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Rapid changes in public perception toward a conservation initiative

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Abstract

Rapid, widespread changes in public perceptions and behaviors have the potential to influence conservation outcomes. However, few studies have documented whether and how such shifts occur throughout the span of a conservation initiative. We examined the 2020 ballot initiative to reintroduce wolves into Colorado, which passed with less support than prior surveys had estimated. We conducted a postelection survey of Colorado residents using the same methods as our preelection survey to compare responses between surveys and to official election results. Reported voting in favor of wolf reintroduction in the postelection survey decreased in comparison to voting intentions shared in the preelection survey, but not enough to reflect the actual vote. While bias from survey methods and/or sampling contributed to differences, we also found evidence that public perception changed. Specifically, beliefs about the potential for negative impacts of wolves increased, while beliefs about the potential for positive impacts of wolves decreased. Our findings highlight the need to conduct longitudinal monitoring of public perception given perceptions may be highly fluid as different entities attempt to sway voters. In addition, to better understand evolving perceptions, survey methods and sampling need to be improved.

KEYWORDS

attitude change, conservation behavior, public perspectives, wolf

1 | INTRODUCTION

Biodiversity conservation initiatives and outcomes are often influenced by public perception and behaviors (Nilsson et al., 2020; Reddy et al., 2017; Schultz, 2011). The public can impact conservation outcomes by engaging in actions

that directly impact species persistence, such as preserving habitat on private lands (Belaire et al., 2014; Paloniemi & Tikka, 2008) or engaging in retaliatory killings of native carnivores (Dickman, 2010). The public can also act in ways that indirectly influence conservation initiatives, such as donating or voting (Larson et al., 2015) or engaging in

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activism in favor of or in opposition to proposed management plans (Peltzer et al., 2019; Warner & Kinslow, 2013). Ultimately, the long-term success of conservation initiatives often depends on the level of public support for those initiatives, and scholars have argued that conservation organizations have a moral imperative to engage publics that are affected by conservation decisions (Manfredo, 2008).

Given the influence of public support on conservation outcomes, a large body of social science research has examined the drivers of public perceptions and behaviors related to conservation initiatives (Bamberg and Möser 2007; Bennett et al., 2017; Kollmuss & Agyeman, 2002; Manfredo, 2008). The term *perceptions* refers to the way an “individual observes, understands, interprets, and evaluates a referent object, action, experience, individual, policy, or outcome” (Bennett, 2016, p. 585). It is a broad term encompassing more specific constructs, such as attitudes, beliefs, and values from social psychology theory, that have been shown to influence individual behavior and support for conservation efforts (Bennett, 2016; Manfredo, 2008). Bright and Manfredo (1996), for example, demonstrate how support for wolf reintroduction is influenced by attitudes, which are individuals’ evaluations of a subject or behavior as positive or negative (Fishbein & Ajzen, 2011). Attitudes are in turn influenced by specific beliefs, such as beliefs about the outcomes of a behavior or policy (Fishbein & Ajzen, 2011), as well as knowledge, prior experiences, and emotional responses (Bright and Manfredo 1996; Manfredo, 2008; Vaske et al., 2021). Attitudes may also be influenced by one’s values, or core motivational goals (Manfredo et al., 2017; Schwartz, 2006). Values have been shown to explain variability in levels of support for various wildlife management actions; for example, people with more domination values towards wildlife (i.e., who believe wildlife should be used and managed for human benefit) tend to be more supportive of lethal control of wolves (Manfredo et al., 2020, 2021). Public support and behaviors towards conservation initiatives may also be impacted by socio-cultural, contextual, and behavior-specific factors, such as perceived social norms (i.e., shared standards of acceptable behavior; Niemiec, Champine, et al., 2020) and perceived behavioral control, or the perceived ease or difficulty of engaging in a behavior (Bamberg and Möser 2007). In the case of controversial or political conservation initiatives where public support is needed, public perception may also be influenced by outreach campaigns by groups with different perspectives, who will apply pressure with the goal of swaying beliefs and ultimately attitudes towards requested support.

2 | EXAMINING RAPID SHIFTS IN PUBLIC PERCEPTION

While research has provided insight into the complexities of public perception and behavior, there have been

few studies documenting the extent and drivers of rapid shifts in public perception towards conservation initiatives (see Warner and Kinslow 2013 and Peltzer et al., 2019 for exceptions). Existing studies have typically used surveys and interviews to document public behaviors, support, attitudes, beliefs, and other correlates at a single time point (e.g., see Bamberg & Möser 2007; Niemiec, Champine, et al., 2020 for reviews). It is often unclear how malleable these factors actually are within the timeframe of a conservation initiative. Studies have also documented shifts in values towards wildlife (Manfredo et al., 2021), which can result in changes in perceptions (George et al., 2016); however, these shifts in values have typically occurred intergenerationally, as a result of societal trends such as increased socioeconomic development, rather than as a result of or in response to specific conservation initiatives (Manfredo et al., 2020, 2021).

A small body of experimental work examines whether outreach, education, and other interventions can shift public perceptions and behaviors related to biodiversity conservation objectives (Byerly et al., 2018; Byerly et al., 2019; Niemiec, Sekar, et al., 2020; Kidd et al., 2019; Reddy et al., 2020; Verissimo et al. 2018). These studies have typically focused on examining changes among a sub-population of study participants in response to one-off messaging or interventions (Byerly et al., 2019; Niemiec, Sekar, et al., 2020; Reddy et al., 2020) and have found that message framing can sometimes impact perceptions and behaviors (Kusmanoff et al., 2020). Less is known, however, about the extent to which broader societal-level engagement with a conservation initiative, such as civic activism or exposure to continuous media coverage and outreach and education campaigns, can result in large-scale and rapid changes in public perception and behavior. In addition, it is difficult to determine impacts when an initiative is highly polarized and the public is receiving competing messages from diverse groups. Understanding potential shifts and what drives these shifts over the course of an initiative is critical to inform effective public outreach and engagement over time.

3 | CASE STUDY: WOLF REINTRODUCTION IN COLORADO

Here, we examine a case study of what appears to have been a rapid (less than a year), large-scale shift in public perception and support towards a conservation initiative: the proposed wolf reintroduction to the U.S. state of Colorado. The gray wolf (*Canis lupus*) was once common throughout North America, including Colorado. However, during the latter half of the 1800s and early 1900s,

government agents and settlers over-hunted wolf prey, such as bison, elk, and deer, and also introduced domestic livestock, an alternate prey source for wolves. Because wolves killed livestock and big game, wolves were shot, trapped, and poisoned through government-sponsored predator control programs, which led to widespread reductions in wolf populations. Wolves were eliminated from more than 95% of their historical range in the lower 48 United States, and were eradicated from Colorado by the 1940s. Public perception towards wolves started changing in the mid-20th century with the increased interest in the preservation of the wilderness more broadly (Kellert et al., 1996). The US Endangered Species Act passed in 1973, and the gray wolf became a federally protected species in the United States in 1978. In the decades following, the US government and conservation partners began efforts to reintroduce and recover wolves in the Northern Rocky Mountains, with reintroductions into Yellowstone National Park and in Central Idaho, where reintroduction was managed in partnership with the Nez Perce Tribe.

