




RESEARCH ARTICLE

Perspectives on wildlife agency management in black bears and other carnivores

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Abstract

Sarcoptic mange is an emerging parasitic disease affecting North American black bears (*Ursus americanus*) and has been increasingly reported since the early 1990s. As mange spreads into naive bear populations, wildlife managers face challenges related to surveillance, interagency coordination, and stakeholder expectations. In 2023, we surveyed 35 state and federal wildlife agency personnel and academic partners to assess management practices for mange, barriers to effective interventions, and how agencies engage with the public and key stakeholders. Respondents represented 17 states, 7 with and 10 without reports of sarcoptic mange in black bears, with over half (51.4%) working in their current institution for more than 10 years. Respondents generally agreed on dispatching severely affected wildlife (97.1%) and monitoring mild to moderate cases. Although respondents supported stakeholder and public reporting of mange cases (71.4%), they opposed stakeholder and public intervention in mange management (e.g., treatment, handling, relocation). Fewer than half of respondents (45.7%) indicated that mange reports are entered into a formal dataset, limiting long-term surveillance and decision-making. Our study highlights the need for a unified multi-state communication framework to increase public support for agency management actions, and the

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importance of implementing a centralized mange data repository to enhance long-term surveillance of mange and improve response efforts.

KEYWORDS

Canis latrans, coyote, disease reporting, disease surveillance, human dimensions, red fox, *Sarcoptes scabiei*, *Ursus americanus*, *Vulpes vulpes*, zoonotic disease management

Effective wildlife disease management involves a complex relationship of ecological, biological, and human dimensions considerations (Riley et al. 2003, Needham and Vaske 2008, Decker et al. 2012a, Leong and Decker 2020, Shapiro et al. 2022). Management of pervasive zoonotic wildlife diseases presents significant challenges due to their potential to cross jurisdictional boundaries, affect multiple species, and persist in the environment (Shapiro et al. 2022). This is especially true of sarcoptic mange, which has a near-global distribution and extremely broad host range (Bhatia 2021, Escobar et al. 2022).

Sarcoptic mange, caused by the ectoparasitic mite *Sarcoptes scabiei*, is an emerging disease of North American black bears (*Ursus americanus*). Sarcoptic mange has been endemic in North American mesocarnivores (e.g., coyotes [*Canis latrans*], gray wolves [*Canis lupus*], red fox [*Vulpes vulpes*]) for over a century, but its impacts on these species remain understudied owing to differing management priorities and public perceptions (Niedringhaus et al. 2019a). This lack of targeted research may be partly due to classification of certain mesocarnivores as nuisance wildlife. For example, coyotes, which are heavily affected by sarcoptic mange, are often viewed as invasive species in the eastern United States, owing to prolific eastward range expansion (Hody and Kays 2018). The recent spread of mange into previously unaffected black bear populations presents significant management challenges for wildlife agencies, requiring a balance between disease mitigation, public engagement and acceptance, and policy constraints.

Black bears, unlike other frequently mange-infested mesocarnivores (e.g., coyotes), are highly valued as a game species and are viewed as charismatic animals by the public. They also play important ecological roles as omnivorous apex predators, contributing to seed dispersal, vegetation modification, and nutrient redistribution, in turn influencing plant and invertebrate communities (Nettles et al. 2025). Black bears also hold significant social and economic value through hunting, ecotourism, and their cultural importance in many regions (Honey et al. 2016, Hughes et al. 2020). Hunters and non-hunting members of the public alike have increasingly reported mange in black bear populations across the eastern United States. Affected bears often exhibit dermatological signs (i.e., alopecia, pruritis, scabbing, erythema), emaciation, abnormal mentation, and, in severe cases, can die of infestation-related disease (Niedringhaus et al. 2019a, b). These visible and often severe clinical outcomes have, in some cases, heightened public scrutiny and triggered calls for intervention, placing agencies in the difficult position of managing an emotionally charged issue with limited precedent.

In recent decades, sarcoptic mange has emerged more prominently in black bear populations across the eastern United States, with increasing frequency and geographic spread reported in states such as Pennsylvania, Virginia, and New York (Niedringhaus et al. 2019b, Rojas-Sereno et al. 2022). Mange cases have been widely disseminated in some regions and more concentrated in others, suggesting complex spatial dynamics that are not yet fully understood. Transmission routes remain unclear, although seasonal peaks and suspected denning-associated exposure patterns may contribute to spread (Rojas-Sereno et al. 2022). While mange is rarely considered a population-limiting disease in mesocarnivores, with affected populations often recovering after localized declines (Pisano et al. 2019), its long-term demographic effects in black bears remain unknown.

