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Eager about beavers? Understanding opposition to species reintroduction, and its implications for conservation

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Abstract

1. The range of keystone species is increasing in some parts of the world, particularly Europe, through a combination of natural recolonization, government-sanctioned and covert reintroductions. Reintroductions are an important conservation tool, particularly in the increasingly popular approach of rewilding.
2. There is relatively little understanding of the politics, broadly conceived, of species reintroduction, particularly around how people who live alongside these newly introduced species might react, and what underpins this reaction, and how the method of reintroduction affects reactions.
3. Here, we explore these issues through a case of beavers in central Scotland, which were covertly reintroduced. We explore opposition to reintroduction as manifest in beaver killing and dam destruction by land managers, quantifying these using the sensitive 'bean count' method.
4. We also explore what underpins land managers' reactions, particularly their views and values around land and land management.
5. We found considerable resistance. We found that beaver killing and dam destruction were widespread, both before and after beavers became a protected species. Nevertheless, beaver populations and ranges in Scotland continue to grow.
6. We found attitudes were grounded in a strong set of relational values around land custodianship. We find a range of views towards beavers, including widespread opposition, particularly regarding the covert nature of beaver introduction, the challenge beavers and beaver protection provide to ideas of proper land management and custodianship, and a lack of trust in formal methods of beaver governance.
7. We argue that species reintroductions policies and research should give careful consideration to potential opposition, its material impacts on reintroduction projects and how it is grounded in wider environmental values and politics.

KEYWORDS
beaver, conservation translocations, reintroduction, resistance to conservation, rewilding, Scotland, sensitive questions, values

1 | INTRODUCTION

In rare good news for conservation, mammal populations and ranges are increasing in some areas. This is particularly true in recent decades in Europe, where populations of wolf (*Canis lupus*), bear (*Ursos arctos*) and beaver (C*astor fibre*) are expanding (Hatfield et al., 2022). This increase is partly due to more and better reintroduction programmes, releasing species into their former ranges to create self-sustaining populations. Such reintroductions are justified in terms of correcting and atoning for past sins of eradication, and increasingly on the grounds of restoring key ecological actors, and thus ecological processes (Jørgensen, 2019). Whilst these reintroductions are mainly driven by government and NGO restoration agendas and follow formal procedures, there have also been informal, unlicensed reintroductions by conservation activists frustrated with the slow pace and lack of ambition of formal reintroductions (Cockerell, 2023; Thomas, 2022).

Reintroductions do not take place in a human-free, apolitical landscape. As these species come back, through various mechanisms, a key question remains of how humans can live with them, how to create human–wildlife coexistence in which animals and humans adapt to one another and share landscapes, with conservation governance maintaining viable animal populations with an acceptable level of risk to both humans and wildlife (Carter & Linnell, 2016). Local human populations demonstrate a spectrum of views towards reintroduction processes and reintroduced species, from enthusiasm to hostility. Negative views are often based on the perceived, actual or anticipated costs of living with these species, such as losses of livestock to predators. Other, less tangible, issues can be important, such as feelings that rural populations are unrepresented or not valued by the urban elites who are considered to dominate environmental decision-making, or the way in which species reintroductions disrupt relationships between rural populations and their environments (Pooley et al., 2021). Local opponents are often not passive, but sometimes contest reintroductions, through formal processes such as political lobbying but also informally, through non-cooperation with conservation authorities, sabotage or killing reintroduced species. Whilst opponents are not always sufficiently powerful to defeat unwanted reintroductions, such formal and informal opposition can undermine these projects (Holmes, 2007).

Whilst there is some literature on the politics of formal, government or NGO-led reintroductions, there is very little on covert reintroductions by conservation activists. At the same time, there has been little literature exploring informal opposition to reintroductions, particularly how it might limit or prevent successful reintroductions. Here, we focus on such a case, focussing on activities that might undermine the success of species reintroductions, through a study of beavers in Scotland.

In 2006, reports reached Scottish Natural Heritage,[1] the autonomous government agency responsible for managing natural heritage in Scotland, of a population of Eurasian beavers living in the catchment of the River Tay in central Scotland. Whilst there has been no criminal trial related to the release of these animals, there is a widespread belief in conservation and policy circles[2] that it was a deliberate, covert release to establish a self-sustaining, free living population. Here, we use 'covert' to describe unlicensed, informal releases with presumed conservation intent, as opposed to animal rights related or accidental releases, although elsewhere such incidents have been referred to as 'illicit', 'illegal' or 'guerrilla'[3] releases (Thomas, 2022). The Tay releases have been followed by covert releases on other British rivers (Werth, 2014), and elsewhere in Europe, with the aim of establishing self-sustaining populations, in a phenomenon known as 'beaver bombing' (Matthews & Kendall, 2023). Genetic analysis has shown that the Tay beavers were from three distinct lineages in Bavaria, southern Germany (McEwing et al., 2015), implying multiple animals were released. Yet, irrespective of a culprit being identified, the Tay beavers have influenced discourse and policy on species reintroductions. They are cited by rewilding advocates as a success and a justification for future reintroductions and may have forced government to address beaver presence and potential further reintroductions (Gow, 2020; Thomas, 2022). As public and political debates about beavers have continued, the discovery of beaver corpses with bullet holes indicated other, informal, responses.

