Wildlife and the restorative potential of natural settings

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ABSTRACT

How does the likelihood of encountering wildlife affect residents' expectations about psychological restoration when visiting a local natural setting, and their choices among settings for future recreation? Do urban and rural residents differ in such expectations and choices? We addressed these questions in a web-based experiment with 223 adult residents randomly sampled from urban and rural areas in each of three regions in Sweden. Residents in all six areas can encounter fear-irrelevant wildlife (roe deer, squirrel) near the home, but the presence of fear-relevant wildlife (wolf, wild boar) differs across the areas. The respondents read scenarios concerning encounters with each of these four animals during recreational visits to a nearby natural setting. The scenarios varied in how frequently the person could expect to encounter each animal across visits (never, sometimes, often). For all 12 scenarios, respondents answered questions about anticipated experiences and restoration outcomes, and the effect of encounter likelihood on future recreational setting choices. Across all areas, with all outcomes, increased likelihood of encounters with the wolves and wild boar detracted from anticipated restorative potential, whereas increased likelihood of encounters with roe deer and squirrel enhanced anticipated restorative potential. A similar pattern showed in recreational setting choices. A domination wildlife value orientation moderated the effects of encounter likelihood for wolf and wild boar, whereas a mutualistic orientation moderated the effects of encounter likelihood for squirrel and roe deer. Our results suggest that wildlife management and public health practice could work together not only to address the fears of residents, but also to enhance the restorative quality of local natural settings by protecting wildlife.

1. Introduction

Psychological research on restorative benefits of nature experiences has come into a mutually reinforcing relationship with public health research on contributions of residential greenspace to health: knowledge of restorative processes supports arguments about greenspace-health associations, and knowledge of greenspace-health associations supports arguments about the cumulative values of restorative experiences (Astell-Burt et al., 2022; Hartig, 2021). However, critics have noted that work in both areas has neglected important aspects of the natural environment. These include aspects of biodiversity (Marselle et al., 2021) and the dynamic and ephemeral aspects of environments, such as the movements and sounds of wildlife (Ratcliffe, 2021; Smalley et al., 2022). Development of the knowledge base in these respects will support practice that serves both public health and biodiversity protection goals.

This study addresses wildlife as a neglected aspect of the biodiversity of natural settings that people might visit for psychological restoration (Johansson et al., 2021). Key issues of concern involve sources of variability in the likelihood of encountering wildlife; the effects of animals on the restorative potential of settings; and the moderating role of wildlife value orientations in the restorative process. In addressing these issues, we reinforce connections between environmental psychology, public health, and a third field, human dimensions of wildlife, concerned with human responses to wildlife and the management of wildlife (Decker et al., 2012; Jacobs et al., 2018).

1.1. Sources of variability in the presence of wildlife

Aspects of the appearance, sounds, smells, behavior and traces of a wildlife species might enhance or detract from a restorative experience, but this depends on whether the person even registers an animal's

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presence. In fact, visitors to a natural setting often fail to perceive (Moen et al., 2012) or recognize the species (Dallimer et al., 2012) known to be present from wildlife monitoring and field surveys by trained biologists. With wildlife, multiple sources of variability figure together in what people can register, what they do register, and in discrepancies between what they can and do register. Sources of variability involve characteristics of the animal species; characteristics of the settings in which a person could encounter and register those animals; and characteristics of the people who would visit the setting.

Seasonal and diurnal behavior patterns as well as visual characteristics of the animal species have implications for both actual and perceived presence in a given location. Some animal species, particularly among birds, migrate with the seasons and only appear in a particular location during part of the year (Berthold, 2001). Other animals, such as turtles and bears, remain present, but at higher latitudes hibernate out of sight during the winter (Nelson et al., 1983). Wild boars (Lemel, 1999) and wolves (Kathlyn et al., 2018), for example, move more during the night, when people are ordinarily not present. Even if primarily active during the day, some animals escape notice, due to small size, camouflaging coloration, a tendency to stay in thick vegetation, and the ability to remain quiet and still. Conversely, characteristics such as large size, striking coloration, flock or herd formation, and distinctive sounds and behaviors make some animals more noticeable. Occasionally, wildlife come close to human settlements and are clearly visible (Penteriani et al., 2016).

Characteristics of the setting also contribute to variability in actual and perceived presence of wildlife. By setting here, we refer to the biophysical features of an area; temporal aspects, such as seasons of the year; affordances for activities there at a given time; social aspects, such as the number of people present and their behavioral norms related to wildlife; and the typical behaviors of wildlife in the presence of the people there. Consider two examples illustrating setting variability. A protected sanctuary for migratory birds attracts groups of birdwatchers in the Spring. Many of them comply with the norm to keep their distance and remain quiet while watching the birds, particularly if they recognize that they might otherwise disturb the birds (see Weston et al., 2015). In contrast, a forest in a remote area may not see many people except for a few gathering berries or mushrooms or hunting in the Autumn. The different activities would orient them to the presence of specific animals to varying degrees, and they could evoke different avoidant reactions from those animals. In both settings, wildlife management policies and measures (e.g., institution of a protected area; hunting seasons) balance the needs of people and the needs of wildlife (Swedish EPA, 2022).

Characteristics of people will also influence what wildlife they register in a given setting. People's motives for visiting a setting reflect expectations about the experience they will have (Manfredo et al., 1996) and guide their attention accordingly (Ittelson, 1973). Common motives include psychological restoration, physical activity, and being together with close others (e.g., Home et al., 2012; Knopf, 1987), with or without planned observation of wildlife. Motives for avoiding a setting are also of concern here, insofar as they involve the possibility of encountering some aversive animal there (Johansson et al., 2019). Other personal characteristics potentially relevant to what species people register may for example include previous experience, knowledge, and the ability to recognize and detect an animal (Bashan et al., 2021). Such characteristics may go together with place of residence, which may affect the likelihood of acquiring experience with and knowledge about different animals, the context in which they are encountered, and the ways in which they are experienced (Johansson et al., 2023). In this regard, such experiences may differ between people who live in regions with or without established populations of a particular animal (Dressel, Sandström, & Ericsson, 2015). The significance of urban versus rural residence also deserves consideration (Dressel et al., 2015; Sponarski et al., 2013), although such differences may, at least in a Nordic context, partly reflect differing social representations of wildlife (Figari & Skogen, 2011) or social trust in managing authorities (Johansson et al.,

2016).

