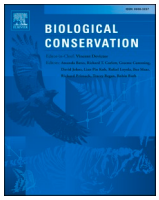
Biological Conservation 262 (2021) 109298

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon



Perspective

Integrating social science into conservation planning

Rebecca M. Niemiec [a,*], Rebecca Gruby [a], Michael Quartuch [b], Christina T. Cavaliere [a], Tara L. Teel [a], Kevin Crooks [h], Jonathan Salerno [a,g], Jennifer N. Solomon [a], Kelly W. Jones [a], Michael Gavin [a], Anna Lavoie [a], Amanda Stronza [c], Leah Meth [d], Ash Enrici [a], Katie Lanter [b], Christine Browne [e], Jonathan Proctor [f], Michael Manfredo [a]

[a] Human Dimensions of Natural Resources Department, Warner College of Natural Resources, Colorado State University, 1401 Campus Delivery, Fort Collins, CO 80523-1401, USA
[b] Colorado Parks and Wildlife, USA
[c] Department of Ecology and Conservation Biology, Texas A&M University, USA
[d] California Environmental Associates, USA
[e] US Fish and Wildlife Service, USA
[f] Defenders of Wildlife
[g] Graduate Degree Program in Ecology, Colorado State University, USA
[h] Department of Fish, Wildlife, and Conservation Biology, Colorado State University

ARTICLE INFO

Keywords:
Social science
Conservation planning
Wolf reintroduction
Adaptive management

ABSTRACT

A growing body of literature has highlighted the value of social science for conservation, yet the diverse approaches of the social sciences are still inconsistently incorporated in conservation initiatives. Building greater capacity for social science integration in conservation requires frameworks and case studies that provide concrete guidance and specific examples. To address this need, we have developed a framework aimed at expanding the role for social science in formal conservation planning processes. Our framework illustrates multiple ways in which social science research can contribute to four stages of such processes: 1) defining the problem and project team; 2) defining goals; 3) identifying impact pathways and designing interventions; and 4) developing and evaluating indicators of success (or failure). We then present a timely case study of wolf reintroduction in Colorado, U.S.A., to demonstrate the opportunities, challenges, and complexities of applying our framework in practice.

1. Introduction

A growing body of literature illustrates the role of the social sciences in addressing conservation challenges (Ban et al., 2013; Bennett et al., 2017a; Bennett et al., 2017b; Moon and Blackman, 2014). The social sciences encompass a range of classic (e.g., sociology, anthropology, political science, psychology, history, human geography) and applied (e.g., law, education, communication) disciplines that seek to "understand, describe, theorize, deconstruct, predict, imagine, or plan" social phenomena (Bennett et al., 2017a). These disciplines, and themes within these disciplines, range from environmental economics, which focuses on topics such as the economic values of the environment and the role of incentives in promoting behavior change, to environmental governance, which examines the formal and informal rules, policies, and norms that influence human behavior and conservation outcomes (Bennett et al., 2017a). Recent reviews provide overviews of basic and applied conservation social sciences and clarify the types of questions that different social science disciplines can address (Bennett et al., 2017a; Sandbrook et al., 2013). Existing reviews suggest that the social sciences can inform conservation in a variety of influential ways, ranging from enabling the planning of conservation initiatives that match different social, economic, cultural and governance contexts to facilitating more socially equitable, inclusive and just conservation processes and improved socio-ecological outcomes (Bennett et al., 2017a; Sandbrook et al., 2013).

In practice, however, significant barriers remain to integrating diverse social science approaches into conservation efforts (Bennett et al., 2017b; Fox et al., 2006; Hartel et al., 2019; Pooley et al., 2014; Welch-Devine and Campbell, 2010). These include failure to adequately incorporate social science throughout all stages of the planning and adaptive management of conservation initiatives (i.e., referred to

* Corresponding author.
E-mail address: rebecca.niemiec@colostate.edu (R.M. Niemiec).

https://doi.org/10.1016/j.biocon.2021.109298
Received 27 October 2020; Received in revised form 28 June 2021; Accepted 6 August 2021
Available online 2 September 2021

hereafter as "conservation planning processes"). Welch-Devine and Campbell (2010), for example, found through interviews with researchers and practitioners at the International Union for Conservation of Nature (IUCN) Fourth World Conservation Congress that conservation initiatives were often designed primarily by natural scientists before engaging social scientists to "talk to people" or "get their buy-in." Historically, social science approaches were rarely used to provide a nuanced or mechanistic understanding of the socio-political context or examine assumptions underlying interventions in practice (Walker and Hurley, 2004). The authors also found that social science was sometimes incorrectly understood as synonymous to "working with local communities." Similarly, Fox et al. (2006) found that social scientists were often recruited at the end of a project to market or evaluate conservation interventions, rather than being involved in the initial planning stages or throughout implementation.

More recently, Bennett et al. (2017b) highlighted barriers such as organizational culture, disciplinary assumptions, lack of practitioner training in social science methods, and lack of social science capacity in organizations that continue to hinder the integration of social science in conservation initiatives. It is common for natural resource management agencies in the United States, for example, to employ relatively few social scientists representing limited disciplinary perspectives compared to natural scientists (Sexton et al., 2013). Lack of understanding regarding the function and utility of social science in agency decision-making often results in these social science practitioners being primarily relegated to roles such as facilitating public meetings or conducting stakeholder opinion polls. Funding limitations have also been found to hamper collection and use of social science information in conservation decision-making (Cornu et al., 2014). Although the value of social science has increasingly been recognized, its legitimacy as a form of science is sometimes questioned by policy makers and decision makers. To illustrate, a January 2019 bill was introduced to the Montana House of Representatives that stated: "the director, department, and commission may only use facts and science when making decisions" but "may not use social science, human dimensions, or people's attitudes, opinions, or preferences in decision-making processes related to fish and wildlife" (HB161). The false dichotomy created by this statement fails to recognize the social sciences as comparable to the natural sciences in providing valid scientific information for decision-making (Manfredo et al., 2019, p. 960).

These challenges served as an impetus to develop a framework that guides the integration of diverse social science approaches in conservation planning processes. While a growing body of literature has focused on the broader value of the social sciences for conservation planning (e.g., Ban et al., 2013; Bennett et al., 2017a; Sandbrook et al., 2013), clear guidance is lacking on how to explicitly apply diverse social science tools and approaches throughout conservation planning processes.

In the sections that follow, we first provide an overview of our framework in relation to four key stages of conservation planning processes (Fig. 1). Then, to demonstrate its utility, we discuss how components of this framework are currently being applied to inform the planning process for wolf reintroduction into the state of Colorado in the U.S. West. A citizen ballot initiative that mandated wolf reintroduction into Colorado passed through a vote in November 2020; the state wildlife agency is currently in the process of planning wolf reintroduction and is working with researchers to collect social science data with the hope that it will inform the process over time. This wolf reintroduction effort therefore provides a real-world case study to examine the efficacy of the framework and the nuances, challenges, and opportunities that arise from implementing our framework in practice.