Ours is case study of how and why local people react to species reintroductions, particularly when the governance framework is weak, and what this reaction tells us about the success or otherwise of reintroductions (Lorimer et al., 2015; Redpath et al., 2015). Here, we ask two questions: What reaction has there been to these covert releases, particularly actions that might impinge the success of beaver reintroductions? And what are the broader values and attitudes that might underpin these reactions?

We start by exploring the overlapping areas of work to which our research contributes: species reintroductions, human–wildlife interactions and particularly the role of environmental values within these. We then briefly describe the history of beavers in Britain and outline our survey methods and our findings. We conclude by arguing that the widespread killing of beavers not only demonstrates dissatisfaction with beaver presence but also the challenges they bring to how people interact with the landscape, perceived lack of governance and antagonism at the unplanned and unregulated nature of beaver release.

[1]Rebranded as NatureScot in August 2020.

[2]This observation is based on numerous informal conversations between GH and well informed conservation officials and rewilding activists within the UK. A consistent story is produced that the Tay beavers, and other UK populations, excluding those formally released in government trials, were released by named conservation activists seeking to establish free-living populations of beavers, and change the UK's freshwater ecology, and the same names are cited as the source of these beavers. These named individuals have never denied involvement. The reticence to give a formal statement may reflect the legal implications of doing so, as such unlicensed releases would be illegal, subject to a maximum prison sentence of 2 years and unlimited fine. It also reflects the contested politics of reintroductions.

[3]We avoid this term in part due to potential homophone error, with grave ecological consequences.

1.1 | Reintroductions, values, resistance and human–wildlife coexistence

The International Union for the Conservation of Nature defines species reintroductions as 'the intentional movement and release of an organism inside its indigenous range from which it has disappeared. Reintroduction aims to re-establish a viable population of the focal species within its indigenous range' (IUCN/SSC, 2013). The modern science and practice of conservation reintroductions emerged in the 1980s, with an initial focus on conservation of individual species. In recent years, particularly with mammals in Europe, reintroductions have become more important as they form part of discourses and practices of rewilding. The idea of rewilding increased in profile within conservation science following the publication of Donlan (2005), and quickly achieved greater public prominence, particularly following Monbiot's (2013) book *Feral*, and the creation of rewilding-focussed NGOs such as Rewilding Europe (in 2011) and Rewilding Britain (in 2015). Whilst there are different interpretations of rewilding between and within regions (Prior & Brady, 2017), they share a focus on restoring ecological processes, making places wilder across diverse spatial and temporal scales by giving nature greater autonomy, and moving conservation away from fixed targets and towards open-ended, dynamic systems (Gammon, 2018; Holmes et al., 2020; Lorimer et al., 2015). Within rewilding, species are reintroduced not just for their own sakes but as key ecological actors, part of restoring key ecological functions such as herbivory and predation. As rewilding increases in influence, the number, ambition and scale of reintroductions may increase, particularly in Europe.

Reintroductions are complex. They are often technically challenging, with careful assessment and delicate procedures needed to ensure the right ecological conditions, animal physiology and behaviour for reintroduced species to establish themselves. Other challenges are simultaneously scientific, moral and philosophical, such as how to define native range in the context of uncertainty over past ecology and over future climate change, or how to select the genetically appropriate sub-population of a species (Lorimer et al., 2015). Others are more political. Whilst many species reintroductions proceed without friction with human populations, particularly of plant and invertebrate species, larger herbivores and predators can be extremely contentious (Pooley et al., 2021). These are the species that rewilders often seek to reintroduce, as part of re-establishing ecological processes, and it is these species' role as disruptive ecological agents that can cause friction. Indeed, many of these species were eradicated because of their impact on human activities. Some conflicts from reintroductions are over tangible processes, such as increased risks of flooding of farmland from beaver dams, predation of livestock or wild game, fish or shellfish species, or risks to human and livestock biosecurity (Lorimer et al., 2015; Pinkerton et al., 2019). Other conflicts are less tangible, such as over control and management of the environment (Holmes et al., 2022). Rewilding entails surrendering some degree of control, making nature more autonomous, and perhaps less predictable and riskier to those who live in or around it, such as farmers (Lorimer et al., 2015). Land managers may feel aggrieved to lose control over their land, particularly without consent—reintroduced species are often subject to more protection and intervention than those already present, bringing new regulations with them and limiting managers' potential responses; yet, they are often an externally imposed problem (Fry, 2023; Ojalammi & Blomley, 2015). Reintroductions, and the ecological ripples they create, interact with existing structures of resource use, including formal laws and treaties, and informally understood moral ecologies, which can create or reinforce injustices and resentment (Braverman, 2021; Pinkerton et al., 2019).

Local people's reactions to reintroductions goes beyond the material impacts and tangible changes brought about by reintroduced species. Rather, reactions are also shaped by environmental values, relating to how people value the environment and what it means to them (Chan et al., 2018). These values influence what people want from the environment. Consequently, understanding values gives a deeper understanding of problems and solutions to issues of environmental regulation.