In humans, exposure to *S. scabiei* can result in a self-limiting but intensely pruritic rash (i.e., clinical scabies; Rubini et al. 2021, Escobar et al. 2022). Hunters or others handling infested carcasses may experience skin irritation and secondary infection risk. Zoonotic concerns, combined with the visible severity of mange in wildlife, can often

provoke public concern and heighten public pressure for intervention. Yet agency response is constrained by limited treatment options and jurisdictional complexity. A range of acaricides have been used in wildlife rehabilitation settings, but few protocols are feasible at scale, and field-based treatment remains logistically and ethically challenging (Rowe et al. 2019). Understanding how agencies approach disease response, coordinate across jurisdictions, and engage stakeholders is critical to developing a more effective and unified mange management strategy (Whittaker et al. 2006, Chase et al. 2000, Shapiro et al. 2022). However, research on agency perspectives regarding mange management and stakeholder engagement remains limited. To address this gap, we surveyed wildlife professionals participating in a voluntary working group aimed at improving communication and management strategies for sarcoptic mange in black bears and other carnivores in the United States. Our objectives were to assess current management practices, identify barriers to effective public engagement, and explore agency expectations regarding responses among the hunting and non-hunting public to mange-affected wildlife, with a focus on black bears. Additionally, we sought to determine preferred management approaches and opportunities for enhancing multi-agency coordination and public communication.

METHODS

Survey design and target population

We designed a structured, exploratory quantitative questionnaire using a mix of multiple-choice, Likert-scale, and open-ended items to capture agency perspectives on mange management and stakeholder engagement. The survey was not intended to produce generalizable data but rather to gather professional insights into current practices, perceived barriers, and stakeholder expectations related to mange management. Although the survey instrument was broadly applicable to sarcoptic mange in wildlife, we primarily focused on species of increasing management concern in the eastern United States: black bears, coyotes, and red foxes. Specifically, we developed the instrument to explore 1) how wildlife agencies manage sarcoptic mange, 2) perceived barriers to effective mange interventions, 3) perceived stakeholder (e.g., hunters, wildlife rehabilitation facilities, public) expectations related to agency management of sarcoptic mange, and 4) strategies used by agencies to inform, educate, and involve stakeholders in mange surveillance, response, and communication (see Supporting Information).

We administered the survey to members of the Bear Mange Working Group (BMWG), a voluntary consortium of approximately 50 wildlife professionals from state and federal agencies and university-affiliated researchers who collaborate to improve bear mange disease management strategies across North America. In many states, academic partners play a critical role in wildlife disease response, particularly when agencies lack dedicated wildlife veterinarians or disease biologists. This sampling approach allowed us to reach individuals directly involved in mange surveillance, response, and communication. We allowed participants to answer demographic information or to choose not to share identifying information about their states, agencies, or job titles. This was intended to preserve respondents' anonymity.

Questionnaire content and validation

The questionnaire included 39 items grouped into thematic sections: disease surveillance and treatment, stakeholder engagement, jurisdictional constraints, and public communication strategies (see Supporting Information). To capture variation in respondent strategies based on mange disease severity, we asked several questions for 3 severities of mange. For example, respondents rated their level of agreement with culling or treating bears that were mildly, moderately, or severely affected by mange. These questions were accompanied by a standardized reference image (Figure 1) illustrating the range of clinical severity to promote consistent interpretation across respondents.



FIGURE 1 Reference image provided to survey respondents to standardize interpretation of mange severity in American black bears (*Ursus americanus*). The image depicts 3 severity categories: severe (left), moderate (center), and mild (right). The mild bear was selected to represent an individual in good body condition with minimal alopecia localized to the face; this alopecia may be unrelated to mange and is potentially within the range of normal variation. The moderate bear exhibits more extensive hair loss, particularly along the trunk, but retains a healthy body condition, reflecting a mid-stage presentation of mange. The severe bear illustrates advanced mange symptoms, including extensive alopecia and markedly poor body condition. This visual aid was included with survey questions assessing agency responses to bears at varying disease severities (e.g., treatment, euthanasia, monitoring), to promote consistency in interpretation across respondents.

Prior to implementing the survey, we pretested the survey with 4 wildlife disease specialists, 3 wildlife biologists, 1 human dimensions expert, and 2 wildlife veterinarians to ensure clarity and validity. We used feedback from these pre-tests to revise question wording, response options, and survey flow prior to distribution.

