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Vulnerability and fascination with wildlife encounters and psychological restoration in local natural settings

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ABSTRACT

People often visit natural settings for recreation and psychological restoration. This study aims to improve understanding of how exposure to and experiences of mammalian wildlife in local natural settings can permit and promote recreation and restoration. Randomly sampled residents in three regions of Sweden ($N = 303$) with varying presence of fear-relevant species (wolf, wild boar) and fear-irrelevant species (roe deer, squirrel) completed a questionnaire. Squirrel and roe deer were rated significantly higher than wolf and wild boar for anticipated positive feelings and restoration outcomes, and significantly lower for negative feelings and avoidance of natural settings. The possibility of exposure explained little of the variation in the restoration variables, whereas the experiences anticipated with an animal encounter contributed substantially to explanation. Vulnerability seems to counteract the restorative benefit of fascination. Wildlife conservation efforts and public health initiatives may find practical utility in distinguishing between potential exposure and anticipated experience when designing interventions.

Introduction

Wildlife species have been neglected in research on the psychological benefits of time spent in local natural settings (Johansson et al., 2021). Not only research neglects wildlife; people who could encounter them may not think of them when considering a visit to a local natural setting (Johansson, Hartig, et al., 2024). Yet, wildlife can have both positive and negative non-material effects on people, as seen in diverse well-being outcomes (Methorst et al., 2020). These constitute shared targets for practice across wildlife management and public health in the discussion of land sharing between people and wildlife.

To understand how a wildlife species affects human health and well-being, it is helpful to distinguish between its presence in an area, people's actual exposure to such animals, and the experiences people have if they encounter such an animal. Because it may prove difficult

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to assess actual exposure, it is often estimated on the basis of presence and density of the species (cf. Bratman et al., 2019). Importantly, exposure does not necessarily imply experience; an animal may be immediately present in a natural setting and yet remain outside of a person's awareness (cf. Hartig et al., 2014). Moreover, the experience will be shaped by the experiential characteristics of the species and the individual's cultural and group belonging (Diaz et al., 2018).

Exposure to and experiences of local wildlife can affect human health and well-being via multiple pathways, which can be grouped in four broad domains defined in terms of their relevance for adaptation (Johansson et al., 2021; Marselle et al., 2021). Wildlife can undermine human adaptation by i) causing harm (e.g. spreading disease or deterring recreational activities), and they can support adaptation ii) by reducing harm (e.g. as when small predators prey on rodents that carry disease-spreading ticks), iii) by contributing to contexts in which people build physical and social adaptive capacities (e.g. physical activity with hunting, social interaction with birdwatching), and iv) by enriching contexts in which people restore adaptive capacities, as through psychological restoration (e.g. attention restoration and stress recovery). These negative and positive effects need not involve an actual encounter; the simple awareness of the possibility of an encounter may affect a person's motivation to avoid or visit a local natural setting.

References to such pathways recur in discussions of negative psycho-social effects of wildlife in local natural settings (Flykt et al., 2022; Kansky & Knight, 2014), and of benefits that wildlife provides to people (Buijs & Jacobs, 2021). The multiple pathways can work simultaneously, in a complementary or competitive fashion. In this study, we focus on pathways in the psychological restoration domain. We build on theory and research in environmental psychology to improve understanding of how presence, exposure to and experiences of wildlife hinder or support psychological restoration (hereinafter simply restoration) in settings people share with wildlife. We complement our theoretical considerations with empirical findings from Sweden.

Wildlife and Psychological Restoration in Natural Settings

People may have multiple motives for visiting a natural setting, including a desire for psychological restoration (Knopf, 1987). Needs for restoration follow from psychophysiological stress and mental fatigue, characterized by elevated autonomic arousal, negative emotions, and cognitive deficits, including difficulty in directing attention (Hartig, 2017). Such conditions attend major life events as well as the ordinary demands of daily life with which people must cope (Evans & Cohen, 1987). Restoration during visits to natural settings can correspondingly manifest in outcomes such as reduction in autonomic arousal, decrease in negative affects, increase in positive affects, and improved cognitive performance (for reviews, see Ohly et al., 2016; Stevenson et al., 2018; Subiza-Pérez et al., 2019). In everyday language, people refer to feeling calmer, more relaxed, and better able to concentrate (R. Kaplan & Kaplan, 1989).

Research on settings people prefer for restoration suggests that biodiversity, including native wildlife species, may be an important feature (Cameron et al., 2020; Schebella et al., 2017). However, research on wildlife *per se* indicates much variation in preferences for and feelings toward different species (Arrindell, 2000; Kellert, 1985; Knegtering et al., 2002), which in turn signals that the presence of different species will likely yield different

psychological outcomes (Bell et al., 2018). It therefore becomes necessary to consider the species of animal when assessing the implications of exposure and experience for restoration.

This study addresses people's responses to four mammalian wildlife species present in the fauna in Sweden: wild boar (*Sus scrofa*), wolf (*Canis lupus*), roe deer (*Capreolus capreolus*), and squirrel (*Sciurus vulgaris*). Wolf and wild boar are long recognized as fear-relevant animals (Davey et al., 1998; Dressel et al., 2021; Johansson et al., 2012). Roe deer are of concern among forest owners and landowners due to browsing damage, but even if they occasionally forage in people's gardens they are not often feared (Dressel et al., 2021). Squirrels have been categorized as fear-irrelevant (Davey et al., 1998).