1.2. Effects of the presence of fear-relevant and irrelevant wildlife on restorative quality

Globally, many actors discuss how to balance human needs with the needs of wildlife (IPBES, 2022). They recognize that wildlife support human well-being in various ways (Methorst et al., 2020), but that wildlife also impact on human interests (e.g. by preying on game animals) and thereby become a source of social conflict between people holding opposing interests (e.g. conservationists and hunters, Eklund et al., 2023) or diverging wildlife value orientations (Sponarski et al., 2013; Landon, Jacobs, Miller, Vaske, & Williams, 2020).

Demands for prioritization of human needs sometimes refer to fear-relevant animals such as wolves or wild boar near residences. This distinction has extensive empirical backing from behavioral research on the structure of animal fears, developed to inform treatments for phobic anxieties (Arrindell, 2000; Davey et al., 1998). This distinction has been fruitfully applied in research on human – wildlife interaction with a view to informing wildlife management (Johansson & Karlsson, 2011), though with a particular concern for fear-relevant animals such as wolves and wild boar. Such animals become a particular source of concern for responsible authorities and the public when they appear or are thought to be near residences. This concern is grounded in residents' anticipated or realized experiences of psychological stress and restoration (Flykt et al., 2022). If they appraise an animal as a threat to their enjoyment of nearby natural settings, their personal safety or the safety of close others, and/or their livelihood, then its presence may evoke fear, anger and tension (Johansson et al., 2023). Such appraisals may also constrain the benefits of recreation they would otherwise enjoy in their residential context, including restoration. The people affected may therefore insist on measures to reduce the animals' presence (Jacobs et al., 2014; Johansson et al., 2012). Conversely, the appearance and activity of fear-irrelevant animals such as roe deer and squirrels might sustain and enhance the restorative processes supported by their recreational activities. Conceivably, the same people who would have tight restrictions on some fear-relevant species in nearby natural settings could also support protective measures for fear-irrelevant species they enjoy.

Elaborating on these possibilities, we examine how fear-relevant and irrelevant wildlife figure in the experiences different people might have in natural settings. In doing so, we work from a framework that builds on theories about environmental supports for restorative experiences (Johansson et al., 2021).

1.2.1. Restorative environments theory

The restorative potential of a natural setting derives from how well it can fulfill two basic requirements. First, the setting permits restoration; a person gains psychological distance from the depleting demands that entailed a need for restoration. Second, the setting promotes restoration; features of the setting attract and hold attention, helping the person disengage from thoughts and emotional experiences related to demands left behind, and so prolonging a restorative process. Two theories about restorative environments offer complementary views on how the presence of different wildlife species relate to the fulfilment of these requirements.

Stress recovery theory (SRT; Ulrich et al., 1991) describes environmental features that support recovery from stress. It assumes that, through evolution, humans became innately attuned to features with adaptive significance, and that people today still show biologically prepared responses to such features, including like-dislike experiences and approach-avoidance behaviors. For a stressed person, a setting would permit restoration in the absence of threats, and it would promote restoration if it had natural contents, like vegetation and water, that signaled possibilities for survival, and visual scene characteristics such as moderate complexity and depth. Positive affect and non-vigilant

attention evoked and maintained by these environmental features would block negative affect and thoughts in the stressed person, promote physiological deactivation, and help restore their readiness for action given a threat or challenge. After the initial affective response, conscious elaboration on what the person is seeing or otherwise sensing could draw on personal and cultural experience. Ulrich (1983, 1993) has noted the relevance for stress and stress recovery of more or less threatening wildlife, and of inferences one could draw about their possible presence on the basis of scene characteristics (e.g., high visual complexity and lack of depth with dense vegetation where a predator might hide).

In contrast to SRT, attention restoration theory (ART; Kaplan & Kaplan, 1989; Kaplan, 1995) describes components of environmental experience that support recovery from directed attention fatigue. It assumes that directing attention to everyday tasks often requires inhibiting competing stimuli. Doing this requires effort, so the ability to direct attention becomes fatigued. Recovery can occur when the person's attention can go without effort to what they find interesting (i.e., fascination). It also requires a change away from routine mental contents, which permits a sense of being away from the circumstances which depleted directed attention capacity. Further, the situation should involve compatibility with what the person wants to do, can do and must do in a setting. A further experiential component involves a sense of extent, relevant to the person's possibility for sustaining fascination while moving around in the setting. Fascination is the main mechanism of attention restoration, particularly, according to ART, moderately intense fascination engaged by unthreatening, aesthetically pleasing aspects of the setting (i.e., "soft" fascination). Kaplan and Kaplan note that natural settings invite fascination in many ways. An animal may engage fascination, but if a person experiences it as threatening, then it may be of a "hard" variety of fascination less conducive to restoration (Ulrich et al., 1991).

Compatibility as described in ART will come into the picture even before the person enters a setting, when they make a choice among the settings available for restoration (Staats et al., 2003). In doing so, a person may consider possibilities for encountering some animals and/or avoiding others. Encounters that do then occur in the setting will involve appraisals like those indicated in both SRT and ART. A basis for detailed examination of ongoing appraisals is provided by the component process model of emotion (Scherer, 2001), as proposed by Johansson et al. (2021).

1.3. Wildlife value orientations as moderators of the restorative process

In a general sense, looking across specific encounters, how people relate to wildlife can be assessed in terms of their wildlife value orientations (Manfredo et al., 2009; Teel & Manfredo, 2010). Those with a domination orientation hold beliefs that refer to wildlife as a source of human benefits, and they would have wildlife managed in a way that prioritizes human well-being. In contrast, individuals with a mutualism orientation hold beliefs about wildlife as capable of relationships of trust with humans. They would have wildlife managed as part of an extended family and deserving of similar rights and care. Accordingly, value orientations have been found to predict conservation intentions regarding wildlife (Fulton et al., 1996); attitudes towards wildlife species and wildlife issues (Teel & Manfredo, 2010); and the acceptability of different management actions (Jacobs et al., 2014).

Conceivably, a person's standing with respect to mutualism and domination orientations will figure in the effect that encounters with wildlife have on their experiences in natural settings. People with a strong mutualistic wildlife value orientation tend to see interactions with wildlife as benign, incidental and recreational, and in these interactions wildlife become "objects of curiosity and learning" (Manfredo, 2008, p. 203). In the present study we therefore focus on the potential moderating effects of the respective wildlife value orientations.