Data collection and analysis

We administered the questionnaire online from 29 March to 1 August 2023. We sent email invitations to all 41 members of the BMWG to participate in our study. To ensure broad representation, we encouraged participants to forward the link to the online questionnaire to colleagues with first-hand professional experience managing sarcoptic mange in wildlife. We sent a reminder email to the BMWG members to complete the survey on 2 May 2023.

We collected all survey responses using Qualtrics XM (Qualtrics, Provo, UT, USA) and performed descriptive statistical analyses in R Studio (version 4.2.2, R Foundation for Statistical Computing, Vienna, Austria). Because the study was exploratory and based on voluntary participation by a small expert community, findings may only reflect practitioner perspectives.

RESULTS

Of the 45 study participants who opened the survey, 35 completed it (77.8% completion rate). We distributed the survey to individuals representing 22 U.S. states and one Canadian province. Respondents represented at least 17 states, with 7 (Arkansas, New York, Maryland, Oklahoma, Pennsylvania, Virginia, and West Virginia) reporting either emerging or endemic sarcoptic mange in free-ranging black bear populations. Ten additional states (California, Connecticut, Florida, Kentucky, Louisiana, Massachusetts, New Jersey, North Carolina, Rhode Island, and South Carolina) bordered states in which black bears have been infested with mange. These states are at risk of regional spread of sarcoptic mange to black bears and face cross-jurisdictional management concerns (Niedringhaus et al. 2019b). Most respondents ($n = 22$; 62.9%) identified as wildlife biologists. Four respondents (11.4%) were wildlife veterinarians, and 6 respondents (17.1%) indicated they held a different role (e.g., health or program coordinators, academics, disease specialists). Eighteen respondents (51.4%) had been employed at their current institution for over 10 years (Table 1).

TABLE 1 Respondents' employment characteristics (*n* = 35) to a survey on sarcoptic mange in the United States, 2023. States with an asterisk have historical reports of sarcoptic mange in their black bear populations.

	Number	Percent
State in which respondent was employed		
Arkansas*	2	5.7
California	1	2.9
Connecticut	2	5.7
Florida	2	5.7
Kentucky	1	2.9
Louisiana	1	2.9
Maryland*	1	2.9
Massachusetts	1	2.9
New Jersey	1	2.9
New York*	6	17.1
North Carolina	1	2.9
Oklahoma*	4	11.4
Pennsylvania*	3	8.6
Rhode Island	1	2.9
South Carolina	2	5.7
Virginia*	2	5.7
West Virginia*	1	2.9
No answer provided	3	8.6
How long have you worked in your current institution?		
Less than 1 year	2	5.7
1 to 5 years	5	14.3
6 to 10 years	7	20.0
More than 10 years	18	51.4
No answer provided	3	8.6
What is your current job title?		
Wildlife Biologist	22	62.9
Wildlife Veterinarian	4	11.4
Other	6	17.1
No answer provided	3	8.6

Agency response to mange in wildlife

Most respondents (*n* = 32; 91.4%) observed wildlife with sarcoptic mange in their state (Table S1) and indicated that mange management was part of their professional responsibilities (Table S2). Nine respondents (25.7%) stated that

mange is a population-level issue for black bears in their state (Table S3), and a further 6 respondents (23.1%) considered that mange would affect black bear populations in their state (Table S4). On average, respondents were not concerned about mange affecting coyote populations, slightly concerned about population-level impacts for foxes, and moderately concerned about population-level impacts for black bears (Figure 2; Table S5).

Agencies primarily responded to mange by dispatching severely affected wildlife ($n = 24$; 68.6%) and monitoring or recording mange cases ($n = 26$; 74.3%; Table S6). These practices were generally aligned with participant opinions on best management practices; however, not all states engaged in the management actions respondents considered ideal. Throughout the survey, we used the terms dispatch or cull to describe lethal removal of mange-affected animals, consistent with operational language used by wildlife agencies. In this context, these terms are analogous to euthanasia, which is more commonly used in clinical contexts to indicate humane death for welfare reasons. Respondents ($n = 34$; 97.1%) agreed that severely affected animals should be dispatched but were more likely to oppose culling of moderately ($n = 15$; 42.9%) or mildly affected wildlife ($n = 28$, 80%; Table S7). Treatment of affected wildlife was generally opposed; most participants ($n = 27$; 77.1%) disagreed with treating even severely affected animals (Figure 3). Opposition to treatment remained high for both moderately ($n = 20$; 57.1%) and mildly affected wildlife ($n = 21$; 60.0%). Thirty-four respondents (97.1%) agreed that mange cases should be monitored and recorded. Respondents most frequently stated that black bears ($n = 27$; 77.1%) are currently targeted when managing sarcoptic mange, with less management focus on mange in foxes ($n = 11$; 31.4%) and coyotes ($n = 8$; 22.9%; Table S8). Current management priorities were consistent with respondents' opinions on which species should be targeted for management (black bears: $n = 31$, 88.6%; foxes: $n = 16$, 45.7%; coyotes: $n = 11$, 31.4%; Table S9).