Social science research has found that that while public perception towards wolves in the North America has become more positive over the past several decades, perceptions can vary significantly by experience with or proximity to wolves, stakeholder group identity (e.g., ranching, hunting, and environmentalist), demographics (e.g., age, income, and urban/rural residence), and political affiliation (George et al., 2016; Hamilton et al., 2020; van Eeden et al., 2021; Williams et al., 2002). Houston et al. (2010) found that discourse about wolves was more positive in newspapers in states and provinces that have had permanent wolf populations for longer, while areas with new or anticipated wolf populations had more negative discourse. Studies also suggest that the topics of wolf reintroduction and management are highly contentious in part because wolves have become surrogate symbols of broader societal-level conflicts, such as clashes between urban and rural values, federal versus state control, and the struggle among stakeholder groups for a say in decision-making about wildlife management (Nie, 2002; Wilson, 1997).

Although small numbers of wolves have occasionally immigrated into Colorado from adjacent states (e.g., Wyoming), there has not been a viable population of wolves in the state since their eradication in the 1940s. Environmental nonprofit organizations and animal advocates therefore pursued a ballot initiative to restore wolves (Proposition 114, which qualified for the state ballot in January 2020) after the state's wildlife commission passed several resolutions in opposition to wolf reintroduction. Multiple surveys have found high levels of public support for wolf reintroduction in the state; a 1994 mail survey, for example, found that 70.8% of

Colorado residents were supportive of wolf reintroduction (Pate et al., 1996), and a 2001 phone survey found that 66.0% of Colorado residents were supportive (Meadow et al., 2005). In August 2019, an online survey of 734 Colorado residents representative in terms of age, gender, and geography, found that 84.0% of residents were supportive of wolf reintroduction (Niemic, Berl, et al., 2020). Surveys identified high levels of support from rural Western Slope communities where wolves would be reintroduced (65.1% in support in Pate et al., 1996 and 79.8% in support in Niemic, Berl, et al., 2020) in addition to more urban Front Range communities (73.8% in Pate et al., 1996 and 84.9% in Niemic, Berl, et al., 2020). Despite the high levels of public support documented in prior surveys, the initiative passed narrowly in November 2020, with 50.9% of the Colorado public voting in favor and the majority of residents in Western Slope counties opposing the initiative (Colorado Election Results 2020).

One contributing cause of the difference between findings in the prior surveys and actual voting behavior could be a widespread shift in public perception as a result of numerous factors related to or independent of the ballot initiative to restore wolves. For example, the initiative occurred during the COVID-19 pandemic, which may have impacted people's perceptions of what policies should have been prioritized in terms of funding and political will. The vote also occurred during a polarizing national election, so public support may have shifted if wolf reintroduction was viewed as a partisan issue (Hamilton et al., 2020; van Eeden et al., 2021). Indeed, Manfredo et al. (2017) found evidence of political backlash to conservation-focused ballot initiatives among groups with more traditional (i.e., utilitarian) values towards wildlife. Additionally, in the year preceding the ballot initiative, a pack of wolves was detected in north-west Colorado; while several of these wolves were later reported to have been shot and killed in Wyoming (Brasch 2020), stakeholder groups that were opposed to reintroduction used the existence of this pack to encourage opposition to the ballot initiative, arguing that wolves were already present in the state. Furthermore, analyses of media coverage found that, before the vote, the media portrayed more negative arguments related to wolf reintroduction than positive arguments (Niemic, Berl, et al., 2020), a trend that has been documented in local media coverage of wolf reintroduction and management elsewhere (Houston et al., 2010). Many county commissioners, editorial boards of newspapers, and leaders of agricultural, hunting, and rural interest groups publicly expressed their opposition to the initiative in the year leading up to the election (CBS Denver, 2020; Phippen, 2020). These factors may have persuaded a portion of the public to oppose the initiative.

It is also possible that part of the discrepancy between public support reported in prior surveys and actual voting behavior was due to limitations of the prior public surveys. For example, several of the prior surveys did not specifically target or control for likely voters (Niemic, Berl, et al., 2020; Pate et al., 1996). Research on the polling-voting disconnect in the 2016 U.S. national election found that more accurate predictions of election outcomes can be derived from models that account for the stated voting intentions of respondents as well as demographic variables that consistently predict turnout and overreporting (Rentsch et al., 2019). Even though prior surveys on public support for wolf reintroduction were conducted using multiple data collection modes (e.g., online, mail, and phone), they each may have been impacted by response bias. Indeed, the survey conducted in 2019, which was closest in time to the ballot initiative vote in 2020, recruited participants through the online Qualtrics survey platform, which may have led to a sample that was biased towards respondents with greater access to and familiarity with the internet (Niemic, Berl, et al., 2020; Pforr & Dannwolf, 2017).

Another limitation of prior public surveys that could explain the discrepancy is the way in which public support for wolf reintroduction was measured. Surveys prior to the election asked respondents how they would vote if given the opportunity to vote for or against reintroducing the gray wolf into Colorado. On the other hand, the ballot initiative provided additional context, asking voters if reintroduction should occur west of the continental divide after holding statewide public hearings. The initiative also stated that the plan should use scientific data, require compensation for livestock losses, and prohibit land, water, or resource use restrictions on private land (Data S1). Voters may have supported wolf reintroduction ideologically, but not in the same context detailed in the ballot initiative (e.g., proposed governance approaches or management actions, such as compensation for depredation). Additionally, the wording of the ballot initiative may have swayed voters by making them more aware of the potential negative impacts of wolves (e.g., through the discussion of impacts to livestock and private landowners). Given the context-specific nature of attitudes (Fishbein & Ajzen, 2011), variability in measures can occur when the context of the issue changes.

The discrepancy may have also been due to the “attitude-action gap” and “behavioral intention-behavior gap” that have been previously identified in psychology research, in which people’s reported attitudes and behavioral intentions do not always correlate with their behavior in reality (Kollmuss & Agyeman, 2002; Nilsson et al., 2020; Zhang et al., 2021). This gap may be due to the variety of additional barriers and motivations to behavior

beyond attitudes and intentions, such as social and contextual factors (e.g., social norms, incentives, and infrastructure; Kollmuss & Agyeman, 2002). Similar gaps between opinions measured in polling and actual voting behavior also have been documented in political science research. Studies suggest these gaps appear to result from people changing their opinion before an election. Zaller (2003), for example, discusses the concept of latent opinion, which is an opinion that might change at some point in response to decision-makers’ actions in the run-up to an election. Low-information voters may be more likely to have such unstable opinions over time and are more likely to respond to factors such as how moderate or extreme a candidate is perceived as during campaigning (Zaller, 2018). Mutz (1992) finds that representations of public opinion in media before an election can also facilitate shifts in public opinion. It is possible that similar factors may have influenced low information voters during the campaigning for or against Proposition 114 after preelection surveys were conducted.