In a preceding experimental scenario study, variations in the anticipated presence of these four animals in a local natural setting had strong effects on restorative potential assigned to a local natural setting, contingent on species. Greater likelihood of encountering wolves and wild boar evoked lower ratings of the restorative quality of natural settings on the self-report measures used, whereas greater likelihood of encountering roe deer and squirrel evoked higher ratings of restorative potential (Johansson, Flykt, et al., 2024). In a qualitative study, encounters with roe deer and squirrels in local natural areas were described as pleasurable and fascinating (Johansson, Hartig, et al., 2024). These results illustrate the importance of considering fear-irrelevant, positively regarded animals as well as fear-relevant animals when trying to understand how wildlife figure in the restorative quality of local natural settings. This in turn requires more detailed consideration of aspects of exposure and of components of restorative experience.

Wildlife Presence and Exposure

With regard to exposure, consideration must first be given to the geographical distribution of the presence of the given species. On the national scale in Sweden, climatic conditions and habitat preferences will restrict the distributions of some species. Wild boar will, for example, have difficulties finding food in the boreal forest in the winter (Lemel, 1999). Policy decisions also affect species distributions. Wolves are generalists and have large territories (1000 km^2 in Scandinavia; Mattisson et al., 2013). They could probably inhabit all parts of Sweden, but they are currently culled annually by decisions of the respective county administration boards in areas where damage to reindeer or livestock is, or might become, an issue (Wabakken et al., 2022). Culling may quickly reduce the local presence of wolves. Conversely, free-ranging wolves may within a short time establish a territory in an area that previously did not have wolves.

On a local scale, land uses may heavily affect the presence of wildlife. In the sub-boreal and boreal regions of Sweden, roe deer (Cederlund & Liberg, 1995) and wild boar (Lemel, 1999) must find food on land cultivated by humans. Whether these animals are attracted or deterred, will depend, for example, on which crops are grown in fields, and when and how they are harvested.

In a broad sense, then, exposure will depend on the region and whether a person lives in a more rural or urban area. These matters aside, people may believe they are relatively less or more exposed to different animals, in keeping with the time they spend in natural settings and what they learn from others and through media (Arbieu et al., 2019). It

follows that the distribution and density of different species as assessed through monitoring may not correspond to people's beliefs about how common or uncommon an animal is in local natural settings (i.e., their potential exposure if visiting the setting, Cameron et al., 2020).

Appraisal Processes Permitting and Promoting Experiences of Psychological Restoration

Theory in environmental psychology describes different processes through which wildlife and other features of natural settings can translate into stressful or restorative experiences (Hartig, 2021; Küller, 1991). These processes involve continuous transactions between the individual and the environment, and, thereby, imply that exposures often are less important than experiences for the psychological outcomes. We draw on three particular bodies of theory here.

First, appraisal theory of emotion, and the component process model (CPM, Scherer, 2001), offer a generic description of a person's appraisals related to a natural setting (Johansson et al., 2021). According to the CPM, the person would appraise the *relevance* of an event (e.g., animal encounter) to personal goals motivating the visit to the setting (e.g., psychological restoration); the positive and/or negative *implications* of the event for the restorative quality of the setting; their *potential to cope* with those implications (e.g., to handle expected negative consequences of an animal encounter); and the extent to which coping actions would be *congruent with personal and societal norms* (e.g., it might be acceptable to scare the animal but not shoot it) (Scherer, 2001). These appraisals are made with sensitivity to the social ecological context, such as existing wildlife habitat and locally prevalent values, attitudes, beliefs and norms. Further, the appraisals reflect how the person perceives specific animal characteristics, features and behavior, and the person's capacity based on knowledge, previous experiences, *et cetera* (Johansson, Hartig, et al., 2024).

Second, theories about restorative environments describe the qualities of experiences in natural settings that support restoration (Hartig, 2021). Stress recovery theory (SRT: Ulrich, 1983; Ulrich et al., 1991) and attention restoration theory (ART: S. Kaplan, 1995; R. Kaplan & Kaplan, 1989) imply that people make appraisals of features of natural settings. These theories lend themselves to understanding how implication appraisals of wildlife presence as described in CPM refer to the permitting and promoting of restoration as separable but intertwined appraisal processes (cf. Hartig, 2017).

ART emphasizes cognitive functioning and concerns recovery from directed attention fatigue, a condition that arises when a person must direct attention to a task that of itself lacks interest (S. Kaplan, 1995). Recovery can occur when a person's attention can go freely and without effort to what they find interesting. Considering implication appraisals of conditions needed to permit restoration, ART specifies the importance of compatibility between the activities a person wants to engage in, what the setting (with wildlife) affords, and what that setting demands. ART further specifies a sense of being away, which involves psychological distance from the conditions in which the need for restoration arose, as with efforts to meet daily demands (S. Kaplan, 1995). Implication appraisals over time within the setting would consider the extent to which an animal's absence or presence is compatible

with what the person wants to do and with the achievement of desired distance from depleting demands.