Environmental values go beyond the intrinsic value of the environment, and its utilitarian contributions to people. They also include includes relational values, understood as values emerging from people's relationships with nature, both in the abstract and particular pieces of it, including how it defines those people and their community, gives meaning to them and to the environment. Relational values can also include moral principles of how nature and specific pieces of it should be treated, such as ideas of stewardship and care, and how people should live a proper and meaningful life in their interactions with nature (Chan et al., 2018). Relational values shape the politics of landscape change and species reintroduction, as groups will differ in how they relate to, value, and seek to benefit from the same landscapes (Drenthen, 2018; Holmes et al., 2022). For example, traditional low-intensity pastoral landscapes, whose landforms and species composition are the co-creation of humans and nature over centuries, might be valued by farming communities through ideas of heritage, custodianship and belonging. The landscapes become cherished, defining these individuals and communities (Fry, 2023). By contrast, conservationists might apply value framings of ecological integrity, and decry these same landscapes as sterile and defaunated (Lorimer et al., 2015). Proposals around rewilding are particularly contentious, not just because of their ecological and economic impacts, but because moving towards a less human-managed landscape challenges the relationships that individuals and communities have with their anthropogenic rural landscapes (Fry, 2023; Holmes et al., 2022). With regard to reintroduced species, individuals who cherish the heritage of the socio-ecological systems of farming landscapes created through generations might see these species as disruptive and destructive, undermining the generations of sustained human actions that created well-ordered landscapes, and thus not legitimately belonging in the landscape (Fry, 2023). Reintroductions can be seen as a lack of respect for those communities and histories (Ojalammi & Blomley, 2015). Those favouring ecological integrity might value these species for their ecological dynamism, and see

them as valued missing pieces that should be restored (Holmes et al., 2020). Proponents of reintroductions may see a species local extirpation as relatively recent moral error, which could be easily corrected by bringing them back, opponents may see the same extirpation as so distant that the species should no longer be considered native (Fry, 2023; Holmes et al., 2022; Jørgensen, 2019). Questions of a species status as belonging or being native are subjective, and whilst related, not necessarily synonymous—people can recognise a species as a recent arrival, even invasive, yet still consider it a legitimate part of the landscape (Fischer et al., 2011). Disputes over what species belong become part of charged public and scientific debates, as well as informal politics of 'barstool biology' (Robbins, 2006), of contested facts and legitimacy, involving diverse forms of knowledge such as peer reviewed science and village gossip and rumours, and questions of whether conservationists value or understand the human societies affected (Crowley et al., 2017; Fry, 2023; Holmes, 2022; Pinkerton et al., 2019). As with broader conservation conflicts, these are not just about conservation but are wrapped up in wider debates such as urban–rural divides, spatial and societal divisions between those making decisions about reintroducing species and those who have to live with them, questions of land ownership and reform, local versus national democracy, or the rights of local and Indigenous peoples (Pinkerton et al., 2019; Von Essen & Allen, 2015; Woods, 2006). They can be part of wider contests over what humans, non-humans and landforms belong in a landscape, such as the way species reintroduction become part of the contest over who, and what, gets to live where within Israel/Palestine (Braverman, 2021).

One consequence of opposition is that governments may be cautious in the face of potential opposition, and governance mechanisms might be based around existing biodiversity, slowing the process of reintroduction. In the UK, proposals for species reintroduction tend to come from conservation groups not government, although ultimately these will be licensed by government agencies. Such government caution in turn can generate opposition from conservationists, who see formal processes of reintroduction as being too slow, unambitious, bureaucratic and risk averse (Cockerell, 2023; Gow, 2020). Some conservationists advocate, and undertake, informal reintroductions, releasing animals and plants without a licence (Thomas, 2022). In the UK, various amphibian and insect species have been informally reintroduced, as well as beavers.

Reintroductions are more likely to succeed, in the sense of producing self-sustaining populations, when there is coexistence with local human populations (Pettersson et al., 2021). Opposition can undermine reintroductions. Those living with reintroduced species are not passive, but frequently attempt to reshape the situation to their liking. This reshaping can be through formal, explicit politics. For example, in the UK, farmers' representatives are vocal within the rewilding debate, opposing what they see as harmful reintroductions in the wrong place, or advocating for better mitigation or compensation (Coz & Young, 2020). There are also consistent with other areas of conservation, hidden, implicit politics. Such informal politics are favoured when formal political pressure is considered too slow, remote, ineffectual, risky or inadequate. Instead, people favour more direct action, which is often hidden and anonymous because it is potentially illegal or socially controversial (Holmes, 2007). Some might be social techniques, such as informally boycotting meetings or ostracising conservationists, but may also be targeted at the species themselves. For example, frustration with white-tailed sea eagle (*Haliaeetus albicilla*) reintroduction in Ireland has led to land managers deliberately poisoning them, with severe consequences for reintroduction of eagles not just from a reduced population, but also from resultant antagonistic political discourse and disrupted management policies (O'Rourke, 2014). In Scotland, some land managers have covertly killed introduced beavers. The literature on resistance to conservation shows that, in the same way that protecting high profile species can be a 'flagship' for conservation in general, killing them can be a high profile statement of dissatisfaction with the animals, their presence, impacts and associated politics and governance (Holmes, 2007). Such events are not solely driven by anger or a desire to mitigate the damage these animals cause but are an intensely political statement about what should be present in the environment, who gets to decide, and how it should be governed. Killing can often be done covertly, making it a high profile, low-risk political act and can undermine conservation to the point of causing it to fail (Holmes, 2007). Understanding how local people react is crucial for making reintroductions fairer, but also more effective, because they have the most ability to undermine or challenge their success.