4 | RESEARCH OBJECTIVES

Through our case study, we sought to examine if and how public perceptions and levels of support regarding wolf reintroduction changed in the year leading up to the election. We compared intentions to vote for or against the ballot measure in 2019 with actual voting on Proposition 114 in the 2020 election and self-reported voting behavior in a survey immediately after the election. Within the broader umbrella of perceptions (Bennett, 2016), we focused on specific beliefs about the potential positive or negative outcomes of wolf reintroduction (Fishbein & Ajzen, 2011), as well as beliefs about what other factors may have influenced their level of support for wolf reintroduction.

We conducted a follow-up public survey immediately after the 2020 election asking about respondents’ voting behavior, their beliefs related to the outcomes of wolf reintroduction, and their beliefs about what influenced their voting behavior. We compared these responses to data from the 2019 preelection survey (Niemic, Berl, et al., 2020). To obtain respondents for the 2020 survey, we used the same recruitment methodology as the 2019 online public survey (Niemic, Berl, et al., 2020). This allowed us to answer the following primary research questions:

1. To what extent do voting rates for wolf reintroduction reported in the 2020 postelection survey differ from expressed voting intentions in the 2019 preelection survey?

2. How accurate is the postelection survey in detecting the level of public support revealed through the election outcome?
3. How does voting behavior reported in the postelection survey vary by demographics and social identity, and how does this compare to the 2019 survey?
4. What arguments and information sources do voters claim influenced their decision-making regarding the ballot initiative to reintroduce wolves?
5. Did beliefs related to the impacts of wolf reintroduction change between 2019 and 2020, influencing overall support for the initiative?

5 | METHODS

We adopted the same stratified sampling approach as the 2019 online public survey described in Niemiec, Berl, et al. (2020) to obtain a representative sample of Colorado residents through Qualtrics (Provo, UT), a commercial sampling firm with a licensed online survey platform. We used a consistent sampling approach so that we could directly compare responses to the 2019 survey to answer research questions #1 and #5. Online sampling through firms such as Qualtrics is increasingly being used to obtain representative samples in the face of declining response rates to phone and mail surveys (George et al., 2016; Manfredo et al., 2020; Stedman et al., 2019; Wardropper et al., 2020). We were not able to access the exact same respondents as the 2019 survey, but we used the same stratification approach to obtain a similar sample. Following Niemiec, Berl, et al. (2020), our target stratification consisted of equal gender representation and equal distribution of the sample across age categories of 18–34, 35–54, and 55 years and older, to reflect state population demographics as reported by the US Census Bureau American Community Survey. Our sampling sought to achieve similar numbers of respondents as Niemiec, Berl, et al. (2020) from each region in Colorado, including the Front Range (11 counties; $n = 365$ in Niemiec, Berl, et al., 2020), Western Slope (35 counties; $n = 277$ in Niemiec, Berl, et al., 2020), and Eastern Plains (18 counties; $n = 92$ in Niemiec, Berl, et al., 2020).

Upon receiving survey responses, we weighted the data to reflect the actual population distribution of the three regions for state-level reporting (Vaske, 2008). We calculated weighting factors separately for the entire sample of survey respondents and for the subsample of voters in the sample (i.e., excluding those who did not vote or did not remember their vote). We calculated the weights as the percentage of the Colorado population in each combination of age group by geographic region from 2019 5-year American Community Survey (ACS) estimates, divided by the

corresponding percentage in our full sample and in our subsample of voters (Niemiec, Berl, et al., 2020; Table S1). In our 2019 survey, we used 2017 5-year ACS population estimates because it was conducted before the updated 2019 5-year estimates were available, but in this postelection survey we used the updated estimates. We report unweighted proportions within regions. Survey recruitment occurred between December 2, 2020 and January 6, 2021, approximately 1–2 months after Proposition 114 to reintroduce wolves to Colorado passed.

All quantitative analyses were conducted in R, primarily using the 'survey' package. Most reported results are descriptive, but we used logistic regression to examine whether belief items predicted voting behavior (Research Question 5). We report 95% CIs for all estimated means and coefficients.

5.1 | Research questions 1, 2, and 3

To compare voting rates with the 2019 preelection survey (Research Question 1) and examine whether the 2020 postelection survey could accurately detect the level of support for wolf reintroduction revealed through the vote (Research Question 2), we asked respondents whether they had voted for or against Proposition 114, had not voted at all, or did not remember how they voted (see Table S2 for all survey questions). We then examined responses to this question among our overall sample, by geographic region (i.e., Front Range, Western Slope, Eastern Plains, as described above), demographics (i.e., age, income, gender, education, race, pet ownership, rural vs. urban residence), and self-reported social identity (i.e., whether respondents reported that they identified not at all, a slight amount, a moderate amount, or a great deal as a wildlife advocate, animal rights advocate, gun or property rights advocate, hunter, rancher, or conservationist), following Niemiec, Berl, et al., 2020 (Research Question 3). We compared responses in our postelection survey to the Colorado election results, overall and by geography (reported in Colorado Election Results 2020), as well as to our predicted levels of public support from the preelection survey (which indicated 84% of Coloradans would vote for the initiative; Niemiec, Berl, et al., 2020). If our follow-up survey did not reflect the election results, this would suggest that the difference in voting and prior polling in both surveys could have been the result of limitations in obtaining accurate estimates of public perspectives and behaviors from these surveys. If our follow-up survey closely reflected the final election results and revealed reduced public support compared with the 2019 survey, this would suggest that widespread and rapid changes in public perspectives occurred. If the

follow-up survey more closely but not did not fully capture the final vote, this would suggest a combination of rapid changes in public support and survey limitations.

5.2 | Research question 4

To examine what may have influenced voter decision-making and thus contributed to potential shifts in perceptions and support (Research Question 4), we asked respondents a series of open-ended questions about the arguments and information sources related to wolf reintroduction that impacted them. Specifically, we asked respondents: (1) Please explain why you decided to vote for or against wolf reintroduction via Proposition 114. Or, describe why you decided to not vote on Proposition 114; and (2) when making your decision about how to vote on wolf reintroduction via Proposition 114, where did you get your information? To analyze participants' responses to these questions, we used inductive thematic coding (Braun and Clarke 2006). Specifically, the first author reviewed participants' responses to each question and developed a codebook (see Table S3) based on iteratively reviewing the first 100 responses and assigning each to an identified thematic code. In vivo coding (Saldana, 2016) was used to create each thematic code, in which words or phrases from the respondents themselves were used in the development of the code name. For example, the code "Wolves are already here" was assigned to the following participant response: "I heard that the gray wolf has already returned to Colorado without human intervention so I don't understand why they want to reintroduce them if they are already here." Due to the straightforward and brief nature of participant responses, coding was only done by the first author, rather than by the whole team. Different codebooks were developed for respondents who voted for and against Proposition 114. The first author then applied this codebook to analyze the remaining responses for each open-ended question. We report the most frequently mentioned themes for each question.

