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Posted Date: 25 December 2023

doi: 10.20944/preprints202312.1875.v1

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*Article*

# The Perspectives of Key Stakeholders on the Reintroduction of Apex Predators to the United Kingdom

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**Abstract:** Apex predators were extirpated from the UK hundreds of years ago. Practitioners have recently advocated for reintroductions of predators in the UK given their role as keystone species. For a reintroduction to take place, a survey of public desirability needs to be conducted. We aimed to understand the perspectives of people across the United Kingdom on the reintroduction of Eurasian lynxes, grey wolves, and brown bears. We collected data via questionnaires from 78 key stakeholders, such as farmers, general public, nature conservationists, and those in environmental sectors, with these areas being seen as the most affected by these reintroductions. It was organizations which front these stakeholder groups which mainly distributed the survey, as well as social media groups. We ran a path analysis, which highlighted that there was a negative correlation between respondents viewing the species as a danger towards livestock and humans, and the respondent seeing it being good to have that species in their region. Overall, participants who stated that rewilding their region was a priority also stated that it would be good to have Eurasian lynx in their region. That said, 70% of farmers strongly disagreed with the reintroduction of Eurasian lynx. These findings showed that much of the United Kingdom would welcome the reintroduction of Eurasian lynx, but both farmers and the public would fear the loss of livestock that may come along with these species. Support can be gained through education and knowledge, a necessary step needed especially targeting farmers before any reintroduction plans can be made.

**Keywords:** rewilding; wolf; bear; lynx; farmers; attitudes; public opinion; attitudes; deer

## 1. Introduction

### 1.1. Drivers of megafauna extinctions

In a time when humans are faced with irreversible climate change and extinction rates, a significant focus has been placed on translocations and reintroductions to conserve and reverse biodiversity loss. One area of life which has seen a great decline is megafauna, with the majority of the loss occurring from North and South America to Europe and Australia [1], with the decline beginning between 10,000 to 50,000 years ago [2,3]. The main contributor to this decline is human colonization, with a link existing between human initial migration and megafauna extinction, and a small attribution from climate change, both focal and lagged [3]. Since these Pleistocene extinction events, humans have continued to drive many species to extinction, through hunting and deforestation [4,5].

The human settlement came hand in hand with the persecution of large predators, mainly due to the threat they posed to livestock, as well as competing for game species [6]. The fear surrounding these predators resulted in most administrations creating bounties for the hunting of these species, with data surrounding these persecutions proving evidence of hunting being a key reason for their extinction [6]. Wolves, *Canis lupus*, saw a deliberate extinction in Scotland through hunting, with the entire British population becoming extinct by 1800 [5–7]. The brown bear, *Ursus arctos*, became extinct from Britain during the Middle Ages, with it believed to have survived until 1000 AD [6,8]. Little

literature reveals how brown bears became extinct throughout Britain, however, it is likely due to similar reasons seen throughout Europe, where deforestation for agriculture and livestock increased the chances of human-wildlife conflict, and, therefore, bears experienced direct persecution by hunters and farmers [9].

Through human activities, the woodland cover of Scotland saw a drop from 75% approximately 5000 years ago to only 4% by 1600 [5]. It is major deforestation events such as this that drive extinctions, whether that is through direct habitat destruction or an indirect decline of prey. Therefore, many areas of life are impacted by these events. One species greatly impacted by this Scottish deforestation was the Eurasian lynx, *Lynx lynx*. Although previous theories on lynx extinction have focused on climate change [10] or mountain hare, *Lepus timidus*, population decline [11], it has since been suggested that this Scottish deforestation is the main driver of extinction. This deforestation resulted in a decline of the European roe deer, *Capreolus capreolus*, populations - the main prey for the Eurasian lynx [12]. Through radiocarbon dating, lynx bones have been discovered in Kinsey cave, Yorkshire Dales, which date to between 425AD to 600AD, too late for climate change to be the cause of their extinction [8,12]. The main form of hunting for lynx includes the use of forests for cover, hence why they were greater affected by deforestation than the wolf populations [6]. Through great deforestation, prey species such as roe deer were placed under pressure, as well as competing with the newly established grazing livestock [12]. This lack of roe deer would see the lynx turn to hunting livestock to survive, resulting in persecution from farmers and other humans. This decrease in top predators in Britain resulted in an imbalance in the ecosystems, resulting in a record-high deer population, which inhibits woodland regeneration and negatively impacts biodiversity [13]. Therefore, the reintroduction of these predators could help restore the balance of British ecosystems.

### 1.2. Reintroductions of Predators

Mills et al. [14] have theorized that top predators are needed as regulatory mechanisms in fully functional ecosystems, such as in aiding the regeneration of natural vegetation by encouraging ungulates to not overgraze areas and that they disperse to alternative areas. Top predators are also often considered keystone species, due to the influence they have on their ecosystem, and therefore, where a 'trophic cascade' occurred with the removal of these keystone species, ecosystem function can recover as they are reintroduced [8,15]. There are, however, concerns that prey may have become naive to their native predators, and, therefore, run a risk of a disequilibrium [16]. Berger [16], however, reported that the behavior of the prey (e.g., regarding vigilance) took, at most, a single generation after carnivore repatriation to return to what would be expected in a coexisting ecosystem.