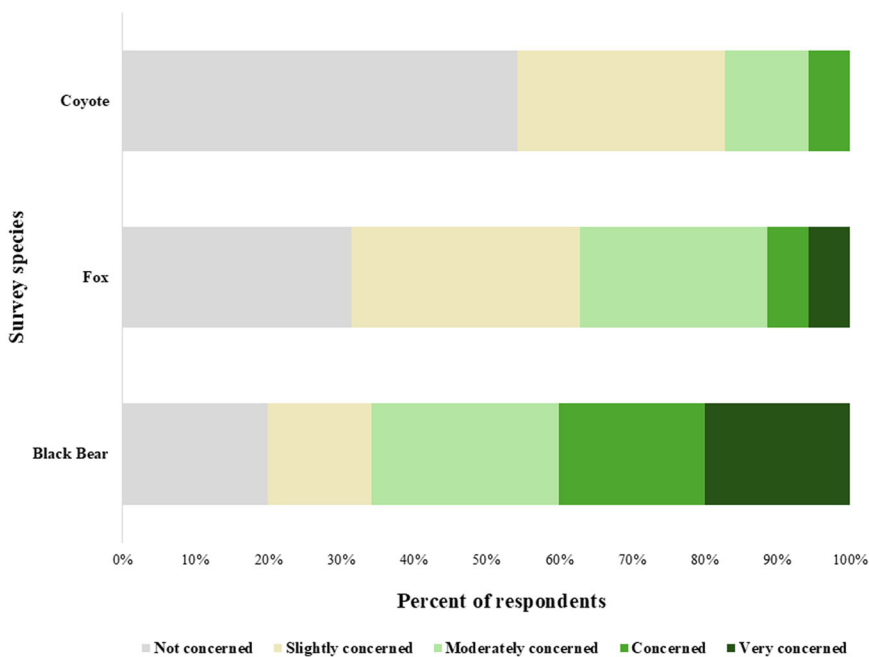


FIGURE 2 Distribution of respondent answers ($n = 35$) to the question “As a biologist, how concerned are you about the population level effects mange may have in your state for black bears, foxes, and coyotes?” from a survey on sarcoptic mange in the United States, 2023.

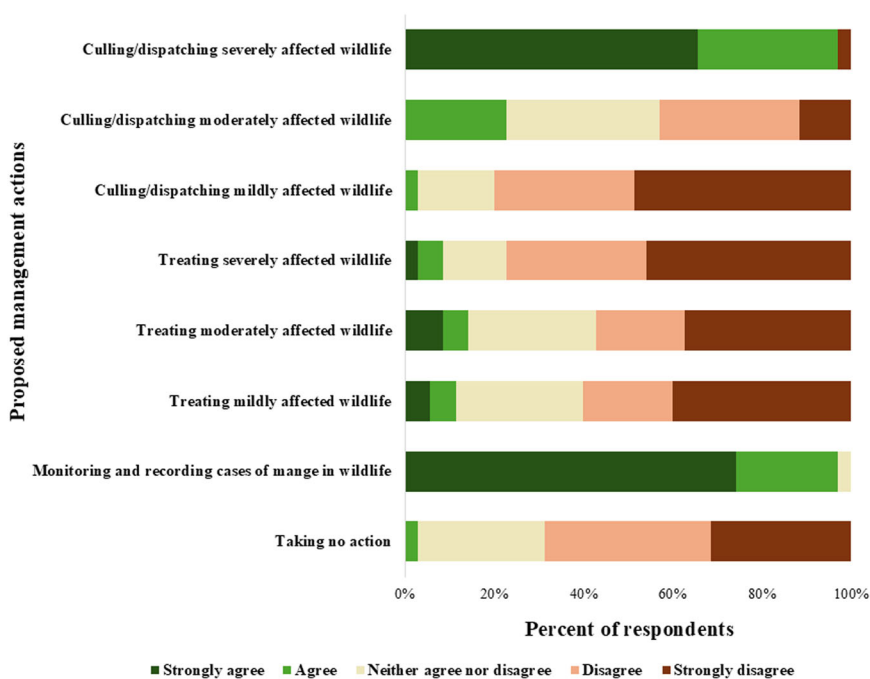


FIGURE 3 Distribution of respondent answers ($n = 35$) to the question “Do you agree or disagree that your agency should address mange in wildlife through the following actions?” from a survey on sarcoptic mange in the United States, 2023.