5.3 | Research question 5

To examine potential changes in specific beliefs related to the impacts of wolf reintroduction (Research Question 5), we asked respondents to rate their level of agreement with a series of belief items about potential perceived outcomes of wolf reintroduction (adapted from Pate et al., 1996) that were also included in the 2019 survey (but not reported in Niemiec, Berl, et al., 2020). These included whether respondents believed reintroducing wolves would result in wolf attacks on livestock, ranchers losing money, wolves wandering into residential areas,

wolf attacks on humans and pets, greater control of rodent populations, increased tourism, a return of the natural environment back to the way it was, the preservation of the wolf as a wildlife species, keeping deer and elk populations in balance, ranchers killing wolves, and a reduction in deer and elk hunting opportunities. We also included three belief items that were not originally in the presurvey to examine if they were associated with voting behavior. These items included whether respondents believed reintroducing wolves would right a past wrong done to the species, result in a waste of taxpayer money, or increase conflict between urban and rural Colorado communities (Table S2). We modeled the binary outcome of voting for the proposition using a survey-weighted generalized linear model, with all belief items as predictors.

6 | RESULTS

6.1 | Comparing pre- and post-election survey responses (Research question 1)

Overall, we received 989 survey responses: 516 from the Front Range, 352 from the Western Slope, and 121 from the Eastern Plains (Figure 1). Of these, 961 provided information on their voting behavior. Our overall weighted results revealed voting rates across the state of 43.7% voting in favor (95% CI: 0.399, 0.474), 26.7% against (0.233, 0.301), 20.1% did not vote (0.172, 0.230), and 9.5% did not remember (0.073, 0.118). This overall estimate of voting in support was lower than the 84.0% reporting they would vote in favor in the 2019 survey (Figure 2a). However, the estimates of support in both surveys are not directly comparable because the 2019 survey only included response options of "would vote for" or "would vote against," while the 2020 postelection survey included "voted for," "voted against," "did not vote" and "do not remember." When those who did not vote or did not remember were excluded from the sample of post-survey respondents ($n = 84$), we found 64.1% (0.597, 0.680) voting in support (Figure 2b). This 64.1% can be compared with the 84.0% in the 2019 presurvey, given both numbers are the percentage of votes in favor of the proposition out of the total number of respondents who had voted or expressed their voting intention.

6.2 | Comparing postelection survey responses and official election results (Research question 2)

Official election results showed 50.9% of votes in support and 49.1% against the ballot initiative (Colorado

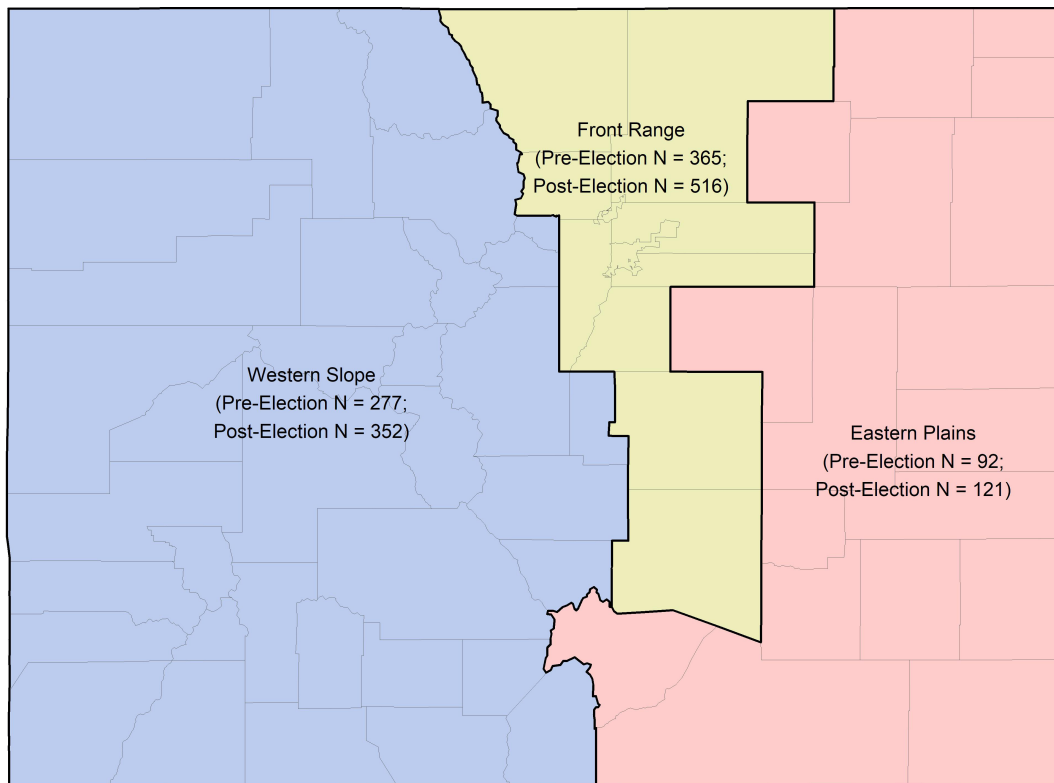


FIGURE 1 Colorado counties included within each stratified sampling region and final sample sizes for preelection (see Niemiec, Berl, et al., 2020) and postelection (present study) surveys