SRT focuses on recovery from psychophysiological stress and asserts that immediate, pre-conscious affective responses to environmental features can influence attention, physiology and behavior to mobilize and give direction for adaptive action (i.e., to flee or fight) (Ulrich, 1983). Humans are thought to be attuned to environmental features that would have had adaptive significance during evolution, so that the perception of these features elicits like-dislike feelings and motivates approach-avoidance behaviors (Ulrich, 1983, 1993). SRT specifies that a setting would permit restoration if there were an absence of perceived threats (Ulrich et al., 1991). This might be especially relevant for implication appraisals of the presence of feared animals, associated with danger or disgust (Arrindell, 2000; Davey et al., 1998, 2003), and commonly associated with avoidance behavior (Johansson et al., 2019; Kubo & Shoji, 2014). If such negative outcomes are expected, appraisals of coping potential and norm compatibility will become important for understanding whether the setting would still permit restoration.

Third, the cognitive vulnerability model (CVM: Armfield, 2007; Johansson & Karlsson, 2011) supports analysis of appraisals of the potential for coping with a threat, and whether appraisals of possible ways of coping are compatible with personal and social norms. CVM proposes that fear experienced in an animal encounter depends on appraisals of a) the danger the animal represents (how much the animal could harm the person), (b) the unpredictability of the animal's movements (uncertainty about whether the animal will approach or attempt to attack), and (c) uncontrollability (the extent of the person's lack of control when responding to an animal encounter) (Armfield, 2007). The presence of an animal perceived as threatening to encounter could still permit restoration if the person would perceive that the animal would behave predictably, that they would have adequate and acceptable coping strategies, and feel in control in the situation.

Given that the situation permits restoration, we assume that appraisals promoting restoration acquire more weight. These include appraisals of relevance in terms of whether the wildlife present in the setting attracts and hold the person's attention, prolonging the restorative process. For restoration, the implications of animal presence should be appraised as positive, driving an approach response. SRT implies that implication appraisals that would permit restoration should block negative affect and negative thoughts by evoking positive affect. This initial affective response would enable non-vigilant attention and initiate physiological deactivation. After this initial response, cognitive elaboration on what the person perceives would become important. ART refers to the perceived scope and coherence of a natural setting, and so the possibilities for exploration, together with effortless attention of moderate intensity, or "soft fascination," engaged by interesting and aesthetically pleasing aspects of the setting. In this regard, birds and mammals seem to be the most appreciated wildlife taxa (Kellert, 1985), especially species of relatively large size and greater rarity (Knegtering et al., 2002), and species experienced as aesthetically appealing, and human in some aspects of appearance, behavior and social interaction (Batt, 2009; Knight, 2008). The potential for some wildlife to promote restoration seems apparent from the field of wildlife tourism (Curtin, 2009). Looking closer to home, the presence and behavior of animals in local

natural settings may draw attention and create moments of fascination (Johansson, Hartig, et al., 2024; White et al., 2017).

Objectives and Hypotheses

This study aims to deepen the understanding of how the actual presence of mammalian animals in local natural settings may hinder or support psychological restoration. The first objective is to identify differences in variables associated with psychological restoration (positive and negative emotions, anticipated restoration outcome, avoidance of setting) between two fear-relevant (wolf, wild boar) and two fear-irrelevant (roe deer, squirrel) animals.

H1: Restoration-related outcomes will differ between fear-relevant and fear-irrelevant animals. Compared to roe deer and squirrel, wolf and wild boar will evoke lower ratings for (a) anticipated restoration outcome and (b) positive emotions, and higher ratings for (c) negative emotions and (d) avoidance of setting.

The second objective is to estimate the relative importance that four sets of variables hold for restoration given the presence of each animal: a person's individual characteristics (gender, age); their exposure to the given animal (region, rural-urban residence, beliefs about the species' presence); anticipated experience that would permit restoration (absence of perceived vulnerability); and experience that would promote restoration (particularly fascination).

H2: Anticipated experiences will contribute more than people's personal characteristics and exposure to the explanation of variation in (a) anticipated restoration outcome, (b) positive emotions, (c) negative emotions and (d) avoidance of setting.

H3: The extent to which the presence of the animal is appraised to permit restoration will be most important to explanation of variance in the restoration variables with fear-relevant animals whereas the extent to which the presence of the animal is appraised to promote restoration will be more important for the restoration variables with the fear-irrelevant animals.

Method

Participants and Settings

The study included 303 participants (45% men and 55% women, 18–81 yrs, m = 57 yrs, SD = 15.54 yrs) resident within three Swedish municipalities: Jönköping (urban: n = 32, rural: n = 65), Falun (urban: n = 50, rural: n = 58), and Östersund (urban: n = 34, rural n = 64).

The municipalities were selected to allow for variation in presence and thereby potential exposure to each of the four species of special interest (wild boar, wolf, roe deer and

squirrel). The municipalities are located in different boreal zones of Sweden, where the animals differ in abundance. The Jönköping area lies in the boreonemoral zone and has for the Swedish context high densities of roe deer and average densities of squirrels, wolves and wild boar. The Falun area lies in the south boreal zone and has relatively high densities of wolves, average densities of squirrels and roe deer, and low densities of wild boar. The Östersund area lies in the middle boreal zone and has an average density of squirrels and low densities of roe deer, wolf and wild boar (Thurfjell et al., 2020). The municipalities all have a central city with more urban living conditions. According to the official statistics for Sweden (SCB, 2003), Jönköping has ca. 100 000 inhabitants; Falun ca. 39 000 inhabitants; and Östersund ca. 53 000 inhabitants. The areas surrounding these cities have relatively sparse populations, with densities from 26 to 75 inhabitants/km^2.