Most respondents agreed that funding ($n = 18, 51.4\%$) and personnel constraints ($n = 22, 62.9\%$) are barriers to successful management of wildlife mange in their state (Table S10). By contrast, respondents were split in their opinions whether individual agency personnel had sufficient knowledge of wildlife mange management and agency protocols, and whether reporting structures affected the success of management efforts ($n = 15, 42.9\%$ agreed; $n = 13, 37.1\%$ disagreed).

Public and agency expectations related to mange response

Respondents ($n = 19; 54.3\%$) most frequently indicated that the public expects agencies to dispatch severely mange-infested wildlife, but they also stated that the public expects agencies to treat wildlife with veterinary drugs (Table S11). Twelve respondents (34.3%) also indicated that the public expects agencies to capture, treat, and release animals once mange is resolved.

Most respondents ($n = 32; 91.4\%$) opposed people capturing and relocating affected wildlife to shelters, animal control facilities, veterinary clinics, or rehabilitation centers (Table S12). Respondents also opposed the public treating wildlife themselves ($n = 34; 97.1\%$) and tended to prefer that the public sometimes ignore mange and refrain from posting images of mangy animals on social media ($n = 19; 54.3\%$). Most respondents ($n = 29; 82.9\%$) opposed people dispatching mange-infested wildlife without agency permission. However, 19 respondents (54.3%) stated that the public should sometimes be allowed to dispatch mangy wildlife if they have prior permission from the wildlife agency (Figure 4). The largest share of respondents ($n = 21; 60.0\%$) defined successful management of

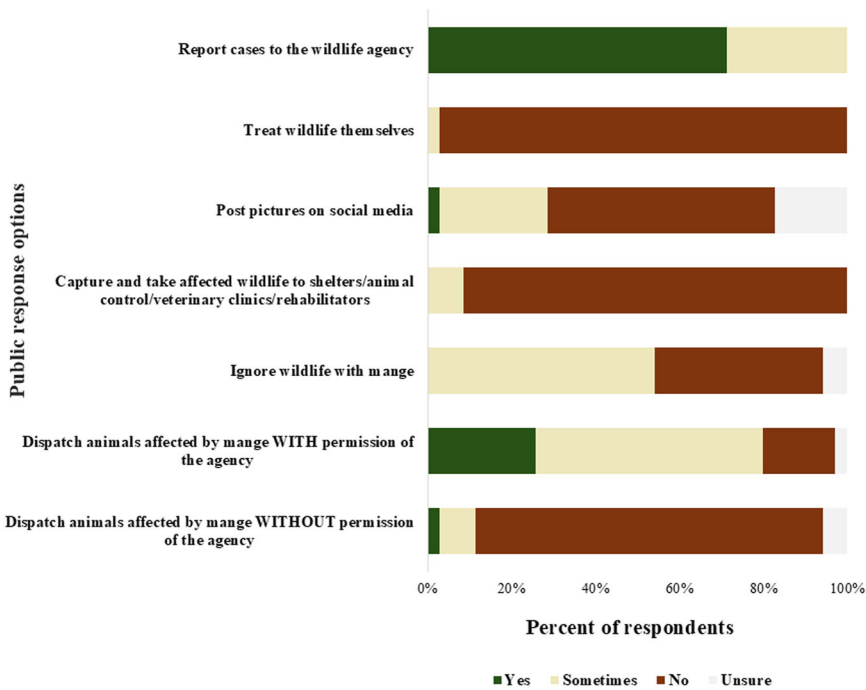


FIGURE 4 Distribution of respondent answers ($n = 35$) to the question “What do you believe the public should do if they encounter a wild animal with mange?” from a survey on sarcoptic mange in the United States, 2023.

wildlife mange as mange being present in wildlife but the public and hunters are aware, accepting of agency actions, and engaged in the management of mange (i.e., by reporting mange) compared to fewer respondents that saw successful management of mange as mange being present but with no population-level effects ($n = 10$; 28.6%), no mange on the landscape ($n = 2$; 5.7%), or other descriptions of success ($n = 2$; 5.7%; Table S13).

Sarcoptic mange reports

Most respondents ($n = 25$; 71.4%) preferred that the public report mange cases to wildlife agencies. However, respondents stated that, in their opinion, key stakeholders (e.g., hunters, landowners, homeowners, renters, wildlife rehabilitators, and state wildlife agency personnel) lacked awareness or knowledge of sarcoptic mange and were unlikely to report mange in wildlife (Tables S14 and S15). Respondents further estimated that less than a third of key stakeholders would report mange in wildlife to the state wildlife agency. Despite concerns that residential homeowners and renters had the least understanding of mange, respondents indicated this stakeholder group (31.1%) would be most likely to report mange (Table S16).