By the 1990s, deer browsing and grazing were creating a serious constraint on British woodland conservation management [13], and, therefore, in Britain, reintroducing a deer predator could aid the conservation of native British woodlands through reducing deer browsing [17]. Due to the smaller size, as well as lower livestock predation tendency, the Eurasian lynx is the most viable option for roe deer predator reintroduction in the United Kingdom [18]. The total forested area of Scotland has seen a great increase recently, with there now being a cover of over 17%, however, only 1-2% of the forest cover is remnants of natural woodland [5]. A study conducted by Hetherington et al. [4] discovered that Scotland could currently support two main populations of Eurasian lynx, with the largest population of approximately 400 lynxes occupying much of the Highlands, in an area as large as 15000 km<sup>2</sup>. These potential habitats could continue to grow, specifically by increasing connectivity, with further reafforestation [4]. The United Kingdom Government have previously rejected the proposal made by the Lynx UK Trust in 2017 of six GPS-collared lynx being reintroduced into Kielder Forest [19], the second area identified by Hetherington et al. [4]. This proposal was refused by DEFRA for multiple reasons, including it not meeting the necessary standards which are set in the IUCN guidelines, as well as Natural England having concerns [20]. Johnson and Greenwood [17] also discovered a suitable habitat for lynx reintroduction in the Southeast of England, proposing an extinction probability of 0.1, however, this is a highly fragmented area and also human-dominated

at 479 people km<sup>-2</sup>, and therefore further research and possible trial reintroductions would be necessary.

Previous brown bear reintroductions include multiple failed releases in Bialowieza, Poland, where released bears were killed by poachers or because of human conflict [21], a successful release of two females and one male into lower Austria between 1989 and 1993, French Pyrenees, Italian Alps [21,22]. Simulations show that brown bears have a minimum viable population of 250 individuals to prevent extirpation in less than 100 years, a number much larger than many of the pre-existing populations in Europe [7]. Issues which prevent brown bear presence and reintroductions include their need for a large habitat, predation on ungulates (however, as stated before regarding lynx, this could be beneficial in Britain), damage to livestock resulting in conflict with farmers, direct aggression with humans (in Europe, a total of 15 attacks, including three fatalities, one of which was later found to be a rabid case, have been reported throughout the 1900s [7]), and emotional impacts on the human population [9,22]. Since the reintroduction of brown bears into the Italian Alps, public opinion has become more negative, most probably due to problem bears which contribute to a biased opinion on the whole population, and, therefore, bear management can greatly influence public opinion [9].

Current red deer, *Cervus elaphus*, populations in the Highlands of Scotland are believed to be close to a food-limited carrying capacity, and are, as previously mentioned, negatively affecting the environment through overgrazing. Too big for lynx, grey wolves have been suggested to reduce the current red deer numbers [23]. Nilsen et al. [23] created a model of the release of three wolf packs, where each contained one dominant pair and two subordinates, into the Scottish Highlands. Wolf numbers hit an equilibrium of 25 per 1000km<sup>2</sup> like the current population recorded in Bialowieza Forest, Poland, and red deer numbers were reduced from 20 to seven deer per km<sup>2</sup>, with the wolf population having a high dependency on prey density [23].

### 1.3. The Need to Survey

In western societies, nature conservation tends to be seen as an important issue, including the protection of large predators [6], and with greater acceptance by stakeholders, the greater success of the reintroduction [19]. Therefore, the opinions of landowners and the public can have a decisive effect on how feasible a reintroduction will be (Brown et al., 2011). However, since the eradication of many of these species from their native lands, human densities have greatly increased, leading to discussions surrounding whether there is room for these large predators with humans [24]. Where reintroductions of large predators have occurred before, the human-wildlife conflict has occurred, often due to perceived predation loss of livestock, and, therefore, carnivore management is required [24]. Scottish Natural Heritage (SNH) guidance, as well as IUCN guidelines, state that for a species reintroduction, any factors which are responsible for extinction should no longer be in operation [4,17]. Therefore, to prevent the risk of hunting and persecution, surveys to discover the desirability and perceptions for reintroducing predators must be conducted.

Previous research suggests that there are several factors which may influence the perceptions of top predators, including demographic characteristics [25]. Studies in mainland Europe revealed that, in general, the elderly, people with lower education, women, people living rurally, and people who do not often experience nature hold a more negative view of wolves and lynx [24]. Those who perceive a risk from top predators are also more likely to hold a negative attitude towards reintroducing lynx and wolves, such as farmers who fear the loss of livestock [24,25]. However, people with greater familiarity with the potential reintroduced species, as well as those with a generally greater interest in nature, tend to hold a more positive attitude towards reintroductions [24].

### 1.4. Aims and Research Predictions

The aim of this paper is to investigate the perceptions of different stakeholders in the United Kingdom regarding the possible future reintroductions of apex predators, mainly the Eurasian lynx, grey wolf, and brown bear. To cover all areas of possible conflicting interests and perceptions, there



is a focus on farmers, nature conservationists, and the general public as stakeholder groups to be investigated. Using evidence from other papers (e.g., [23–26]), it can be predicted that the stakeholder groups of farmers will have a more negative perception of possible reintroductions, because of the effects predators, such as grey wolves, may have on livestock, as well as the danger imposed to humans from species such as the brown bear. These perceptions will likely be reflected also in the general public who consider themselves to live in rural areas. Other demographic features which can be expected to play a factor in perceptions are that the younger members of the population, as well as those considered to live in urban areas, will hold a more positive attitude towards reintroduced species. This view will also hold for nature conservationists. Therefore, there will be a large variation in perceptions in this study, however, with the increase in global focus on rewilding and climate change, it is predicted that, overall, the majority will be positive attitudes towards predator reintroductions.