Questionnaire

Participants provided assessments of exposure, experience, and restoration outcomes for each of the four animals, together with sociodemographic (age, gender) and other background information. A brief description of each animal preceded the respective set of assessments, given in the same order for all participants (roe deer, wild boar, wolf, squirrel, see Supplementary Material).

Participants' possible exposure to the animals was extrapolated from the place of residence (municipality and rural/urban respectively), and a question about the perceived local presence of each animal. The extent to which the experience of encountering the given animal would permit restoration was operationalized according to the cognitive vulnerability model and assessed by items derived from Johansson et al. (2019). The extent to which the experience of encountering the animal would promote restoration was operationalized according to the perceived restorative potential and assessed by items covering compatibility, a sense of being away from daily demands and routine mental contents (e.g., concerns about work deadlines), and fascination (Johansson, Flykt, et al., 2024). Positive restoration outcomes were assessed by anticipated restoration and positive emotions, and negative restoration outcomes by negative emotions and avoidance of local natural settings adapted from Johansson, Flykt, et al. (2024). Table 1 gives all items, response scales and scale reliability coefficients.

Procedure

A stratified random sample was 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/informa tion/svenska-postnummer-och-postorter). For each group of districts, we obtained a random sample of 170 addresses. The final sample included 996 persons with valid addresses. Data were collected in 2022 by Institutet för kvalitetsindikatorer AB, a Swedish survey company. A personal invitation to participate stated that participation was voluntary and ethical approval had been received (Swedish Ethical Review Authority ref. nr. 2021–05895–01). This was sent together with a paper-and-pencil questionnaire by post. The invitation also gave the option to respond via a web link

Table 1. Questionnaire overview: variables, items, response formats, and, for multi-item scales, internal consistency coefficients (Cronbach's alpha (α), Pearson's *r* or Spearman's rho).

Potential exposure

Municipality: Obtained from sampling postal code Jönköping, Falun, Östersund

Place of residence: Obtained from sampling postal code, Rural, Urban

Perceived presence of animal: How common-uncommon do you believe that the following animals [roe deer, wild boar, wolf, squirrel] are in natural settings close to where you live? Response options: 1 = Never or rarely present, 2 = Sometimes present, 3 = Often or always present

Experience of encountering given animal permits restoration

Cognitive vulnerability(Johansson et al., 2019): "I believe that if I came close to a (animal) I would be harmed;" "*I do not believe (animal) could be dangerous to me*;" "I believe that I would be able to deal effectively with a (animal) by myself if encountered;" "*If a (animal) came near me, I would probably not feel in control*;" "I think that the movement of (animal) is impossible to understand in advance;" "*I find (animal) to be predictable in their movements*." Items in italics were reversed. A 5-point response format was used:

1 = Absolutely not, 5 = Yes, absolutely. Internal consistency: roe deer, α = .596; wild boar, α = .835; wolf, α = .827; squirrel, α = .555.

Experience of encountering given animal promotes restoration

Restorative potential (Johansson, Hartig, et al., 2024): The presence of (animal) in the natural area helps that . . .

"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" A 5-point response format was used: 1 = Absolutely not, 5 = Yes, absolutely. Internal consistency: roe deer, α = .709; wild boar, α = .822; wolf, α = .838; squirrel, α = .799

Restoration outcomes

Anticipated restoration outcome (Johansson, Flykt, et al., 2024): "The presence of animal 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." A 7-point response format was used: − 3 = Decreases significantly, + 3 = Increases significantly. Internal consistency: roe deer, *r* = .709; wild boar *r* = .822, wolf *r* = .838, squirrel *r* = .799.

Positive Emotions: The current presence of (animal) in the natural area makes me feel . . . "comfort," "joy." A 7-point response format was used: 0 = Not at all, 6 = Very strongly. Internal consistency: roe deer, *r* = .934; wild boar, *r* = .876; wolf, *r* = .915; squirrel, *r* = .949.

Negative Emotions: The current presence of (animal) in the natural area makes me feel . . . "fear" "anger." A 7-point response format was used: 0 = Not at all, 6 = Very strongly. Internal consistency: roe deer, *rho* = .263; wild boar, *r* = .541; wolf, *r* = .524; squirrel, *rho* = .298; all *p* < .001 (NB. responses for the fear irrelevant animals showed strong positive skew, thus the use of the non-parametric rho).

Avoidance of local natural setting: "Considering the presence of (animal) in the natural area where you live, which place do you choose when you will get away a while, clear your mind and relax?""I choose other natural areas even if they are further away,""I choose to be outdoors in an urban environment,""I choose to stay home and do something outdoors in the garden or yard,""I choose another place indoors." A 5-point response format was used: 1 = Absolutely not, 5 = Yes, absolutely. Internal consistency: roe deer, α = .659; wild boar, α = .797; wolf, α = .793; squirrel, α = .784.

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with personal log in. The invitation was followed by a phone text message reminder 2 weeks later and a postal reminder with web login three weeks later followed by another text message reminder. After six weeks, a final reminder including a paper questionnaire was sent by post. A total of 303 responses were obtained, which represents a 30.4% response rate.