Coexistence does not entail no risk or conflict with wildlife, but rather tolerable levels, with a strong emphasis on effective and legitimate institutions that can engender positive attitudes and behaviours, and adequately manage issues as they emerge (Carter & Linnell, 2016). Institutional legitimacy depends on having governance structures and rules, which are appropriate to local ecology, society and environmental values. Such structures might include the creation of protection schemes to mitigate impacts and costs, such as corralling against predators, subsidies for coexisting with problematic wildlife, or compensation or insurance schemes to pay for losses. Whilst institutions and rules can be developed a priori for regulated reintroductions, covert reintroductions negate the possibility of preparatory work that might enhance coexistence, either physical infrastructure, economic mechanisms or dialogues that might build trust (Auster et al., 2021, Coz & Young, 2020). Any dialogue will necessarily be after the event and will be with a different actor, such as government ministry, to that responsible for the release. The lack of dialogue or preparatory work can lower the perceived legitimacy of the illicitly reintroduced species and its presence, and the role of conservationists in managing them (Auster et al., 2021; Coz & Young, 2020). The surreptitious nature of covert reintroductions can drive rumours and gossip, creating anxiety and uncertainty and potentially exaggerated stories that might undermine later attempts to create coexistence (Holmes, 2022; O'Rourke, 2014).

In sum, the literature demonstrates that reintroductions, like other conservation activities, are intensely political, and can generate conflict based on their material impacts but also the way they intersect with broader environmental values and politics. In

the next section, we outline the history of beavers in Britain, and how they intersect with the social and political aspects of species reintroduction.

1.2 | A short history of beavers in Britain

Beavers were present in Great Britain from the end of the last ice age until extensive hunting for their fur and scent glands drove them to extinction by the end of the 17th century. Beavers are present in the historical record and many place names, but absent from the collective human memory, although there were some campaigns in the late 1970s to reintroduce beavers to Scotland (Arts et al., 2012). Ecological modelling in the 1990s suggested that Scotland could support a population of between 350 and 770 adult beavers (Macdonald et al., 2000). Whist an increasing number of campaigners advocated for reintroducing beavers, no beavers were recorded within the British Isles outside of zoos and private collections until the official discovery of the Tay population in 2006. The beaver population expanded rapidly, reaching between 106 and 187 individuals by 2012 (Campbell et al., 2012) and around 1000 by 2021—Thomas (2022) argues that beavers are particularly amenable to establishing populations following covert reintroduction because they breed and expand their range relatively rapidly in the absence of persecution, particularly in landscapes such as Tayside with ample watercourses and trees. Managers reported direct impacts, as beavers damaged or killed trees, and as their damming and tunnelling flooded farmland and undermined riverbanks (Hamilton & Moran, 2015). There was concern over how altered river ecology might impact Atlantic Salmon (*Salmo salar*) breeding, given the cultural and economic importance of recreational fishing (Stringer & Gaywood, 2016). Based on experiences elsewhere in Europe, there were predictions that beavers would increase habitat diversity. By altering water courses through damming, creating slow water in ponds and faster sections downstream of dams, beaver presence was predicted to benefit those invertebrate and amphibian species that prefer such habitats, at the expense of those which favour more intermediate water speeds. Beaver herbivory was expected to promote regrowth of beaver-adapted trees species such as willow and aspen, at the expense of other species, and through tree-felling and more open riparian habitat, create winners and losers for birds, depending on feeding and nesting habits (Stringer & Gaywood, 2016). As yet, there have been no long-term assessments of the actual impacts of beavers on Scotland's ecology.

