

CONTRIBUTED PAPER

Persistent negative stakeholder perspectives limit recovery of a critically endangered carnivore

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Abstract

The human component in endangered species conservation has the potential to significantly limit the ability to achieve recovery of these species globally. Across the Great Plains of North America there have been significant declines in populations of several grassland-obligate species, including the black-tailed prairie dog (*Cynomys ludovicianus*) and the critically endangered black-footed ferret (*Mustela nigripes*). Social surveys conducted in Montana, USA, 27 years ago, immediately prior to reintroduction of black-footed ferrets, described widely differing attitudes and knowledge among stakeholder groups—with most local and state residents being opposed to conservation and recovery of these two wildlife species. We conducted a mail survey replicating methods of the 1993 study to assess current attitudes and knowledge concerning prairie dogs and black-footed ferrets among five stakeholder groups (local and state-wide ranchers, urban and local residents, and members of conservation organizations). Our results demonstrate that despite concerted outreach efforts and a general rise in knowledge about black-footed ferrets and prairie dogs across stakeholder groups, similar differences in attitudes persisted among stakeholder groups over time, with local stakeholders adjacent to recovery sites maintaining the most negative attitudes. We also observed that local stakeholders supported a significantly shorter time threshold (<10 years) for abandoning efforts to restore an endangered species should recovery goals not be met. Given the reliance on local public support for conserving these species, and other endangered species globally, our findings highlight the importance of continually reassessing stakeholder attitudes and knowledge over time to assess challenges and identify opportunities for endangered species restoration.

KEYWORDS

Cynomys ludovicianus, endangered species, human dimensions, *Mustela nigripes*, reintroduction

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1 | INTRODUCTION

Endangered species recovery is a multi-faceted and complex process, requiring an interdisciplinary approach to understanding the ecological, political, and human dimensions surrounding decision-making (Clark & Wallace, 2002). Increasingly, human dimensions are acknowledged as a leading factor influencing the success of endangered species recovery (Esmaeili, Hemami, & Goheen, 2019; Hadlock & Beckwith, 2002). This is particularly the case for carnivore species that are often viewed as direct threats to human safety, damage property, or limit land use practices (Miller, Jhala, & Schmitz, 2016; Torres, Lopes, Fonseca, & Rosalino, 2020). For example, even where adequate habitat for tigers (*Panthera tigris*) exists in India, recovery of this species has been challenged by persistent human-tiger conflict, leading to further animosity toward its recovery (Goodrich, 2010). For carnivores and many other endangered species, it is clear that the human component of conservation has the potential to significantly limit recovery of these species globally.

As one of the original species to receive federal protection under the Endangered Species Act in 1967, the black-footed ferret (*Mustela nigripes*; hereafter referred to as ferret) has been the subject of one of the longest-running endangered species recovery efforts. Ferrets were thought to be extinct in the wild until a small population was rediscovered near Meeteetse, Wyoming, in 1981. Since 1991, >3,800 captive-reared ferrets have been released at 30 reintroduction sites in eight U.S. states, Canada, and Mexico. Of these sites, only three are self-sustaining (i.e., they support 30 or more breeding adults and experience annual reproduction, U.S. Fish and Wildlife Service, 2013).

Multiple biological and social factors have limited the recovery of ferrets across their range, many of which are related to the reliance of ferrets on prairie dogs (*Cynomys* sp.) as prey (Jachowski, Gitzen, Grenier, Holmes, & Millsaugh, 2011). Agricultural interests have commonly viewed prairie dogs as pest species. Landscape-scale poisoning campaigns to eradicate prairie dogs on many public and private lands throughout the American West have reduced these species to <2% of their former range (Miller et al., 2000; Miller, Ceballos, & Reading, 1994). Despite this precipitous decline, prairie dog poisoning campaigns persist on public and private lands today, including some of the most suitable sites for black-footed ferret reintroduction (U.S. Department of Agriculture, 2020). Disease also has served as a major obstacle to recovery. Sylvatic plague (*Yersinia pestis*) has decimated many remnant prairie dog populations in addition to directly impacting ferrets (Biggins & Godbey, 2003; Matchett, Biggins, Carlson, Powell, & Rocke, 2010). Indeed, plague mitigation through a vaccine and vector management is a major focus of current

research and conservation efforts for these species (Rocke et al., 2017; Salkeld, 2017). Given the need for changes in public policy to allow ferrets and their obligate prey to persist where they currently occur, and to support prairie dog conservation efforts that include long-term, active plague mitigation (Biggins & Eads, 2018), public support is an ongoing concern. In particular, because most current and future potential reintroduction sites for ferrets occur on private lands or public lands where nearby private landowners hold grazing use rights for domestic cattle, local stakeholder support is particularly critical to successful ferret recovery (Jachowski, 2014).

