agricultural markets ([Archer et al. 2008](#)), rangeland social science will likely need to diversify to cope with such dynamic changes.

[Peterson and Horton's \(1995\)](#) use of mythic criticism of rancher discourse and [Sluyter's \(2015\)](#) analysis of Africans' impacts on cattle ranching in the Americas are examples of social questions, theories, and methods that are underrepresented in the rangeland social science literature. [Peterson and Horton's \(1995\)](#) use of critical theory on public policy discourse contributes knowledge on rancher perceptions and identity and serves as an example of the application of innovative social science approaches and methods. In addition, only 5% of the rangeland social science articles constitute historical research, but this subset contains works that research Indigenous communities and the history of North American colonization (e.g., [Garcia-Bernal 1994](#); [Sanderson 2011](#)). In a literature body often focused on the individual and applied management questions, such works contribute significantly to concepts of social dynamics and the historical context of rangelands. Further inclusion of more diverse epistemologies, theoretical frameworks, methodologies, and methods could expand how we study and understand rangelands as historical, cultural, and social-ecological landscapes. At the *Rangeland Social Science Gathering 2018*, leading scholars brainstormed that the implementation of rangeland social science curricula, the recruitment of social science faculty in rangeland departments, social science editors for REM, and interdisciplinary collaborations with social science principal investigators are actionable ways to diversify and further develop rangeland social science (personal communication, January 26, 2018).

Opportunities for Interdisciplinary Research

The identified rangeland social science articles span at least 22 different academic fields and 121 journals from both the social sciences and natural sciences, suggesting the importance of rangelands to a diversity of social and natural science researchers. We also found significant contributions to the rangeland social science literature from the natural sciences, notably agriculture and animal science (e.g., [Hendrickson et al. 2008](#); [Turner et al. 2016](#); [Laforge](#)

Attribute/identity or operation characteristic

Dimension of consideration	Attribute/identity or operation characteristic						
	Operational scale	Class, socio-economic status, or income	Age	Education	Sex and gender	Race and ethnicity	
Singular and stand-alone	152	122	87	74	52	23	
Multiple, simultaneous, and intersecting	34	40	36	35	25	17	
Multiple, intersecting, and marginalizing within structures of power	11	13	5	9	7	13	

Figure 7. Evidence gap map for the rangeland social science literature. The numbers indicate the count of articles that research the attribute/identity or operation characteristic on the x-axis and the associated dimension of how these attribute(s)/identity(s)/characteristic(s) are considered on the y-axis. The color gradient represents the count of articles, with white representing a low count (0–25 articles) and increasing article counts represented by darker shades of blue.

et al. 2017) and wildlife management (e.g., Irby et al. 1997; Stronen et al. 2007; Parks & Messmer 2016). In addition, the bibliometric citation analysis displays a high number of journals (57 journals) with low levels of citation by and of the central clusters (64 journals) of rangeland social science. This indicates that many researchers and academic fields are doing social research on rangelands but remain disconnected from the central rangeland social science literature body. Opportunities exist to cultivate broader research and perspectives through interdisciplinary research that integrates multiple academic disciplines (Tress et al. 2005). Such interdisciplinary work can extend our ability to address dynamic social-ecological challenges, such as climate change (Yung et al. 2015; Havstad et al. 2018), land use change (Huntsinger & Fortmann 1990; Huntsinger et al. 1997; Huntsinger et al. 2010), and rapid demographic changes in the western US (Lorah & Southwick 2003).