1.4. The present study

We aim to assess the extent to which variations in the presence of fear-irrelevant animals (roe deer, squirrel) and fear-relevant animals (wild boar, wolf) affect expectations about psychological restoration in local natural settings. The choice of species reflects the Swedish context for this study. Previous research has found that Swedes respond differently to these four species in terms of fear-relevance versus irrelevance (Dressel et al., 2021; Hagström, 2014; Johansson et al., 2012). Wolves are primarily framed in terms of threats to people, livestock, and hunting interests versus conservation interests; with wild boar, threats to people and agriculture. Roe deer generally arouse less concern, and squirrels pass with little comment.

Using a web-based experimental approach, we manipulate animal species and the level of their presence as within-subjects factors. We treat region as an independent variable by sampling respondents from regions with varying abundances of wolves and wild boars in particular. We also treat place of residence as an independent variable through sampling. As noted earlier, urban versus rural residence might have overarching relevance for the likelihood and appraisal of wildlife encounters.

To narrow the focus on restoration outcomes, we use a scenario method which asks the participant to imagine themselves in need of restoration and to anticipate that they would soon have time free for a walk in a natural area. Such scenarios have proven useful in previous studies on restorative environments (Staats et al., 2003) and the role of wildlife in shaping the restorative potential of a natural setting (White et al., 2017).

We also use the scenarios to experimentally manipulate the levels of wildlife presence. This enables us to bring perceived and actual presence into congruence by expressing the actual presence of the species in terms of the likelihood that the person would encounter the given animal over a given number of visits. Importantly, the scenarios allow us to specify levels of presence that do not currently exist, but which could exist given different wildlife management targets.

Our experimental set up opens for consideration of multiple main effects and interactions, but our focus in this study is on the following questions:

RQ1: To what extent does the likelihood of encountering *any* wildlife matter to a person's expectations regarding (a) the restorative potential of the natural setting; (b) the positive and negative emotions experienced there; (c) the outcomes of restoration they would realize; and (d) their intentions regarding a future choice of that setting for recreation? RQ1 thus addresses the main effect of the level of presence.

RQ2: To what extent do expectations about (a) through (d) above vary across roe deer, squirrel, wild boar and wolf? RQ2 thus concerns the main effect of species and the interaction of species and level of animal presence.

RQ3: To what extent do expectations about (a) through (d) above vary between urban and rural residents? RQ3 thus addresses the main effect of place of residence and its interactions with species and level of animal presence.

RQ4: To what extent do wildlife value orientations moderate expectations about the restorative potential, with regard to change in the level of each animal's presence? We thus address the role of a theoretically relevant individual difference variable alongside standard sociodemographic variables.

2. Method

2.1. Design and settings

We manipulated Species (roe deer, squirrel, wild boar, wolf) and Likelihood of encounter (never, sometimes, often) as within-subjects

factors in a web-based experiment.

We included Region (represented by the municipalities of Jönköping, Falun, Östersund) and Residence (urban, rural) as between-subjects factors. The municipalities capture regional variation in actual abundances of wild boar and wolf in the rural areas. All municipalities have populations of roe deer and squirrel in their urban and rural areas, so participants would likely have encountered them near their homes. Other setting characteristics bear on the urban-rural distinction. All three municipalities have a city that lends its name to the municipality. The cities hold the greater part of the municipal population, and the municipalities therefore have distinct urban and rural areas. The distinction is however bounded by the Swedish context, in which cities are typically not so large or densely populated. See online Supplemental Material.

2.2. Participants

Our participants came from a stratified random sample obtained from the national register of personal addresses (https://www.statenspersonadressregister.se/master/start/english-summary/) We identified the urban and rural areas in each municipality using district postal codes, defining the urban area as the centrally located districts and the rural area as districts served by a rural delivery service (https://www.postnummerservice.se/information/svenska-postnummer-och-postorter). For each of the six areas, we obtained addresses for 200 people. Our sample size determination reflects experience with response rates from previous surveys of the given population and anticipation that we would secure sufficient responses for a well-powered test of moderately sized (partial eta-squared = 0.06) interactions, in particular between species and level of animal presence. Of the 1200 people sampled, 1190 had a valid address. We received questionnaires from 274 people, but 51 did not provide complete data and we excluded them from analyses. The 223 people who returned fully completed questionnaires correspond to a response rate of 18.7%.

Our sample has a broad age range (20–81 years, $M = 53.7$, $SD = 16.04$); more women than men (58 vs 42%); and fewer urban residents than rural ones (41 vs 59%). The uneven representation of place of residence held similarly across the three municipalities: Jönköping (urban $n = 26$; rural $n = 40$), Falun (urban $n = 38$; rural $n = 48$), and Östersund (urban $n = 27$; rural $n = 44$) ($\chi^2 = 0.69$, $p = .70$, Cramer's $v = 0.06$).

2.3. Scenarios

Each scenario combined one of the four species with one of the three levels of the likelihood of an encounter (never, sometimes, often), yielding 12 different scenarios.

Each animal was introduced with a short description accompanied by an image of the animal in silhouette beside a similarly scaled human (see Supplemental Material). Following this description, the participant was asked to imagine being in need of restoration and anticipating a visit to a nearby natural setting (Staats et al., 2003):

You have had some demanding days and feel tired and spent. You have difficulty concentrating and easily get irritated. Tomorrow you are free and have time to relax. You will go for a walk for an hour in a natural area near where you live. Try to imagine the surroundings there as realistically as possible. Imagine how it would be to go there if you could expect to (never/sometimes/often) meet (roe deer/wild boar/wolf/squirrel), that is, see traces of droppings, hear sounds from the animal or possibly get a brief glimpse of the animal (translated from Swedish).

The three levels of the likelihood of encounter were as follows:

Never: You can count on not meeting [roe deer/wild boar/wolf/squirrel] or seeing any traces of these animals.

Sometimes: It could happen about once in every 100 times you visit the area.

Often: You can count on meeting [roe deer/wild boar/wolf/squirrel] rather often, that is, see traces of scat, hear sounds from the animal or possibly get a brief glimpse of the animal. It could happen about every fifth time you visit the area (ca. 20 of 100 occasions).

The animals and likelihood were presented in the same order across all participants.

2.4. Instrument

After providing informed consent, and before responding to the scenarios, the participants reported their interest in being out in forests and fields (1 = *Uninterested*; 4 = *Very interested*) and their experience of walking in a nearby natural area to relax and clear their mind (1 = *Never*; 2 = *Yes, on occasion*; 3 = *Yes, often*; 4 = *Yes, very often*). Then, for each of the 12 scenarios the participants assessed the contribution of the given animal at the given level of presence to their experience in the natural area. The experience was framed in terms of the perceived restorative potential of the setting, anticipation of the emotional experiences evoked, expectations about restorative benefits, and choices among settings for restoration in the future. After the scenarios, the respondents reported on their wildlife value orientation and recreation activities. Details of these measures follow, here translated from Swedish.