Our framework focuses on rational planning processes for developing conservation initiatives because of their suitability in many settings and their prolific use among conservation and natural resource management professionals, especially in the United States (Ban et al., 2013; Bright et al., 2000). Rational planning processes typically involve governments or organizations setting goals and developing approaches for achieving and evaluating those goals (Ban et al., 2013; Bright et al., 2000). We recognize that not all conservation initiatives are developed using rational planning processes – nor should they be. In fact, decades of research on the governance of common pool resources has revealed the benefits of self-organized governance where resource users design their own sustainability practices without government or other external intervention (Ostrom, 2005). More broadly, social science research has advocated for contextualized conservation planning processes that emphasize the importance of locally-specific cultural protocols,

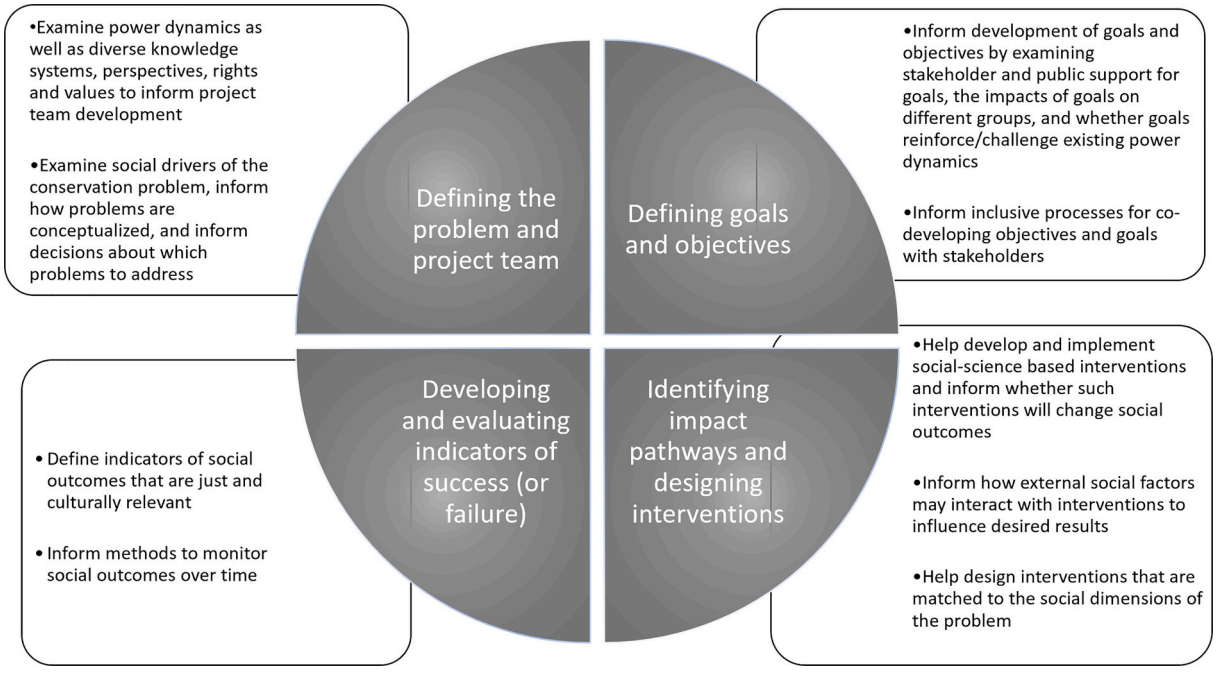


Fig. 1. An expanded role of social science approaches in each stage of conservation planning processes. Stages inform planning in a non-linear and iterative approach.

knowledge systems, and institutions in decision-making (i.e., biocultural approaches to conservation) (Gavin et al., 2015). While rational planning models are not the only approach to conservation planning, they are our focus here because of their frequent use in the conservation and natural resource management fields.

2. Integrating the social sciences in conservation planning processes

Our framework focuses on providing specific ways in which the social sciences can be integrated into four fundamental stages of conservation planning processes: 1) Defining the problem and project team; 2) Defining goals; 3) Identifying impact pathways and designing interventions (e.g., policies, programs, projects); and 4) Defining and monitoring indicators of success (or failure) (Fig. 1). We focus on these four stages of planning processes as they are relevant and applicable to a diversity of rational planning approaches (Bright et al., 2000; Schwartz et al., 2018), including adaptive management and Theory of Change (ToC; Biggs et al., 2017), which are both fundamental components of the Open Standards for the Practice of Conservation (i.e., Conservation Standards (CS); Conservation Measures Partnership, 2013). Below, we describe how each stage fits within these existing planning frameworks. While we present the four stages in a specific order, we recognize that planning often does not occur linearly, and that the different stages may inform one another in an iterative and adaptive fashion, as we later illustrate with our case study.

2.1. Stage 1: defining the problem and project team

To successfully integrate social sciences in conservation, it is important to include them in the early stages of planning processes where they can offer a more holistic understanding of the problem and the social context in which conservation interventions will be applied. Defining the problem and project team is the first step typically included in adaptive management frameworks and involves analyzing the conservation situation to identify targets, threats, and opportunities as well as members of the project team. In CS this is referred to as "defining planning purpose and project team."

This stage involves understanding and identifying diverse actors, what level of involvement each actor should have (or is interested in having), and how power will be navigated and shared during the process. Social science approaches can help inform the development of an inclusive and diverse project team by examining and incorporating diverse knowledge systems, perspectives, and values and ensuring there is a recognition of rights (to land, resources, decision-making, etc.) of different groups (Cassidy and Salerno, 2020; David-Chavez and Gavin, 2018; Gavin et al., 2015), including both human and non-human marginalized groups (Cavaliere and Ingram, 2021). For example, social science approaches for stakeholder analysis (e.g., interviews, surveys, and network analysis) can provide an understanding of how diverse actors want to be included in decision-making and the diversity of perspectives and knowledge systems different stakeholders may represent (Reed, 2008; Ban et al., 2013). By identifying and facilitating the integration of multistakeholder perspectives into the project team, social scientists can help avoid perpetuating neoliberal conservation approaches (Branstrator et al. Unpublished Results) and actively negate replications of antiquated structures of power that benefit from oppression and unequal access to decision making (Branstrator et al. Unpublished Results).

This stage also involves deciding what aspects of the conservation problem require intervention. This decision should be based on a systematic analysis of the social drivers of the problem (including cultural, economic, governance, and institutional factors) across multiple scales and the interactions between those drivers and biological elements (often the management focus) relevant to the problem. To illustrate, understanding social drivers may involve studying: human values, attitudes, and behaviors that are often at the root of conservation problems and thereby define the socio-cultural context of conservation efforts in an area; pre-existing social rules and norms; and how different stakeholders, including underrepresented and marginalized groups, affect or are affected by the problem (Carlisle and Gruby, 2018; Manfredo et al., 2020; Santos, 2015). Such an analysis often requires a critical assessment of the dominant narratives about the cause of the problem and problem framings, which can lead to the surfacing of previously unrecognized inequalities and alternative narratives where necessary (e.g., Fairhead and Leach, 1995). Ideally, this systematic analysis is co-developed by all affected stakeholders through participatory processes to facilitate projects that adequately reflect and serve context-specific community interests and needs (Enrici and Hubacek, 2018).

2.2. Stage 2: defining goals and objectives

Defining overarching goals is central to adaptive management, developing a ToC, and the "planning" step of CS, in which specific targets (e.g., species recovery) are defined and measurable time-limited goals are set for each target (Mayne, 2017). In CS, goals are focused on the ultimate conservation outcome(s), which in the most recent versions of CS are the desired status of biodiversity and human well-being targets. Objectives represent the ecological, social, cultural, economic, and political milestones that define the achievement of distinct steps in a theory of change (referred to as "results chains" in CS) that end in the desired status of the target. Defining goals and objectives involves determining what the intervener (often a multi-stakeholder group representing diverse interests) is trying to achieve through the conservation initiative, for whom, and why. These build upon what is determined and learned from the problem definition stage. Social science approaches can inform this stage by investigating the conservation-related goals that the public and key stakeholder groups support, the potential for conflict or consensus among different stakeholder groups over various goals, the potential positive or negative impacts of different goals on various stakeholder groups, how different goals will reinforce or challenge existing power dynamics, and how to develop contextually appropriate stakeholder processes for co-developing goals in a participatory, democratic, and inclusive way (Boluk et al., 2019a; Campbell et al., 2014; Manfredo et al., 2003; Teel and Manfredo, 2009; Reed, 2008; Stronza, 2009).