2. Materials and Methods

2.1. Questionnaire Compiling

To gather as many perceptions as possible, a questionnaire was created using quantitative and qualitative research methods. Google Forms was used as the software for the questionnaire creation as well as response collection. The questionnaire was split into four parts. The initial section provided the information required by the University and Ethics team (Reference number: HLS/2023/MC/124), used to ensure consent was given to continue with the questionnaire. If permission was not given, then the participant could not continue with the questionnaire. Section two was used to collect demographic information on the participants. Questions included in this section allowed for gathering data on age, occupation, gender, postal code, and education level (Table 1). We extracted the rural urban classification based on the postal code. We considered urban (Urban City and Town, Urban with Minor Conurbation, Urban with Major Conurbation), mixed (Urban with Significant Rural - Between 26% and 49% of the population resides in rural areas) and rural (Mainly Rural - 80% or more of the population resides in rural areas; Largely Rural - Between 50% and 79% of the population resides in rural areas) based on the UK Rural Urban Classification [27]. This was followed by a quantitative section, which took a Likert-type approach to establish discrete values which could be categorized. A 5-point Likert scale was used, so that a range from ‘strongly disagree’ to ‘strongly agree’ could be recorded, including a ‘neither agree nor disagree’ for those who cannot create a definite opinion. There was a total of 14 questions in this section. The fourth section had a qualitative approach, where respondents were asked open-ended questions (Table A1). The structure of the questionnaire was based on a perception survey of the lynx reintroduction in Kielder Forest [26].

**Table 1.** Summary table of the different demographic groups and their overall percentage for the respondents of the survey.

Variable	Category	%
Age	18-24	19.23
	25-34	12.82
	35-44	15.38
	45-54	19.23
	55-64	24.36
	65+	8.97
Gender	Female	61.54
	Male	38.46
Rural urban classification	Rural	38.46
	Mixed	19.23
	Urban	42.31
Education level	GCSE	8.97
	A level	11.54

Career	Undergraduate	42.31
	Master	32.05
	PhD	5.13
	Farmer	12.82
	Nature conservationist	19.23
	Environmental sector	16.67
	Other	51.28

2.2. Questionnaire Dissemination

In total, we collected 78 responses to the survey between February and September 2023. We used different means to disseminate the questionnaire. First, we sent an email with a link to the questionnaire to organizations which were linked to key stakeholders (The Wildlife Trusts, National Farmers Unions, Wild Ireland, and Community Supported Agriculture). Then, we shared a post with a link to the questionnaire on multiple Facebook groups linked to stakeholder groups (e.g., Sheep farmers UK and Team Wilder).

2.3. Data Analysis

To test if demographic variables had an effect on the attitudes towards apex predators, we used ordinal regressions in R 4.1.0. We used the Likert scale questions as response variables and the demographic variables (age, gender, rural urban classification, education level, and career) as fixed factors. Age and education level were considered as ordinal variables to reduce the degrees of freedom used for the analysis. To further understand what can drive the perceptions on apex predator reintroductions, we conducted a path analysis using the “sem” function of the “lavaan” package in R 4.1.0 [28]. We standardized all variables which were to be included in the path analysis into a numerical system. Using a 5-point Likert scale for this section of the questionnaire, the values could be switched from ‘strongly disagree’ at 1, up to ‘strongly agree’ at 5. A model was created where the responses to the questions regarding the species’ possible actions (harmful to livestock, dangerous to humans, and dangerous to pets), as well as general reintroduction perspectives (predation on deer would be a benefit and rewilding is a priority) were the exogenous variables explaining the overall perspectives on whether it would be good to reintroduce a species. To check for additional covariance terms to include in the model that could improve the fit, we used the “modificationindices” function in R under the minimum value of 10 [28]. We checked the model fit based on the Comparative Fit Index (CFI) and the Standardized Root Mean Square Residual (SRMR).

3. Results

3.1. Overall Summary

The majority of respondents (53.8%) expressed net disagreement that it would be good to reintroduce brown bears to their region (Figure 1). For grey wolves, respondents split into the ones in favor of their reintroductions (46.2%) and the ones against it (42.3%). There was a net agreement that it would be good to introduce lynx (59.0%). There was a general net agreement that all three species would be harmful to livestock: 46.2% for bears, 60.3% for wolves, 47.4% for lynxes. The figure shows that 50.3% agreed that bears would be harmful to humans, but only 37.2% and 26.9% agreed that wolves and lynx (respectively) would be. All three species had a net agreement that they would be harmful to pets. Respondents had a strong net agreement of predation of deer would be a benefit of reintroductions (67.9%), and there was also a net agreement that rewilding the respondent’s region was a priority (55.1%).