Although most respondents ($n = 32$; 91.4%) stated that wildlife mange reports are submitted to government agencies, 21 respondents (60.0%) also noted that mange is likely reported to local wildlife rehabilitators (Table S17). Most respondents indicated that wildlife disease reports to state agencies are submitted via telephone hotlines ($n = 26$; 74.3%) and email ($n = 23$; 65.7%; Table S18). Despite the importance of public reports of mange, only 5 states (California, Connecticut, Kentucky, Pennsylvania, and Virginia) provided a website form for reporting mange cases. Once collected, 16 respondents (45.7%) stated mange data were compiled into a long-term dataset,

12 respondents (34.3%) indicated data were analyzed in collaboration with academic partners (e.g., to study mange treatment and survival), and 10 respondents (28.6%) stated data were used to inform direct management actions (Table S19). Nine respondents (25.7%) indicated that mange reports are not currently used.

Mange education and public engagement

Respondents most frequently indicated that the state wildlife agency currently engages the public about wildlife mange through a dedicated website information page ($n = 16$; 45.7%) and social media ($n = 11$; 31.4%; Table S20). Respondents stated that public education most frequently included information about what mange is ($n = 26$; 74.3%), which wildlife are affected by mange ($n = 25$; 71.4%), how to report wildlife mange ($n = 21$; 60.0%), and expected recovery of wildlife from mange ($n = 19$; 54.3%; Table S21). Less focus was placed on preventing mange in pets and livestock ($n = 15$; 42.9%) or public health concerns ($n = 11$; 31.4%).

Respondents noted current limitations to outreach and education efforts. At least half indicated that improved education is required for residential homeowners and renters ($n = 24$; 68.6%), hunters ($n = 21$; 60.0%), rural or agricultural landowners ($n = 19$; 54.3%), and pet owners ($n = 19$; 54.3%; Table S22). Respondents also reported inconsistencies in informational messaging. Thirteen respondents (37.1%) believed mange messaging within their state was consistent, while 16 (45.7%) described messaging as inconsistent (Table S23). Most respondents ($n = 21$; 60.0%) thought providing people with facts about mange would result in some behavior change, but 5 respondents (14.3%) expressed doubt about education resulting in changed behaviors by the public (Table S24).

DISCUSSION

Wildlife disease management is an increasingly challenging task, which requires wildlife agencies to engage in reliable disease surveillance, coordinated management responses (Ryser-Degiorgis 2013, Portier et al. 2019, Stephen et al. 2019), and effective outreach and engagement with the public and key stakeholders (Decker et al. 2012, Pedersen et al. 2012, Shapiro et al. 2023a, b, c). It is therefore encouraging that wildlife agency personnel and academic researchers who participated in our study largely agreed upon an overarching management strategy, namely that wildlife that are severely affected by sarcoptic mange should be dispatched, while wildlife with mild or moderate mange should be monitored but not treated. This finding reflects an understanding that reactive, case-by-case interventions are insufficient to address the broader emergence and concerns regarding sarcoptic mange.

Hesitancy to treat mange-infested bears is not unfounded. While isolated case studies have reported clinical resolution of mange following treatment, such as a single-dose fluralaner administration in a free-ranging black bear (Van Wick and Hashem 2019), follow-up data demonstrated that this individual later became reinfested and died, consistent with the majority of other bears that were rehabilitated for mange and collared to understand long-term outcomes (R. Francisco, Southeastern Cooperative Wildlife Disease Study, unpublished data). Such cases underscore the complexity of mange management in free-ranging wildlife, the need for caution when interpreting short-term treatment success, and broader ethical considerations related to whether short-term clinical improvements justify intervention in free-ranging wildlife when long-term efficacy is uncertain and may compromise animal welfare or public trust (Hanisch-Kirkbride et al. 2013, 2014). Although the public mistakenly believes that mange treatment is straightforward because sarcoptic mange can be readily and successfully treated in domestic animals (Dumitrache and Cadiegues 2023), treating free-ranging wildlife presents substantial challenges, including difficulties with drug delivery, concerns about drug residues in game animals, and lack of standardized protocols or long-term efficacy data (Rowe et al. 2019).