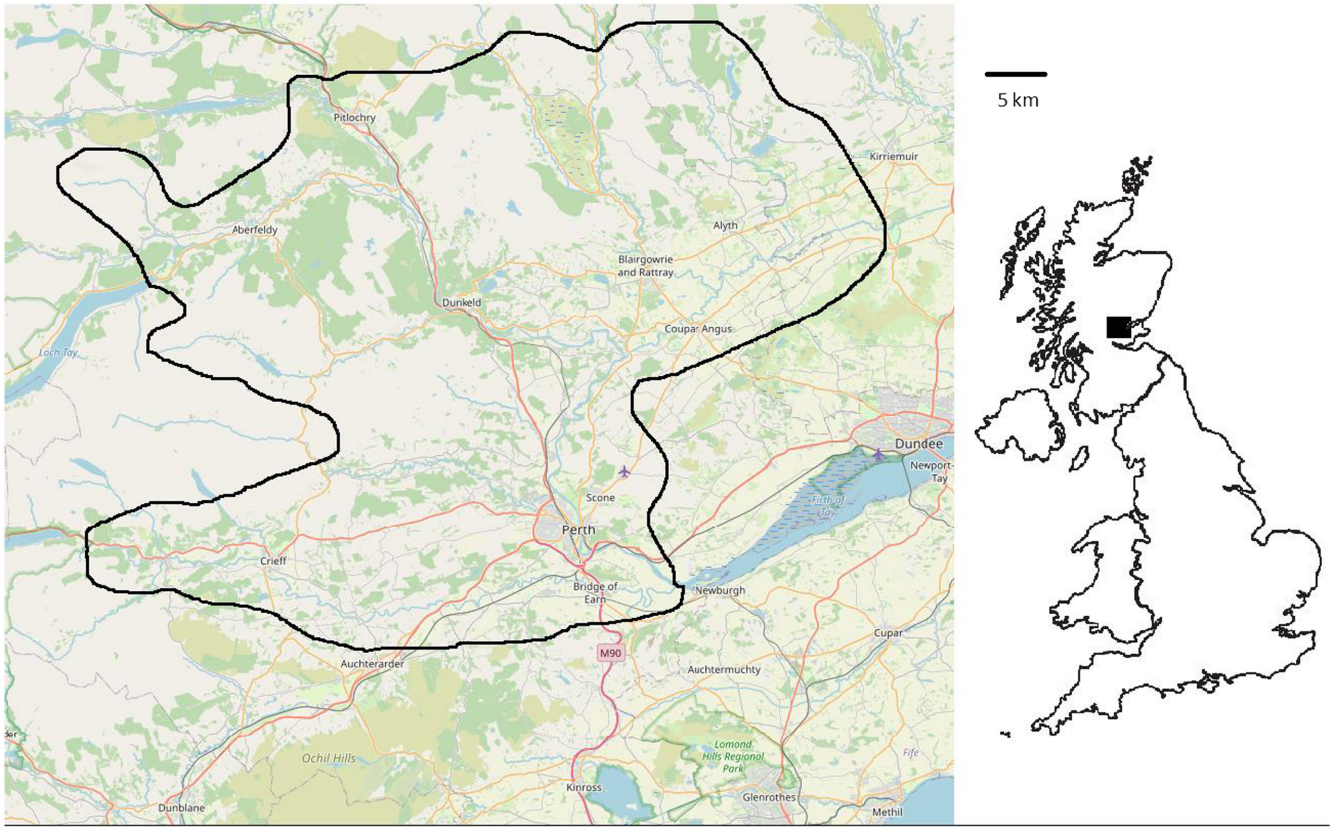
The covert reintroduction left land managers to deal with these impacts without support from government bodies, or a sense of how the situation might be resolved. They felt a loss of ability to control their landscape (Coz & Young, 2020). These impacts, and the failure to identify and punish those responsible for beaver release, exacerbated land managers' resentment, to the extent that some farmers claimed there was a 'conspiracy' against them (Coz & Young, 2020).

In the absence of an official response, some land owners responded by killing beavers (Ward & Prior, 2020). Such killing was not necessarily illegal—beavers were not a protected species until May 2019—but they could be liable under animal cruelty laws if done inhumanely, although there were no such prosecutions. The Tay beavers existed for a long time in a vulnerable state, technically killable as a non-native species[4] (Ward & Prior, 2020). Yet, the extent of killing, and the implications for reintroductions, has not been studied.

Beavers are not universally disliked in Scotland. Coz and Young (2020) show a diversity of views amongst land managers, including individuals reporting mixed feelings. Attitudes were strongly influenced by the process by which beavers arrived and were managed. Even those strongly concerned about beaver reintroduction reported, they would not oppose beavers in the 'correct' habitat, away from valued agricultural land and potential human impacts, which may not be 'correct' for beaver ecology. The discourses of both land managers and conservation authorities were anthropocentric, assessing beavers as economic assets or liabilities, rather than a value-based discussion of how humans might relate to beavers (Coz & Young, 2020). Much of the discourse promoting beaver reintroduction has focussed on supposed net economic benefit, although support for beaver reintroduction remains higher in urban areas than in regions where beavers are present or amongst those working in agricultural or fisheries sectors (Auster et al., 2020).

Thomas (2022) observes that covert reintroductions can influence policy, by demonstrating that it is effectively impossible to prevent the reintroduction and spread of species, by acting as an experimental proof of concept that such reintroduced species can co-exist with humans and maintain a viable population, or because authorities pragmatically choose to tolerate these new populations. All three have been observed in the UK following the emergence of the Tay beavers. It forced the Scottish government to consider beaver introduction and existence in Scotland. Their initial approach, of neither culling nor protecting the Tay beavers, tolerated their presence without endorsing their release. They also gave permission in 2008 for a controlled trial to reintroduce and closely monitor a small beaver population at Knapdale, some 100 km west of the Tay catchment. Whilst perhaps not as ecologically amenable to beavers as Tayside, Knapdale is more remote, with less chance of conflict with agriculture or a rapid population expansion (Ward & Prior, 2020). There were also subsequent covert reintroductions of beavers elsewhere—beavers were reported in 2015 to be living on the River Otter in Devon, England, and the River Dyfi, west Wales (Crowley et al., 2017). Beyond the UK, between 1998 and 2007, there were covert beaver reintroductions in Belgium and the Spanish Pyrenees (Cockerell, 2023; Vaccaro & Beltran, 2010). The English authorities were risk averse, concerned with flooding and biosecurity, carefully monitored the population rather than considering it a native species and endorsing the reintroduction (Crowley et al., 2017). Following

[4]Vaccaro and Beltran (2010) report a similar situation in the Spanish Pyrenees, where beavers were reintroduced illicitly rather than by government. As such, they were at least initially considered illegal and unnatural, rather than eligible for protection.



this tacit wild experiment, the UK and Welsh governments[5] approved their own beaver reintroductions, and other tentative attempts to reintroduce other herbivores, such as semi-wild European Bison (*Bison bonasus*) to southern England.