2.3. Stage 3: identifying impact pathways and designing interventions

After goals are determined, the next step in the planning process typically involves identifying impact pathways for how potential interventions (e.g., policies, programs, projects) may influence systems to achieve desired goals. Corresponding interventions can then be designed accordingly to achieve those goals. A crucial component of this stage is investigating the causal assumptions behind the links in the pathway (e.g., the assumption that providing information to the public will lead to behavior change). Social science approaches can inform realistic assumptions about the capacity to implement an intervention, who an intervention will reach/impact, whether it will change human attitudes, behaviors, and structures of power, how such change may influence broader social-ecological systems, and how external factors may interact with the intervention to influence desired results (Bennett and Satterfield, 2018; Boluk et al., 2019b; Byerly et al., 2018; Gruby and Basurto, 2013; Niemiec et al., 2019). In other words, social science approaches can define the theory of change, or what the CS framework refers to as the "results chains" that link interventions to changes in targets. For example, many social science disciplines and applied fields, such as communication, tourism, marketing, environmental education, conservation psychology, and environmental economics, seek to understand how education, outreach, and incentives influence the decision-making of actors with regard to a conservation initiative. Social scientists in

these disciplines/fields use a variety of qualitative and quantitative methods, and increasingly conduct lab or field experiments or use quasi-experimental designs to test different public outreach and engagement approaches (e.g., Byerly et al., 2018; Niemiec et al., 2019). Findings from these studies can inform identification of impact pathways that are likely to be effective at changing human behavior or achieving other desired outcomes for conservation and can help reduce the likelihood of intervention failure, saving resources.

Once the impact pathways have been identified, social science approaches can also facilitate the design and implementation of interventions that are well-matched to the social dimensions of the problem and therefore more likely to be successful. These interventions may include new or adapted decision-making processes, governance structures, and education, outreach, or incentive programs (Bennett and Satterfield, 2018; Browne-Nuñez et al., 2015; Byerly et al., 2018; Gruby and Basurto, 2013; Luyet et al., 2012; Niemiec et al., 2019; Richmond et al., 2019). The social sciences can also contribute meta-insights about the process of developing impact pathways and interventions, such as the need to view every intervention as an experiment and avoid "blueprint" or "one-size-fits-all" approaches in favor of contextualized approaches and adaptive learning (Berkes and Turner, 2006; Ostrom, 2005).

2.4. Stage 4: developing and evaluating indicators of success (or failure)

Social science approaches can inform the development of social indicators, and broader indicators of social-ecological systems. They can also be used to monitor and evaluate success and limitations of interventions in achieving goals, and also determine any unintended consequences (Ban et al., 2013; Gruby et al., 2017). For example, indicators could be developed to measure impacts on social conflict, cultural norms, attitudes and behaviors, power dynamics, social networks, and income, livelihoods, or material well-being (Ferraro and Pattanayak, 2006; Jones and Lewis, 2015; Jones et al., 2020; Mascia et al., 2014; Salerno et al., 2017). Social science research suggests that indicators are often most effective and fair when they are context-specific and culturally embedded (Dacks et al., 2019; Sterling et al., 2017). In addition to using a variety of qualitative and quantitative methods, social scientists increasingly use experimental and quasi-experimental impact evaluation designs to measure the impacts of different conservation interventions including public outreach campaigns, community-based conservation initiatives, biocultural interpretation and education strategies, and financial incentives (e.g., Ferraro and Pattanayak, 2006; Jones and Lewis, 2015). Impact evaluation best practices identify mechanistic relationships along a causal pathway, from intervention to outcome, in order to enable adaptive management. Results of impact evaluation should also inform the development of updated interventions or impact pathways (McCarthy and Possingham, 2007).

3. Examining our framework in practice: the case study of wolf reintroduction in Colorado

In this section, we apply a case study of wolf reintroduction into Colorado to illustrate how current planning practices align (or not) with our framework, and to identify opportunities and challenges to facilitate greater integration of the social sciences into conservation planning. Gray wolves were once common in Colorado but were extirpated by humans in the 1940s. Over 70 years later, several environmental organizations pursued a ballot initiative to restore wolves (Proposition 114, which qualified for the state ballot in January 2020). Multiple surveys conducted before the ballot initiative found high levels of public support for wolf restoration ranging from 66% to 84% (Niemiec et al., 2020; Meadow et al., 2005; Pate et al., 1996). In November, 2020, the initiative passed with 50.9% of the Colorado public voting in favor (Colorado Secretary of State, 2020).

In Spring, 2021, Colorado Parks and Wildlife (CPW), the state wildlife agency, began implementing a potential process to reintroduce wolves on the Western Slope of Colorado by the end of 2023, as mandated by the ballot initiative. The planning process includes the formation of a Technical Working Group (TWG) of scientific experts on wolf biology and management as well as the development of a public outreach process and Stakeholder Advisory Group (SAG) led by a third-party facilitator. The SAG is tasked with developing recommendations for wolf management, which the Colorado Parks and Wildlife Commission (the citizen board, appointed by the Governor, that sets state regulations and policies for Colorado's state parks and wildlife programs) will consider. The public outreach process will involve a suite of opportunities for managers and facilitators to provide information to and seek input from the public, while the SAG will involve deliberative discussions among a small (~15 person) group of stakeholders with diverse perspectives. Below, we reflect on how components of our framework are being applied, or could be applied, to integrate social science into the four stages of planning for wolf reintroduction and management in the state. We combine our discussions of stages 1 and 2, as well as our discussions of stages 3 and 4, to illustrate the complex, non-linear way in which the stages inform one another in an iterative process.

3.1. Stages 1 & 2: defining the problem and setting goals related to wolf reintroduction

As our framework indicates, planning efforts can be most effective when the problem and corresponding goals are co-developed by a diverse set of stakeholders and informed by social science research. However, a challenge to implementing this approach is that in some cases, constraining factors, such as laws and regulations, result in predefined conservation goals for agencies and organizations. In the case of wolf reintroduction in Colorado, the ultimate ecological goal of restoring a viable population of wolves to the state was defined by Proposition 114 *(Stage 2 of our framework)*. A corresponding socio-ecological goal held by CPW and many stakeholders is to ensure the viable population of wolves has minimal negative impacts to human livelihoods and endeavors.

While the ultimate ecological goal was defined by the ballot initiative, an understanding of "the problem" from social science research *(Stage 1 of our framework)* provides the opportunity to identify additional desired social outcomes associated with the wolf reintroduction process. Following our framework above, research on "the problem" in this context involves studies on different stakeholder perspectives of the problem being created or solved by the wolf reintroduction ballot initiative and the social factors that led to the ballot initiative. Below, we summarize this research on the problem and how it informs planning by leading to the identification of additional desired social outcomes.

Social science research on different stakeholder views of the problems associated with wolf reintroduction conducted via surveys, media analysis, interviews, and a stakeholder workshop (Niemiec, 2020; Niemiec et al., 2020; Pate et al., 1996) has revealed that the perceived problem being created or addressed by wolf reintroduction varies among stakeholders (Niemiec, 2020; Niemiec et al., 2020). Some stakeholders argue that wolf reintroduction itself is the problem due to perceived threats posed by wolves to livestock, hunting opportunities/industries, and human and pet safety (Niemiec, 2020; Niemiec et al., 2020). Other stakeholders argue that the ballot initiative resolved the problem of wolves' absence from the landscape and that reintroduction will improve the health of Colorado's ecosystems and "right a past wrong" of exterminating wolves (Niemiec, 2020; Niemiec et al., 2020).