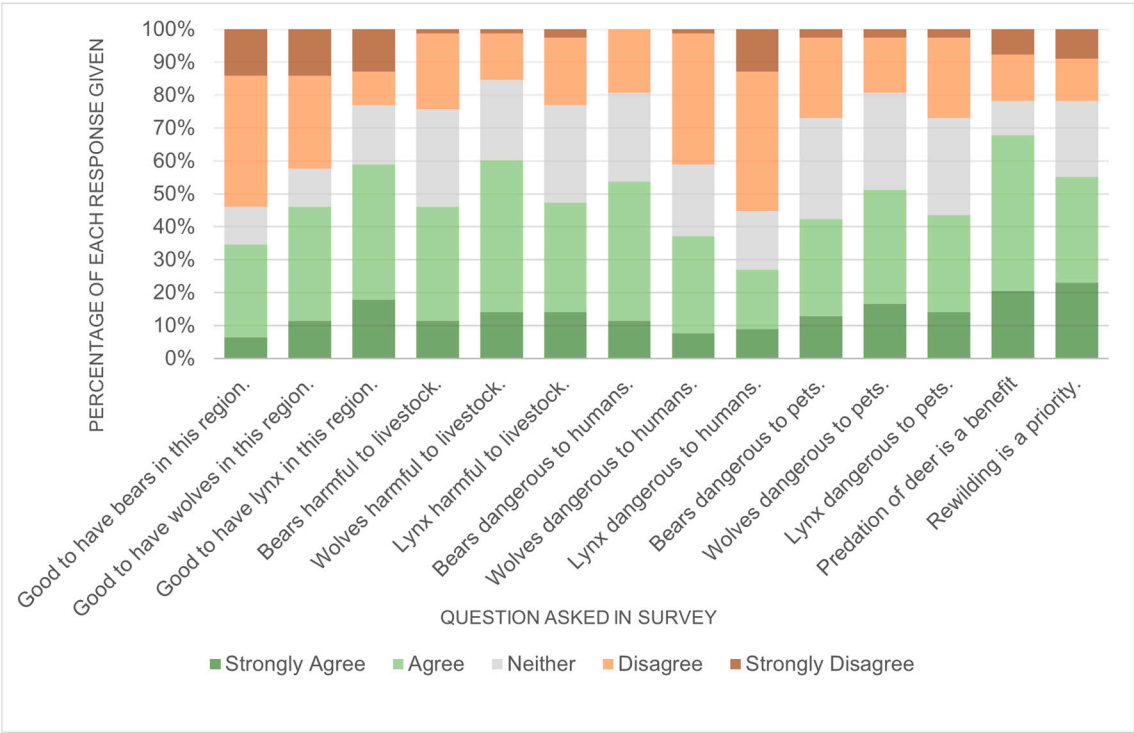


Figure 1. Summary of the responses to the Likert-like scale questions.

When asked what the benefits of reintroductions would be, there were three main themes in people’s responses. The most common theme mentioned was the restoration of nature and biodiversity, with ‘balance’ being a key term mentioned by respondents; some direct quotes include ‘to get nature’s balance back’, ‘a rewilded, balanced and more natural UK ecosystem’ and ‘balance in ecosystems’. Many respondents also used the term biodiversity, such as ‘good for biodiversity’, ‘enable great biodiversity’ and ‘biodiversity would hopefully be enhanced’. In total 69.9% of respondents had replies which fitted the theme of nature and biodiversity restoration. This theme also leads into the mentioning of deer/ungulate/herbivore predation - ‘would help control populations of prey species such as deer’ and ‘restore the ecosystem and reduce deer overpopulations, naturally’. The final benefit that was acknowledged was the human dimension, through ‘ecotourism’, as well as ‘engages public to conservation’.

The main negative that was acknowledged from these reintroductions was the chance of human-wildlife conflict, whether that be through an ‘increase in livestock predation’, or ‘fear of people entering wild areas’. Over 82% of respondents mentioned some form of human-wildlife conflict as a negative. Other negatives included the belief of that the United Kingdom has an unsuitable habitat for these species now - ‘fact of whether or not populations would actually be viable in some parts of the UK’ and ‘not enough unfragmented habitat to sustain viable populations’ - as well as the risk to the ecosystem that these reintroductions could cause with ‘possible unforeseen damage to ecosystems’ and ‘nature has adapted without them for so long’.

The species which respondents answered as the one they would rather see reintroduced was the Eurasian lynx, with 42.5% of respondents agreeing so. When asked why, most respondents went along the lines of ‘ideal for deer control, limited risk of any harm to humans’. Grey wolves came second, with 28.8% preferring to see them reintroduced over the other two species. As for reasons why, wolves were stated as ‘nervous of human contact’, ‘best suited for the habitat’ and ‘they have been shown to do well with introductions in other areas’. Due to them being considered ‘very cute’, having ‘adorable ears’, and ‘they’re cuter’, brown bears received 13.7%.

When asked how they would describe an encounter with one of the named species, 45.2% of respondents gave positive terms. The most popular include ‘Amazing’, ‘Exciting’ and ‘Thrilling’, with a couple also describing it as ‘magical’. Although also containing terms like ‘thrilling’ and ‘amazing’, 26% had a mixed opinion, often stating terms like ‘pretty scary! However ... thrilling!’,

‘exhilarating, inspiring, slightly frightening’ and ‘magnificent and scary’. The remaining 21% used just negative adjectives, such as ‘scary’ and ‘terrifying’.

The final question asked respondents what the best alternative to reintroductions would be, however, 32.9% either stated that ‘none would be as effective as reintroductions’ or listed other potential species such as ‘pine martens’ or ‘red squirrels’. A large proportion (26%) mentioned some form of general rewilding or habitat management, such as ‘more hedgerows, wildflower areas, greenways’, ‘more nature reserves’ and ‘protected vast areas dedicated to conservation’. Other mentioned alternatives included ‘education on the importance of our wildlife’, ‘careful culling of deer’ and ‘reduced hunting and shooting’ (Table 2).

**Table 2.** Exemplary statements from different stakeholders on their perceptions on reintroduction of apex predators in the UK.

What are the benefits of these reintroductions?	What are the negatives to these reintroductions	What alternatives to reintroductions would you prefer to see?
<b>Environmental sector</b>		
1. Improved biodiversity, diversification of the natural environment. 2. Balance in ecosystems, more natural balance, restoring ecological balance 3. Deer predation, natural control of out-of-control species, management of undulates overgrazing 4. Increase public interest in wildlife	1. Predation on existing populations of thriving native species, the reintroduced species could also be targeted by poachers, killed by infrastructure (roads, railways), competition of food and shelter/cover. 2. Concerns about predation in farms and areas in which these species may be reintroduced 3. Require significant management and maintenance 4. Risk and danger for other animals and humans	1. A return to low intensity traditional agricultural management with UK rare breeds. 2. Time and effort spent on preserving our habitats - limitation on housing developments, encouraging farms to 'think green'; clean rivers, protection areas extended. 3. Garner much more interest in wildlife amongst the general public than any other scheme or plan (e.g. biodiversity net gain) ever could. 4. Natural rewilding of environment
<b>Farmers</b>		
1. Bringing back endangered animals is always a positive 2. Balancing ecosystems	1. Not suitable for highly populated areas 2. Harm to current populations 3. Would require a complete change of management requiring livestock to be managed more intensively and be fenced in, rather than extensively, and the use of livestock guardian dogs which is not even achievable within our current UK dog welfare legislation. Livestock guardian dogs weighing over 45kg, in wolf country, have to wear collars fitted with metal spikes to protect them from wolf attacks. A ewe or lamb would have no chance. 4. To reintroduce these species is to go back a thousand years. Farmers have to ensure the welfare of their animals and	1. To start with we need to get habitats managed and suitable for wildlife to be able to thrive 2. Controlled humane cull, when necessary, of any overpopulated species that we already have in the UK. 3. Instead of reintroduction, concentrate on supporting the species already here. Cull badgers to help hedgehogs & bees. Reintroduce legal hunting.