After their initial cautious approach, the Scottish government became more accepting of beavers. From May 2019, beavers became a protected species, making killing them or damaging their dams illegal without a permit. To mitigate conflict, the government established a system to govern beavers, whereby land managers could report problem beavers, and these beavers would then be culled, relocated or have their dams destroyed. In 2021, under this new management system, 120 Tayside beavers were captured, of which 87 were culled and 33 relocated, and 47 dams were destroyed (NatureScot, 2022). Although there was opposition to culling from the public and some politicians, on animal rights and conservation grounds, putting pressure on NatureScot to relocate problem animals rather than cull them, there was a shortage of sites deemed suitable for relocation, with suitable habitat and lack of local opposition (BBC, 2020).

2 | METHODOLOGY

Our work seeks to understand what reaction there has been to covert beaver releases, particularly actions that might impinge the success of beaver reintroductions, and to understand the broader values and attitudes that might underpin these reactions. We first explore responses to reintroductions, including coexistence, conflict and opposition. Within opposition, we focus not on more commonly explored public arenas such as consultations and interviews with officials, but on informal politics, specifically covert killing of beavers, and destruction of beaver dams, which are a known and potentially ecologically important response, but one that has not been widely studied (Holmes, 2007). We chose these two acts as NatureScot identified them as key responses to beaver reintroduction, and because these were key acts that could restrict an increase in beaver numbers and range, and therefore a 'successful' reintroduction. As such, we analyse a random sample of land users who were, or who had the potential to be affected by beavers, and to use methods that would allow us to ethically and robustly quantify covert killing of beavers and dam destruction. Second, we explore attitudes to rewilding and reintroduced species that might explain and contextualise responses to reintroduction. We explore attitudes in the context of environmental values, which qualitative work has shown to be critical in shaping responses to reintroductions, even as questions of economic and material costs and benefits still dominate most consultations and research, particularly on beavers (Coz & Young, 2020). Beavers are a good case study as they have been widely reintroduced, including through covert reintroductions, which are particularly poorly understood. Our study was approved by our institutional ethical review board (reference AREA 20-159).

We focussed on the Tayside beavers, as the original and largest population of free-living beavers in Britain, and as they were likely

[5]The UK government has responsibility for environmental and agricultural matters in England, but these are devolved matters in Wales and Scotland, and responsibility of their respective governments.

released covertly. Our study area sample population consists of all riparian land in the Tay, Earn and upper Forth river catchments (see Map 1). Riparian was defined as all rivers, related lochs (lakes), as well as any tributaries wider than 1 metre, which we assumed to be a reasonable proxy for appropriate beaver habitat (Scottish Natural Heritage, 2015).

Map 1, showing study area, delinated by the black line, and position in the UK, indicated by black box. The study area is delineated as the watershed of the Tay upstream of the city of Perth as far as the town of Aberfeldy on the Tay, its tributaries including the Almond (as far upstream as Dallick), the Isla (upstream to Bridge of Brewlands), the lower Ericht between its confluence with the Isla and the confluence with the Blackwater, the Blackwater (upstream to Cray), the Ardle (upstream to Kirkmichael). On the Earn, the study area was defined as the watershed upstream of Bridge of Earn, as far as Lochearn, and on the Forth, as the watershed of the Allan Water between Dunblane and Blackford, as far as Braco on its tributary the Knaik (Source data from Ordnance Survey).

Within the study area, we identified any rural business that might be affected by beavers flooding, burrowing or feeding. This included farms, forestry and recreational businesses such as golf courses, but excluded housing, holiday accommodation and businesses not directly dependent on the riparian land, as flooding of these properties was not associated with beavers (NatureScot officials, pers. comm). We used Ordnance Survey 1:25,000 scale maps and satellite images (via Google maps) to identify any properties located within 1 km of a waterbody that might reasonably contain one such business. The entire study area was independently mapped by two members of the team (KF, GR), and combined, producing a total of 489 properties across the study area. During August 2021, we used a random number generator to select 60 properties to visit and administer surveys. Once these 60 properties had been visited, and either surveyed or discounted and removed from our sample, we added additional randomly selected properties in batches of 20 as fieldwork progressed, until the end of our field season. In total, we visited 180 properties. Following our shared protocol, we discounted a total of 24 properties which, upon visiting, did not meet our criteria of appropriate rural businesses, indicating that there are 424 ± 19 ($p = 0.05$) eligible properties in the area. If there was no response at the property, we attempted a second visit on another day before discounting it and removing it from our sample. We removed 25 properties for this reason. A further 24 were removed as respondents were unwilling to participate. Thirty-nine were removed for other reasons, for example where landowners were interested but could not arrange a suitable time to undertake a survey because of a busy farm schedule, where multiple properties were identified as belonging to the same owner, or where the property was inaccessible due to flooded tracks. At each property, we asked for the person responsible for land management decisions, typically the landowner or farmer themselves, or the 'factor' (Scottish legal term for someone with authority to manage land on the owner's behalf, though for convenience here we refer to all respondents as 'land managers'). We completed 68 surveys. We obtained written consent from all respondents prior to them starting the survey.