More broadly, social science research suggests that one of the problems inherent in wolf reintroduction is social conflict, or conflict between stakeholder groups, which is driven by deeper value and identity-based differences (Madden and McQuinn, 2014; Manfredo et al., 2020; Nie, 2001; Wilson, 1997). Social conflict is defined as a struggle over values and claims to status, power, and scarce resources

(Coser, 1967) and can range from disagreements or disputes to destructive escalation and polarization between stakeholders (Burgess and Burgess, 1996). In the case of wolf reintroduction and management, signs of social conflict may include polarizing rhetoric, obstructive activism, and unwillingness of stakeholder groups to collaborate, engage with scientific information, or engage in productive dialogue. This social conflict over wolves can result in negative outcomes for both people and wildlife, such as a reduction in the ability for stakeholder groups to cooperate and develop mutually acceptable solutions that minimize conflict between wolves and people (Wilson, 1997). Social science studies indicate that many environmental groups advocate strongly for wolf reintroduction in part because wolves have become symbolic of the broader fight to preserve wilderness and ecological integrity (Nie, 2001). On the other hand, interview-based, ethnographic research has found that opposition to wolves, particularly among ranchers and rural communities, represents a type of cultural resistance to social trends perceived as economically and culturally threatening (Wilson, 1997). Social conflict can escalate when stakeholders' desires to pursue or protect these deeper values and identities result in groups making harmful assumptions about others with different beliefs, fueling anger, hatred, and mistrust between groups (Čehajić-Clancy et al., 2016). This research on the problem being created by wolf reintroduction *(Stage 1 of our framework)* highlights a *first potential social outcome (Stage 2 of our framework) that could be pursued in relation to wolf reintroduction: reducing social conflict between stakeholders through participatory planning processes.* Facilitating reductions in social conflict could benefit the socio-ecological goal of a viable population of wolves with minimal impacts to people by enabling stakeholders to develop and help implement mutually agreed upon solutions that minimize conflict between wolves and people. Achieving this outcome could also reduce the likelihood of stakeholder groups engaging in obstructive actions, such as retaliatory killings of wolves or lawsuits, and could help promote collaboration between stakeholders on future initiatives.

Research from *Stage 1 of the framework* also suggests that some see the problem associated with wolf reintroduction in Colorado as the ballot initiative itself, which is an alternative approach for making decisions about wildlife management. Some social science scholars have highlighted potential concerns with and benefits from this approach. For example, Loker et al. (1998) suggested that ballot initiatives may result in uninformed decisions by voters with little knowledge of the subject. On the contrary, ballot initiatives may also allow expression of public preferences for wildlife management by some citizens that traditionally have not effectively participated in wildlife management decisions (Loker et al., 1998). Ballot initiatives can also circumvent the state wildlife agency's decision-making authority. This authority is often rooted not just in ecological science but in a culture of "traditionalist" (i.e. consumptive-based or anthropocentric) values, which characterize wildlife primarily as a resource to be used and managed for human benefit (Manfredo et al., 2020; Manfredo et al., 2019; Teel and Manfredo, 2009). These values are tied to historical traditions of hunting and game management that defined the origins of the wildlife profession, and to traditional uses of wildlife (e.g., hunting and fishing) that remain the primary funding mechanism for state wildlife agencies in the U.S. (Jacobson and Decker, 2008; Williams, 2010). In contrast, recent studies have shown a growing percentage of the U.S. public expresses "mutualist" values toward wildlife (seeing wildlife as a part of their broader social network and deserving of rights like humans). This shift in public values has been linked to increased challenges for wildlife agencies, such as less social support for "traditional" (i.e. consumptive-based) forms of wildlife management (e.g., lethal control; Manfredo et al., 2020; Manfredo et al., 2017).

The ballot initiative to reintroduce wolves may be understood within this narrative of changing values and power dynamics; specifically, the ballot initiative can be seen as an attempt by mutualist-oriented groups to have a greater say in decision-making about wildlife management in the state. Indeed, in a stakeholder workshop organized and designed by the first author in advance of the ballot initiative, some stakeholders reported that they believed the ballot initiative addressed the problem that their values related to wolves were not being adequately considered in decision-making about wildlife management in the past (Niemiec, 2020). Other stakeholders, such as ranchers, discussed their opposition to the ballot initiative, in part because it circumvented historical processes for decision-making and enabled the urban majority to impose their will on the rural minority who will have to live with the potential negative impacts of wolves (Niemiec, 2020). The workshop identified other important power dynamics and values among diverse stakeholder groups and government representatives, including the desire for representatives from sovereign Native American Nations to be meaningfully included in decision-making about wolf management (Niemiec, 2020).

This research on the social context that led to the ballot initiative *(Stage 1 of our framework)* illustrates the need for a *second social outcome associated with wolf reintroduction (Stage 2 of our framework): to incorporate diverse values and empower diverse stakeholders in the development of the management plan.* Incorporating diverse values and empowering diverse stakeholders could achieve the socio-ecological goal of a viable population of wolves with minimal negative impacts to humans by potentially *enhancing public acceptance of management plans and trust in agencies*. These social outcomes could also provide broader benefits to CPW and society; for example, enhancing public trust could facilitate public compliance with and support for future initiatives and CPW's mission overall, and incorporating diverse values can help "reduce the likelihood that those on the periphery of the decision-making context or society are marginalised" (Reed, 2008).

3.2. Stages 3 & 4: identifying impact pathways and designing and evaluating interventions for wolf reintroduction

There are numerous opportunities and challenges to applying social science research to adaptively and iteratively develop (*Stage 3 of our framework*), evaluate, and refine (*Stage 4 of our framework*) impact pathways for wolf reintroduction. Here, we focus on two types of impact pathways that can help achieve the four social outcomes outlined above (i.e., reduced social conflict, incorporating diverse values/empowering diverse stakeholders, and enhancing public acceptance and trust) and the socioecological goal of restoring a viable population of wolves with minimal negative impacts to humans: 1) stakeholder and public involvement processes; and 2) policies and programs to address and minimize the potential negative impacts of wolves on people. We reflect on the challenges, opportunities, and current attempts to integrate social science into the iterative design and evaluation of both of these types of impact pathways for wolf reintroduction.

The first impact pathway social science could inform is stakeholder and public involvement processes for wolf reintroduction planning, which have the potential to address the social outcomes described above. A large body of social science literature highlights the importance of meaningful multistakeholder engagement in deliberation and shared decision-making to achieve various social outcomes, such as a reduction in social conflict (e.g., see Luyet et al., 2012; Reed, 2008 for reviews), particularly for contentious and value-based debates over natural resources (Nie, 2001; Madden and McQuinn, 2014). To aid in wolf reintroduction planning, CPW followed recommendations from this literature by convening the Stakeholder Advisory Group (SAG) and, with guidance from M. Quartuch (CPW staff scientist), applying several best practices, including using a third-party facilitator and seeking out diverse and balanced voices.

However, several challenges were also identified when attempting to implement lessons learned from social science literature in the design of the SAG that emerged from a lack of clarity on how existing social science findings translate to practice. For example, one of the best practices recommended in the literature is to use a systematic approach to identify and select stakeholders to be included in participatory processes (Reed, 2008). A systematic approach typically involves conducting some form

of stakeholder analysis, which often involves the application of methodological tools from the social sciences (e.g., social network analysis, interviews, surveys) to identify interested and affected stakeholders, differentiate between stakeholders, and investigate relationships between stakeholders to prioritize who to include in processes (Reed, 2008). Even after a detailed literature review, however, questions remained about how different systematic methods of stakeholder selection might influence social outcomes in various contexts and thus what selection approach was ideal for the SAG. For example: In what circumstances does stakeholder assessment *have to be* conducted by a social scientist using analytical methods such as social network analysis to achieve social outcomes? In what context is it beneficial (or appropriate) to survey those interested in serving on advisory groups to inform stakeholder selection, versus drawing upon local knowledge from key informants who are embedded in the communities most likely to be affected? In the case of wolf reintroduction planning, stakeholder selection for the SAG occurred by CPW leadership, who recruited participants via an open application process that was available to anyone who was interested in order to enhance transparency and inclusiveness. Leadership used three criteria to select stakeholders: 1) geographic representation, (2) representation of diversity of interests/perspectives/opinions, and (3) willingness to work together to accomplish the goals outlined in the ballot initiative. Using an open application process has the potential to address issues of inequity and power and increase legitimacy and transparency, all of which are described in the social science literature as best practices of stakeholder engagement. However, the same literature often falls short of being prescriptive with respect to when various approaches for stakeholder selection could, should, or must be applied in different contexts to achieve social outcomes.