To understand the factors influencing public perceptions toward species recovery efforts, it is important to assess public knowledge and attitudes toward endangered species before, during, and after reintroduction attempts (Balčiauskas & Kazlauskas, 2014; Hiroyasu, Miljanich, & Anderson, 2019). While temporally replicated surveys of stakeholder attitudes toward wildlife are rare, examples from Croatia (Majić & Bath, 2010) and Utah (USA: Bruskotter, Schmidt, & Teel, 2007) suggest the negative attitudes toward grey wolves (*Canis lupus*) can persist over time. However, to our knowledge, such temporal analyses have not been attempted prior to and following wildlife reintroductions. Prior to one of the first attempts to reintroduce ferrets, Reading and Kellert (1993) and Reading, Miller, and Kellert (1999) studied stakeholder attitudes toward and knowledge of black-tailed prairie dogs (*Cynomys ludovicianus*; hereafter referred to as prairie dogs) and ferrets in central Montana. Results from this work showed that local cattle ranchers maintained the most negative attitudes toward ferret conservation compared with other sample groups prior to reintroductions (Reading & Kellert, 1993). They also found that local cattle ranchers were the most knowledgeable about prairie dogs, yet they were the least tolerant toward prairie dog conservation in the area surrounding the proposed reintroduction site (Reading et al., 1999; Reading & Kellert, 1993). To address these concerns, targeted educational and outreach efforts were made at local, national and international levels to bolster public support for prairie dog and ferret conservation (Jachowski & Lockhart, 2009; USFWS, 2013; <http://blackfootedferret.org/>). Now that 27 years have elapsed during which sustained reintroductions and associated outreach have occurred, there is a need to assess if these efforts have influenced knowledge and attitudes of local stakeholders, particularly owners of private land closest to reintroduction sites.

The primary objective of this study was to evaluate if attitudes toward and knowledge of ferrets and prairie dogs changed since initial survey efforts following nearly 30 years of recovery efforts. Given the failure of several ferret reintroduction attempts in the region over this period of time, we also evaluated current attitudes and

perceptions regarding endangered species management in general, including when to abandon recovery efforts. By conducting replicated surveys over such a long-time scale, findings from this study bring to light the complex social attitudes that limit success of ferret recovery, and that are likely to limit success of other endangered species recovery programs globally.

2 | METHODS

2.1 | Study area

This study was conducted in Montana, USA, with a specific focus on Phillips County, given its proximity to three

ferret reintroduction sites and because past survey efforts took place in the same region prior to reintroductions (Figure 1). This portion of the Northern Great Plains was a focus of ferret recovery efforts because, at the time, it contained relatively large populations of prairie dog colonies on public and tribally maintained native grassland. Prior to establishment of one of the first ferret reintroduction site in 1994 at UL Bend National Wildlife Refuge, Reading and Kellert (1993) conducted a statewide survey of Montana residents representing five stakeholder groups. The UL Bend ferret population has never exceeded 56 individuals and has been sustained over the past 26 years by additional releases of a total of 263 captive-reared ferrets. As of fall 2019, no ferrets were present at UL Bend (R. Matchett, U.S. Fish and Wildlife Service,