Our survey instrument had two parts. First, based on our review of the literature of social science of species reintroduction and the grey and academic literature on beaver reintroduction, we used a paper survey to collect basic data on participants' properties, business and personal demographics, experiences and preferences around beaver interactions. As previous research has indicated that land managers' relationships to land, their ideas around management and stewardship, and conservation politics may determine attitudes towards reintroduced species (Coz & Young, 2020), we included Likert items on these subjects. We chose Likert items because it allows respondents to express a nuanced view. Our items were based on multiple key themes identified through reviewing literature on UK beaver reintroductions, and on wider landscape values as they relate to reintroductions (e.g. Coz & Young, 2020; Crowley et al., 2017; Holmes et al., 2022; Thomas, 2022; Ward & Prior, 2020). The second part aimed to explore covert and informal acts against beavers, specifically killing and dam removal. We used the 'bean count' method (Jones et al., 2021), a technique to quantify the total number of incidents. The bean count technique is designed to reassure participants that there is no realistic possibility that researchers, or any other party, would know their individual responses, making it easier for them to answer accurately without fear of repercussions. Anonymity and confidentiality are important as land managers who kill beavers might face social pressure, or legal prosecution under animal cruelty laws (pre-May 2019) or animal protection laws (post-May 2019). As such, the bean count technique can be considered as a more methodologically and ethically robust way to quantify illegal or controversial behaviour (see Jones et al., 2021, for a full discussion).

Participants were given three sealed transparent containers, and three bags of small plastic tokens, in red, black and white, and the protocol for the 'bean count' method was explained. The containers were each labelled, with method instructions written on the lid. Fieldwork was undertaken in parallel by KF and GR, giving a total of six containers. The first container acted as a trial for the technique. Respondents were asked, once the researcher had turned their back, to place one black counter into the box for every apple eaten in the last 7 days, and one red counter for every sausage eaten in the last 7 days, up to a maximum of 10 counters of each colour. They were also asked to add some white tokens. These did not measure anything, but added mass to the container. The containers were pre-loaded with 15 white counters, and 10 each of red and black, meaning it was impossible to identify the additional contribution from early respondents. Given that the same boxes were used for multiple respondents, it would therefore be impossible for the researchers to know which counters had been added by individual respondents. Although other bean count studies have used trial questions that ask respondents to recall items on a similar time frame and theme to the main research questions, such as on farming activities, here the diversity of respondents made it difficult to identify a universally applicable theme, so we chose to ask about something unrelated but tangible.

Once the trial was completed, respondents were given the second container. They were instructed to add, once the researcher's back was turned, one black counter for each beaver the respondent had killed during the period prior to May 2019, and one red counter for every beaver dam they had destroyed during the same period, up to a maximum of 10 counters, and some white tokens for additional mass. Respondents were then given the third container, and instructed to add one black token for each beaver they had personally killed during the period since May 2019, explicitly excluding those undertaken under licence from NatureScot, one red token for every beaver dam destroyed during the same period, whether or not it was under licence, and some white tokens for additional mass. We distinguished between licensed and unlicensed killings after May 2019, the period when licensing started, as licensed kills are counted elsewhere, and we were interested in quantifying the hidden killing. Containers were not opened until all fieldwork was concluded.

Respondents reported that they found the method easy to follow and answer. A significant minority were also willing to verbally tell the research team how many beavers were killed, demonstrating a willingness amongst respondents to speak about killing beavers, though we did not formally record these responses. The bean count method is not perfect. For example, participants may overstate beaver killings to give a stronger impression of discontent, although the 10 counter limit was intended to act against this. One respondent noted that they had killed well in excess of 100 beavers, although they had only added 10 counters. It is therefore possible that our method under-estimates the total killings and dam removals.

3 | RESULTS

Our 'bean counter' method showed that respondents reported killing 64 beavers prior to May 2019, and 19 afterwards, and destroying 50 dams before May 2019 and 49 afterwards, up until the fieldwork in August 2021. Assuming that respondents placed no more than 10 counters of each colour into the containers, this shows that at least 7 and a maximum of 64 respondents killed beavers before 2019, and between 2 and 19 after May 2019. Extrapolating from these results would indicate that a minimum of 40 ($p = 0.05$) land managers, of 424 ± 19 eligible properties in the catchment, killed beavers prior to May 2019, and between 103 and 722 ($p = 0.05$) beavers were killed. After 2019, this would indicate that between 19 and 293 beavers were killed, by between 2 and 170 land managers across the catchment ($p = 0.05$). For dams destroyed, these responses indicate that prior to 2019, between 7 and 323 land managers destroyed between 87 and 588 dams, and between 7 and 307 land managers destroyed between 86 and 573 dams ($p = 0.05$). The margins of error are so high because the standard deviation cannot be known at individual level, just extrapolated from the theoretical minimum and maximum number of respondents who killed beavers or destroyed dams in each period, based on the most and least even distribution of counters. However, it would indicate that killing was relatively widespread prior to beavers becoming protected, and continued afterwards, and that dam destruction has always been prevalent.