The challenge described above highlights the need to conduct longitudinal social science evaluations of social outcomes *(Stage 4 of our framework)* to learn what types of impact pathway designs may be effective in a particular context. This type of research could inform the adaptive management of stakeholder and public involvement processes over time. For example, such longitudinal investigations can lend insight into stakeholders' perceptions of whether the selection process was systematic and more broadly incorporates diverse values. To inform wolf reintroduction planning, CPW and Colorado State University (CSU) social science researchers are collaborating to conduct such a longitudinal investigation of stakeholder perceptions and social outcomes. This collaborative research effort evolved from two years of relationship building between CPW and CSU social scientists and a RAPID grant from the National Science Foundation Decision, Risk, and Management Sciences Directorate, which was awarded to M. Quartuch and R. Niemiec. The researchers are currently developing context-specific indicators of social conflict, social learning, public acceptance of management options, and trust. The researchers plan to implement a series of longitudinal surveys and interviews of the general public and as well as highly involved stakeholders (including members of the SAG and those who are not participating in the SAG) to monitor and evaluate changes in these outcomes over a year. They also plan to implement surveys to evaluate whether stakeholders believe that procedural criteria from the social science literature (e.g., transparency, representativeness of the process) are being met (building on Young et al., 2013). This research is intended to inform planning of stakeholder engagement and public outreach for wolf reintroduction and improve CPW's stakeholder engagement efforts over time.

A second type of impact pathway for wolf reintroduction that social science could inform *(Stage 3 of our framework)* is policies and programs designed to address and minimize potential negative impacts of wolves on people's livelihoods. These programs and policies in other states typically include: compensation to landowners for livestock losses caused by wolf depredation; cost sharing opportunities for landowners to implement proactive management strategies (e.g., range riders, fladry) for reducing the likelihood of wolf depredation; education and outreach to landowners about these proactive strategies; lethal control of wolves; and in some circumstances, "payment for presence" programs that provide payments to landowners for the additional costs of living in areas with wolves (Karlsson and Sjöström, 2011; Macon, 2020). The assumption of these programs and policies is that they will offset or reduce the negative costs to landowners from wolves and, in some circumstances, increase landowners' acceptability of wolves and likelihood of implementing proactive management approaches for reducing conflict with wolves. There is an opportunity for the development of these impact pathways to be informed by existing or new, context-specific social science insights (e.g., Scasta et al., 2017). For example, research in other states with wolves has suggested the importance of integrating methods (e.g., participatory focus groups) that build trust and empower livestock producers to adopt new management tools (Browne-Nuñez et al., 2015). Other research on forestry and invasive species management suggests the potential for outreach that facilitates peer-to-peer learning to encourage the adoption of new landowner management practices (Niemiec et al., 2019; Ma et al., 2012; Quartuch et al., 2021).

One challenge when seeking to integrate social science into the development of these policies and programs is that little is known about the relative effectiveness of these different types of programs (i.e., compensation, subsidies, payment for presence, lethal control, outreach in the form of peer-to-peer learning, etc) in different contexts *(Stage 4 of our framework)*. In particular, there are few existing social science studies examining the causal impact of different policies, payments, and outreach programs at promoting tolerance towards carnivores and encouraging landowner adoption of proactive carnivore conflict reduction practices (Treves and Bruskotter, 2014). Research in other fields suggests that payments may vary in their effectiveness at encouraging adoption of new behaviors, depending on socio-cultural context and the type of payment (Quartuch and Beckley, 2014; Rode et al., 2015); in some cases, payments can reduce people's intrinsic motivation to engage in a new behavior.

This challenge points to a significant need for social scientists to conduct experimental or quasi-experimental studies to examine the causal impact of various programs and policies on landowner tolerance towards carnivores and adoption of practices for reducing conflict with carnivores. Several of the authors on this paper, however, have found that pursuing this line of research poses its own difficulties. For example, when attempting to develop proposals and advocate for this type of research, the first author has heard concerns from some stakeholders who believe that certain management approaches (e.g., compensation, a certain amount of lethal control of wolves) are effective at reducing conflict and thus do not need to be tested using quasi-experimental or experimental methods. Some practitioners and stakeholders are also concerned about the inequity of providing interventions to some landowners and not others, as would be required in an experimental design, while others do not fully agree that the indicator (increasing landowner adoption of proactive tools and tolerance) is a valid measure of the ultimate goal (reducing human-wolf conflict). These challenges suggest the need for increased opportunities for social science researchers, wildlife managers, and conservation practitioners to engage in specific dialogue about the efficacy of these different approaches, how to evaluate their success, and which metrics are critical for doing so.

It is yet to be seen whether and how social science research will be integrated into the design and evaluation of impact pathways related to minimizing conflict between wolves and stakeholders in Colorado. In addition to the challenges described above, CPW faces several constraints when considering how to integrate social science into the identification, design, and evaluation of impact pathways *(Stages 3 and 4 in our framework)* on this topic. For example, the ballot initiative mandates a process to reintroduce wolves on the Western Slope of Colorado by the end of 2023, which poses a time constraint for planning and decision-making. Collecting social science data on context-specific outcomes can often take longer than the two years allocated for planning and implementation, demonstrating the need for an adaptive management approach that utilizes social science research. Furthermore,

agency staff have limited capacity to take on additional social science projects on such short timelines. This constraint highlights the critical importance of partnerships between state agency staff and researchers from outside the agency.

4. Discussion

While a growing body of literature has sought to clarify the role of diverse social sciences in conservation (e.g., Bennett et al., 2017a), social science information is still rarely incorporated throughout the adaptive management cycle of conservation planning processes. Often, when the social sciences are utilized, they are incorporated late in the project cycle (Christie et al., 2003; Lischka et al., 2018; Pooley et al., 2014). We have provided a framework that identifies specific, practical opportunities for social science integration within four stages of conservation planning processes. Applying our framework to the timely case of wolf reintroduction in Colorado demonstrates the relevance and contribution of the social sciences at each stage.

In practice, there are many challenges to integrating social science research into conservation planning, some of which we highlighted through our case study. These may include: a lack of clarity on what some social science research implies for practice; time or resource constraints to conducting and synthesizing social science research; a lack of social science "champions" or social science capacity within conservation organizations and governmental agencies; an incentive and recognition system for academic researchers which often focuses more on publications and research grants than on outreach and engagement with practitioners; and the time, difficulty, and sometimes contentiousness associated with re-thinking research questions, goals, and management approaches using social science approaches (Bennett et al., 2017b). Further, challenges may stem from a failure to recognize or understand the breadth and value of social science disciplines and applied fields that could be brought to the project; it is not uncommon, for example, to recruit a single social scientist who may then be expected to represent a variety of specializations within the broader field (Bennett et al., 2017b). The legitimacy of different disciplinary paradigms and methods of data collection within the social sciences themselves must be acknowledged, understood, and embraced for a more holistic approach to social science integration in conservation planning. Of course, this diversity comes with its own set of challenges, such as ideological differences and variations in core values among the disciplines that can create barriers to collaboration (Campbell, 2005; Welch-Devine and Campbell, 2010). However, bringing diverse social science perspectives to conservation planning is crucial given it provides important opportunities for achieving a more comprehensive understanding of the problem, goals, possible interventions, and the social impacts of those interventions.