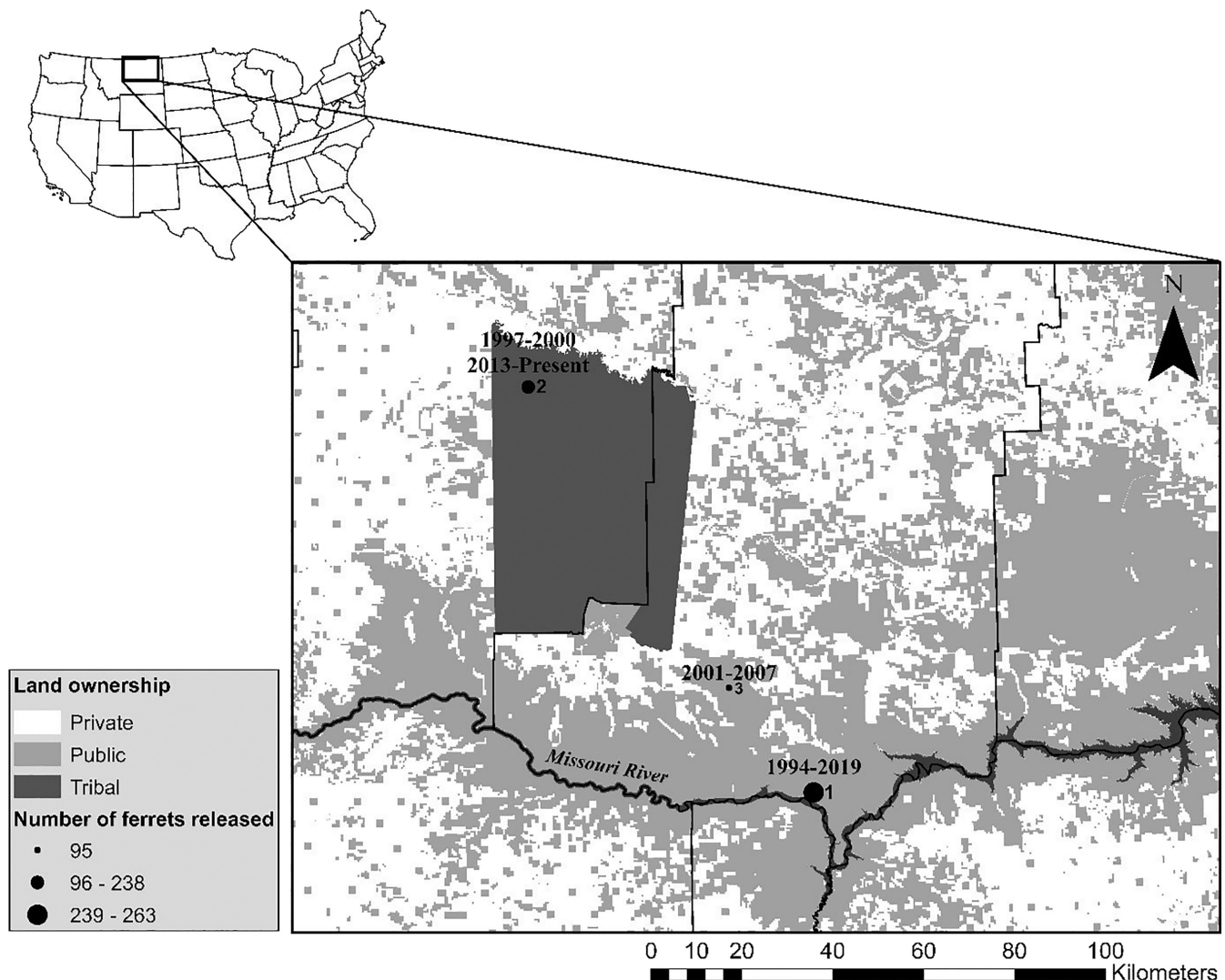


FIGURE 1 Land ownership within study area and initial black-footed ferret (*Mustela nigripes*) reintroduction sites at (1) UL Bend National Wildlife Refuge (1994), 2) Fort Belknap Reservation (1997, 2013), and 3) BLM 40-Complex (2001). The size of the symbol represents the number of black-footed ferrets released, and solid lines represent county boundaries in Montana, USA. Date ranges represent initial reintroduction effort and the dates of subsequent black-footed ferret extirpation at each site

pers. comm.). In addition to UL Bend, a total of 95 captive-reared ferrets were released from 2001 to 2007 on a different reintroduction site on Bureau of Land Management property in Phillips County (Figure 1), but that population was considered extirpated by 2007. Also, a total of 167 captive-reared ferrets were released from 1997 to 2000 on the Fort Belknap Indian Reservation. That population never exceeded 55 individuals and was considered extirpated by 2002. A subsequent reintroduction effort on Fort Belknap involved the release of 67 additional ferrets from 2013 to 2015 (followed by a final supplemental release of four ferrets in 2020), with a small population (<20 individuals) persisting at the time of this study.

2.2 | Participant selection

To facilitate comparison with the previous survey by Reading and Kellert (1993), we used mail surveys to evaluate the relative change in perceptions, values, knowledge, and attitudes toward conservation of ferrets and prairie dogs among local ranchers and residents, ranchers statewide, residents of Billings, MT (hereafter, urban residents), and members of wildlife conservation nongovernmental organizations (NGOs) in Montana. We randomly sampled 1,000 individuals, consisting of 100 local ranchers, 200 ranchers throughout the state, 200 local residents, 300 urban residents, and 200 members of NGOs. We used the Montana State University Cadastral Framework (<http://geoinfo.msl.mt.gov/msdi/cadastral>), which maintains spatially referenced information on public and private land property ownership, to identify local (i.e., Phillips County-based) and statewide ranches. We selected parcels that were listed as agricultural or farmland with >200 grazing acres (to exclude small-scale urban or commodity ranches), then randomly sampled 100 local and 200 statewide individual ranchers. We identified local rural residents (those living in Phillips County) and urban residents (those living in Billings, MT, the nearest large city) by randomly selecting individuals within regional telephone directories. To identify NGO members, we randomly sampled membership lists from the Montana Wildlife Federation (MWF, $n = 100$) and World Wildlife Fund (WWF, $n = 100$) who were Montana residents.

2.3 | Questionnaire

Mail surveys followed methodology described by Reading and Kellert (1993). Prenotice letters were mailed 1 week prior to the survey, followed by the 34-question survey, \$2 cash incentive, and a postage-paid return envelope.

Reminder postcards were sent to nonrespondents 2 weeks after the initial survey was sent, and another copy of the survey was sent to nonrespondents a month after the initial survey was mailed. To facilitate comparisons with Reading and Kellert (1993) and Reading et al. (1999), questions pertaining to attitudes and knowledge about ferrets and prairie dogs were asked in multiple choice or 5-point Likert Scale format. We posed questions directly replicated from Reading and Kellert (1993) as well as new questions related to current ferret recovery efforts. We also included eight questions to more generally assess attitudes and perceptions about funding allocation, management responsibilities, barriers to recovery, and the time scale appropriate for endangered species recovery efforts in central Montana. All survey instruments and the sampling protocol were approved by the Clemson University Institutional Review Board (IRB2019-207).