Statistical Analysis

One-way repeated measures ANOVA was done for each restoration variable with Animal (squirrel, roe deer, wolf and wild boar) as the independent variable. Greenhouse-Geisser corrections were made and the correction value (ε) is given for each analysis. The uncorrected degrees of freedom are given to facilitate reading. Partial eta-squared (η_p^2) indicates effect size. Bonferroni post-hoc tests identify specific differences among the animals. Hierarchical multiple linear regression was used to assess prediction of the different restoration variables by the individual characteristics and the exposure and experience variables.

Results

Psychological Restoration Assessments Linked to the Four Animals

Descriptive statistics for the assessments of Restoration Outcome, Positive Emotions, Negative Emotions and Avoidance of local natural settings for restorative purposes are displayed in Table 1. As illustrated in Figure 1, the mean values of the assessments of wild boar and wolf show that their presence in general would hinder restoration, whereas the presence of roe deer and squirrel would generally support restoration.

Considering H1, the repeated measures ANOVAs revealed a significant main effect of Animal on all dependent variables. Participants assessed the Restoration Outcome as likely to be highest with the presence of squirrel, followed by roe deer, that in turn was assessed as higher than with the presence of wolf and wild boar. The assessments of Positive Emotions showed a similar pattern; highest with the presence of squirrel, followed by roe deer, which in turn was higher than for wolf and wild boar. Wolf was assessed as significantly higher than wild boar (Table 2).
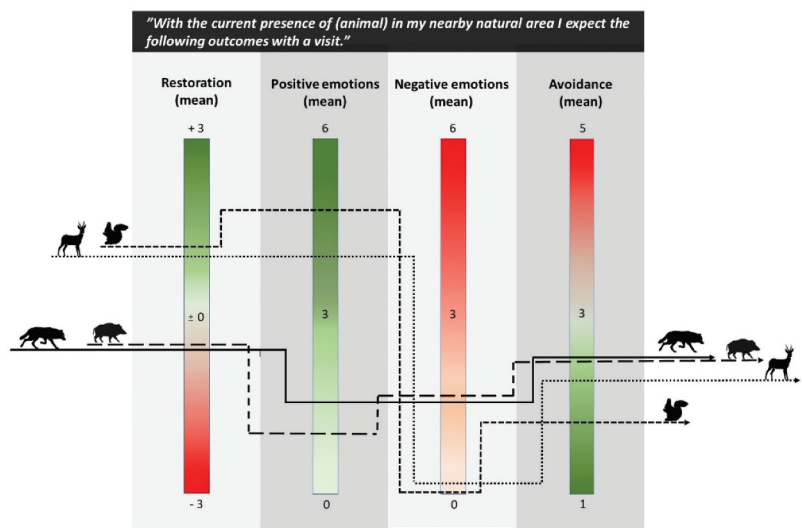

Figure 1. Overview of mean values for the four restoration variables (Restoration outcome, positive emotions, negative emotions and avoidance) per animal (roe deer, squirrel, wolf and wild boar).

Table 2. Descriptive statistics for the psychological restoration variables.

Variable	Wild Boar M (SD)	Wolf M (SD)	Roe deer M (SD)	Squirrel M (SD)	Repeated measures ANOVA			
					F(3, 906)	p	ηp^2	ε
Restoration Outcome Scale: −3 - + 3,	−0.30 (1.31)c	−0.32 (1.32)c	1.08 (1.28)b	1.35 (1.33)a	168.41	<.001	.358	.828
Positive Emotions Scale: 0–6	1.23 (1.55)d	1.66 (1.74)c	4.31 (1.71)b	4.59 (1.74)a	448.79	<.001	.598	.922
Negative Emotions Scale: 0–6	1.78 (1.71)a	1.66 (1.71)a	0.21 (0.58)b	0.06 (0.32)c	201.63	<.001	.400	.698
Avoidance Scale 1–5	2.44 (0.97)a	2.45 (1.03)a	1.98 (0.87)b	1.74 (0.89)c	88.43	<.001	.227	.882

*Letters show the results of the Bonferroni post-hoc tests.

Analysis of Negative Emotions and Avoidance revealed the opposite pattern. Participants assessed Negative Emotions as highest for presence of wild boar and wolf, followed by roe deer, that in turn was higher than for the presence of squirrel. Finally, Avoidance was likely to be assessed as highest with the presence of wild boar and wolf, followed by roe deer, that in turn was assessed as higher than with the presence of squirrel (see Table 2).

Relative Importance of Exposure and Experiences to Psychological Restoration

Referring to H2 and H3, hierarchical regression analyses were carried out to test the relative importance of the different predictors in explanation of variation in the assessments of the restoration variables for each of the four animals. Individual characteristics (Gender and Age), exposure (Municipality, rural vs. urban Residence, personally Perceived Presence), and anticipated experience of an animal encounter (Vulnerability for permitting restoration, and Restorative Potential for promoting restoration) were entered in four successive steps. All analyses displayed variance inflation factor (VIF)-values below 2.04, indicating no cause for concern for multi-collinearity.

Wild Boar

In the analyses of wild boar, significant amounts of variance could be explained in the final regression models for Restoration Outcome (13.8%), Positive Emotions (31.4%), Negative Emotions (30.7%) and Avoidance (32%) (Table 3).

Restoration Outcome was associated with experience variables only. Positive Emotions was in the first step associated with individual variables (4.3% variance explained), with younger participants expressing more positive emotions. Still, the experience variables made the major contribution to explanation. Restoration Outcome and Positive emotions were associated with relatively lower vulnerability and higher restorative potential.