Given that social science can inform more just and effective interventions, it is also critical that social science research be recognized as a priority from the beginning of conservation planning processes, rather than being added on to existing research projects or relegated to a supporting role (Campbell, 2005; Lischka et al., 2018). It may be easier to convince decision-makers to integrate social science *for* conservation (i.e., that helps achieve conservation objectives), rather than *on* conservation (i.e., that reflects on the ethics, power dynamics and assumptions of conservation), as the latter can often challenge deeply ingrained assumptions and practices, and structures of power (Sandbrook et al., 2013). Such critiques may be met with resistance and frustration if not accompanied by suggestions for more effective conservation practices (Brosius, 2006). Similarly, while social science research should be grounded in established theory and concepts where possible, positioning of that research to contribute to applied problems demands clearly specified implications for conservation practice (Teel et al., 2018).

Despite these challenges, there are a growing number of examples of social science integration already happening through formal collaborations, beyond the case study of wolf reintroduction reviewed in this paper. As an illustration, in 2016, over 125 researchers and practitioners convened a Think Tank on the Human Dimensions of Large Scale Marine Protected Areas to understand the unique challenges of managing large-scale marine protected areas and develop best management practices and a research agenda for addressing these issues (Christie et al., 2017). In 2009, the Maryland Sea Grant brought together several teams of physical scientists and a team of social scientists to create a plan for Ecosystem Based Fisheries Management to help restore the health of Chesapeake Bay (Green, 2010). Another example is the work of the North American Bird Conservation Initiative (NABCI) to advance social science applications to bird conservation in the North American context; their efforts have recently led to a compilation of social science "success stories" (see https://nabci-us.org/success-stories/) to provide guidance and build greater support for social science integration (Dayer et al., 2020). The Human Dimensions Branch of the U.S. Fish and Wildlife Service serves as an additional illustration, offering a host of resources for incorporating the social sciences in conservation, including trainings for practitioners and contributions to the HDgov web portal, which contains stories of "social science in action" across the agency (see https://doi.sciencebase.gov/hd/team/fws). Additionally, in response to calls for academics to facilitate transdisciplinary approaches for human-carnivore coexistence (Hartel et al., 2019), in 2020, a team of social and ecological scientists at CSU formed the Center for Human Carnivore Coexistence to integrate interdisciplinary research, education, and practice focused on reducing conflict among stakeholder groups about carnivores as well as conflict between carnivores and people. In addition to engaging with the wolf reintroduction process as described above, members of that same team collaborated to advance a model for the integration of social and ecological information to understand and manage human-wildlife interactions, more broadly (Lischka et al., 2018). These are just a few examples from our collective knowledge and experience, included here for illustration, that may offer guidance for future integration efforts.

The growing body of literature on collaboration, participatory and action research, and co-production of knowledge provides additional insight into how to facilitate this integration (Lemos et al., 2018; Österblom et al., 2017; Wilmer et al., 2019; Zafra-Calvo et al., 2020). Ultimately, certain enabling conditions may be required for successful application of social science research in conservation planning processes. In our experience, examples of these enabling conditions include corollaries to the challenges identified above: funding, such as the NSF grant provided in our case study, which can serve as a catalyst for greater integration of social sciences; time spent building trust and relationships between researchers and practitioners (e.g., through "communities of practice" discussed in Hartel et al., 2019); and social science 'champions' who engage in advocacy, education, and training to raise awareness among non-social-scientists and agency/organization leadership about the importance and role of the social sciences. We also found that the process of developing this paper with an interdisciplinary group of researchers and practitioners helped clarify some of the ways in which social science could inform wolf reintroduction planning; we hope that our framework could be used by others in this way to help aid social science integration. Success stories or case studies that highlight the critical contributions of social science research to conservation planning and practice, such as the case study shared here and NABCI's compilation of case studies mentioned above, are also important. Future work should examine in more depth the challenges, enabling conditions, and approaches for further integrating the social sciences into conservation initiatives. It is our intention that our framework and case study application provide motivation and guidance for such integration moving forward.

Declaration of competing interest

The authors declare that they have no known competing financial

interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This paper was made possible by a grant from the Department of the Human Dimensions of Natural Resources at Colorado State University, an anonymous donation to the Center for Human Carnivore Coexistence at Colorado State University, and a RAPID grant from the National Science Foundation Decision, Risk, and Management Sciences Directorate (Award #2128620), titled "A Longitudinal Investigation of the Social Outcomes of Participatory Stakeholder Engagement Processes." The findings and conclusions in this article are those of the author(s) and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

References

Ban, N.C., Mills, M., Tam, J., Hicks, C.C., Klain, S., Stoeckl, N., Chan, K.M., 2013. A social–ecological approach to conservation planning: embedding social considerations. Front. Ecol. Environ. *11* (4), 194–202.

Bennett, N.J., Roth, R., Klain, S.C., Chan, K., Christie, P., Clark, D.A., Greenberg, A., 2017a. Conservation social science: understanding and integrating human dimensions to improve conservation. Biol. Conserv. *205*, 93–108.

Bennett, N.J., Roth, R., Klain, S.C., Chan, K.M., Clark, D.A., Cullman, G., Thomas, R.E., 2017b. Mainstreaming the social sciences in conservation. Conserv. Biol. *31* (1), 56–66.

Bennett, N.J., Satterfield, T., 2018. Environmental governance: a practical framework to guide design, evaluation, and analysis. Conserv. Lett. 11 (6), 1–13.

Berkes, F., Turner, N.J., 2006. Knowledge, learning and the evolution of conservation practice for social-ecological system resilience. Hum. Ecol. 34 (4), 479.

Biggs, D., Cooney, R., Roe, D., Dublin, H.T., Allan, J.R., Challender, D.W., Skinner, D., 2017. Developing a theory of change for a community-based response to illegal wildlife trade. Conserv. Biol. 31 (1), 5–12.

Boluk, K.A., Cavaliere, C.T., Duffy, L.N., 2019b. A pedagogical framework for the development of the critical tourism citizen. J. Sustain. Tour. 27 (7), 865–881.

Boluk, K.A., Cavaliere, C.T., Higgins-Desbiolles, F., 2019a. A critical framework for interrogating the united nations sustainable development goals 2030 agenda in tourism. J. Sustain. Tour. 27 (7), 847–864. https://doi.org/10.1080/09669582.2019.1619748.

Branstrator, J., Cavaliere, C.T., Xiong, L. and Knight, D.. (Unpublished Results). Extended reality for transformative sustainable tourism: restoring human-wildlife relationships for biocultural conservation.

Bright, A.D., Manfredo, M.J., Fulton, D.C., 2000. Segmenting the public: an application of value orientations to wildlife planning in Colorado. Wildl. Soc. Bull. 218–226.

Brosius, J.P., 2006. Common ground between anthropology and conservation biology. Conserv. Biol. 20 (3), 683–685.

Browne-Nuñez, C., Treves, A., MacFarland, D., Voyles, Z., Turng, C., 2015. Tolerance of wolves in Wisconsin: a mixed-methods examination of policy effects on attitudes and behavioral inclinations. Biol. Conserv. *189*, 59–71.

Burgess, H., Burgess, G., 1996. Constructive confrontation: a transformative approach to intractable conflicts. Mediation Quarterly *13* (4), 305–322.

Byerly, H., Balmford, A., Ferraro, P.J., Hammond Wagner, C., Palchak, E., Polasky, S., Fisher, B., 2018. Nudging pro-environmental behavior: evidence and opportunities. Front. Ecol. Environ. *16* (3), 159–168.

Campbell, L.M., 2005. Overcoming obstacles to interdisciplinary research. Conserv. Biol. 19 (2), 574–577.

Campbell, L.M., Hagerman, S., Gray, N.J., 2014. Producing targets for conservation: science and politics at the Tenth Conference of the Parties to the Convention on Biological Diversity. Global Environmental Politics 14 (3), 41–63.