2.4 | Analysis

We developed three attitudinal scales consisting of seven questions each that focused on (a) attitudes toward ferrets, (b) attitudes toward prairie dogs, and (c) attitudes toward endangered species management in the context of ferret recovery. We conducted item analysis for questions used in each attitudinal scale and calculated Cronbach's alpha coefficient to assess scale reliability. Scale scoring followed protocol from Reading and Kellert (1993), where scores were weighted for positive responses toward the main issue posed by the question (2 points for strong level of agreement, 1 point for moderate level of agreement, and 0 points for neutral or negative response). Total scores from questions in each scale were standardized on a 100-point scale; thus, higher scores on each scale represent more positive attitudes.

We also included two knowledge scales based on 11 questions about ferrets and 11 questions about prairie dogs. A third scale addressing total knowledge was formed as the product of the summed knowledge scales about ferrets and prairie dogs. Knowledge was evaluated for each topic by developing scores based on correct answers (2 points), acknowledgement by the respondent that he or she did not know the answer (1 point), and incorrect answers (0 points). Knowledge scales were standardized on a 100-pt scale for comparison.

We evaluated the extent to which responses were missing in the data and ran a nonparametric test of missing completely at random (MCAR) using the `testMCARNormality` function in package "MissMech" (Jamshidian, Jalal, & Jansen, 2014). We then used multiple imputation with Full-Information Maximum

Likelihood Estimation (FIML) to impute missing data for questions that had less than 10% missing. Because our data were MCAR and we used a FIML estimator, we felt confident that imputing questions with 10% missing would not bias our estimates (Madley-Dowd, Hughes, Tilling, & Heron, 2019).

For both attitude and knowledge evaluations, we compared differences in individual questions as well as differences in scales between sample groups using analysis of variance (ANOVA) with a Bonferroni correction for multiple comparisons. To further compare changes in attitudes over time, we ran paired *t*-tests on mean scores for each sample group to test for differences between 15 replicated attitudinal questions that focused on ferrets and prairie dogs from Reading and Kellert (1993) and Reading et al. (1999). All analyses were conducted in the program R (v.3.6.2; R Core Team, 2017).

3 | RESULTS

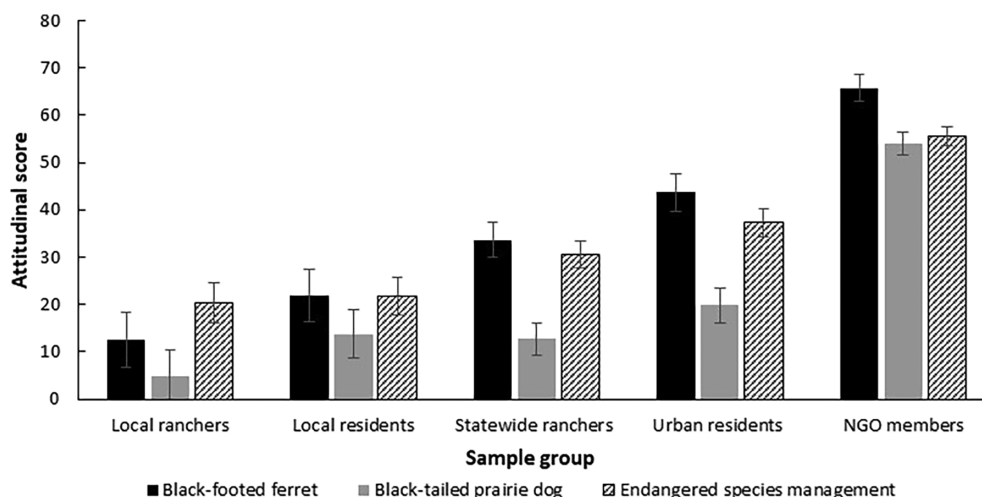
The initial response rate to our survey was 23.8%, however, 185 of the 1,000 surveys were undeliverable giving a 29.2% overall response rate for the deliverable surveys. Response rates within sample groups were relatively consistent for local ranchers (22%), statewide ranchers (27%), and local residents (23%); however, urban residents and NGO members yielded much lower (17%) and higher (57%) response rates, respectively.