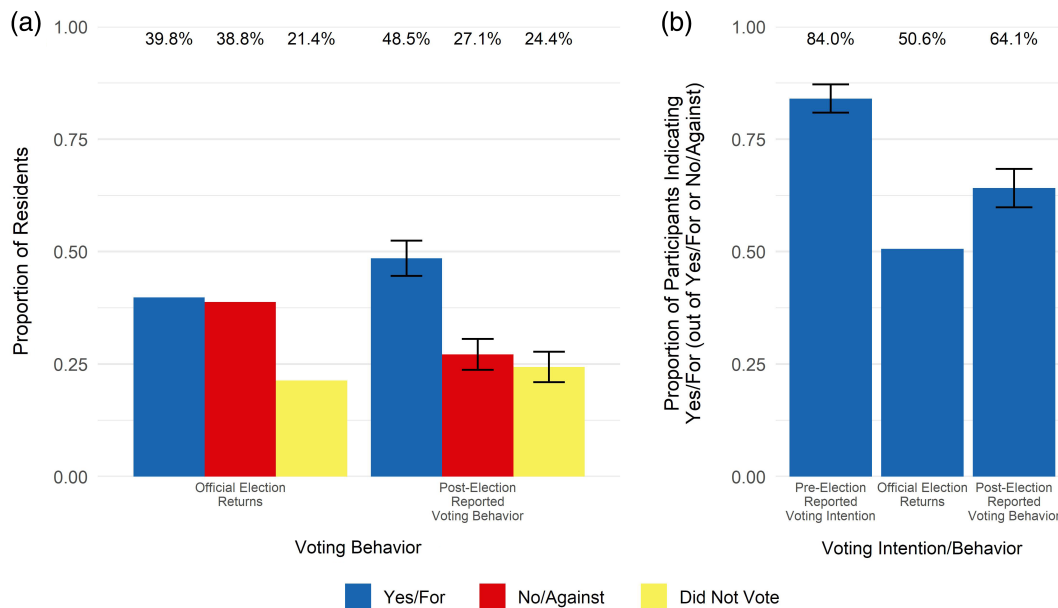


FIGURE 2 Comparison of voting behavior reported in the 2019 preelection survey, the 2020 postelection survey, and official election returns. (a) Comparison of voting behavior among all Colorado residents in the official election returns and the full sample of the 2020 postelection survey, including those who did not vote and (b) comparison of voting behavior among voters in official election returns, voting intentions from the 2019 preelection survey (Niemiec, Berl, et al., 2020), and voting behaviors among the subsample of those who voted and remembered how they voted in the postelection survey (i.e., excludes $n = 827,816$ in election data and $n = 84$ in postelection survey sample who did not vote or did not remember how they voted). Error bars represent weighted 95% confidence intervals for survey-based estimates

Secretary of State, 2020; Figure 2b), compared with the 64.1% votes in support and 35.9% against in our survey. Regionally, aggregated election results from counties showed totals of 53.6% voting in favor in the Front Range, 38.1% in the Western Slope, and 28.8% in the Eastern Plains. Our postelection survey found 65.7% (0.606, 0.707) of respondents voted in favor in the Front Range, 57.2% (0.509, 0.634) in the Western Slope, and 55.0% (0.434, 0.666) in the Eastern Plains. Similar to our postelection data, which found that 20.1% did not vote, voter data showed that 21.4% of registered voters did not vote on the ballot initiative, and this number was consistent across regions (Official election results: 21.7% Front Range, 19.2% Western Slope, 21.2% Eastern Plains did not vote). In summary, the second survey reduced the original overestimation error from about 65% (estimate of 84% support compared with 50.9% revealed in voting) down to about 26% (estimate of 64.1% support compared with 50.9% revealed in voting). The remaining difference between the second survey and the vote (i.e., the overestimation error of 26%), can be interpreted as the contribution from survey errors (and random error), while the reduction in error from the first survey to the second (i.e., 65–26%) can be interpreted as changes in voting behaviors due to shifts in public perspectives.

6.3 | Voting behavior by demographics and social identity (Research question 3)

Within our sample, 779 participants provided responses to all voting, demographic, and social identity questions (400 Front Range, 284 Western Slope, 94 Eastern Plains), with 164 additional participants providing responses for voting, gender, and age but no further demographic or identity-based questions. Similar to the 2019 preelection survey, we found that the percentage voting in favor of wolf reintroduction was greater among self-identified pet owners (Figure S1), wildlife advocates, and animal rights advocates (Figure S2). Also as in the preelection survey, self-identified ranchers and hunters were less supportive of wolf reintroduction than those who did not self-identify as ranchers or hunters (Figure S2). Those who self-identified as gun rights advocates or property rights advocates reported less support for reintroduction compared with those who did not self-identify with these groups. These differences based on social identity were greater in the postelection survey compared with the preelection survey (15.4% points difference for gun rights advocates and 10.6% points difference for property rights advocates in the postelection survey, compared with <1% difference in the preelection survey) (Figure S2). We also found that, while those who identified as conservationists

reported greater support in both surveys than those who did not, the gap in support among these two groups narrowed in the postelection survey (8% points difference) compared with the preelection survey (13% points difference; Figure S2). While the preelection survey found little difference in support by age group, our postelection survey found older residents were less supportive than younger residents; specifically, 49.8% of those in the 55+ age group voted for reintroduction in the postsurvey, compared with 75.9% of those in the 18–34 age category (Figure S1). Additionally, while the 2019 survey found little difference in support by community size, the postelection survey found that support for reintroduction was higher among people living in cities (65.3%) compared with those in rural areas (42.1%).

6.4 | Arguments and information sources influencing voting behavior (Research question 4)

Thematic analysis (Table S3) revealed a diversity of responses to the open-ended survey question on why respondents voted for or against wolf reintroduction;

TABLE 1 Results of thematic analysis of participant responses to the open-ended survey question on why respondents voted for or against wolf reintroduction

Reasons for voting against	Number of respondents mentioned
Impacts to livestock, agriculture, and ranchers	94
Wolves are already in CO	51
Cost/waste of money	32
Human and pet safety	30
Impacts to wildlife (especially deer and elk)	26
General negative attitudes/beliefs towards wolves	18
Wolves and wolf reintroduction generally not needed	17
People should not interfere	14
Reasons for voting for reintroduction	
Restore ecological balance and improve the environment	147
Moral arguments: protecting and returning wolves is “right”	128
Positive attitudes towards wolves	28
Help wolf population or species	30
General positive attitude towards nature and animals	11

here, we report on the overarching thematic categories that were mentioned by more than 10 respondents (the number of individuals that mentioned each theme is reported in Table 1). The most common theme regarding why respondents voted for wolf reintroduction was to restore ecological balance. Responses in this thematic category included beliefs that wolves had the ability to: provide balance to ecosystems or improve the environment; and balance populations of deer, elk, or “pest” prey species. The second most common reason why respondents voted for wolf reintroduction was the moral argument that protecting and returning wolves was the right thing to do. Responses in this thematic category included the beliefs that: wolves belong in Colorado because they are native; wolves should be returned because they were exterminated by humans; wolves should be back in their natural environment; wolves deserve to live here; wolves have as much of a right to the land as humans; the lives of wolves are important; wolves need a place to live; and humans should right the past wrong of exterminating wolves. The third most commonly mentioned theme in support of wolf reintroduction was positive attitudes towards wolves, such as participants liking wolves and wanting to see more wolves on the landscape. Other thematic categories included the desire to help the wolf population/species and prevent extinction and more general positive attitudes towards nature and animals.

The two most common themes reported among those opposed to wolf reintroduction were concerns about the impacts of wolves to ranchers, livestock, and agriculture and the belief that wolves were already in Colorado so there was no need to reintroduce them (Table 1 and S3). Other commonly reported themes in opposition to wolf reintroduction were: costs and the belief that reintroduction was a waste of taxpayer money (five of these respondents mentioned funds should go to COVID-19 relief instead); concern for human and pet safety; and concern about the negative impacts of wolves on wildlife, such as deer and elk. Additionally, some respondents reported overall negative attitudes towards wolves (e.g., the belief that wolves were killers or undesirable animals); the belief that wolves or wolf reintroduction in general were not needed; and the belief that people should not interfere with nature and should let wolves arrive into the state on their own.