to reintroduce would mean that's not possible. Also the so called uptake in eco-tourism which I'm very sceptical about would mean it's not a wild area anyway. Also ground nesting birds which are struggling anyway would be wiped out		
Nature conservationist		
1. Creating a more resilient ecosystem that operates more functionally	1. Not enough natural food for bear likely to cause conflict with people	1. None really, I would just say that a lynx reintroduction should be trailed first before any of the other species are seriously planned.
2. Would reinvigorate a new sense of wonder and attraction for the UK countryside	2. Drastic increase in livestock predation, possible unforeseen damage to ecosystems	2. Unprecedented change in policy and law in the UK regarding safeguarding and care of ecosystems and the environment would be useful
3. Not enough natural food for bear likely to cause conflict with people	3. People feeling unsafe walking in nature (whether this is justified or not)	3. The right habitats need to be restored before allowing large predators back to the UK, also livestock will need to be protected much better as there are a lot of free roaming sheep.
4. Putting the UK at the forefront of restoring degraded ecosystems	4. Not enough in fragmented habitat to sustain viable populations	4. We should protect and restore what we have left, improved habitat management and protection in locations where the species still exist.
Other		
1. Halt the destruction we have done to our planet.	1. Needs a suitable compensation scheme	1. More hedgerows, wildflower areas, greenways so wildlife can get from area to area, and education on the importance of our wildlife starting from nursery children and carrying on throughout the whole school system.
2. Lead to a reversal of the current decline in native species both animals and plants	2. I fear for their safety, particularly from poaching, disgruntled farmers and trophy hunters.	2. Successful implementation of the new farming scheme
	3. Farmers need to be involved heavily as they are the main custodians of the open land.	3. Careful culling of deer - in a way that makes sure they suffer a little as possible - followed up by birth control for them if possible.
		4. Removing licences to hold grouse shoots. Allowing the regeneration of moorland without burning peat. Banning the use of snares or any other form of trapping mammals and birds. Prevent the shooting of birds of prey.
		Shooting deer in a controlled way leaving some carcasses for foxes, birds of prey and carrion beetles.

	5. Maybe the creation of enclosed habitats, large enough to create a natural and realistic habitat, but secure enough to keep them contained
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3.2. Demographic predictors of attitudes

Career was the factor that influenced all of the Likert scale answers, with farmers being more in disagreement with reintroduction of apex predators (Table 3). Reintroduction of wolves was also seen as more negative with increased age and education. The fact that reintroduction of apex predators was bringing benefits in terms of predation of deer was positively influenced by education. Wolves and lynxes were seen as less dangerous for humans by nature conservationists compared to farmers. Farmers had a lower disagreement than the other careers with the statement that rewilding is a priority (Figure 2).

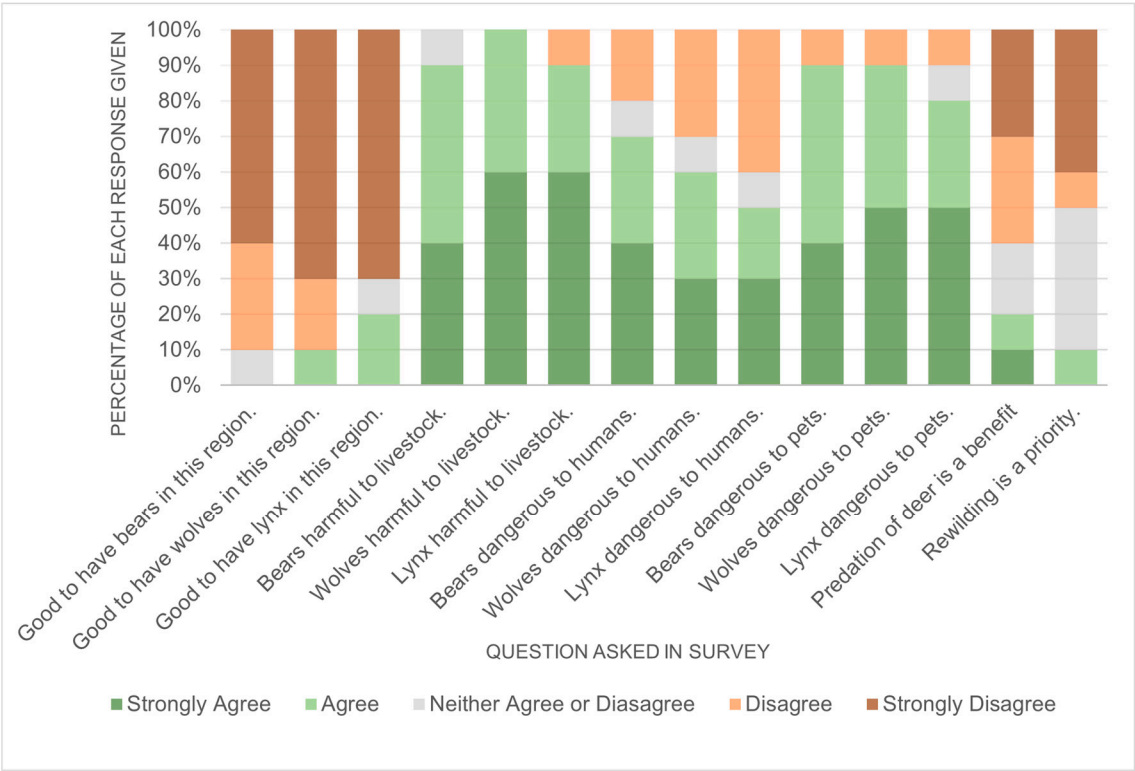


Figure 2. Summary of the responses to the Likert-like scale questions only considering the farmers.