We found significant differences in overall attitudes toward ferrets among sample groups ($F_{4,225} = 28.72$, $p < .001$, $\eta^2 = 0.338$; Figure 2). Local ranchers and local residents scored lowest on the ferret attitudinal scale ($M = 12.5$, $SE = 5.91$; $M = 22.0$, $SE = 5.51$, respectively) and both of these groups differed significantly from statewide ranchers ($M = 33.7$, $SE = 3.77$), urban residents ($M = 43.7$, $SE = 3.98$), and NGO members ($M = 65.8$,

$SE = 2.72$). This pattern of negativity toward ferrets was persistent among local ranchers and local residents for nearly all questions asked about ferret recovery. For example, when asked “How much money do you support the state spending each year on efforts to reestablish black-footed ferrets in Montana,” 65% of local ranchers and 52% of local residents indicated that the state should not spend any money on recovery efforts (Table 2). Conversely, statewide ranchers and urban residents generally demonstrated more neutral attitudes toward ferrets, and NGO members were overwhelmingly supportive of ferret recovery efforts (Table 1). For example, 43% of statewide ranchers, 59% of urban residents, and 85% of NGO members agreed that ferrets should be saved because they are important members of the ecological community (Table 1). Results from paired *t*-tests on mean scores from 15 attitudinal questions that we replicated from Reading and Kellert (1993) showed no significant differences between our survey and theirs in responses among sample groups ($p = .91$). We did not find evidence for significant differences in knowledge about ferrets among sample groups within our survey ($F_{4,225} = 0.762$, $p = .55$; Figure 3). Local residents scored highest on knowledge of ferrets ($M = 66.4$, $SE = 2.59$) followed by NGO members ($M = 65.1$, $SE = 1.28$), urban residents ($M = 63.1$, $SE = 1.87$), statewide ranchers ($M = 62.5$, $SE = 1.78$), and local ranchers ($M = 62.0$, $SE = 2.78$).

Attitudes toward prairie dogs were also significantly different among sample groups ($F_{4,225} = 39.75$, $p < .001$, $\eta^2 = 0.414$; Figure 2). Compared with attitudes toward ferrets, there was a stark reduction in attitudinal scores for prairie dogs among nearly all sample groups, with the exception of NGO members ($M = 54.0$, $SE = 2.48$). Similar to the previous survey, local ranchers scored lowest on attitudes toward prairie dogs ($M = 5.0$, $SE = 5.38$) followed by statewide ranchers ($M = 12.8$, $SE = 3.43$),

FIGURE 2 Mean attitudinal scores among five stakeholder groups in Montana toward black-footed ferrets (*Mustela nigripes*), black-tailed prairie dogs (*Cynomys ludovicianus*), and endangered species management based on survey conducted in 2020



Question/sample group ^a	Strongly or moderately agree	Neither agree nor disagree	Strongly or moderately disagree
“I do not want to see black-footed ferrets go extinct in Montana.”			
Local ranchers•	35%	15%	50%
Local residents?	43	29	29
Statewide ranchers•	60	27	13
Urban residents†	70	20	9
NGO members†	91	4	4
“Black-footed ferrets should be conserved so that future generation can enjoy them.”			
Local ranchers†	25%	15%	60%
Local residents†•	26	26	48
Statewide ranchers•?	35	35	31
Urban residents?	55	27	18
NGO members	78	14	9
“Black-footed ferret should be conserved because they are important members of the ecological community.”			
Local ranchers†	10%	15%	75%
Local residents†•	35	17	48
Statewide ranchers••	43	37	20
Urban residents•	59	25	16
NGO members	85	9	6

^aSample groups with the same symbol are not significantly different ($p < .05$) using Bonferroni's test.

TABLE 1 Responses to select attitudinal questions pertaining to black-footed ferret (*Mustela nigripes*) restoration among five stakeholder groups in Montana, USA

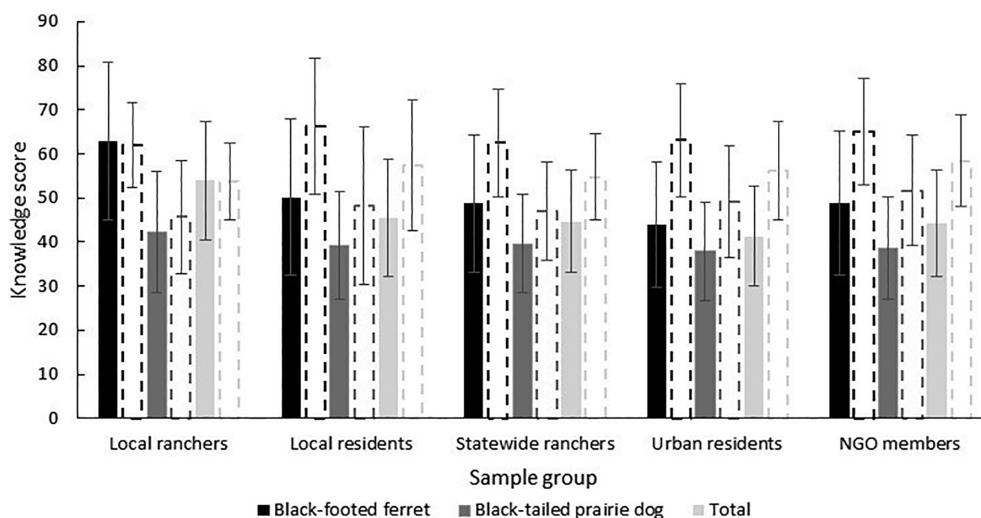


FIGURE 3 Mean knowledge scores among five stakeholder groups in Montana representing current knowledge (dashed bars) of black-footed ferrets (*Mustela nigripes*), black-tailed prairie dogs (*Cynomys ludovicianus*), and total knowledge compared to findings from Reading and Kellert (1993) (solid bars)