Diverse Methods for Diverse Inquiry

Survey (52% of the 296 articles) and interview (33%) research have made significant contributions to the rangeland social science literature (e.g., Brunson & Steel 1996; Huntsinger et al. 1997, 2010a, 2010b; Liffmann et al. 2000; Kreuter 2001, 2005; Fernández-Giménez et al. 2005; Meador et al. 2011; Sorice 2012). As our research questions change, it is likely that our methods will also diversify. For example, as we seek more knowledge on the subjective lived experience, an ethnographic or oral history study may be most appropriate. In addition, a strength of the sample is that 42% of the literature listed the name of a collaborative partner, but only 8% of the research was evidently participatory. This demonstrates that while our research often involves collaboration, there is an opportunity to apply participatory methods when appropriate. The combined emphasis on lived experience, reflection, and reflexivity of participatory methods and methodologies could further contribute to our need for more inclusion, diversity, and consideration of power in rangeland systems (McTaggart 1991; Baum et al. 2006). In addition, much rangeland social science is not explicitly framed by a theory. We hypothesize that this gap is linked to the applied nature of the field. While this applied management approach has contributed significantly to range management, the use of theory enables researchers to build from and onto existing knowledge. For example, Toledo et al. (2014) explicitly apply social exchange theory (Cropanzano & Mitchell 2005) and Waage (2001) draws from the theory of nation-building (Anderson 1983), contributing to the application and development of theory in rangeland social science. Given the historical focus of rangeland science on applied questions, we have the opportunity to explore the complementary relationship between applied research and theory,

using applied research to test theory and theory to guide applied inquiry (Hawkins 1978). In addition, greater theoretical contributions could further foster the application of social science theories, methodologies, and methods to the critical questions of rangeland science and other adjacent social science fields (Sherren & Darnhofer 2018).

Implications

Research Implications

Given the recent increase of peer-reviewed North American rangeland social science, this systematic map takes stock of what has been done and highlights knowledge gaps for researchers, funders, and practitioners. We speculate that social science on North American rangeland systems has been historically constrained by the limited rangeland social science curriculum and few opportunities for cross-disciplinary exchange. We propose that greater inclusion of social sciences in rangeland curricula and recruitment of social scientists into rangeland departments could contribute to the expansion of social inquiry in rangeland science and management. An analysis of rangeland curricula across North American universities could identify education gaps and illuminate opportunities for deeper integration of rangeland social science scholarship. Further, *Rangeland Ecology & Management* is the most prominent journal related to rangelands, but the identified rangeland social science literature spans 121 journals. This diverse distribution of rangeland social science suggests an opportunity to connect more broadly with researchers and fields that share a common interest in rangelands. Although this research is focused on North America, future research could extend this systematic map and bibliometric research to the international rangeland science literature. We speculate that opportunities for collaboration and interdisciplinarity would emerge, most notably across the research traditions of the Global North and South.

A major gap revealed by this review is the relative paucity of North American social science research on rangeland stakeholders other than ranchers, landowners, and farmers, such as the general public and rangeland recreational users, to name a few. Thus, there are opportunities for future research, such as stakeholder mapping, that explore the diversity of rangeland stakeholders and their social, economic, and conservation networks. We posit that diversifying the research populations will lead to a shift in the research questions, and with this shift, there will likely be a need to employ a wider breadth of research methods, methodologies, and theories. As rangeland science starts to engage more diverse populations and considers social identities and dynamics on rangelands, there are opportunities to learn from and collaborate with diverse social

sciences such as feminist and ethnic studies. Finally, we propose that a next step of this map is a systematic review of the findings from the research body, especially on the large subset of adoption of innovation literature. Research questions could include “What factors are studied as predictors to or correlated to adoption, which have been significant predictors of adoption and how much of adoption behavior do they explain?” and “What do we know about effective processes for promoting adoption?” Just as the rangeland ecology paradigm strives to incorporate the complexity of rangelands at scale, rangeland social science must also capture the diversity of social settings to effectively contribute to sustainable and equitable resource management.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.rama.2019.10.005>.