Carlisle, K.M., Gruby, R.L., 2018. Why the path to polycentricity matters: evidence from fisheries governance in Palau. Environ. Policy Gov. 28 (4), 223–235.

Cassidy, L., Salerno, J., 2020. The need for a more inclusive science of elephant conservation. Conserv. Lett. 13 (5), e12717.

Cavaliere, C.T., Ingram, L.J., 2021. Climate change and anger: misogyny and the dominant growth paradigm in tourism. Ann. Leis. Res. 1–18.

Čehajić-Clancy, S., Goldenberg, A., Gross, J.J., Halperin, E., 2016. Social-psychological interventions for intergroup reconciliation: an emotion regulation perspective. Psychol. Inq. 27 (2), 73–88.

Christie, P., Bennett, N.J., Gray, N.J., Wilhelm, T.A., Lewis, N.A., Parks, J., Taei, S., 2017. Why people matter in ocean governance: incorporating human dimensions into large-scale marine protected areas. Mar. Policy *84*, 273–284.

Christie, P., McCay, B.J., Miller, M.L., Lowe, C., White, A.T., Stoffle, R.W., Fluharty, D.L., McManus, L.T., Chuenpagdee, R., Pomeroy, C., Suman, D.O., 2003. Toward developing a complete understanding: a social science research agenda for marine protected areas. Fisheries *28* (12), 22–26.

Colorado Secretary of State. 2020. Colorado Election Results: 2020 General Election, State Offices & Questions. Retrieved from https://results.enr.clarityelections.com/CO/105975/web.264614/#/summary?category=C_2.

Conservation Measures Partnership, 2013. Open Standards for the Practice of Conservation.

Cornu, E.L., Kittinger, J.N., Koehn, J.Z., Finkbeiner, E.M., Crowder, L.B., 2014. Current practice and future prospects for social data in coastal and ocean planning. Conserv. Biol. 28 (4), 902–911.

Coser, L., 1967. Continuities in the Study of Social Conflict. Free Press, New York, p. 272.

Dacks, Rachel, Ticktin, Tamara, Mawyer, Alexander, Caillon, Sophie, Claudet, Joachim, Fabre, Pauline, Jupiter, Stacy D., et al., 2019. Developing biocultural indicators for resource management. Conservation Science and Practice 1 (6), e38.

David-Chavez, D.M., Gavin, M.C., 2018. A global assessment of Indigenous community engagement in climate research. Environ. Res. Lett. 13 (12), 123005.

Dayer, A.A., Barnes, J.C., Dietsch, A.M., Keating, J.M., Naves, L.C., 2020. Advancing scientific knowledge and conservation of birds through inclusion of conservation social sciences in the American Ornithological Society. Condor 122 (4), duaa047.

Enrici, A., Hubacek, K., 2018. Challenges for REDD+ in Indonesia: a case study of three project sites. Ecol. Soc. 23 (2).

Fairhead, J., Leach, M., 1995. False forest history, complicit social analysis: rethinking some West African environmental narratives. World Dev. *23* (6), 1023–1035.

Ferraro, P.J., Pattanayak, S.K., 2006. Money for nothing? A call for empirical evaluation of biodiversity conservation investments. PLoS Biol. 4 (4), e105.

Fox, H.E., Christian, C., Nordby, J.C., Pergams, O.R., Peterson, G.D., Pyke, C.R., 2006. Perceived barriers to integrating social science and conservation. Conserv. Biol. 20 (6), 1817–1820.

Gavin, M.C., McCarter, J., Mead, A., Berkes, F., Stepp, J.R., Peterson, D., Tang, R., 2015. Defining biocultural approaches to conservation. Trends Ecol. Evol. 30 (3), 140–145.

Green, Shannon, September 2010. Ecosystem-based fisheries management in Chesapeake Bay. Update. In: Chesapeake Quarterly. Maryland Sea Grant. https://www.chesapeakequarterly.net/images/uploads/siteimages/ebfm/EBFMSeptember2010Update.pdf.

Gruby, R.L., Basurto, X., 2013. Multi-level governance for large marine commons: politics and polycentricity in Palau's protected area network. Environ Sci Policy 33, 260–272.

Gruby, R.L., Fairbanks, L.W., Acton, L., Artis, E., Campbell, L.M., Gray, N.J., Mitchell, L., Zigler, S.B.J., Wilson, K., 2017. Conceptualizing Social outcomes of large marine protected areas. Coast. Manag. 45 (6), 416–435.

Hartel, T., Scheele, B.C., Vanak, A.T., Rozylowicz, L., Linnell, J.D., Ritchie, E.G., 2019. Mainstreaming human and large carnivore coexistence through institutional collaboration. Conserv. Biol. 33 (6), 1256–1265.

Jacobson, C.A., Decker, D.J., 2008. Governance of state wildlife management: reform and revive or resist and retrench? Soc. Nat. Resour. 21, 441–448.

Jones, K.W., Etchart, N., Holland, M.B., Naughton-Treves, L., Arriagada, R., 2020. The impact of paying for forest conservation on perceived tenure security in Ecuador. Conserv. Lett. https://doi.org/10.1111/conl.12710.

Jones, K.W., Lewis, D.J., 2015. Estimating the counterfactual impact of conservation programs on land cover outcomes: the role of matching and panel regression techniques. PLoS One 10 (10), e0141380. https://doi.org/10.1371/journal.pone.0141380.

Karlsson, J., Sjöström, M., 2011. Subsidized fencing of livestock as a means of increasing tolerance for wolves. Ecol. Soc. 16 (1).

Lemos, M.C., Arnott, J.C., Ardoin, N.M., Baja, K., Bednarek, A.T., Dewulf, A., Mach, K.J., 2018. To co-produce or not to co-produce. Nature Sustainability *1* (12), 722–724.

Lischka, S.A., Teel, T.L., Johnson, H.E., Reed, S.E., Breck, S., Don Carlos, A., Crooks, K.R., 2018. A conceptual model for the integration of social and ecological information to understand human-wildlife interactions. Biol. Conserv. 225, 80–87.

Loker, C.A., Decker, D.J., Chase, L.C., 1998. Ballot initiatives—antithesis of human dimensions approaches or catalyst for change? Hum. Dimens. Wildl. 3 (2), 8–20. https://doi.org/10.1080/10871209809359121.

Luyet, V., Schlaepfer, R., Parlange, M.B., Buttler, A., 2012. A framework to implement stakeholder participation in environmental projects. J. Environ. Manag. 111, 213–219.

Ma, Z., Kittredge, D.B., Catanzaro, P., 2012. Challenging the traditional forestry extension model: Insights from the Woods Forum Program in Massachusetts. Small-scale Forestry 11 (1), 87–100.

Macon, D., 2020. Paying for the presence of predators: an evolving approach to compensating ranchers. Rangelands 42 (2), 43–52.

Madden, F., McQuinn, B., 2014. Conservation's blind spot: the case for conflict transformation in wildlife conservation. Biol. Conserv. *178*, 97–106.

Manfredo, M., Vaske, J., Teel, T., 2003. The potential for conflict index: a graphic approach to practical significance of human dimensions research. Hum. Dimens. Wildl. *8* (3), 219–228.

Manfredo, M.J., Salerno, J., Sullivan, L., Berger, J., 2019. For United States wildlife management, social science needed now more than ever. BioScience 69 (12), 960–961.

Manfredo, M.J., Teel, T.L., Don Carlos, A.W., Sullivan, L., Bright, A.D., Dietsch, A.M., Bruskotter, J., Fulton, D., 2020. The changing sociocultural context of wildlife conservation. Conserv. Biol. 34 (6), 1549–1559.