Negative Emotions, were also in the first step explained by the individual variables, gender and age, (3.8%), but they became non-significant when the experience variables were added. Higher vulnerability and lower restorative potential were associated with more Negative Emotions. In the analyses with Avoidance, the exposure variables contributed to 11.8% of explained variance; relatively less Avoidance was reported by participants who lived in Jönköping (where wild boar is more common) as compared to those who lived in Östersund (and likely Falun), by participants in rural areas compared to urban areas, and among those who reported lower perceived presence of wild boars. In the final step, perceived presence of wild boar became non-significant and perceived vulnerability became the strongest predictor, whereas restorative potential was non-significant (Table 3).

Wolf

In the analyses of assessments made for wolf, significant amounts of variation were explained in the final regression models for Restoration Outcome (27.2%), Positive Emotions (38.5%), Negative Emotions (35.8%) and Avoidance (28.3%) (Table 3).

Restoration Outcome could be significantly explained in the final model only. As for the individual variables, being a man yielded a lower Restoration Outcome. As for the exposure variables, living in Östersund/Falun as compared to Jönköping was associated with higher Restoration Outcome. However, the experience variables were most important. This was

Table 3. Hierarchical regression models for the fear-relevant animals (wild boar, wolf) and for the fear-irrelevant animals (roe deer, squirrel).

Fear-relevant animals	Wild Boar				Wolf			
	Restoration Outcome	Positive Emotions	Negative Emotions	Avoidance	Restoration Outcome	Positive Emotions	Negative Emotions	Avoidance
	β	β	β	β	β	β	β	β
Individual variables								
Gender Female = 1 Male = 2	−0.061	0.13	0.014	0.108*	−.118*	0.017	0.119*	0.076
Age	0.009	−.109*	0.075	0.020	0.082	−.127	0.049	0.026
Exposure Region Dummy Falun = 1	0.002	0.058	0.053	−.110	−.004	−.018	0.000	−.114 (*)
Jönköping = 1	0.103	0.086	0.078	−.160*	−.117*	−.090	0.013	−.049
Rural-Urban Rural = 1, Urban = 2	−0.014	0.017	−.054	12.7*	−0.013	−0.060	−0.139**	.021
Perception Uncommon-Common	−0.039	−0.054	0.067	−0.076	−0.024	−0.045	0.098*	0.126*
Experience Permit: Vulnerability	−0.197**	−0.225***	0.453***	0.476***	−0.117*	−0.111*	0.463***	0.513***
Promote: Restorative Potential	0.259***	0.408***	−0.208**	−0.035	0.450***	0.519***	−0.233***	−0.076
	F(8.294) = 7.061, p < 0.001. R2 = 0.161, R2adj = 0.138	F(8.294) = 18.255, p < .001. R2 = 0.332, R2adj = 0.314	F(8.294) = 17.746, p < .001. R2 = 0.326, R2adj = 0.307	F(8.294) = 18.783, p < .001 R2 = 0.338, R2adj = 0.320	F(8.294) = 15.131, p < .001. R2 = 0.292, R2adj = 0.272	F(8.294) = 22.034, p < .001. R2 = 0.404, R2adj = 0.385	F(8.294) = 21.070, p < .001. R2 = 0.375, R2adj = 0.358	F(8.294) = 15.869, p < .001 R2 = 0.302, R2adj = 0.283

(Continued)

Table 3. (Continued).

Fear-relevant animals	Roe deer				Squirrel			
	Restoration Outcome	Positive Emotions	Negative Emotions	Avoidance	Restoration Outcome	Positive Emotions	Negative Emotions	Avoidance
Individual variables	β	β	β	β	β	β	β	β
Gender Female = 1 Male = 2	−0.009	−0.048	−0.087	0.078	−0.057	−0.047	0.069	0.059
Age	0.000	−0.070	0.070	0.057	0.027	0.034	−0.20	−0.37
Exposure								
Region Dummy Falun = 1	−0.24	−0.155**	−0.022	0.033	−0.093	−0.033	−0.032	0.055
Jönköping = 1	−0.022	−0.069	−0.007	−0.088	0.001	−0.052	.083	−0.25
Rural-Urban Rural = 1, Urban = 2	−0.060	−0.038	0.090	0.081	−0.018	0.007	0.140*	0.022
Perception Uncommon-Common	0.002	0.088	0.153*	0.003	0.161**	0.080	0.70	−0.003
Experience								
Permit: Vulnerability	−0.037	−0.086	0.094	0.102	0.007	−0.071	0.168**	14.6*
Promote: Restorative Potential	0.417***	0.512***	−0.282***	−0.031	0.373***	0.523***	0.034	0.027
	$F_{(8,294)} = 8.952$, $p < .001$. $R^2 = 0.196$, $R^2adj = 0.174$	$F_{(8,294)} = 21.536$, $p < .001$. $R^2 = 0.369$, $R^2adj = 0.352$	$F_{(8,294)} = 4.349$, $p < .001$. $R^2 = 0.106$, $R^2adj = 0.081$	$F_{(8,294)} = 1.680$, n.s. $R^2 = 0.044$, $R^2adj = 0.018$	$F_{(8,294)} = 3.971$, $p < .001$. $R^2 = 0.208$, $R^2adj = 0.187$	$F_{(8,294)} = 22.034$, $p < .001$. $R^2 = 0.321$, $R^2adj = 0.302$	$F_{(8,294)} = 2.507$, $p < .012$. $R^2 = 0.064$, $R^2adj = 0.038$	$F_{(8,294)} = 1.215$, $p <$ n.s. $R^2 = 0.032$, $R^2adj = 0.006$

*p < .05, ** p < .01, *** p < .001.

also the case for Positive Emotions; lower perceived vulnerability and higher restorative potential being associated with higher Restoration Outcome and Positive Emotions.