References

- Aboeela, S.W., Larson, E., Bakken, S., Carrasquillo, O., Formicola, A., Glied, S.A., Haas, J., Gebbie, K.M., 2007. Defining interdisciplinary research: conclusions from a critical review of the literature. *Health Services Research* 42, 329–346.
- Anderson, B., 1983. *Imagined communities: reflections on the origin and spread of nationalism*. Verso Books, Brooklyn, New York, USA.
- Anthias, F., 2012. Hierarchies of social location, class and intersectionality: towards a translocational frame. *International Sociology* 28, 121–138.
- Archer, D.W., Dawson, J., Kreuter, U.P., Hendrickson, M., Halloran, J.M., 2008. Social and political influences on agricultural systems. *Renewable Agriculture and Food Systems* 23, 272–284.
- Arksey, H., O'Malley, L., 2005. Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology* 8, 19–32.
- Arnold, J.S., Fernández-Giménez, M., 2007. Building social capital through participatory research: an analysis of collaboration on Tohono O'odham tribal rangelands in Arizona. *Society and Natural Resources* 20, 481–495.
- Barry, S.J., 2014. Using social media to discover public values, interests, and perceptions about cattle grazing on park lands. *Environmental Management* 53, 454–464.
- Baum, F., MacDougall, C., Smith, D., 2006. Participatory action research. *Journal of Epidemiology and Community Health* 60, 854–857.
- Berrang-Ford, L., Pearce, T., Ford, J.D., 2015. Systematic review approaches for climate change adaptation research. *Regional Environmental Change* 15, 755–769.
- Bhattacharjee, A., 2012. *Social Science Research: Principles, Methods, and Practices*. Textbooks Collection. 3. South Florida Scholar Commons, Tampa, FL, USA. Available at: http://scholarcommons.usf.edu/oa_textbooks/3. Accessed October 22, 2018.
- Briske, D.D., Fuhlendorf, S.D., Smeins, F.E., 2003. Vegetation dynamics on rangelands: a critique of the current paradigms. *Journal of Applied Ecology* 40, 601–614.
- Briske, D.D. (Ed.), 2011. *Conservation benefits of rangeland practices: assessment, recommendations, and knowledge gaps*. United States Department of Agriculture, Natural Resources Conservation Service, Washington, DC, USA.
- Briske, D.D., 2017. Rangeland systems: foundation for a conceptual framework. In: Briske, D.D. (Ed.), *Rangeland systems: processes, management and challenge*. Springer, Cham, Switzerland, pp. 1–21.
- Brunson, M.W., 2012. The elusive promise of social-ecological approaches to rangeland management. *Rangeland Ecology & Management* 65, 632–637.
- Brunson, M.W., Steel, B.S., 1996. Sources of variation in attitudes and beliefs about federal rangeland management. *Journal of Range Management* 49, 69.
- Brunson, M.W., Gilbert, L., 2003. Recreationist responses to livestock grazing in a new national monument. *Journal of Range Management* 56, 570–576.
- Bryson, J.M., 2004. What to do when stakeholders matter: stakeholder identification and analysis techniques. *Public Management Review* 6, 21–53.
- Buys, C.J., 1975. Predator control and ranchers' attitudes. *Environmental Behavior* 7.
- Coles, A.R., Scott, C.A., 2009. Vulnerability and adaptation to climate change and variability in semi-arid rural southeastern Arizona, USA. *Natural Resources Forum* 33, 297–309.
- Colquhoun, H.L., Levac, D., O'Brien, K.K., Straus, S., Tricco, A.C., Perrier, L., Kastner, M., Moher, D., 2014. Scoping reviews: time for clarity in definition, methods, and reporting. *Journal of Clinical Epidemiology* 67, 1291–1294.
- Crenshaw, K., 1989. Demarginalizing the intersection of race and sex: a Black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. *The University of Chicago Legal Forum* 140, 139–167.
- Crenshaw, K., 1990. Mapping the margins: intersectionality, identity politics, and violence against women of color. *Stanford Law Review* 43.
- Crenshaw, K., 1997. Intersectionality and identity politics: learning from violence against women of color. In: Shanley, L., Narayan, U. (Eds.), *Reconstructing political theory*. The Pennsylvania State University Press, University Park, PA, USA, pp. 178–193.
- Crenshaw, K., 2018. Demarginalizing the intersection of race and sex: a black feminist critique of antidiscrimination doctrine, feminist theory, and antiracist politics [1989]. In: *Feminist legal theory*. Routledge, Oxfordshire, England, pp. 57–80.