Table 3. Significant factors influencing responses to the Likert-like questions. Factors considered were age, gender, career, rural urban classification, and education.

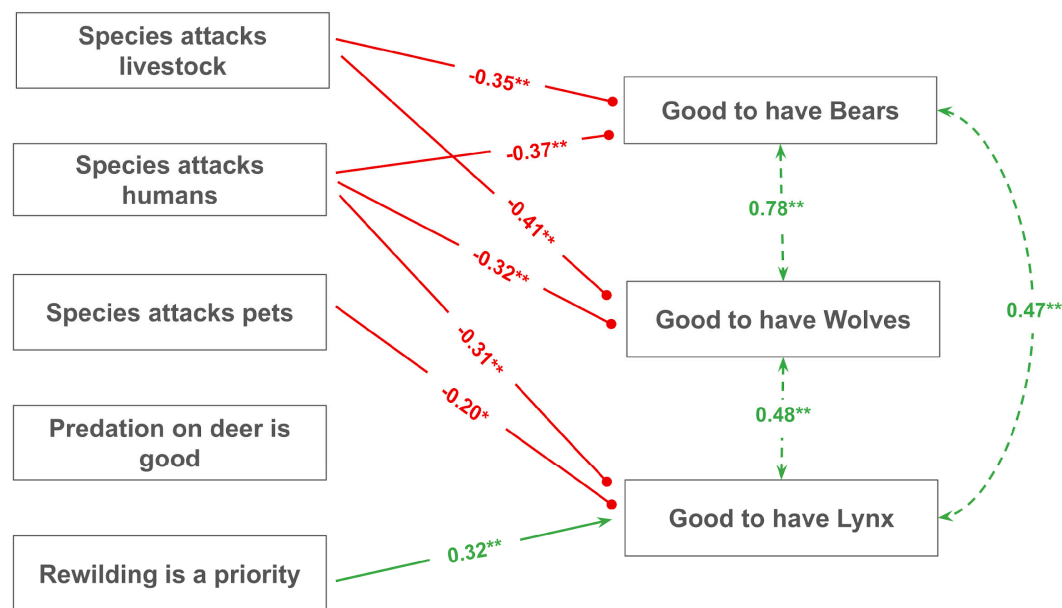
Response	Predictor <sup>a</sup>	Mean estimate (SE)	Wald $\chi^2$	p-value
Good to have bears	Career: other	3.17 (0.83)	14.43	<0.001
	Career: nature conservation	2.20 (0.90)	6.03	0.014
	Career: environmental sector	3.56 (1.01)	12.35	<0.001
Good to have wolves	Age	-0.30 (0.15)	4.05	0.044
	Education	-0.50 (0.25)	3.38	0.051
	Career: other	3.95 (0.92)	18.30	<0.001
Good to have lynx	Career: nature conservation	4.04 (1.03)	15.38	<0.001
	Career: environmental sector	4.72 (1.10)	18.39	<0.001
	Career: other	3.15 (0.87)	13.15	<0.001
	Career: nature conservation	3.85 (1.00)	14.68	<0.001

	Career: environmental sector	3.55 (1.05)	11.34	<0.001
Bears harmful to livestock	Career: other	-2.04 (0.74)	7.55	0.006
	Career: nature conservation	-3.00 (0.88)	11.54	<0.001
	Career: environmental sector	-2.41 (0.92)	6.83	0.009
Wolves harmful to livestock	Career: other	-3.20 (0.84)	14.14	<0.001
	Career: nature conservation	-3.78 (0.99)	14.55	<0.001
	Career: environmental sector	-3.86 (1.02)	14.31	<0.001
Lynx harmful to livestock	Career: other	-2.52 (0.81)	9.69	<0.001
	Career: nature conservation	-3.36 (0.97)	12.09	<0.001
	Career: environmental sector	-3.22 (0.99)	10.52	<0.001
Bears dangerous to humans	Career: other	-1.63 (0.83)	3.86	0.049
Wolves dangerous to humans	Career: nature conservation	-1.93 (0.93)	4.32	0.038
Lynx dangerous to humans	Career: nature conservation	-3.19 (0.96)	10.95	<0.001
Bears dangerous to pets	Career: other	-2.03 (0.73)	7.67	0.006
	Career: nature conservation	-2.26 (0.87)	6.83	0.009
	Career: environmental sector	-1.69 (0.90)	3.52	0.061
Wolves dangerous to pets	Career: other	-2.21 (0.77)	8.19	0.004
	Career: nature conservation	-2.55 (0.91)	7.76	0.005
	Career: environmental sector	-2.11 (0.92)	5.24	0.022
Lynxes dangerous to pets	Career: other	-1.88 (0.76)	6.10	0.014
	Career: nature conservation	-3.32 (0.95)	12.20	<0.001
	Career: environmental sector	-2.23 (0.94)	5.63	0.018
Predation of deer is a benefit	Education	0.53 (0.25)	4.53	0.033
	Career: other	1.51 (0.75)	4.05	0.044
	Career: nature conservation	2.63 (0.90)	8.51	0.004
Rewilding is a priority	Career: other	1.87 (0.72)	6.71	0.010
	Career: nature conservation	3.03 (0.88)	11.95	<0.001
	Career: environmental sector	2.78 (0.91)	9.34	0.002

<sup>a</sup> Reference category for Career: farmer.