Negative Emotions could be significantly explained by the individual variables entered in the first model (2.4%). Being a male was associated with stronger Negative Emotions. Entering the exposure variables explained an additional 5.8% of variance, with participants in rural areas and those who perceived the wolf to be commonly present reporting more Negative Emotions. In the final step, the experience of relatively higher vulnerability and lower restorative potential were both associated with Negative Emotions. For Negative Emotions, vulnerability was the strongest explanatory variable.

The amount of variation explained in the analysis of Avoidance reached significance in the final model only. The exposure variable of perception of wolf as common contributed to the explanation, but the experience variable vulnerability was the strongest explanatory variable whereas restorative potential was non-significant (Table 3).

Roe Deer

In the analyses of roe deer, significant amounts of variation could be explained in the final regression models for Restoration Outcome (17.4%), Positive Emotions (35.2%), Negative Emotions (8%), but not for Avoidance (Table 3).

Restoration Outcome could be significantly explained by the experience variable restorative potential. Positive Emotions could be significantly explained by the exposure variables (4.2% of variance), with more positive emotions among people in Östersund and Jönköping than in Falun, and more positive emotions among people who perceived roe deer to be more common. When introducing the experience variables, this variable became non-significant, as restorative potential accounted for the explained variation. Negative Emotions were in the final model explained by both exposure and experience. When roe deer were perceived to be more common (i.e., greater exposure), higher levels of Negative Emotion were reported. When restorative potential was assessed as lower (i.e., poorer environmental experience), respondents also reported higher levels of Negative emotions.

Squirrel

The final set of regression analyses concerned the squirrel. Significant amounts of variation could be explained in the final regression models for Restoration Outcome (18.7%), Positive Emotions (30.2%), and Negative Emotions (3.8%), but not for Avoidance (Table 3).

In the analyses of Restoration in the second model, the exposure variables contributed 6.3% of explained variance. Participants who perceived the squirrel as relatively more common reported higher Restoration Outcome. In the final model, the experience variable of restorative potential greatly added to the total explained variance. Positive Emotion was to some extent explained by exposure variables perception of squirrel as common (3.3% explained variance); however, this effect disappeared with the entry of the experience variables in the final step, and restorative potential became the only significant explanatory variable.

Negative Emotion could in the second step partly be explained by the exposure variables; urban participants reported higher negative emotions with regard to squirrels. In the final model, the experience of vulnerability also significantly added to the explained variance (Table 3).

Discussion

This study contributes to the understanding of how wildlife may affect opportunities for psychological restoration in landscapes where residential areas overlap with wildlife habitat. The results show that wild boar, wolf, roe deer, and squirrel each has its own pattern of assessments with regard to how they hinder or support perceived opportunities for psychological restoration in local natural settings.

In the view of our participants, the presence of wildlife changes opportunities for psychological restoration in opposite directions depending primarily on the animal and the (anticipated) experiences of an encounter with that animal. Therefore, the presence of wildlife should be understood as one aspect of an integrated human-environment-animal transaction, and the effect of wildlife in natural settings on a person's psychological restoration can be seen as situation dependent (Johansson et al., 2021).

The first objective of this study was to identify differences in variables associated with psychological restoration between fear-relevant and fear-irrelevant animals. With regard to this objective, we have found a clear divide in how people appraise the presence of fear-relevant and fear-irrelevant mammal animals in local natural settings. In support of H1, the analyses consistently showed significant effects, with large effect sizes for animal. The fear-relevant animals, wolf and wild boar were likely to be assessed lower than roe deer and squirrel for anticipated restoration outcomes and positive emotions, but higher for negative emotions and avoidance of setting. The salient difference between the fear-relevant and fear-irrelevant animals comes as no surprise and confirms the results from experimental studies (Johansson, Flykt, et al., 2024; Zhao & Gong, 2022). In an earlier interview study with people from the same regions considered in the present study, squirrels were described as cute and roe deer as graceful (Johansson, Hartig, et al., 2024), animal features associated with appreciation and fascination (Batt, 2009; White et al., 2017), whereas wolves were described as exciting and charismatic, but also as feared and disliked. In that earlier study, wild boar had few positive connotations, and the interviewees considered it an invasive species (Johansson, Hartig, et al., 2024).

The second objective addressed the relative importance of individual characteristics (gender, age), exposure, and key aspects of experience for the explanation of outcomes relevant to psychological restoration. The hierarchical regression analyses univocally showed that the experiences were the relatively stronger predictor variables of Restoration Outcome, Positive Emotion, Negative Emotion and Avoidance. However, H2 was only partly supported. Although the individual variables and exposure variables to some extent did contribute to the explained variation, this was not consistent. These results lend support to our third hypothesis regarding the relative importance of the experience of wildlife, and in this they align with current frameworks for description of the association between biodiversity and human health and well-being (e.g. Bratman et al., 2019; Johansson et al., 2021; Marselle et al., 2021). The relative importance of experience is also congruent with studies analyzing the contributions of exposure and experience to people's responses to geese (Eriksson et al., 2020) and ticks (Johansson et al., 2020). Experience variables thus appear to be most important for understanding the role of animals in processes of psychological restoration.