- Cropanzano, R., Mitchell, M.S., 2005. Social exchange theory: an interdisciplinary review. *Journal of Management* 31, 874–900.
- Davis, K., 2008. Intersectionality as buzzword: a sociology of science perspective on what makes a feminist theory successful. *Feminist Theory* 9, 67–85.
- Denzin, N.K., Lincoln, Y.S. (Eds.), 2008. *Strategies of qualitative inquiry*, 3rd ed. SAGE Publications, Thousand Oaks, CA, USA.
- Dyson-Hudson, R., Dyson-Hudson, N., 1980. Nomadic pastoralism. *Annual Review of Anthropology* 9, 15–61.
- Elo, S., Kyngäs, H., Kyngä, H., 2008. The qualitative content analysis process. *Arctic Journal Advanced Nursing* 62, 107–115.
- El-Osta, H.S., Morehart, M.J., 1999. Technology adoption decisions in dairy production and the role of herd expansion. *Agricultural Resources and Economic Review* 28, 84–95.
- Escobar, A., 1996. Construction nature: elements for a post-structuralist political ecology. *Futures* 28, 325–343.
- Evans-Pritchard, E.E., 1940. *The Nuer: a description of the modes of livelihood of a Nilotic people*. Clarendon, Oxford, England.
- Fernandez-Cornejo, J., Mishra, A., Nehring, R., Hendricks, C., Southern, M., Gregory, A., 2007. *Off-Farm Income, Technology Adoption, and Farm Economic Performance*. Economic Research Report 7234, United States Department of Agriculture, Economic Research Service, Washington, DC, USA.
- Fernández-Giménez, M.E., McClaran, S.J., Ruyle, G., 2005. Arizona permittee and land management agency employee attitudes toward rangeland monitoring by permittees. *Rangeland Ecology & Management* 58, 344–351.
- Fischer, H., Burton, R.J.F., 2014. Understanding farm succession as socially constructed endogenous cycles. *Sociologia ruralis* 54, 417–438.
- Fishbein, M., Ajzen, I., 1975. *Belief, attitude, intention, and behavior: an introduction to theory and research*. Addison-Wesley, Reading, MA, USA.
- Fleischer, T.L., 1994. Ecological costs of livestock grazing in western North America. *Conservation Biology* 8, 629–644.
- García-Bernal, M.C., 1994. The development of cattle-ranches and its effects on the indigenous population of Yucatan. *History of Mexicana* 43, 373–400.
- Gay, B., Weaver, S., 2011. Theory building and paradigms: a primer on the nuances of theory construction. *American International Journal of Contemporary Research* 1, 24–32.
- Harding, S., 2006. *Science and social inequality: Feminist and postcolonial issues*. University of Illinois Press, Champaign, IL, USA.
- Havstad, K.M., Brown, J.R., Estell, R., Elias, E., Rango, A., Steele, C., 2018. Vulnerabilities of southwestern U.S. rangeland-based animal agriculture to climate change. *Climate Change* 148, 371–386.
- Hawkins, D.F., 1978. Applied research and social theory. *Evaluation Quarterly* 2, 141–152.
- Hendrickson, J., Sassenrath, G.F., Archer, D., Hanson, J., Halloran, J., 2008. Interactions in integrated US agricultural systems: the past, present and future. *Renewable Agriculture and Food Systems* 23, 314–324.
- Higgins, J. P. T., and Green, S. [eds.]. 2011. *Cochrane handbook for systematic reviews of interventions*. Version 5.1.0 [updated March 2011]. The Cochrane Collaboration. Available at: <https://www.training.cochrane.org/handbook>.
- Hruska, T., Huntsinger, L., Brunson, M., Li, W., Marshall, N., Oviedo, J.L., Whitcomb, H., 2017. Rangeland systems processes, management and challenges. In: Briske, D.D. (Ed.), *Rangeland systems processes, management and challenges*. Springer, Cham, Switzerland, pp. 263–302.
- Hunter, J.D., 2007. Matplotlib: a 2D graphics environment. *Computer Science Engineering* 9, 90–95.
- Huntsinger, L., Fortmann, L.P., 1990. California's privately owned oak woodlands: owners, use, and management. *Journal of Range Management* 43, 147.
- Huntsinger, L., Buttolph, L., Hopkinson, P., 1997. Ownership and management changes on California hardwood rangelands: 1985 to 1992. *Journal of Range Management* 50, 423.
- Huntsinger, L., Forero, L., Sulak, A., 2010a. Transhumance and pastoralist resilience in the western United States. *Pastoral Restoration Policy Practice* 1, 1–15.