### 3.3. Path Analysis

The path analysis revealed that there was a strong correlation between the suspected influence that species may have and whether they should be reintroduced (Figure 3). Species attacks on livestock had a strong negative impact on it being good to have brown bears ( $\beta = -0.35 \pm 95\% \text{ CI } 0.18$ ,  $Z = -3.89$ ,  $p < 0.001$ ) and grey wolves ( $\beta = -0.41 \pm 95\% \text{ CI } 0.19$ ,  $Z = -4.23$ ,  $p < 0.001$ ). Species attacks on humans had a strong negative impact on all of the species; bears ( $\beta = -0.37 \pm 95\% \text{ CI } 0.16$ ,  $Z = -4.51$ ,  $p < 0.001$ ), wolves ( $\beta = -0.32 \pm 95\% \text{ CI } 0.16$ ,  $Z = -3.92$ ,  $p < 0.001$ ), and lynx ( $\beta = -0.31 \pm 95\% \text{ CI } 0.19$ ,  $Z = -3.24$ ,  $p = 0.001$ ). There was a significant positive influence on the reintroduction of lynx by people regarding rewilding as a priority ( $\beta = 0.32 \pm 95\% \text{ CI } 0.19$ ,  $Z = 3.28$ ,  $p = 0.001$ ). We also found a negative influence on the reintroduction of lynx by people stating that lynx would be harmful to pets ( $\beta = -0.20 \pm 95\% \text{ CI } 0.20$ ,  $Z = -1.98$ ,  $p = 0.048$ ).



**Figure 3.** Path diagram to show the significant correlations between species being considered good in the respondents' region, and views the respondents have on the species. Bold arrows show direct relationships from one variable to another, and double-headed dotted arrows show correlations between variables.

All species were positively correlated with each other in whether it would be good to reintroduce them, as highlighted by the covariance terms in **Figure 8**. The strongest correlation was found between bears and wolves, with a lesser, but still significant positive correlation between wolves and lynx, and bears and lynx. The model fit parameters were CFI = 1, and SRMR = 0.024.

#### 4. Discussion

Article 22 of the EU Habitats Directive states that 'Member states shall study the desirability of re-introducing species ... that are native to their territory where this might contribute to their conservation' [29]. Therefore, studies such as this one are necessary before any form of reintroducing species such as the Eurasian lynx, grey wolves, or brown bears can be considered in the United Kingdom. As was predicted, farmers had a much greater negative response when asked whether it would be good to see Eurasian lynx, brown bears, and grey wolves in their region, compared with the other key stakeholder careers. The other participants, however, did also disagree that brown bears would be good in their region. Brown bears are regarded as the most harmful of all the species to humans (Figure 1). Throughout the 1990s, over 15 cases of bear attacks had been reported in Europe, three of which were fatal [7], and therefore a disagreement about the reintroduction of brown bears due to their danger to human lives was expected to be seen in this study.

##### 4.1. Attacks on Livestock

Farmers, as predicted, had a very large agreement in all species being dangerous to livestock, with the path analysis revealing a significant link between people that believed a species would be dangerous to livestock and having a negative response to it being good to have that species in the region. It is this overwhelming perspective that species would be harmful to livestock that is likely to have resulted in the disagreement of species being good in their region, with farmers fearing a loss of their livelihood. This view of species being a danger to livestock was not unique to farmers, with the risk of human-wildlife conflict becoming the most common negative named for reintroductions. Smith et al. [30] also experienced the farming perspective as the least likely to show support for reintroducing a species which is now extinct in the UK. Hawkins et al. [26] found that farmers named

their biggest risk of lynx reintroduction as ‘risks to farming’, which included ‘risks to livestock’. However, there was also a large concern for the possible economic suffering that farmers could experience, leading to the conversation of possible compensation payments for farmers who experience losses [26]. Although livestock danger was a key issue raised by our participants, there was no mention of compensation payments or economic worry. Dolton-Thornton [31] also experienced the loss of livestock as a key negative factor associated with rewilding, as mentioned by two representatives of community land trusts. One of these respondents also mentioned the fear of lynx attacks on humans [31], however, both farmers (Figure 2) and the overall summary (Figure 1) saw a disagreement about lynx being harmful to humans in this study.

It is human-wildlife conflict such as this fear of livestock loss which drove these species to extinction in the first place, and therefore, to resolve the SNH and IUCN’s guidelines which state that for a species reintroduction to be possible, any factors which are responsible for extinction should no longer be in operation, some form of guarantee that these species will not be persecuted for livestock attacks is needed. For example, the main risk highlighted during the lynx reintroduction into Kielder Forest was focused on farming and livestock, with many members of the community urging compensation payments [26]. However, there was also fear highlighted for the lynx population regarding traffic incidents, illegal poisoning, and farmer retaliation [26].

#### 4.2. *Changing Views on Rewilding*

Overall, respondents agreed that grey wolves and Eurasian lynx would be good in their region, results which align with other papers such as Smith et al. [30], which found strong support regarding the reintroduction of Eurasian lynx, as well as Nilsen et al. [27] which was regarding wolf reintroductions to Scotland. Wilson’s [7] review revealed that many papers found a minority were in support of reintroduced large carnivores, predominantly wolves at the time of this paper’s release. Larger support is given to the reintroduction of smaller predators, such as the pine marten *Martes martes* (90% of the general population and 64-65% of farmers and gamekeepers), and the beaver (86% proactive, 63% public) [7]. However, the past 20 years have seen a perspective shift regarding rewilding and reintroductions, on both a national level with charities such as Rewilding Britain, which was established in 2015, as well as globally, with the United Nations decade on ecosystem restoration 2021-2030 [32].