The five *restorative potential* items represented constructs drawn from SRT (threat) and ART (fascination, compatibility, being away). Some were adapted from items in the Perceived Restorativeness Scale (Hartig, Korpela, Evans, & Gärling, 1997a). The items had a common stem specific to the given scenario: "That there [never/sometimes/often] are [roe deer/wild boar/wolves/squirrels] in the natural area helps that …." They then continued as follows: "I experience it as dangerous and threatening for me" (reversed); "I can be engaged and delighted by watching the animals' activity and movement"; "I feel that it is as it should be for me to be able to really relax"; "It is easy to get away from what usually demands my attention"; "I experience that there is much to discover and which can capture my attention" (1 = *Absolutely not*; 2 = *No, hardly*; 3 = *Neither nor*; 4 = *Yes, a bit*; 5 = *Yes, absolutely*). We used the mean item response for analysis. In the responses for "sometimes" encountering the animal, the Cronbach's alphas for the item set ranged across the animals from 0.79 to 0.84.

The four items used to assess *emotional experiences* read as follows: "That there [never/sometimes/often] are [roe deer/wild boar/wolves/squirrels] in the natural area makes me feel … comfort; joy; fear; anger" (0 = *Not at all*; 6 = *Very strongly*). In the responses to "sometimes" encountering the animal, the two positive feelings correlated strongly for all animals, with rs from 0.86 to 0.93. Correlations between the two negative emotional experiences were weaker, $r = 0.18$ for roe deer and otherwise 0.40-0.56. All correlations were nonetheless positive, and we therefore used the mean item response for each pair in analyses.

The two items used to assess *anticipated restoration* outcomes after a visit read as follows: "That there [never/sometimes/often] are [roe deer/wild boar/wolves/squirrels] in the natural area affects my ability to … feel calm and relaxed after I have visited the natural area; concentrate after I have visited the natural area" (−3 reduced considerably; +3 increased considerably). In the responses to "sometimes" encountering the animal, the items were highly correlated (rs from 0.69 to 0.79), and we used the mean item response in analyses.

The three items used to assess *future choices among settings for restoration* read as follows: "That there [never/sometimes/often] are [roe deer/wild boar/wolves/squirrels] in the natural area means that in the future I would choose to … go to the same natural area; rather do something at home; take a walk in a different natural setting" (1 = *Absolutely not*; 2 = *No, hardly*; 3 = *Neither nor*; 4 = *Yes, a bit*; 5 = *Yes, absolutely*). The choice of a different setting was followed-up with an open-ended question in which the participants could further describe

their choice. After responding to the 12 scenarios, the participants completed a short version of the *wildlife value orientation* scale developed by Miller et al. (2018; reduced and translated into Swedish by Eriksson et al., 2020): Three items represented a domination orientation: "The needs of humans should take priority over wildlife protection"; "Humans should manage wildlife populations so that humans benefit"; "Wildlife is only valuable if it produces human benefits." Four items represented a Mutualism orientation: "We should strive for a world where humans and wildlife can live side by side without fear"; "I feel a strong emotional bond with animals"; "Wildlife are like my family and I want to protect them"; "I view all living things as part of one big family" (1 = *Disagree completely*; 2 = *Disagree partly*; 3 = *Neither nor*; 4 = *Agree partly*; 5 = *Agree completely*). Cronbach's alpha was for domination 0.69. and for mutualism 0.77. We used the respective mean item responses in analyses. Thus, for each subscale, a higher score indicated the given value orientation was held more strongly.

The participants also provided *background information,* including gender, birth year, personal experience of the animal near their residence, and engagement in any of 18 outdoor activities during the last 12 months (see Supplemental Material). We summed the number of activities checked to obtain a simple measure of outdoor experience.

2.5. Procedure

The study was administered by Kvalitetsindikator AB, a Swedish survey company. An invitation to participate in an online study on recreation and wildlife in local natural settings was sent by post to the 1200 selected people in mid-February 2022. The invitation contained a web link and personal login details. The invitation also explained that participation was voluntary and that formal ethical approval for the study had been obtained from the Swedish Ethical Review Authority (reference number 2021-05895-01). The invitation was followed by an SMS reminder, a postal reminder and a second SMS reminder before closing the data collection by the end of March 2022. Participants received a gift card worth 99 SEK/10 USD.

2.6. Statistical analysis

We treated restorative potential as our main dependent variable. We assumed that anticipated emotional experiences, restorative benefits, and choices among settings for restoration theoretically would follow from the assessment of restorative potential and therefore treated them as complementary dependent variables. We initially conducted a mixed ANOVA with Region (Jönköping, Falun, Östersund), Species (roe deer, wild boar, wolf, squirrel) and Likelihood of encounter (never, sometimes, often) as the independent variables and restorative potential as the dependent variable. This analysis did not show any main or interaction effects involving Region (all $ps > .20$, all $\eta_p^2 < 0.02$). In the further analyses, we replaced Region with Residence (rural, urban) as a between-subjects independent variable. To address RQ 1–3, we ran Residence x Species x Likelihood ANOVAs with the following dependent variables: restorative potential; emotions (positive and negative separately); anticipated restoration outcomes; and future choices among settings for restoration. For the last of these, we did separate analyses for staying at home or going to another place as alternatives to going to the natural setting where the given animal would or would not be encountered.

In a second series of analyses, we used hierarchical regression to assess the explanatory power of individual characteristics with regard to the difference in scores on restorative potential for the lowest and highest likelihoods of encounter for each species. To first reduce context effects, we entered residence at step 1, followed by gender, age, outdoor experience, and wildlife value orientations at step 2. Because the dependent variable is a difference score, each of the independent variables is in effect treated as a moderator of the effect of likelihood of encounter on restorative potential. Of particular interest is whether the

value orientations have moderating effects after adjustment for other individual differences, as per RQ4.

All analyses were carried out using SPSS version 27. We applied the conventional criterion for statistical significance ($p \leq .05$), and report η_p^2 values as effect sizes.