- Huntsinger, L., Johnson, M., Stafford, M., Fried, J., 2010b. Hardwood rangeland landowners in California from 1985 to 2004: production, ecosystem services, and permanence. *Rangeland Ecology & Management* 63, 324–334.
- Huntsinger, L., Oviedo, J.L., 2014. Ecosystem services are social-ecological services in a traditional pastoral system: the case of California's Mediterranean rangelands. *Ecol Soc* 19, art8.
- Irby, L.R., Saltiel, J., Zidack, W.E., Johnson, J.B., 1997. Wild ungulate damage: perceptions of farmers and ranchers in Montana. *Wildlife Society Bulletin* 25, 320–329.
- James, K.L., Randall, N.P., Haddaway, N.R., 2016. A methodology for systematic mapping in environmental sciences. *Environmental Evidence* 5, 7.
- Jeffrey, P., 2003. Smoothing the waters: observations on the process of cross-disciplinary research collaboration. *Social Studies of Science* 33, 539–562.
- Kreuter, U.P., Amestoy, H.E., Kothmann, M.M., Ueckert, D.N., McGinty, W.A., Cummings, S.R., 2005. The use of brush management methods: a Texas landowner survey. *Rangeland Ecology & Management* 58, 284–291.
- Kreuter, U.P., Amestoy, H.E., Ueckert, D.N., McGinty, W.A., 2001. Adoption of brush busters: results of Texas county extension survey. *Journal of Range Management* 54, 630.
- Laforge, J.M.L., Anderson, C.R., McLachlan, S.M., 2017. Governments, grassroots, and the struggle for local food systems: containing, coopting, contesting and collaborating. *Agricultural Human Values* 34, 663–681.
- Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., Thomas, C.J., 2012. Transdisciplinary research in sustainability science: practice, principles, and challenges. *Sustainable Science* 7, 25–43.
- Liffmann, R.H., Huntsinger, L., Forero, L.C., 2000. To ranch or not to ranch: home on the urban range? *Journal of Range Management* 53, 362.
- Lorah, P., Southwick, R., 2003. Environmental protection, population change, and economic development in the rural western United States. *Population Environment* 24, 255–272.
- Martin, L.E., Sorice, M.G., Kreuter, U.P., 2013. Understanding and influencing urban residents' knowledge about wildland management in Austin, Texas. *Urban Ecosystems* 16, 33–51.
- McAdoo, J.K., Schultz, B.W., Swanson, S.R., 2013. Society for Range Management aboriginal precedent for active management of sagebrush-perennial grass communities in the Great Basin. *Rangeland Ecology & Management* 66, 241–253.
- McClaran, M.P., Butler, G.J., Wei, H., Ruyle, G.D., 2015. Increased preparation for drought among livestock producers reliant on rain-fed forage. *Natural Hazards* 79, 151–170.
- McCurdy, S.A., Kwan, J.A., 2012. Ethnic and gender differences in farm tasks and safety practices among rural California farm youth. *Journal of Occupational Environmental Hygiene* 9, 362–370.
- McKinney, W., 2010. Data structures for statistical computing in Python. *Proceedings of the 9th Python in Science Conference*.
- McTaggart, R., 1991. Principles for participatory action research. *Adult Education Quarterly* 41, 168–187.
- Mealor, R.D., Meiman, P.J., Hild, A.L., Taylor, D.T., Thompson, J.S., 2011. New rangeland residents in Wyoming? A survey of exurban landowners. *Rangeland Ecology & Management* 64, 479–487.
- Miake-Lye, I.M., Hempel, S., Shanman, R., Shekelle, P.G., 2016. What is an evidence map? A systematic review of published evidence maps and their definitions, methods, and products. *Systematic Review* 5, 28.
- Milchunas, D.G., Lauenroth, W.K., 1993. Quantitative effects of grazing on vegetation and soils over a global range of environments. *Ecological Monographs* 63, 327–366.
- Miller, S.G., Knight, R.L., Miller, C.K., 2001. Wildlife responses to pedestrians and dogs. *Wildlife Society Bulletin* 29, 124–132.
- Nash, J.C., 2008. Re-thinking intersectionality. *Feminist Review* 89, 1–15.
- Neuwirth, E., 2014. RColorBrewer: ColorBrewer palettes. R package version 1.1-2. Available at: <https://CRAN.R-project.org/package=RColorBrewer>. Accessed November 13, 2019.