local residents ($M = 13.8$, $SE = 5.01$), and urban residents ($M = 19.8$, $SE = 3.62$). Individual attitudinal questions regarding prairie dogs showed less inter-group variation (with the exception of NGO members) and local residents and ranchers tended to be more negative about tolerating prairie dogs on existing rangelands. For example, when

asked “How much of the public grazing lands would you like to see maintained as prairie dog colonies,” local ranchers (90%), local residents (83%), and statewide ranchers (65%) indicated that they would like to see $\leq 2\%$ of public grazing lands maintained as prairie dog colonies; whereas 66% of NGO members wanted to

see >2% of public grazing lands maintained as prairie dog colonies (Table 2). Similarly, >50% of individuals in each sample group (except NGO members at 22%) agreed with the statement “prairie dogs significantly reduce the amount of cattle that can be grazed on a plot of land.” We found no significant difference within sample groups regarding knowledge of prairie dogs ($F_{4,225} = 0.76$, $p = .55$; Figure 3), and no significant difference among sample groups regarding the overall knowledge scale (the summed average of ferret and prairie dog scales; $F_{4,225} = 1.37$, $p = .24$; Figure 3).

Similar patterns were observed in attitudes toward endangered species recovery, where sample groups differed significantly ($F_{4,225} = 28.1$, $p < .001$, $\eta^2 = 0.339$; Figure 2) and local ranchers scored lowest ($M = 20.4$, $SE = 4.32$); followed by local residents ($M = 21.7$, $SE = 4.0$), statewide ranchers ($M = 30.6$, $SE = 2.8$), urban residents ($M = 37.3$, $SE = 2.9$), and NGO members ($M = 55.6$, $SE = 1.9$). Local ranchers and local residents consistently expressed pessimistic attitudes toward

endangered species management in central Montana compared with other sample groups. For example, 84% of local ranchers and 67% of local residents indicated that “Endangered species should not be given precedence for conservation dollars” (Table 3). Sample groups showed a higher level of consensus on questions regarding endangered species on private lands. For example, >50% of respondents in all sample groups (except NGO members at 27%) agreed to the statement “I would be more supportive of endangered species if they did not restrict what you can do on private land” (Table 3). Preference for state rather than federal management of endangered species was also expressed by most sample groups, where >60% of respondents in all sample groups (except NGO members at 34%) agreed with the statement ‘State agencies, not federal agencies,’ should manage endangered species in Montana.

Local ranchers and local residents (hereafter collectively referred to as local stakeholders) demonstrated much lower thresholds for endangered species recovery

TABLE 2 Responses to select attitudinal questions pertaining to public lands management, funding allocation, and temporal obligation toward recovering black-footed ferret (*Mustela nigripes*) among five stakeholder groups in Montana, USA

Question/sample group ^a				
“How much of the public grazing lands would you like to see maintained as prairie dog colonies?”	None	Less than 2%	Between 2 and 5%	Greater than 5%
Local ranchers†•	50%	40%	5%	5%
Local residents†	57	26	9	4
Statewide ranchers†•	47	18	18	10
Urban residents ⁱ	20	32	14	16
NGO members	1	10	16	46
“How much do you support the state spending each year on efforts to reestablish black-footed ferrets in Montana?”	None	Less than \$50,000	Between \$51,000 and \$100,000	Greater than \$100,000
Local ranchers•	65%	10%	5%	0%
Local residents†	52	22	0	13
Statewide ranchers•	24	33	14	10
Urban residents [?]	18	27	11	27
NGO members [?]	4	14	17	47
“If endangered species recovery efforts fail after __ years, the USFWS should give up and focus resources on other species.”	10 years or less	Between 15 and 20 years	Between 25 and 30 years	They should never give up
Local ranchers [?]	75%	15%	0%	10%
Local residents [?]	87	4	4	4
Statewide ranchers [?] •	47	24	6	22
Urban residents•	30	27	7	36
NGO members	7	10	7	76

^aSample groups with the same symbol are not significantly different ($p < .05$) using Bonferroni's test.