3. Results

3.1. Interest in nature and wildlife value orientation

Almost all (97%) participants reported being very or somewhat interested in spending time in natural settings, and 90% reported they had walked in a nearby natural setting for relaxation and recreation. All (100%) of the participants had seen or heard squirrels, 93.3% roe deer, 27.8% wild boar and 22% wolf nearby where they lived. During the last year they had on average engaged in seven of the 18 outdoor activities listed in the questionnaire ($SD = 3.27$). They tended to hold a moderately weak Domination wildlife value orientation ($M = 2.28$, $SD = 0.87$) and a moderately strong Mutualist wildlife value orientation ($M = 3.70$, $SD = 0.85$). The two orientations were negatively correlated ($r = -0.524$) Their substantial experience in natural settings and varying views on human-wildlife relations should reinforce confidence in the validity of their responses to the scenarios.

3.2. Effects on assessments of restorative potential, emotions, and restoration outcomes

Responding to the scenarios, our participants first assessed how the given Species/Likelihood combination would contribute to the restorative potential of their self-recalled local natural settings. To simplify the presentation of results, we first address RQ3 concerning the effects of their place of residence. Collapsing across Species and the Likelihood of encounter, rural participants anticipated greater restorative potential in the nearby natural setting than did urban residents: $M = 3.66$, 95% $CI = 3.58$–3.74 versus $M = 3.51$, 95% $CI = 3.42$–3.60. This main effect of Residence is significant ($p < .02$) but small ($\eta_p^2 = 0.03$). Residence did not interact with Species or Likelihood to a substantial degree in affecting restorative potential assessments nor for any of the other dependent variables. We therefore collapse across Residence in presenting the remaining ANOVA results here. We provide details on the effect estimates and descriptive statistics for all variables in the Supplemental Material (Tables S1–S7).

With regard to RQ1 and RQ2, our ANOVA revealed substantial main effects of Species and Likelihood of encounter on the restorative potential of the setting. Collapsing across levels of Likelihood, both roe deer and squirrel contributed more to restorative potential than did wild boar and wolf ($p < .001$). Collapsing across species, restorative potential increased when moving from never encountering the animal to some encounters ($p < .001$). However, these effects conceal the interaction of Species and Likelihood ($p < .001$). Our participants gave lower restorative potential ratings to the setting if they would never encounter a fear-irrelevant species (roe deer or squirrel) there, and restorative potential increased as imagined likelihood of encounters with those animals increased to sometimes and often (Fig. 1). Conversely, ratings of restorative potential decreased substantially when participants imagined sometimes encountering wild boar or wolf versus never encountering them. More frequent encounters with those animals further diminished the setting's restorative potential, though to a smaller degree (Fig. 1). No other effects were statistically significant (Table S1). We present the complete set of means for restorative potential broken out by Species and Likelihood in Table S2.

The dependent variables correlated moderately to strongly: roe deer, all $rs > \pm0.34$; squirrel, all $rs > \pm0.34$; wild boar, all $rs > \pm0.45$; wolf, all $rs > \pm0.58$. Accordingly, the results from the ANOVAs for the remaining dependent variables either echo or mirror those just reported for restorative potential. Main effects of Species and Likelihood appear
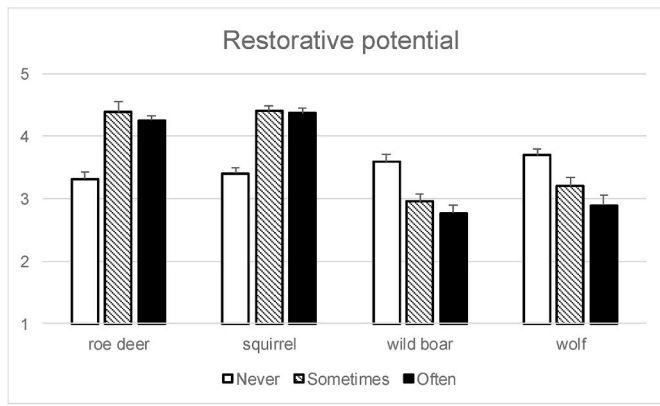
Fig. 1. Mean ratings of the restorative potential of a nearby natural setting with different likelihoods of encountering fear-irrelevant and fear-relevant wildlife species. Higher values indicate stronger agreement regarding the animal's positive contribution to the restorative potential of the setting. Error bars are for 95%*CIs*.

Fig. 3. Mean ratings of restoration outcomes anticipated after having visited a nearby natural setting with different likelihoods of encountering fear-irrelevant and fear-relevant wildlife species. Negative values indicate anticipated constraint of restoration, and positive values indicate a greater degree of anticipated restoration. Error bars are for 95%*CIs*.

consistently (the only exception being the effect of Likelihood for anticipated restoration outcome, which did not reach significance), as does the Species × Likelihood interaction (most $ps < .001$, η_p^2 between 0.06 and 0.51; Table S1). These effects can be discerned in Figs. 2–4. Additional descriptive statistics are given for the respective variables in Tables S3–S7 in the Supplemental Material.

With regard to choosing a different setting given a particular combination of species and likelihood of encounter, we observe a generally weak intention to stay at home; however, the choice of a different place becomes more salient when the fear-relevant animals are present (Fig. 4a and b).

In addition to the main effects of Species and Likelihood and their interaction, like those found with the other dependent variables, we
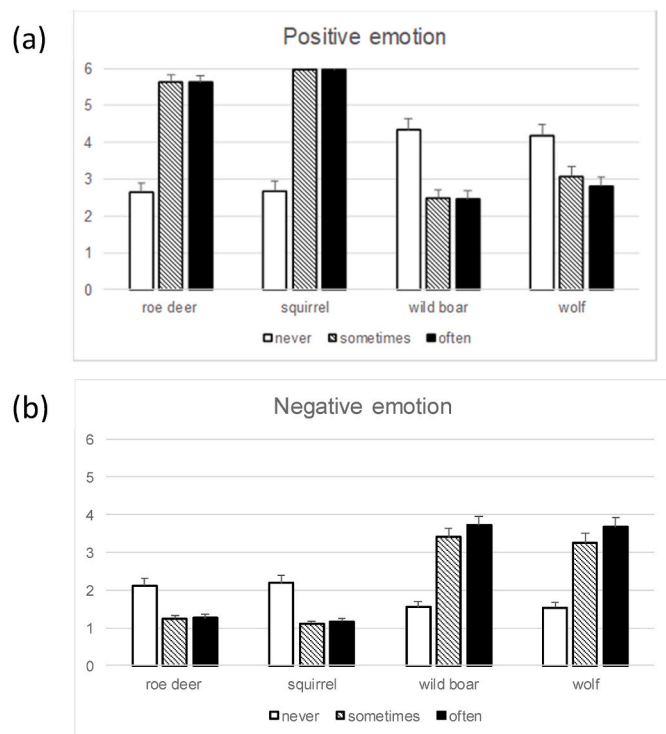
(a) Stay at home

(b) Other place

Fig. 4. Mean ratings of the intention to do something at home (panel a) or go to another place (panel b) rather than to go to the natural setting given different likelihoods of encountering fear-irrelevant and fear-relevant wildlife species. Higher values indicate greater strength of intention. Error bars are for 95%*CIs*.