- Oliphant, T.E., 2007. Python for scientific computing. *Computing in Science & Engineering* 9, 10–20.
- Ostrom, E., 1990. *Governing the commons: the evolution of institutions for collective action*. Cambridge University Press, New York.
- Ostrom, E., 2009. A general framework for analyzing sustainability of social-ecological systems. *Science* 325, 419–422.
- Parente, S.L., Prescott, E.C., 1994. Barriers to technology adoption and development. *Journal of Political Economy* 102, 298–321.
- Parks, M., Messmer, T., 2016. Participant perceptions of Range Rider Programs operating to mitigate wolf-livestock conflicts in the western United States. *Wildlife Society Bulletin* 40, 514–524.
- Peterson, T.R., Horton, C.C., 1995. Rooted in the soil-how understanding the perspectives of landowners can enhance the management environmental disputes. *Quarterly Journal of Speech* 81, 139–166.
- Plunkett, S., Henry, C., 1999. Family stressor events, family coping, and adolescent adaptation in farm and ranch families. *Adolescence* 34, 147–149.
- Pullin, A.S., Stewart, G.B., 2006. Guidelines for systematic review in conservation and environmental management. *Conservation Biology* 20, 1647–1656.
- Randall, N.P., James, K.L., 2012. The effectiveness of integrated farm management, organic farming and agri-environment schemes for conserving biodiversity in temperate Europe—a systematic map. *Environmental Evidence* 1, 4.
- Rasmussen, W.D., 1985. Historical overview of US agricultural policies and programs. USDA Agricultural Economic Report No. (AER530), Washington, DC, USA, p. 3.
- R Core Team, 2013. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at: <http://www.R-project.org/>. Accessed September 5, 2017.
- Declaration on Environment and Development. In: Report of the United Nations conference on environment and development, UN Doc. A/CONF.151/26 (Vol. I), 12 August 1992.
- Ribot, J.C., Peluso, N.L., 2009. A theory of access. *Rural Sociology* 68, 153–181.
- Rogers, E., 2003. *Diffusion of innovations*, 5th ed. Free Press, New York, NY, USA.
- Ross, J.V., 1984. Managing the public range-lands: 50 years since the Taylor Grazing Act. *Rangelands Archives* 6, 147–151.
- Ryan, B., Gross, N.C., 1943. The diffusion of hybrid seed corn in two Iowa communities. *Rural Sociology* 8, 15.
- Sagoff, M., 2003. Cows are better than condos, or how economists help solve environmental problems. *Environmental Values* 12, 449–470.
- Sampson, M., McGowan, J., Cogo, E., Grimshaw, J., Moher, D., Lefebvre, C., 2009. An evidence-based practice guideline for the peer review of electronic search strategies. *Journal of Clinical Epidemiology* 62, 944–952.
- Sanderson, N.B., 2011. "We were all Trespassers" George Edward Lemmon, Anglo-American cattle ranching, and The Great Sioux Reservation. *Agricultural History* 85, 50–71.
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H., Jinks, C., 2018. Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & Quantity* 52, 1893–1907.
- Sayre, N.F., deBuys, W., Bestelmeyer, B.T., Havstad, K.M., 2012. "The range problem" after a century of rangeland science: new research themes for altered landscapes. *Rangeland Ecology & Management* 65, 545–552.
- Sayre, N.F., McAllister, R.R., Bestelmeyer, B.T., Moritz, M., Turner, M.D., 2013. Earth stewardship of rangelands: coping with ecological, economic, and political marginality. *Frontiers in Ecology and the Environment* 11, 348–354.
- Sayre, N.F., 2017. *The politics of scale: a history of rangeland science*, 1st ed. The University of Chicago Press, Chicago, IL, USA.
- Scoones, I., 1999. New ecology and the social sciences: what prospects for a fruitful engagement? *Annual Review of Anthropology* 28, 479–507.
- Sheridan, T.E., 2001. Cows, condos, and the contested commons: the political ecology of ranching on the Arizona-Sonora borderlands. *Human Organization* 60, 141–152.