Manfredo, M.J., Teel, T.L., Sullivan, L., Dietsch, A.M., 2017. Values, trust, and cultural backlash in conservation governance: The case of wildlife management in the United States. Biol. Conserv. 214, 303–311.

Mascia, M.B., Pailler, S., Thieme, M.L., Rowe, A., Bottrill, M.C., 2014. Commonalities and complementarities among approaches to conservation monitoring and evaluation. Biol. Conserv. 169, 258–267.

Mayne, J., 2017. Theory of change analysis: Building robust theories of change. Can. J. Program Eval. *32* (2).

McCarthy, M.A., Possingham, H.P., 2007. Active adaptive management for conservation. Conserv. Biol. 21 (4), 956–963.

Meadow, R., Reading, R.P., Phillips, M., Mehringer, M., Miller, B.J., 2005. The influence of persuasive arguments on public attitudes toward a proposed wolf restoration in the southern Rockies. Wildl. Soc. Bull. 33 (1), 154–163.

Moon, K., Blackman, D., 2014. A guide to understanding social science research for natural scientists. Conserv. Biol. 28, 1167–1177. https://doi.org/10.1111/cobi.12326.

Nie, M.A., 2001. The sociopolitical dimensions of wolf management and restoration in the United States. Hum. Ecol. Rev. 8 (1), 1–12.

Niemiec, R.M., 2020. Report: A Summary of Key Perspectives Shared at the February, 2020, Stakeholder Discussion on the Conflict Over Potential Wolf Restoration and Management in Colorado. Colorado State University, Department of Human Dimensions of Natural Resources, Fort Collins, CO.

Niemiec, R.M., Berl, R.E.W., Gonzalez, M., Teel, T., Camara, C., Collins, M., Salerno, J., Crooks, K., Schultz, S., Breck, S., Hoag, D., 2020. Public perspectives and media reporting of wolf reintroduction in Colorado. Peer J. 8, e9074. https://peerj.com/articles/9074/.

Niemiec, R.M., Willer, R., Ardoin, N.M., Brewer, F.K., 2019. Motivating landowners to recruit neighbors for private land conservation. Conserv. Biol. 33 (4), 930–941.

Österblom, H., Jouffray, J.B., Folke, C., Rockström, J., 2017. Emergence of a global science–business initiative for ocean stewardship. Proc. Natl. Acad. Sci. 114 (34), 9038–9043.

Ostrom, E., 2005. Self-governance and forest resources. In: Terracotta reader: A market approach to the environment, *12*.

Pate, J., Manfredo, M.J., Bright, A.D., Tischbein, G., 1996. Coloradans' attitudes toward reintroducing the gray wolf into Colorado. Wildl. Soc. Bull. 421–428.

Pooley, S.P., Mendelsohn, J.A., Milner-Gulland, E.J., 2014. Hunting down the chimera of multiple disciplinarity in conservation science. Conserv. Biol. 28 (1), 22–32.

Quartuch, M.R., Beckley, T.M., 2014. Carrots and sticks: New Brunswick and Maine forest landowner perceptions toward incentives and regulations. Environ. Manag. 53 (1), 202–218.

Quartuch, M.R., Broussard Allred, S., Markowitz, E., Catanzaro, P., Markowski-Lindsay, M., 2021. Applying the transtheoretical model of change to legacy planning decisions. Small-scale Forestry 1–22. https://doi.org/10.1007/s11842-021-09476-7.

Reed, M.S., 2008. Stakeholder participation for environmental management: a literature review. Biol. Conserv. 141 (10), 2417–2431.

Richmond, L., Gruby, R.L., Kotowicz, D., Dumouchel, R., 2019. Local participation and large marine protected areas: Lessons from a United States Marine National Monument. J. Environ. Manag. 252, 109624.

Rode, J., Gómez-Baggethun, E., Krause, T., 2015. Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. Ecol. Econ. *117*, 270–282.

Salerno, J., Mwalyoyo, J., Caro, T., Fitzherbert, E., Mulder, M.B., 2017. The consequences of internal migration in sub-Saharan Africa: a case study. BioScience 67 (7), 664–671.

Sandbrook, C., Adams, W.M., Büscher, B., Vira, B., 2013. Social research and biodiversity conservation. Conserv. Biol. 27 (6), 1487–1490.

Santos, A.N., 2015. Fisheries as a way of life: Gendered livelihoods, identities and perspectives of artisanal fisheries in eastern Brazil. Mar. Policy 62, 279–288. https://doi.org/10.1016/j.marpol.2015.09.007.

Scasta, J.D., Stam, B., Windh, J.L., 2017. Rancher-reported efficacy of lethal and non-lethal livestock predation mitigation strategies for a suite of carnivores. Sci. Rep. 7 (1), 14105.

Schwartz, M.W., Cook, C.N., Pressey, R.L., Pullin, A.S., Runge, M.C., Salafsky, N., Sutherland, W.J., Williamson, M.A., 2018. Decision support frameworks and tools for conservation. Conserv. Lett. *11* (2), e12385.

Sexton, N.R., Leong, K.M., Milley, B.J., Clarke, M.M., Teel, T.L., Chase, M.A., Dietsch, A. M., 2013. The state of human dimensions capacity for natural resource management: Needs, knowledge, and resources. The George Wright Forum 30 (2), 142–153.

Sterling, E.J., Filardi, C., Toomey, A., Sigouin, A., Betley, E., Gazit, N., Newell, J., Albert, S., Alvira, D., Bergamini, N., Blair, M., 2017. Biocultural approaches to well-being and sustainability indicators across scales. Nature Ecology & Evolution 1 (12), 1798–1806.

Stronza, A., 2009. Commons management and ecotourism: Ethnographic evidence from the Amazon. Int. J. Commons *4* (1).

Teel, T.L., Anderson, C.B., Burgman, M.A., Cinner, J., Clark, D., Estevez, R.A., Jones, J.P. G., McClanahan, T.R., Reed, M.S., Sandbrook, C., St. John, F.A.V., 2018. Publishing social science research in Conservation Biology to move beyond biology. Conserv. Biol. 32 (1), 6–8.

Teel, T.L., Manfredo, M.J., 2009. Understanding the diversity of public interests in wildlife conservation. Conserv. Biol. 24 (1), 128–139.

Treves, A., Bruskotter, J., 2014. Tolerance for predatory wildlife. Science *344* (6183), 476–477.

Walker, P.A., Hurley, P.T., 2004. Collaboration derailed: The politics of "community-based" resource management in Nevada County. Soc. Nat. Resour. 17 (8), 735–751.

Welch-Devine, M., Campbell, L.M., 2010. Sorting out roles and defining divides: social sciences at the World Conservation Congress. Conserv. Soc. 8 (4), 339.

Williams, S., 2010. Wellspring of wildlife funding: How hunter and angler dollars fuel wildlife conservation. Wildlife Professional *4*, 35–38.

Wilmer, H., Porensky, L.M., Fernández-Giménez, M.E., Derner, J.D., Augustine, D.J., Ritten, J.P., Peck, D.P., 2019. Community-engaged research builds a nature-culture of hope on North American Great Plains rangelands. Soc. Sci. 8 (1), 22.

Wilson, M.A., 1997. The wolf in Yellowstone: Science, symbol, or politics? Deconstructing the conflict between environmentalism and wise use. Soc. Nat. Resour. 10 (5), 453–468.

Young, J.C., Jordan, A., Searle, K.R., Butler, A., Chapman, D.S., Simmons, P., Watt, A.D., 2013. Does stakeholder involvement really benefit biodiversity conservation? Biol. Conserv. 158, 359–370.

Zafra-Calvo, N., Balvanera, P., Pascual, U., Merçon, J., Martín-López, B., van Noordwijk, M., Cabrol, D., 2020. Plural valuation of nature for equity and sustainability: insights from the Global South. Glob. Environ. Chang. *63*, 102115.