(a) Positive emotion

(b) Negative emotion

Fig. 2. Mean ratings of the positive emotions (panel a) and negative emotions (panel b) anticipated in a nearby natural setting with different likelihoods of encountering fear-irrelevant and fear-relevant wildlife species. Higher values indicate greater strength of the given emotions. Error bars are for 95%*CIs*.
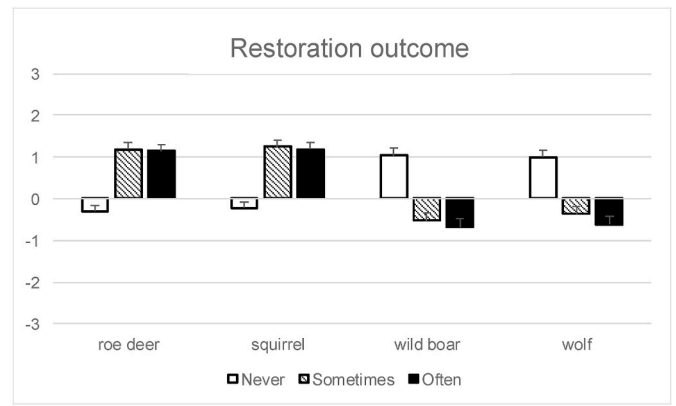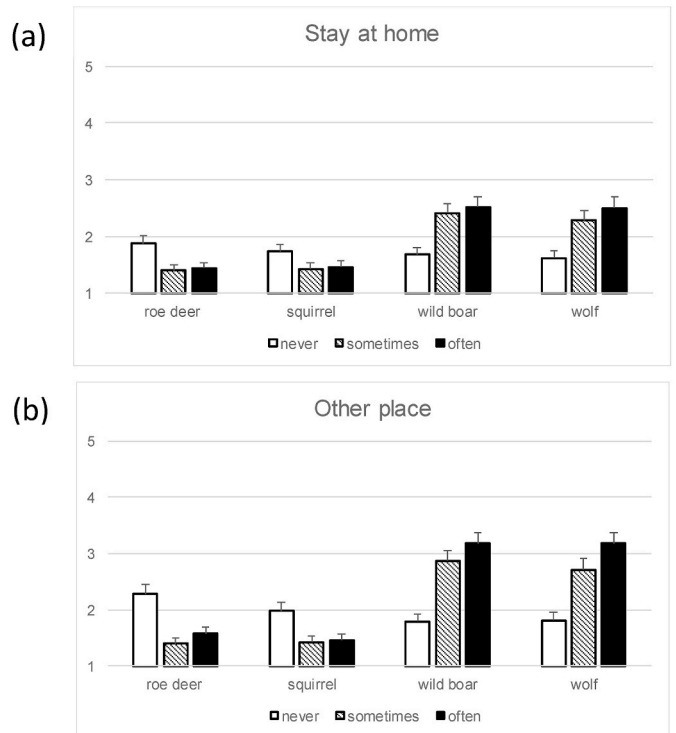
found a main effect of Residence and a Species × Likelihood × Residence interaction effect on the intention to visit another place instead ($ps < .01$; however, both effects were relatively small (Tables S1 and S7).

For each species, the quantitative results could be informed by participant responses to an open-ended question about the kind of place they would go to instead. Those who responded regarding roe deer ($n = 42$) and squirrel ($n = 19$) stated that, if they would never encounter those animals in their local natural setting, they would choose livelier settings and places where they could view the animals. For wild boar ($n = 101$) and wolf ($n = 104$), participants said that if they would encounter those animals sometimes or often, then they would likely choose to walk in urban settings such as shopping malls and parks or

along a running path with lighting. One participant remarked, "I would no longer pick my own berries but buy frozen berries in the supermarket."

3.3. The role of individual variables in anticipated differences in restorative potential

The series of ANOVA showed that ratings of the dependent variables differed across levels of Likelihood of encounter in different ways, depending on the species. Addressing RQ4, we used a series of hierarchical regressions to examine how much of the variance in the difference for each species could be explained by the participants' place of residence (step 1), gender, age, outdoor experience, and value orientations (step 2). For these analyses, we used the difference in scores for restorative potential, our main dependent variable, between the highest and lowest likelihoods of encountering the animal. The difference scores can range from −1 indicating that the restorative potential is lowest with the highest likelihood of encounter (never) to +1 indicating that the restorative potential is higher when the likelihood of encounter is the highest (often). The means and standard deviations for the difference scores are given for each species in Fig. 5, showing that for roe deer and squirrel the restorative potential gets higher when the likelihood of encounter increases, and for wild boar and wolf the restorative potential gets lower when the likelihood of encounter increases. Detailed results from the respective regression analyses are given in Table 1.

Four general results deserve mention here. First, in none of the analyses did the set of independent variables explain more than 18% of the variance; the consequences of moving from no likelihood of encounter (never) to a substantial likelihood of encounter (often) are largely due to other causes.

Second, for roe deer, but not for the other species, those with rural versus urban residence anticipated a greater increase in restorative potential when the likelihood of encountering shifted from never to often.

Third, gender had a significant moderating effect on the difference in restorative potential ratings for the two fear-relevant animals but not for the two fear-irrelevant animals. Compared to males, females anticipated a greater decrease in restorative potential when the likelihood of encountering a wild boar or wolf shifted from never to often.

Fourth, a mutualistic wildlife value orientation was a relatively

strong and statistically significant contributor to explanation in the analyses for roe deer and squirrel. The coefficient was positive in these analyses, which indicates an increase in restorative potential among those participants with a stronger mutualism value orientation. A domination wildlife value orientation was a relatively strong and statistically significant contributor to explanation in the analyses for wolf while somewhat weaker in the analyses for wild boar. In both cases the coefficient was negative, which indicates a stronger decrease in restorative potential among those participants with a stronger domination value orientation. As for wild boar, gender was by far the strongest explanatory variable, indicating that women anticipated a stronger decrease in the restorative potential when the likelihood of encountering wild boar changed from never to often.