Agencies currently employ varying strategies to manage sarcoptic mange in black bears, ranging from limited interventions such as passive surveillance and voluntary public reporting systems to more invasive methods such as euthanasia of severely affected individuals (R. Francisco, personal observation; Niedringhaus et al. 2019b).

Consistent with these management approaches, respondents largely defined successful management of sarcoptic mange as low-level mange presence in the environment without population-level impacts. Respondents prioritized surveillance and management of sarcoptic mange in black bears over other affected species (i.e., foxes and coyotes). They opposed stakeholder engagement in the treatment, handling, or transportation of wildlife that are affected by sarcoptic mange. Instead, respondents preferred that the public and stakeholders report sarcoptic mange cases to wildlife agencies, an important component of data collection to inform management responses.

As mange continues to affect black bear populations across multiple jurisdictions, cross-agency collaboration has become essential, particularly given the zoonotic nature of *S. scabiei* and the uncertainties surrounding its transmission dynamics, long-term population effects, and stakeholder responses (Leong and Decker 2020, Shapiro et al. 2022). The spread of sarcoptic mange in black bears highlights the need for coordinated efforts among agencies, standardized surveillance protocols, and consistent reporting mechanisms to track and mitigate spread effectively (Carmichael 2012, Mazzamuto et al. 2022). Unfortunately, our findings suggest that funding and staff constraints, in combination with inconsistencies in public outreach and messaging, mange reporting structures, and use of mange data, are likely hindering effective, coordinated management responses across states (Siemer et al. 2012, Ryser-Degiorgis 2013, Portier et al. 2019, Stephen et al. 2019, Shapiro et al. 2022). Unlike prior research that highlights these challenges conceptually or through case studies, our study provides a multi-state, agency-level assessment, derived from direct engagement with wildlife managers who critically evaluated their own protocols and identified actionable improvements.

Widespread and highly visible wildlife diseases, such as sarcoptic mange, often garner heightened public concern, necessitating clear communication strategies that balance scientific uncertainty with management transparency (Decker et al. 2012b). Effective disease management depends on public and stakeholder understanding of, and support for, agency actions (Decker et al. 2012b). However, less than 40% of respondents believed their state has a coordinated, standardized communication strategy pertaining to sarcoptic mange. Inconsistency in messaging and management approaches can contribute to public confusion, erode trust in wildlife agencies, and lead to misinformation about disease outcomes and appropriate responses (Riley et al. 2003, Triezenberg et al. 2011).

Respondents emphasized the importance of increased stakeholder understanding of sarcoptic mange, particularly among residential homeowners and renters, who may have limited knowledge of mange as a naturally occurring disease. Respondents also recognized that wildlife rehabilitators are key stakeholders in mange outreach and management because rehabilitators are likely to receive reports from the public of affected bears and, for species like foxes and coyotes, may admit animals directly. Wildlife agencies need to communicate that mange occurs naturally in wildlife populations and that black bears can recover from mild and moderate mange. Recent studies suggest that approximately 80% of black bears that are mildly and moderately affected by sarcoptic mange recover without intervention (Tiffin et al. 2024).

Although agencies provide basic information on sarcoptic mange and which species of wildlife are most commonly affected (e.g., coyote, red fox, and, in some regions, black bear), they offer less information on expected outcomes for affected wildlife. Better aligning people's risk perceptions pertaining to sarcoptic mange with the actual risks to wildlife health is important to attain public and stakeholder support for non-intervention when an individual is not severely affected by mange (Niedringhaus et al. 2019a, Moroni et al. 2020). For example, sharing evidence-based stories that highlight recovery cases in black bears and other wildlife affected by mange that were not treated may foster greater acceptance of, and compliance with, management decisions (Leong and Decker 2020, Tiffin et al. 2024). Strengthening working relationships between state wildlife agencies and wildlife rehabilitators may also increase mange reporting rates and improve consistency in public outreach, ultimately reducing misinformation and reinforcing science-based management approaches.

Timely and accurate reporting is essential for effective wildlife disease monitoring and management, yet agencies face significant challenges in streamlining their reporting structures (Ryser-Degiorgis 2013). Current mange reporting systems rely heavily on direct contact with agency personnel (e.g., telephone or email), a method that is labor-intensive and inefficient. Reporting challenges are further compounded by staffing constraints and incomplete knowledge by agency personnel of sarcoptic mange. Respondents believed that roughly 25% of agency personnel were likely unaware of sarcoptic mange, and only 67.4% of personnel could accurately identify the disease, highlighting the need for internal staff

training on identifying, reporting, and responding to mange cases. Agencies may benefit from implementing virtual training modules, hybrid workshops, or accredited continuing education programs tailored to disease identification, standardized reporting, and public communication. These formats offer flexibility across jurisdictions, can be deployed without major staffing expansions, and could be done in collaboration with academic institutions. Providing clear information to the public and key stakeholders on how to report mange cases and expanding digital reporting options (e.g., online submission platforms or mobile apps) could also improve efficiency, reduce workload, and facilitate more timely data entry.