When asked from what source respondents got their information when making a decision on Proposition 114, the most common theme was through the news ($n = 183$). Among respondents who mentioned news, 40 mentioned televised news specifically, 67 mentioned local news specifically, and the remaining 76 more generally wrote “news.” Respondents also commonly mentioned receiving information through an internet search or online website ($n = 153$). Additional sources of information reported by respondents included election

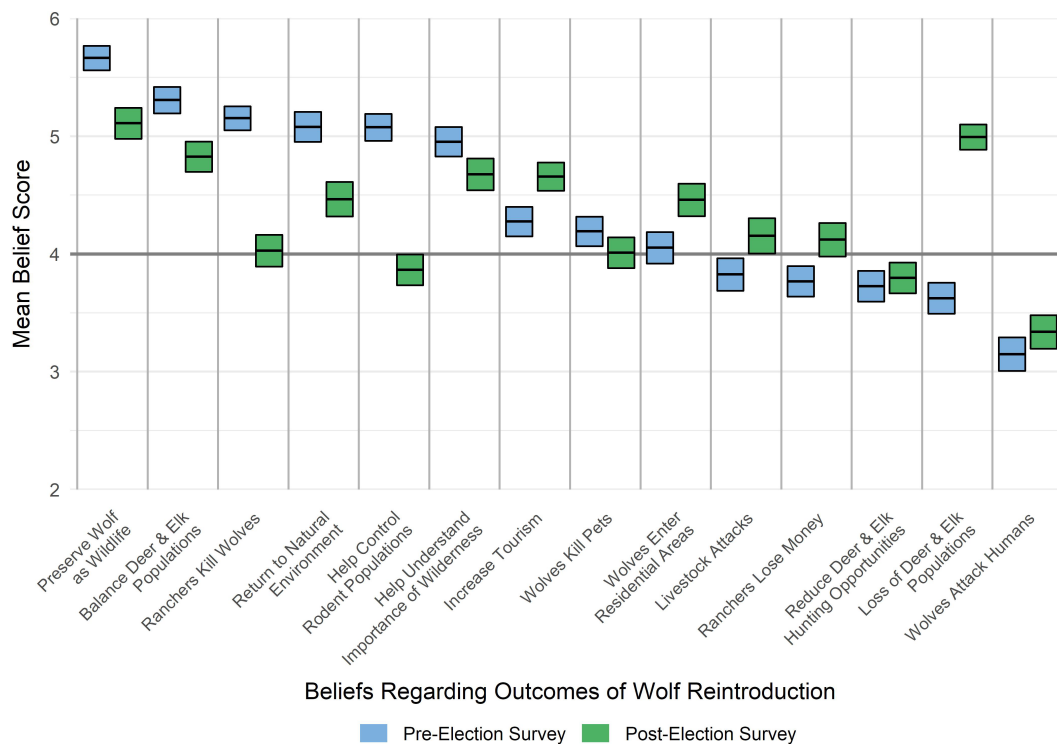


FIGURE 3 Beliefs regarding the potential outcomes of wolf reintroduction from preelection and postelection surveys. Boxes depict mean statewide scores (weighted by region and age group) on a 7-point response scale from “strongly disagree” (1) to “strongly agree” (7), where the midpoint (4) represents “neither.” The upper and lower bounds of each box depict 95% confidence intervals

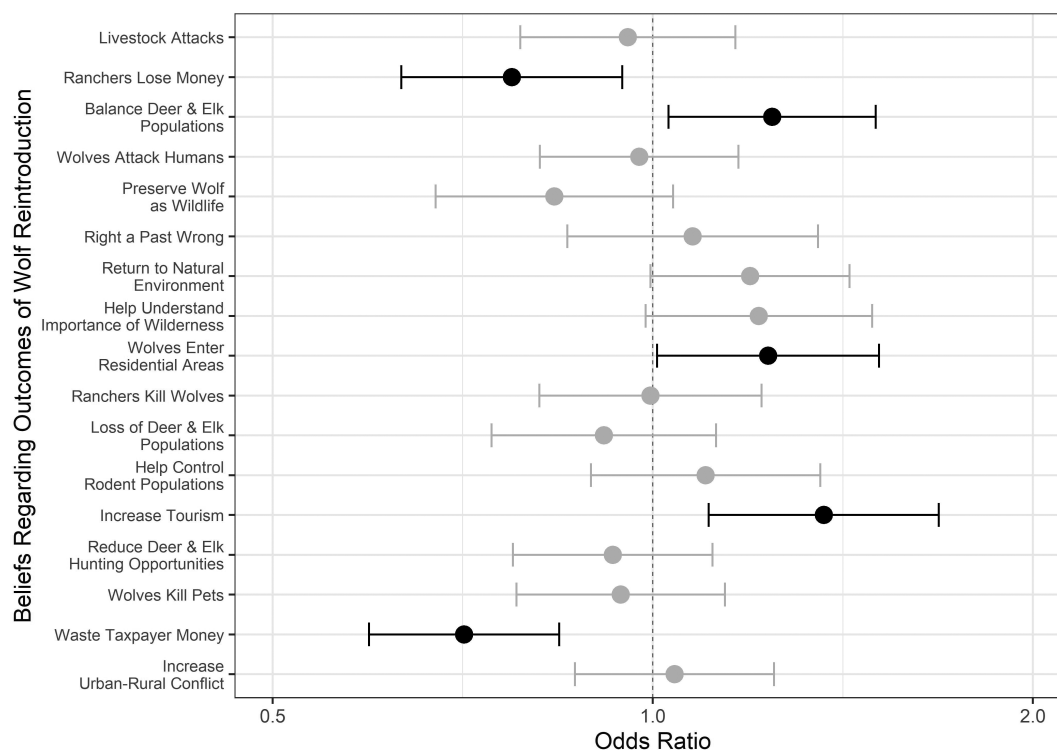


FIGURE 4 Effects of beliefs regarding the potential outcomes of wolf reintroduction on voting behavior. Forest plot depicts odds ratios from 0.5 (half as likely to vote for the proposition) to 2.0 (twice as likely to vote for the proposition), with 95% confidence intervals surrounding each estimate. Items with confidence intervals that do not overlap with 1 have a significant positive (above 1) or negative (below 1) effect on voting behavior and are shown in black, compared with other variables which do not have a significant effect and are shown in gray

booklets or voting guides ($n = 112$); friends, family, or others in their community ($n = 63$); personal experience (e.g., outdoor experience, experience encountering wolves; $n = 30$); social media ($n = 27$); farmers or ranchers ($n = 21$); or radio or podcasts ($n = 20$). Other less-common sources that were mentioned by more than 10 respondents were wolf sanctuaries, past reintroduction programs, Colorado Parks and Wildlife (CPW), government agencies more generally, mailers/pamphlets, or ads or commercials.