Question/sample group ^a	Strongly or moderately agree	Neither agree nor disagree	Strongly or moderately disagree
“If endangered species recovery efforts fail, the U.S. Fish and Wildlife Service should give up”			
Local ranchers [†]	60%	25%	15%
Local residents ^{†•i}	52	10	38
Statewide ranchers [•]	29	27	44
Urban residents ^{‡i}	23	23	55
NGO members	3	7	90
“Endangered species should be given precedence for conservation dollars”			
Local ranchers [†]	0%	16%	84%
Local residents ^{†•}	14	19	67
Statewide ranchers ^{†‡}	21	19	60
Urban residents ^{•‡}	27	32	41
NGO members	55	25	20
“I would be more supportive of endangered species if they did not restrict what you can do on private land”			
Local ranchers [†]	95%	5%	0%
Local residents ^{•i}	71	10	19
Statewide ranchers ^{†•}	69	8	23
Urban residents ^{‡•}	59	18	23
NGO members ⁱ	27	24	48

^aSample groups with the same symbol are not significantly different ($p < .05$) using Bonferroni's test.

TABLE 3 Responses to select attitudinal questions pertaining to endangered species management in the context of black-footed ferret (*Mustela nigripes*) restoration among five stakeholder groups in Montana, USA

relative to other sample groups. For example, 60% of local ranchers and 52% of local residents agreed that “the U.S. Fish and Wildlife Service should give up if endangered species recovery efforts fail” (Table 3). Similarly, we found significant differences among sample groups in the perceived level of temporal obligation by the USFWS to recover endangered species ($F_{4,225} = 35.2$, $p < .001$, $\eta^2 = 0.335$; Table 2), where local stakeholders indicated on average that the USFWS should give up on “failed” recovery efforts after only 10 years compared with 20 years or more for other sample groups.

4 | DISCUSSION

In this first attempt to evaluate long-term trends in attitudes and knowledge over nearly 30 years of endangered species reintroduction efforts, we found that negative attitudes persist toward ferrets in Montana. This situation poses a challenge for population restoration and overall species recovery. Our findings align with previous research showing residents near endangered species restoration sites have more negative attitudes and decreased support for conservation action (Eriksson, Sandström, &

Ericsson, 2015; Karlsson & Sjöström, 2007). Negative attitudes toward endangered species reintroductions are often related to the potential, or perceived potential, for the target species to threaten human safety, damage property, or limit land management practices (Miller et al., 2016; Torres et al., 2020). In the case of ferret recovery, our findings support previous studies that suggested persistent negative attitudes seem to be related to federal policy and to impacts of measures taken to conserve prairie dogs (Clark & Wallace, 2002; Reading & Kellert, 1993). Perhaps more troubling, we found that such animosity toward the reintroduction of ferrets persisted over an extended period of time, despite no evidence of direct human-wildlife conflict following reintroduction and failure of the species to become established. This suggests that despite concerted outreach efforts, significant social barriers still exist that might limit the successful recovery of ferrets in the wild.

Our study illustrates that strong opposition to prairie dog conservation is likely to remain a critical barrier to successful ferret reintroduction and recovery. Local landowner opposition to prairie dog conservation is well-documented (Lamb, Reading, & Andelt, 2006; Lamb & Cline, 2003; Reading et al., 1999; Zinn & Andelt, 1999).

We similarly found that the majority of respondents in our study indicated that <5% of public grazing lands should be maintained as prairie dog colonies. This is problematic for ferret recovery, given the evidence that successful ferret reintroductions require large contiguous prairie dog populations (or colonies) >4,000 ha in size (Jachowski et al., 2011). Few such areas currently exist in the Great Plains (USFWS, 2013). Moreover, the general lack of support among local stakeholders is a significant obstacle to wildlife conservation on private lands where efforts are underway to provide financial incentives for conserving and restoring prairie dogs (Bodenchuk, Halstead, & Yearly, 2013). One of the primary reasons why ranchers are believed to have negative attitudes toward prairie dogs is the perception that they compete with cattle for limited forage (Lamb et al., 2006; Lybecker, Lamb, & Ponds, 2002; Miller et al., 2007). However, scientific evidence has suggested that the potential for diminished returns on cattle weight gain due to reduced forage availability by co-occupying a pasture with prairie dogs is minimal (Augustine & Springer, 2013; O'meilia, Knopf, & Lewis, 1982). Further, the relative increase in forage quality on areas occupied by prairie dogs has been found likely to outweigh any reduction in forage availability attributable to them (Connell, Porensky, & Scasta, 2019). We found that despite local stakeholders being consistently more knowledgeable about prairie dog biology than other groups, they still perceived prairie dogs as competitors with cattle for forage. This suggests that either there is a shortcoming in communication of these key scientific findings, or that negative local rancher attitudes toward prairie dogs are complex and multifaceted, and not based on the economics of livestock weight gain alone. Regardless, negative perceptions of prairie dogs among local stakeholders and other groups are a significant persistent challenge to ferret recovery in our study area, and more broadly across the Great Plains (Miller et al., 2007).