No standardized interjurisdictional framework currently exists for mange data collection or reporting. Standardizing reporting protocols across agencies would enhance interagency coordination, ensuring that reports are compiled in a centralized, accessible format for long-term monitoring and decision-making (Artois et al. 2009, Ryser-Degiorgis 2013, Harper et al. 2015, Stephen et al. 2019). Science-based data is not only essential but foundational for guiding effective, transparent, and timely management decisions. However, inconsistencies in data-sharing and use across jurisdictions, particularly for sarcoptic mange, have limited data integration into management actions and long-term disease surveillance planning. Notably, only 16 respondents (45.7%) indicated that mange reports were consistently logged into a formal dataset, while 9 respondents (25.7%) indicated that the data were not used. Similar challenges have been documented in European surveillance programs. Pisano et al. (2019) found that fragmented reporting systems hindered interpretation of mange emergence and spread in red foxes, while Heiderich et al. (2024) emphasized that decentralized frameworks frequently result in information blind spots and inconsistent data availability. Developing a standardized reporting form and centralized data-sharing framework would allow agencies and research partners to compare mange case data across regions, identify emerging hotspots, assess the effectiveness of disease interventions, and engage in proactive management strategies for sarcoptic mange.

Our recommendations are not meant as a critique of agency efforts but as a collaborative roadmap toward more effective, ethical, and coordinated mange management. That agencies voluntarily participated in this self-assessment underscores their commitment to improving wildlife health and disease response strategies. By identifying current practices, systemic barriers, and areas of shared opportunity, this work aims to support agencies in advancing a more unified, transparent, and proactive approach to wildlife disease management, one that meets both ecological challenges and evolving public expectations. In doing so, we emphasize the importance of science-based decision frameworks, enhanced workforce training, and continued research into host health, disease dynamics, and landscape change, critical knowledge gaps that must be addressed to anticipate and navigate the future of wildlife health.

Research limitations

While this study provides valuable insights into sarcoptic mange management in wildlife, we acknowledge several limitations of these data. The survey relied on self-reported data, which may introduce biases related to recall accuracy and individual perceptions of agency effectiveness. Results regarding stakeholder perceptions are based on respondents' estimates rather than direct responses from those groups and should be interpreted accordingly. We did not ask respondents to specify the rationale behind euthanasia decisions (e.g., animal welfare, population health, environmental concerns, public safety), limiting our ability to characterize how such decisions are made across agencies. Similarly, the survey did not address collaboration with or reporting to animal control officers, which may be relevant in some jurisdictions. Additionally, while respondents represented a diverse range of geographic locations and professional roles, the sample size was relatively small and may not fully capture the perspectives of all agencies managing sarcoptic mange, particularly those from states with black bear populations that were not represented. Finally, our study focused on the more common carnivore mange hosts in the eastern United States; however, similar data are needed to understand management of mange in sarcoptic mange hosts in the western United States (e.g., gray wolf [*Canis lupus*]), some of which are threatened or endangered (e.g., San Joaquin kit fox [*Vulpes macrotis mutica*]) or are unusual mange hosts (e.g., porcupines [*Erethizon dorsatum*], squirrels, raccoons [*Procyon lotor*], rabbits; Almborg et al. 2012, Cypher et al. 2017, Sinnott et al. 2018, Chouhan et al. 2025).

MANAGEMENT IMPLICATIONS

Wildlife agencies play a critical role in managing sarcoptic mange in black bears and other carnivores, yet our results revealed inconsistencies in public messaging, fragmented mange reporting structures, and underutilization of mange data across states. Fewer than half of respondents reported compiling mange data into a formal dataset, and only a minority described communication strategies as consistent within their agencies. These findings highlight management opportunities to enhance coordination through a unified, multi-state communication strategy that improves consistency in mange-related messaging and ensures messaging remains clear, evidence-based, and aligned across jurisdictions. In addition, standardizing data collection, improving staff training, and expanding digital reporting tools would directly address gaps identified by respondents and foster a more proactive, coordinated, and data-driven approach to wildlife disease management.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

ETHICS STATEMENT

Our survey underwent a full review by the Institutional Review Board at the authors' university and was categorized as non-human subjects research. All research participants were informed in writing that participation was voluntary and how data would be used and reported.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

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