4. Discussion

4.1. Summary of main findings

Asked to consider a walk in a nearby natural setting, our participants largely saw the restorative values of the visit increase with the likelihood of more frequent encounters with roe deer and squirrel, and decrease as encounters with wild boar and wolf became more likely. The fear-relevance of the animal moderated the relationship between an increase in the likelihood of encounters and all of the outcomes used to represent restorative value (restorative potential, positive and negative emotions, anticipated restoration outcome). Moreover, as the likelihood of encountering a fear-relevant animal increased, our participants showed a stronger inclination to stay home or choose another place for their recreational walks. The effect sizes for these interaction effects were consistent across the outcomes. Although our results indicate an increasing likelihood of encountering wildlife *per se* does matter to expectations regarding the restorative values of a visit to a nearby natural setting (i.e., a main effect of likelihood; RQ1), as a practical matter it would be unwise to consider increasing the likelihood of encounter independently of the species that would be encountered (RQ2). Our results affirm calls for species-specific understanding of the impact of local wildlife on psychological restoration (Bell et al., 2018; Johansson et al., 2023) and the relevance of psychological categorizations of animal fears for the restorative potential of natural settings (Arrindell, 2000).

In contrast to other studies that addressed fear of large carnivores (Johansson et al., 2016), we did not find that urban versus rural residence had a consistent main effect on our participants' assessments of their experience in nearby natural settings, nor did it interact with either species or the likelihood of encounters (RQ3). This may be explained by the relatively small size of the regional cities from which we sampled our urban participants, the ease with which they could move into the rural surroundings, as well as value heterogeneity across the relatively more urban and rural areas included (Sponarski et al., 2013).

Similarly, region of residence did not affect the outcomes, despite the varying degrees of actual presence of the fear-relevant animals. This may reflect the fact that all four animals are nonetheless present in the Swedish fauna. Roe deer and squirrel are present across all three regions. Wild boar and wolf are not, but the media coverage of these species is extensive in national news media as well as social media and hardly possible to miss. The discussions heavily circulate around the management of these animals with regard to whether these animals should be perceived as threats to property and people or not. This presumably enabled our participants to imagine the differences in actual presence needed to make their assessments.

Finally with regard to our key findings, wildlife value orientations came across as relatively strong explanatory variables, but the importance of a domination orientation and mutualistic orientation differed between the fear-relevant and fear-irrelevant animals. The domination wildlife value orientation was the strongest explanatory variable for the difference in restorative potential between never versus often
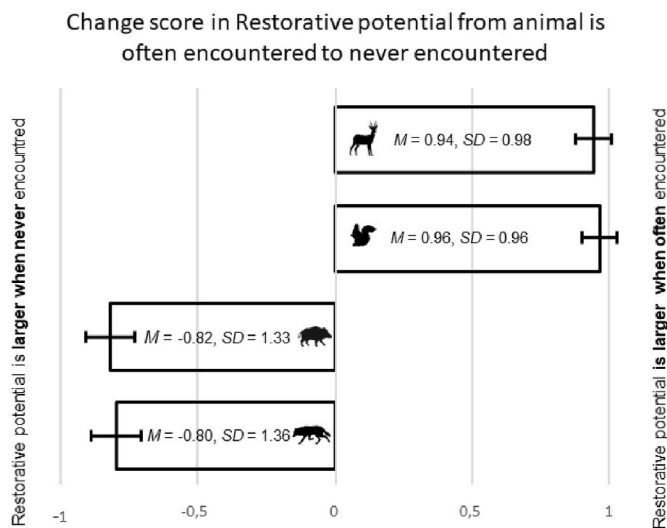

Change score in Restorative potential from animal is often encountered to never encountered

M = 0.94, SD = 0.98
M = 0.96, SD = 0.96
M = -0.82, SD = 1.33
M = -0.80, SD = 1.36

Restorative potential is larger when never encountred
Restorative potential is larger when often encountered

Fig. 5. Mean values and standard deviations for the difference scores in restorative potential if the given species (roe deer, squirrel, wild boar, wolf) would never versus often be encountered. A positive value is equivalent to the restorative potential being larger when the animal is often encountered, and a negative value is equivalent to the restorative potential being larger when the animal is never encountered.

Table 1

Final regression models for the difference scores in restorative potential given different likelihoods of encounter with the animal in a local natural setting (N = 223).

	Roe deer			Squirrel			Wild boar			Wolf		
	Δ Restorative potential			Δ Restorative potential			Δ Restorative potential			Δ Restorative potential		
	$M = 0.94$ ($SD = 0.98$)			$M = 0.96$ ($SD = 0.96$)			$M = -0.82$ ($SD = 1.33$)			$M = -0.80$ ($SD = 1.36$)		
	B	SE	β	B	SE	β	B	SE	β	B	SE	β
Constant	−0.661	.558		0.211	0.550		−1.795	0.735		−1.936	0.737	
Residence												
Urban = 1	0.372	0.131	0.187**	−0.112	0.129	−0.057	−0.029	0.172	−0.011	0.096	0.173	0.035
Rural = 2												
Gender												
1 = female	0.071	0.131	0.036	0.019	0.129	−0.010	1.092	0.173	0.407***	0.697	0.173	0.254***
2 = male												
Age	−0.003	0.004	−0.047	−0.005	0.004	−0.082	−0.001	0.006	−0.017	0.009	0.006	0.108
Outdoor experience	0.011	0.021	0.037	0.004	0.020	0.016	0.008	0.027	0.020	−0.010	0.027	−0.025
Domination	−.052	.087	−0.046	−0.042	0.086	−0.038	−0.276	0.114	−0.180*	−0.517	0.115	−0.331***
Mutualism	0.298	0.088	0.258***	0.332	0.087	0.295***	−0.009	0.117	−0.006	0.205	0.117	0.129
	$F (6, 216) = 5.069, p < .001.$			$F (6, 216) = 4.11, p < .001.$			$F (6, 216) = 7.34, p < .001.$			$F (6.216) = 9.097, p < .001.$		
	$R^2 = 0.123, R^2\text{adj} = 0.099$			$R^2 = 0.103, R^2\text{adj} = 0.078$			$R^2 = 0.171, R^2\text{adj} = 0.148$			$R^2 = 0.202, R^2\text{adj} = 0.180$		

encountering wolf in a nearby natural setting, and although a less strong explanatory variable, the result for wild boar was in the same direction. Considering that wolves psychologically are categorized as fear-relevant animals, this result is in line with the idea that a domination orientation accentuates the prioritization of human well-being over wildlife (Manfredo, 2008).