Community-focused educational programs have been implemented to increase positive attitudes toward endangered species conservation and management decisions in various parts of the world (Majić & Bath, 2010; Störmer, Weaver, Stuart-Hill, Diggle, & Naidoo, 2019). In the context of ferret recovery in our study area, multiple attempts to involve and educate local stakeholders were made over the past 27 years including dedicated educational and outreach programs, public meetings, targeted incentive programs, tribal ceremonies upon release of ferrets into the wild, flexibility in grazing rights, and many others (R. Matchett, USFWS, personal communication). We observed an increase in knowledge about ferrets and prairie dogs for nearly all sample groups relative to the study conducted in 1993. The exception was local

ranchers, who had high knowledge scores in both surveys, which suggests local ranchers did not become more knowledgeable over time, and rather that other stakeholder groups became as knowledgeable over time. When considered in concert with the persistence of negative attitudes toward ferrets and prairie dogs by local stakeholders, our findings support previous calls for the shortcomings of education and outreach programs to be effective where an individual's knowledge is derived from personal experiences (Chaiken & Stangor, 1987), which is often the case for natural resource dependent groups such as ranchers and rural residents (Reading et al., 1999). As an alternative to local stakeholders primarily being engaged through outreach and education efforts after reintroduction decisions have been made, we suggest practitioners adopt community-based or local landowner-led conservation initiatives, which have been shown to increase social capital and trust among stakeholder groups (Wagner & Fernandez-Gimenez 2008). These models have proven successful in our study area and throughout the Great Plains (Gripne, 2005; Charnley, Sheridan, & Nabhan, 2014), and we encourage future comparative studies to assess the extent to which endangered species recovery programs might benefit not only from community involvement, but also from community or local leadership.

Negative attitudes toward endangered species recovery are common among groups that depend directly on natural resources. Such attitudes often are related to perceived regulatory constraints that are associated with species listing (Giampaoli & Bliss, 2011). Such negative perceptions can manifest due to a lack of transparency and lack of collaborative engagement with local communities during recovery efforts, which ultimately diminish trust among private landowners (Knapp, Chapin III, & Cochran, 2015). We found that a majority of local stakeholders in our study had low confidence in the ability of federal agencies to reestablish black-footed ferrets and that they preferred state management of endangered species. Given the black-footed ferret is likely to be one of many species that are conservation reliant (i.e., threats cannot be eliminated and require continued management; Goble, Wiens, Scott, Male, & Hall, 2012; Rohlf, Carroll, & Hartl, 2014) for the foreseeable future, there is a need for closer coordination and long-term planning among federal and state agencies, with state agencies being seen in a leadership role if local stakeholders are to be more supportive of endangered species reintroduction.

To our knowledge, this is the first study to document when various groups believe practitioners should give up on endangered species recovery. We found that tolerance for sustaining recovery attempts varied among the groups that we sampled. Specifically, we found that local

stakeholders supported giving up on endangered species recovery efforts after 10 years, whereas NGO members indicated efforts should continue for >30 years. Given that ferret recovery has been ongoing in this region for nearly 30 years, there is clearly a dissonance among conservation organizations, the general public, and local stakeholders on when to abandon recovery efforts. Previous debates surrounding the application of conservation triage for endangered species have focused largely on the economic and ethical aspects of species abandonment (Bottrill et al., 2008; Wilson & Law, 2016), with limited examples of directly incorporating stakeholder perspectives (but see Wheeler et al., 2016). Our results indicate the possibility of incorporating a social threshold into future conservation triage evaluations. Albeit, we urge that a sufficient amount of time should be allowed for species to achieve self-sustaining populations based on their reproductive ecology and life history. Regardless of these complexities, we suggest the direct integration of social survey data could better inform models and policy decisions on future allocation of limited conservation funds toward species reintroduction and recovery (Martin et al., 2018; Wheeler et al., 2016).

Among the many elements of endangered species recovery, sociological considerations are increasingly important to successful restoration efforts (Bennett et al., 2017; Wallace, Clark, & Reading, 2002). Accordingly, continual assessment of social factors in response to endangered species conservation efforts can provide insights into mechanisms that facilitate human coexistence with endangered species. Our study demonstrates that persistent negative attitudes toward a keystone species (the prairie dog) likely limits the recovery of a critically endangered carnivore. Thus, while there are biological obstacles to recovering ferrets in the wild (i.e., disease, low genetic diversity), our findings highlight how increasing social capacity to tolerate and proactively conserve prairie dog populations is essential to the successful recovery of black-footed ferrets throughout their range. Our study suggests that a failure to do so effectively can impact perceptions of the temporal obligations for recovering an endangered species. In an increasingly human-dominated world, successful recovery of endangered species will require programs that consider and address long-term sociological considerations in conjunction with ecological conditions.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

AUTHOR CONTRIBUTIONS

Keifer L. Titus: Conceptualization, study design, data collection, analysis, manuscript drafting, editing reviewing. **David S. Jachowski:** Conceptualization, study design, editing reviewing.

DATA AVAILABILITY STATEMENT

Relevant data used in this study is available upon request.

ETHICS STATEMENT

All survey methodology and instruments used in this study were approved by the Clemson University Institutional Review Board (IRB2019-207). We can confirm that this manuscript has not been published elsewhere and is not under consideration by another journal and all authors have approved this manuscript for submission.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

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