In an earlier theoretical description of relevant experience that laid the foundations for the present study, Johansson et al. (2021) drew on SRT and ART to identify aspects of the

encounter situation critical for the extent of psychological restoration. These included the absence of perceived threat from an animal combined with appraisals of the animal as compatible with the recreational activity in a natural setting, allowing for the experience of being away from daily demands and for effortless attention to the features of the natural setting and the animal within it. In confirmation of H3, the analyses revealed different patterns for the fear-relevant, respectively, fear-irrelevant animals. The data confirm that for fear-relevant animals, experienced threat, operationalized as perceived vulnerability, is likely to hinder psychological restoration, but that most people do not experience vulnerability with the fear-irrelevant animals.

For all of the four animals, the restorative potential (comprising compatibility, being away, and presence of a visually interesting content that capture attention and triggers fascination) was the most important variable to understand the variation in psychological restoration outcome and positive emotions. For roe deer, wild boar and wolf, lack of perceived restorative potential also significantly explained negative emotions. These results suggest that if a person does not feel vulnerable in an encounter situation, the animal presence could promote restoration. This in turn suggests that people would gain a stronger restorative effect in local natural settings with noticeable wildlife.

The relatively small but statistically significant effects of exposure resonate well with previous studies on negative emotions toward wolves, showing more negative emotions in rural areas (Johansson et al., 2016). Relatively higher presence of wolf (Falun region tendency, rural areas, and perception as common) was associated with more negative feelings and avoidance behavior. However, relatively higher presence of wild boar (Jönköping and rural area) was associated with less avoidance behavior, indicating that people may have adopted coping functional strategies.

Individual characteristics were of relatively minor importance for the explanation of restoration. The most consistent result was that men tended to report lower restoration outcome and more negative emotions for presence of wolves than did women. This deviates somewhat from previous studies, in which women generally tend to report higher feelings of fear than men (Arrindell, 2000). A plausible explanation is that in the present study, negative emotions included combined assessments of fear and anger, which men might be more likely to express.

Strengths and Limitations

This study was limited to four animals, serving as models for fear-relevant and fear-irrelevant animals. However, the consistent findings across the psychological restoration variables suggests that the results are also valid for the presence of other fear – relevant and fear-irrelevant animals in the Swedish fauna, such as brown bears and hedgehogs, respectively.

Another limitation was that exposure to the animals was extrapolated from the participants' current residence (municipality, urban-rural) and combined with their self-reported perception of how common each one of the animals is in their area. This approach was chosen because actual exposure to a specific animal is hard to measure, and it may be difficult for participants to remember the frequency of exposure for animals that are common.

In light of the research on psychologically restorative environments, a strength of this study is our effort to represent the process of psychological restoration from

before to after a visit to a natural setting; however, this approach may have entailed some inflation of estimates in the regressions of psychological restoration outcomes. We sought to overcome this limitation by in parallel analyzing a broader set of outcome variables. This study was also typical for research on restorative environments based on Western perspectives involving populations using local natural settings for recreational psychological well-being. We suggest that future studies should strive to include not only other ecological contexts but also different cultural contexts.

Implications and Conclusions

Local natural settings offer places for people to cope with stress and cognitive fatigue caused by pressing daily demands. This study indicates that wildlife conservation efforts and public health initiatives promoting outdoor recreation could benefit from further coordination. In landscapes shared between people and wildlife, discussions on the suitability of local natural settings as places to gain psychological restoration must distinguish between potential exposure to wildlife and the individual's experiences of wildlife (encounters). Although exposure may say something about frequency of encounter and risks, experience must be taken into account to understand the value of a local natural settings as a setting for psychological restoration – what could be framed as a cultural eco-system service or a contribution of nature to people (Bratman et al., 2019; Diaz et al., 2018). Consistent with research presented in the field of human dimensions of wildlife, it is important to look into the experiences associated with different animals. A coarse, but likely functional, distinction would be to make use of the psychological categories of fear-relevant and fear-irrelevant animals (Arrindell, 2000; Davey et al., 1998) or in a Swedish context fear of large mammals (Johansson et al., 2012).

From a wildlife management perspective, most effort should be spent on understanding experiences permitting psychological restoration as a person's perceived vulnerability in an encounter situation appears to be a key aspect. In this respect, research on fear of brown bears suggest that interventions based on experiential learning may help people re-appraise an encounter situation as less threatening and provide access to problem-solving coping strategies, such as learning how to avoid a close encounter (Johansson et al., 2019; Sponarski et al., 2016). Wildlife management and conservation might benefit from acknowledging that some animals do hinder the fulfillment of important psychological needs through outdoor recreation, and they could identify strategies that facilitate coping so that psychological restoration is permitted even in the presence of fear-relevant wildlife.

The restorative potential of fear irrelevant animals – here, the extent to which the animal facilitates experiences of being away, extent, and fascination – deserves more attention in wildlife management as well as in public health. Positively valued experiences, would be significant not only for the immediate psychological restoration, but also for the long-term development of positive relations with nature and concern for wildlife, in local natural settings and more broadly.

Acknowledgments

Disclosure statement

Funding

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