In contrast, the mutualistic wildlife value orientation was the strongest explanatory variable for the difference in restorative potential between never versus often encountering roe deer and squirrel in a nearby natural setting (RQ4). For these animals, a higher mutualistic wildlife value orientation was associated with a relatively greater positive difference in perceived restorative potential with increased encounter frequency. This result aligns with research showing that a mutualism orientation correlates with support of habitat protection, favorable attitudes towards wildlife, and promotion of wildlife viewing (Manfredo et al., 2021). In sum, our results suggest that the two wildlife value orientations have different relative importance in appraisals of situations associated with fear-relevant and fear-irrelevant animals.

4.2. Strengths and limitations

We used a well-established scenario method, which had participants imagine themselves in need of restoration and anticipating they would soon have time free for a walk in a natural area. The validity of the responses obtained is reinforced by the fact that our results come from a sample in which an overwhelming majority expressed interest in spending time in natural settings and had walked in a nearby natural settings for relaxation and recreation, among other outdoor activities. Moreover, the scenarios involved animals present in Sweden. The engagement with the scenarios therefore could build on substantial experience, both direct and mediated.

The scenario method enabled an experimental manipulation that brought perceived and actual presence of the given wildlife species into congruence by expressing the actual presence of the species in terms of the likelihood that the person would encounter the animal over a given number of visits. At the same time, we could specify as comparison conditions levels of presence that do not currently exist, but which could exist given climate change and wildlife management targets. Furthermore, by using a within-subjects design to manipulate species and likelihood, we could efficiently address the multiple potential sources of variance in differences between actual and perceived presence.

Although many Swedes spend time in nature, possible limitations of the study are the modest response rate and attendant self-selection bias, entailing underrepresentation of people with less interest in wildlife or fewer opportunities to spend leisure time in natural settings. On the other hand, we are fairly confident we have acquired data from people

who value experiences in the natural settings where they might encounter the wildlife in focus here. Insofar as the collected responses are not based on guesswork by participants who lack familiarity with the settings in question, this selection bias might have also contributed to the internal consistency of our measures and the internal validity of our findings. The low response rate nonetheless encourages caution with generalisation to the general population in the studied regions.

Although our analyses controlled for individual factors that the literature indicated could have relevance for the outcomes measured here (i.e., gender, age and wildlife value orientation), other variables may weaken or strengthen people's reactions to local natural settings and to the wildlife within them. Further research could consider the main and moderating effects of variables such as place attachment (Scannell and Gifford, 2010) and attitude toward nature and its variants, such as nature connectedness (Brügger et al., 2011), with a further narrowing of focus on the wildlife that characterizes the places and nature in question (Folmer et al., 2013).

Finally, even though our sample is from a limited geographical context, the kind of practical issues that motivate this work, especially with regard to wolves and wild boars, are currently faced in countries across Europe and North America.

4.3. Theoretical and practical implications

Our point of departure for this study was that the variability in the exposure to presence, movements and sounds of wildlife is underrepresented in research on nature and health generally and restorative environments more specifically (Johansson et al., 2021). Our study shows how the variability of wildlife can, depending on people's appraisal of an animal encounter, both undermine and enhance the restorative value of one and the same natural setting a person could visit to satisfy restoration needs. In this perspective, the dynamics of natural settings that come with wildlife, and how such dynamics shape expectations and experiences of a setting, need further attention, not least with reference to the components of restorative experience described in SRT (Ulrich et al., 1991) and ART (Kaplan & Kaplan, 1989).

In showing that a mutualistic wildlife value orientation may strengthen appraisals of wildlife as beneficent with some animals (roe deer, squirrel) and a domination orientation weakens such appraisals with other animals (wild boar, wolf), we attend to a seemingly paradoxical aspect of the nature-and-health literature. Much research in the field has been motivated by concerns about a growing disconnect between people and the natural world. Here, though, it seems useful to distinguish different types of (dis)connection (Beery et al., 2023). Experiential and emotional disconnection with wildlife appears to have ensued with the growing concentration of the human population in

urban areas; however, a parallel increase in formal education, income and urban lifestyle, which are known drivers of a mutualistic wildlife value orientation (Manfredo et al., 2021), may simultaneously have strengthened a more abstract or philosophical connection to wildlife and the natural world. Further theoretical and empirical development is needed to understand how different types of human-nature (dis)connections relate to perceived variability in wildlife and the restorative potential of natural settings.

Increasingly, ecosystems include both humans and wildlife (e.g., Woodroffe et al., 2005). To date, research on human dimensions of wildlife has emphasized animals as sources of potential negative impacts on human livelihood and lifestyle and as a focus of social conflict (e.g., Eklund et al., 2023). In contrast, research in environmental psychology has emphasized the contributions made to restorative quality in natural settings, as with bird song (Ratcliffe, 2021) and marine animal behavior (White et al., 2017) (see also Zhao and Gong, 2022). Our results affirm the relevance of both emphases. They support a needed complementary perspective that recognizes the different ways in which wildlife management practice can serve both public health and biodiversity protection goals. Such perspectives align with target 4 in the Global Biodiversity Framework, stressing the importance of effectively managing human-wildlife interactions to minimize human-wildlife conflict for coexistence. As a concrete example, wildlife management can come into congruence with public health and related health care practice both by protecting people from sources of chronic stress and other harm, and by enhancing the restorative quality of natural settings that they rely on for recreation. This means that interventions such as "green prescriptions" (i.e., the prescription of physical activity in natural settings) could go hand in hand with efforts to protect populations of fear-irrelevant animals and/or to help residents in areas with fear-relevant animals develop adequate coping strategies. From a joint public health – wildlife management perspective, our results also strengthen arguments against allowing attractants for fear-relevant animals (e.g., feeding stations) to be maintained close to residential settings. Moreover, in designated recreational areas with dense concentrations of residences, management could favour habitats for species that are likely to promote or at least not prevent restoration. The values of such congruence are increasingly salient; the human population continues to grow and to concentrate in urban areas, pushing ever further outward into rural hinterlands and infringing on ever diminishing areas of wildlife habitat (Ripple et al., 2014).

Authors' contribution

All authors have contributed to funding acquisition, study concept and design. MJ and AF were responsible for data acquisition and analysis. TH and JF contributed to analysis. MJ, AF and TH drafted the manuscript with critical commentary from JF. All authors revised the text.

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Declaration of competing interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jenvp.2024.102233.

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