6.5 | Changes in beliefs related to wolf reintroduction (Research question 5)

Of our participants, 822 provided information on their voting behavior and responded to all items regarding their beliefs about the outcomes of wolf reintroduction (420 Front Range, 302 Western Slope, and 100 Eastern Plains). We observed significant changes in many of these beliefs between the preelection and postelection surveys (Figure 3). In general, residents became more negative in their beliefs between 2019 and 2020 and less likely to perceive positive outcomes from wolf reintroduction.

Agreement with the following belief statements regarding negative outcomes of wolf reintroduction increased significantly: reintroducing wolves would lead to large losses in deer and elk populations; reintroducing wolves would result in wolves wandering into residential areas; reintroducing wolves would result in ranchers losing money; and reintroducing wolves would result in large numbers of wolf attacks on livestock. One positive outcome statement increased significantly: reintroducing wolves would increase tourism in Colorado. We observed agreement significantly decreasing with the following positive outcome belief statements: reintroducing wolves would lead to greater control of rodent populations; reintroducing wolves would return the natural environment back to the way it was; reintroducing wolves would preserve the wolf as a wildlife species; reintroducing wolves would keep deer and elk populations in balance; and reintroducing wolves would help people understand the importance of wilderness. Agreement significantly decreased for one negative outcome statement: reintroducing wolves would result in ranchers killing wolves. The mean responses of three of these items switched direction entirely: reintroducing wolves would lead to greater control of rodent populations (changed

from agree to disagree); reintroducing wolves would result in large numbers of wolf attacks on livestock (changed from disagree to agree); and reintroducing wolves would lead to large losses in deer and elk populations (changed from disagree to agree).

From the results of our logistic regression model (Figure 4), we found that agreement with the following beliefs significantly increased the likelihood of voting in favor of the proposition, rather than voting against the proposition or not voting at all: wolf reintroduction will increase tourism (*odds ratio [OR]* = 1.419 [95% CI: 1.169, 1.723]; $p < .001$); wolves will wander into residential areas ($OR = 1.247$ [95% CI: 1.017, 1.528]; $p = .042$); and wolf reintroduction will keep deer and elk populations in balance ($OR = 1.243$ [95% CI: 1.029, 1.501]; $p = .024$). Conversely, agreement with the belief that wolf reintroduction will waste taxpayer money (a statement included in the postelection survey but not the preelection survey) significantly decreased the likelihood of voting for the proposition ($OR = 0.709$ [95% CI: 0.596, 0.843]; $p < .001$), as did agreement with the belief that wolf reintroduction will result in ranchers losing money ($OR = 0.773$ [95% CI: 0.632, 0.946]; $p = .013$). These relationships held across demographic categories, including urban versus rural residents.

7 | DISCUSSION

Understanding the extent and drivers of shifts in public perception towards conservation initiatives is critical, given the public's ability to influence the success of such initiatives. Further, such an understanding can inform the development of public outreach and engagement campaigns on conservation initiatives over time. We examined the 2020 state ballot initiative to reintroduce wolves into Colorado, which passed with significantly less support than prior surveys had estimated, to investigate a potential case study of rapid, widespread changes in public support and perception. By comparing survey responses gathered in 2019 to those collected immediately after the election in 2020, and accounting for survey error, we found evidence that changes in public support and perception did occur in the year leading up to the election. Specifically, reported rates of voting in favor of wolf reintroduction in the postelection survey were lower than the preelection survey and more closely resembled the actual vote than the preelection survey. While there is no way to infer causality, it could be reasoned that the contribution of changes in perspectives was the difference in voting preferences between the two surveys. In support, we found that specific beliefs about the negative impacts of wolves increased and beliefs about the positive

impacts of wolves decreased in the time period between the two surveys.

However, we also found evidence of survey bias; specifically, we found that the postelection survey still overestimated the percentage of voters who voted for wolf reintroduction. A sampling bias would suggest there may have been some residents against wolf reintroduction, particularly in the rural areas of Colorado, who were not captured in the online Qualtrics sampling of both surveys. This may be due to Qualtrics relying on a convenience sample of people with internet access who have the time, interest, and knowledge to participate as an online survey taker. Additionally, while Qualtrics claims to not inform potential respondents about the topic of the survey when recruiting participants to reduce nonresponse bias, such bias may have still occurred if respondents dropped out after beginning the survey. Further, the differences reported above do not take into account voters who did not remember their choice (9.5% of our sample); it is possible that more voters who voted against reintroduction did not remember how they voted. In addition, the problem may lie in the survey instrument. For example, respondents may have viewed the hypothetical nature of the survey differently than an actual vote. In their study about how people respond to survey questions, Carson and Groves (2007) referred the need for consequentiality in surveys—that is making the respondent believe that their responses to the survey may have real world consequences in terms of government agency decisions or costs. Perhaps the survey did not properly represent the consequentiality of an actual vote on the ballot initiative.

These findings highlight the need for future methodological research on obtaining accurate estimates of public perception on conservation issues. Specifically, our findings suggest that future studies may wish to use alternative recruitment methods or a combination of different methods to combat nonresponse bias, particularly in more rural areas (Coon et al., 2020; Stedman et al., 2019). Improved likely voter models also can reduce bias and error in polls and surveys by integrating both data on voting intentions and demographic variables that better predict turnout and overreporting (Rentsch et al., 2019). Future study could utilize voting results on conservation initiatives as opportunities to assess the effectiveness of various survey recruitment and weighting and modeling procedures at obtaining accurate estimates of public perception on conservation issues. More broadly, the identified limitations of public opinion polls suggest the importance of integrating additional social science methodologies to understand diverse public and stakeholder perspectives. Interviews, focus groups, and participatory research, for example, could help better understand the

diversity of attitudes, beliefs, values, and other factors influencing public and stakeholder opinions and behaviors related to conservation initiatives, particularly in rural areas that may be underrepresented in online surveys.

Our findings provide several insights into the observed decline in support for wolf reintroduction. Our results indicate that the public may have been influenced by media coverage; indeed, we found that the most common information source that respondents reported using when making a decision about wolf reintroduction was some form of news, and Niemiec, Berl, et al. (2020) found that 2019 local Colorado news sources more frequently covered stories opposing reintroduction. Further, in our postelection survey, we found that the possibility of wolves negatively impacting ranchers due to depredation was the most commonly reported reason for why respondents voted against wolf reintroduction, which was the most commonly reported potential negative impact of wolves in news coverage in 2019 (Niemiec, Berl, et al., 2020). Prior studies have also found that local news tends to primarily cover stories in opposition to wolves (Houston et al., 2010), which has been suggested to influence public attitudes (Enck and Brown 2002).

Our results also suggest that the decreased support we observed may have been influenced by the public outreach campaigns launched by a coalition of special interest groups (i.e., the “Stop the Wolf Campaign”), as well as opposition to reintroduction expressed by county commissioners and other political leaders. These outreach campaigns focused on convincing the public that wolves would devastate hunting and ranching and pose a threat to human safety (e.g., Rocky Mountain Elk Foundation, 2020; Stop the Wolf Campaign, 2020). Opposition campaigns may have been particularly effective at reaching certain demographic groups and stakeholder group identities in Colorado; when comparing support for wolf reintroduction between 2019 and 2020, we found that support decreased most among older, rural residents who identified as property or gun rights advocates.