- Sherrin, K., Darnhofer, I., 2018. Precondition for integration: in support of stand-alone social science in rangeland and silvopastoral research. *Rangeland Ecology & Management* 71, 545–548.
- Sluyter, A., 2015. How Africans and their descendants participated in establishing open-range cattle ranching in the Americas. *Environment and History* 21, 77–101.
- Smith, A.H., Martin, W.E., 1972. Socioeconomic behavior of cattle ranchers, with implications for rural community development in the West. *American Journal of Agricultural Economy* 54, 217.
- Sprague, J., 2016. Feminist methodologies for critical researchers: Bridging differences. Rowman & Littlefield, Lanham, MD, USA.
- Sorice, M.G., Kreuter, U.P., Wilcox, B.P., Fox, W.E., 2012. Classifying land-ownership motivations in central, Texas, USA: a first step in understanding drivers of large-scale land cover change. *Journal of Arid Environment* 80, 56–64.
- Stemler, S., 2001. An overview of content analysis. *Practical Assessment, Research & Evaluation* 7, 137–146.
- Stets, J.E., Burke, P.J., 2000. Identity theory and social identity theory. *Social Psychology Quarterly* 63, 224–237.
- Stoddard, L.A., 1965. What hope for grazing on the public lands. *Journal of Range Management* 18, 109.
- Strauss, A., Corbin, J., 1998. *Basics of qualitative research techniques*, 2nd ed. Sage Publications, Thousand Oaks, CA, USA, 15.
- Stronen, A.V., Brook, R.K., Paquet, P.C., McLachlan, S., 2007. Farmer attitudes toward wolves: implications for the role of predators in managing disease. *Biology Conservation* 135, 1–10.
- Stryker, S., Burke, P.J., 2000. The past, present, and future of an identity theory. *Social Psychology Quarterly* 63, 284–297.
- Taylor, A.R., Knight, R.L., 2003. Wildlife responses to recreation and associated visitor perceptions. *Ecological Applications* 13, 951–963.
- Toledo, D., Kreuter, U.P., Sorice, M.G., Taylor, C.A., 2014. The role of prescribed burn associations in the application of prescribed fires in rangeland ecosystems. *Journal of Environmental Management* 132, 323–328.
- Tress, G., Tress, B., Fry, G., 2005. Clarifying integrative research concepts in landscape ecology. *Landscape Ecology* 20, 479–493.
- Turner, B.L., Wuellner, M., Nichols, T., Gates, R., Tedeschi, L.O., Dunn, B.H., 2016. Development and evaluation of a system dynamics model for investigating agriculturally driven land transformation in the north central United States. *Natural Resources Model* 29, 179–228.
- UN General Assembly, 1972. United Nations conference on the human environment, A/RES/2994. Available at: <https://www.refworld.org/docid/3b00f1c840.html>. Accessed 19 November 2018.
- van Eck, N.J., Waltman, L., 2007. VOS: A new method for visualizing similarities between objects. Springer, Berlin, Heidelberg, Germany, pp. 299–306.

- van Eck, N.J., Waltman, L., 2009. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics* 84, 523–538.
- van Kooten, G.C., Thomsen, R.W., Hobby, T., 2006. Resolving range conflict in Nevada? Buyouts and other compensation alternatives. *Review of Agricultural Economy* 28, 515–530.
- Waage, S.A., 2001. (Re)claiming space and place through collaborative planning in rural Oregon. *Political Geography* 20, 839–857.
- Watson, R.T., 2005. Turning science into policy: challenges and experiences from the science–policy interface. *Philosophical Transactions of the Royal Society B Biological Science* 360, 471–477.
- Wickham, H., 2016. *ggplot2: elegant graphics for data analysis*. Springer-Verlag, New York, NY, USA.
- Wilmer, H., Fernández-Giménez, M.E., 2016. Some years you live like a coyote: gendered practices of cultural resilience in working rangeland landscapes. *Ambio* 45, 363–372.
- Yung, L., Phear, N., Dupont, A., Montag, J., Murphy, D., 2015. Drought adaptation and climate change beliefs among working ranchers in Montana. *Weather Climate Society* 7, 281–293.
- Zimmerer, K.S., 1994. Human geography and the “new ecology”: the prospect and promise of integration. *Annual Association of American Geography* 84, 108–125.