We found a general agreement that rewilding their region is a priority (Figure 1) and there was a strong positive correlation between people viewing rewilding their region as a priority and agreeing that it would be good to have lynx in their region (Figure 8). Although lynxes were viewed as being dangerous to livestock and pets, respondents selected them as the best species to reintroduce, with 42.5% selecting them, often stating that this is due to them being seen as a ‘limited risk to humans’ - as shown through the low 26.9% that agreed lynx could be harmful to humans. Lynxes are often seen as a keystone species due to their predation on deer, resulting in ecosystem restoration, and it is this view that is likely to be why they were perceived as the best species to reintroduce. Although there was no correlation found in the short answers between people agreeing that it would be good to have lynx (or any species), and that predation of deer would be a benefit to reintroductions, this was given as a large reason as to why it would be good to have lynx, as well as being given as a reason for wolves, and as a general benefit to any of these reintroduced species. As Martone et al. [33] discovered, the idea of increased ecotourism from these reintroductions was also given as a benefit of reintroductions. Although not largely represented in this study, there was still the mention of ‘ecotourism’ and ‘engaging the public in conservation’ as benefits of the reintroductions.

#### 4.3. *Is predation of deer a benefit to reintroductions?*

Overall, 67.9% viewed deer predation as a benefit to reintroductions. It was also named as a key benefit to any of these reintroductions, linking to many who also stated that they would like to see a restoration of nature - ‘restore the ecosystem and reduce deer overpopulations, naturally’. The browsing of an uncontrolled deer population has resulted in a depletion of the natural regeneration of British woodlands [13], and as rewilding has gained motion in Britain, the benefit that people see



by this natural reduction of deer populations is unsurprising. Hawkins et al. [26] however, found that there was a large disagreement with the statement 'lynx should be reintroduced as a natural control of deer'. This could explain why, although lynxes were seen as a great aid for restoring nature, and that deer predation was a benefit received a high agreement, there was no correlation found between the two in the path analysis. Although these species have been identified as a keyway to resolving the increasing deer issues across the UK, people's fear for livestock may be of more importance in their decision-making.

Philips [19] proposes the use of an Agent-Based Model (ABM) to consider the possible movement of a released population of predators (e.g., lynx), highlighting where territories would have a higher chance of being established. ABM use computer simulations to determine how individuals will interact together and with the environment [19]. Models such as these could be used to address concerns proposed by stakeholders. Support for the reintroduction of large carnivores can be increased through education and knowledge [24].

## 5. Conclusions

Although support was found from the general public for reintroductions in this study, support would also be needed by key stakeholders such as farmers before any form of reintroduction can be initiated. Van Heel et al. [24] found support can be gained through education and knowledge. Educating the general public and stakeholders with realistic statistics, such as the low-risk Eurasian lynx would have on livestock, could further shift perspectives, allowing for future reintroductions.

Brown bears did not receive a positive response through this study, with the only consideration of their reintroduction being due to their 'cute' looks. Although they did once roam the British countryside, with the restricted habitat connectivity which is now seen across Britain, it is unlikely that a viable population could be sustained - as well as the threat they pose to human life, livestock and pets, preventing the species from getting the public approval that would be necessary for reintroduction to be seen.

The general public saw grey wolves as a good option for reintroduction, even though they received the highest response in being dangerous to livestock. The overgrazing of red deer in the Scottish Highlands is negatively impacting the environment [13]. Although Eurasian lynx could predate on this species of deer, it would be unlikely and only in the case of their being a lack of easier prey [12], so the introduction of wolves is the best natural control of this species [23]. Considering the development of models, such as Nilsen et al. [23], which show the viability of populations of wolves, a more in-depth study of stakeholders, both nationally and closer to the affected areas, would need to be conducted, ensuring education and knowledge is provided to the respondents before the survey - including statistics of livestock losses experienced where these populations are already found.

By far, it was the Eurasian lynx which had the most support for reintroduction in this paper. As the only species that positively correlated with the view that rewilding is a priority, the reintroduction of lynx would likely greatly benefit the biodiversity of Britain, through their reduction of overgrazing species such as roe deer [18]. Lynx saw at least some support from all stakeholders, although 70% of farmers strongly disagreed that lynx should be reintroduced. And farmers were the group least represented in this survey, despite being a key stakeholder. This is due to the difficulties in engaging with the farmer communities. Hawkins et al. [26] also expressed a struggle to get farming communities to engage in their research due to disagreement with the study. Through the current work of Lynx UK, this species is likely to be the first apex predator reintroduced to the UK, however, as stated with the grey wolves, further stakeholder studies will be necessary before this is truly viable.

**Author Contributions:** Conceptualization, S.W. and M.C.; methodology, S.W. and M.C.; software, S.W. and M.C.; validation, S.W. and M.C.; formal analysis, S.W. and M.C.; investigation, S.W.; resources, M.C.; data curation, S.W.; writing—original draft preparation, S.W.; writing—review and editing, M.C.; visualization, S.W. and M.C.; supervision, M.C. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy reasons.

**Conflicts of Interest:** The authors declare no conflict of interest.

Appendix A

Table A1. Questionnaire used.

Type	Question	Response option
Demographical	What is your age?	Categorical
	What is your gender identity?	Categorical
	What is your outward postal code?	Open
	What is your job/career	Categorical
	What is your level of education	Categorical
Likert scale	It would be good to have brown bears in this region	5 Likert scale categories
	It would be good to have grey wolves in this region	
	It would be good to have Eurasian lynxes in this region	
	Brown bears would be harmful to livestock	
	Grey wolves would be harmful to livestock	
	Eurasian lynxes would be harmful to livestock	
	Brown bears would be harmful to humans	
	Grey wolves would be harmful to humans	
	Eurasian lynxes would be harmful to humans	
	Brown bears would be harmful to pets	
	Grey wolves would be harmful to pets	
	Eurasian lynxes would be harmful to pets	
	Predation of deer would be a benefit of reintroduction	
	Rewilding your region is a priority	
Open questions	What are the benefits of these reintroductions?	Open
	What are the negatives of these reintroductions?	
	Which would you rather see reintroduced: brown bear, grey wolf, Eurasian lynx? Why?	
	How would you describe an encounter with one of these reintroduced species?	
	What alternatives to reintroductions would you prefer to see?	

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