We found that the belief that reintroduction would be a waste of taxpayer money was particularly important for predicting opposition to reintroduction. This argument was commonly discussed by groups opposed to reintroduction (e.g., Rocky Mountain Elk Foundation, 2020) and quoted in the media (e.g., Tejada, 2020). This argument may have been particularly effective given that the vote took place during the global COVID-19 pandemic, when many individuals were experiencing personal financial burdens at higher rates and resources both nationally and state-wide were limited. Indeed, economic insecurity can lead to declines in environmental concern (Panarello, 2021).

We also found evidence that some decrease in support may have been triggered by the arrival of a small group

of up to six wolves in northwest Colorado in early 2020, which may have led people to believe that reintroduction was unnecessary. In our postelection survey, we found that the belief that “wolves are already here” was the second most common reason people reported for voting against the ballot initiative. The few wolves detected in Colorado alone are not a self-sustaining viable population, and whether or not they would lead to long-term recovery of wolves in the state is unknown. Nonetheless, groups against reintroduction highlighted the presence of wolves in Colorado as a reason for why “forced reintroduction” via the ballot initiative was unnecessary. It appears from our survey responses that this discourse had a significant impact on public support for wolf reintroduction.

8 | LIMITATIONS

There are several limitations of our study that should be considered in the interpretation of results and future research. First, measures of voting intentions from the 2019 preelection survey and voting behaviors from the 2020 postelection survey reported here are not directly comparable, given the different response options for these questions. Further, while we used the same recruitment methods and weighting approach to obtain a representative sample in terms of age, gender, and geography in both surveys, Qualtrics was not able to follow up with the same exact survey respondents. Thus, it is possible that some of the differences in responses to the surveys could have been due to individual-level differences among participants.

It is also possible that some respondents may not have accurately reported their voting behavior in the postelection survey; studies suggest that self-reports of behavior are not always accurate (Kormos & Gifford, 2014; Nilsson et al., 2020). This study was able to compare self-reported behavior with aggregate actual behavior via election results, but we were unable to verify the individual-level self-reported behavior of respondents. More research is needed in the conservation social sciences that uses direct behavioral observation (e.g., Lischka et al., 2020).

Additionally, participants' self-reports on what influenced their voting behavior are not the same as experimental evidence on the impact of various arguments on voting behavior. People's self-reported influences may be impacted by cognitive biases, such as social desirability bias (i.e., peoples' tendency to deny socially undesirable beliefs/actions and highlight socially desirable ones; Chung & Monroe, 2003) or recall bias (people's inaccuracy when remembering past events or experiences, which can result in underreporting or

overreporting; Infante-Rivard & Jacques, 2000). Further, it is difficult to gauge the impact of various arguments and information sources on perspective change when the amount of information from various sources (e.g., social media, news, opinion leaders), some supportive and others not supportive of an initiative, is unaccounted for, or even unknown. To address these limitations, future experimental work could examine the impacts of various positive and negative arguments reported here on behavior related to conservation initiatives (e.g., Casola et al., 2020; Niemiec, Sekar, et al., 2020). Such experimental studies could be integrated with longitudinal investigations of public perspective and behavior change and media coverage to gain a more in-depth understanding of how the socio-cultural context surrounding conservation initiatives contributes to shifts in perspectives and behaviors.

Finally, while we examined whether participants brought up the COVID-19 pandemic in open-ended survey responses about what influenced their voting behavior, our study did not test the causal impact of the COVID-19 pandemic on shifts in public perspectives. To evaluate whether the pandemic influenced public perspectives, future studies could examine whether people impacted most by COVID-19 experienced the largest change in perspectives and could repeat our survey over time as the impacts and saliency of the pandemic change.

9 | MANAGEMENT IMPLICATIONS

We found evidence for rapid, widespread changes in public perception regarding a controversial conservation initiative. These results suggest the need to continually monitor public perceptions throughout the course of conservation initiatives, as opposed to gathering social science information at a single point in time. The dynamic nature of public perception identified in our study also suggests the need for practitioners and scientists to disseminate science-based information in advance of and throughout controversial conservation initiatives. Our study identified several beliefs about the outcomes of wolf reintroduction that changed in the year leading up to the election and/or that influenced voting. These included the beliefs that wolves will result in large losses in deer and elk populations, are already established in Colorado, and will enter residential areas. Sharing accurate scientific information related to these beliefs via the news media might be particularly important, given our finding that news was the most important information source for voters. Scientific information may help the public and decision-makers develop informed opinions on wolf reintroduction and management; however,

decisions about such contentious issues are also strongly influenced by people's values and socio-political dimensions (Nie 2001).

Additionally, public outreach and engagement strategies that move beyond information provisioning are likely necessary to address shifts in public perception and effectively engage the public in conservation initiatives, given that knowledge alone is often insufficient for public perception and behavior change (Kollmuss & Agyeman, 2002). Agencies and organizations, for example, could seek to build trust by engaging communities in decision-making and addressing community needs and values, building social norms by facilitating peer-to-peer sharing and community goal setting, and identifying and addressing additional socio-cultural and economic factors influencing stakeholder and public perceptions and behaviors (Abrahamse & Steg, 2013; Davenport et al., 2007; McKenzie-Mohr & Schultz, 2014; Niemiec et al., 2019). Sustained investment into public outreach and engagement and monitoring of public perspectives throughout the course of conservation initiatives is critical given the dynamic nature of public perception highlighted in this study.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Rebecca Niemiec conceived and designed the survey, collected data, analyzed the qualitative data, authored drafts of the paper, and approved the final draft. Richard E.W. Berl analyzed the quantitative data, prepared figures and/or tables, authored and reviewed drafts of the paper, and approved the final draft. Mireille Gonzalez helped collect data and design the survey, reviewed drafts of the paper, and approved the final draft. Tara Teel conceived and designed the survey, helped author and review drafts of the paper, and approved the final draft. Jonathan Salerno conceived and designed the survey, reviewed drafts of the paper, and approved the final draft. Stewart Breck conceived and designed the survey, reviewed drafts of the paper, and approved the final draft. Cassiopeia Camara helped draft the paper, reviewed drafts of the paper, and approved the final draft. Matthew Collins helped draft the paper, reviewed drafts of the paper, and approved the final draft. Courtney Schultz conceived and designed the survey, reviewed drafts of the

paper, and approved the final draft. Dana Hoag conceived and designed the survey, reviewed drafts of the paper, and approved the final draft. Kevin Crooks conceived and designed the survey, authored and reviewed drafts of the paper, and approved the final draft.

ETHICS STATEMENT

Final survey and administration procedures were approved by Colorado State University's Institutional Review Board (protocol #19-8942H).

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