Within our diverse sample (Table 1), the majority (50 of 68) reported that they had beavers on, or very close to, their land, with 12 disagreeing and 6 unsure. There were strong views on where they thought beavers came from, with the majority (47) attributed it to deliberate release by conservationists. In informal conversations, many respondents identified a particular local private collection as the alleged source. A further 8 attributed it to deliberate release by government, 7 to accidental release by conservationists and 2 to accidental release by government. Nine were not sure. Beaver impacts were widespread, with 37 reporting some kind of damage from beaver activity, and 31 no impact. Of these, 35 reported damage to trees, 32 reported eroded or collapsed riverbanks, 17 flooding to their property and 9 reporting other kinds of impact.

A majority thought that beavers neither were native nor belonged to Tayside (Figure 1). In most cases ($n = 37$, 54%), respondents gave the same answer to these two items. A further six scored them differently only by strength of feeling, scoring agree/disagree to one and strongly agree/strongly disagree to the other. There was less certainty, and slightly less disagreement, that beavers belonged elsewhere in Scotland. Respondents overwhelmingly thought beavers were not good for them personally, though they were more equivocal about wider benefits to society and nature. There was a strong desire to see beaver populations decrease. Thirty-eight

TABLE 1 Characteristics of properties surveyed.

	Feature of property	No. of properties
Significant land uses on property	Livestock farming	38
	Arable farming	33
	Tourism/recreation	16
	Forestry	6
	Fruit/vegetables	8
Property size	Less than 25 ha	10
	25–50 ha	4
	50–100 ha	7
	100–200 ha	11
	More than 200 ha	36
Land tenure on property	Owned by land manager	36
	Tenanted by land manager	13
	Land manager part-owns, part-tenants on property	8
	Other	11
Age of land manager	Under 40	13
	40–49	17
	50–59	9
	60 or over	29

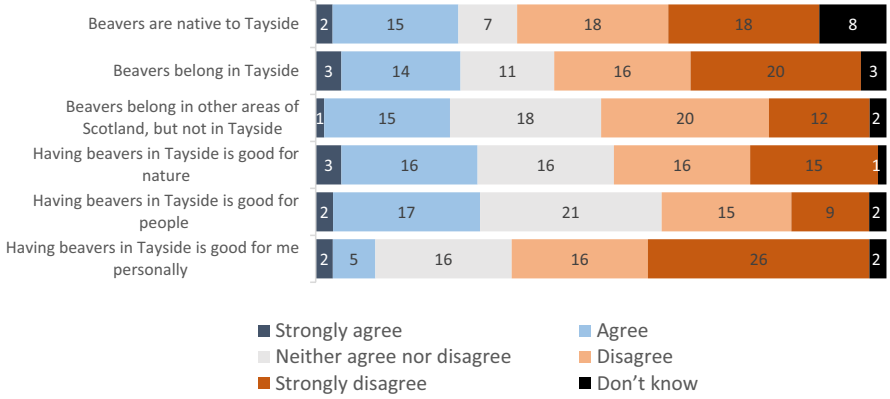


FIGURE 1 Attitudes of respondents to whether beavers were native or belonged, and attitudes to beavers.

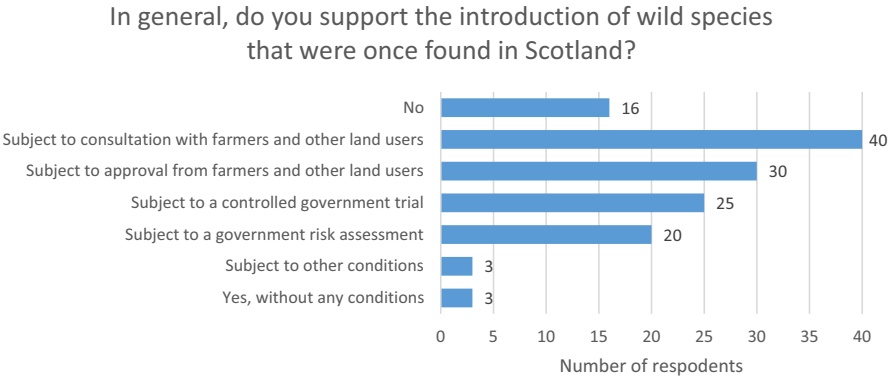


FIGURE 2 Land managers' views on whether, and under what conditions, they would support species.

respondents wanted them to decrease, 19 remain the same, and five wanted to see beaver numbers increase, with six responding 'don't know'. There was a belief that others felt the same way—35 respondents though most people in the area wanted to see beaver numbers decrease, 14 to stay the same and four increase. Fifteen responded 'don't know'. This opposition to beavers contrasts with the general acceptance of the return of species, subject to appropriate consultation (Figure 2).

Land managers had taken various actions to mitigate beaver damage, and identified areas where they would take future action, favouring government support in removing beavers and their dams rather than ways of living alongside beavers (Figure 3). The government, and to a lesser extent environmental groups, were seen as responsible for ameliorating the costs of living with beavers. 56% ($n = 38$) respondents thought the extra costs of living with beavers should be met through government subsidy, and 45% ($n = 31$) thought that the government should compensate land users directly for any additional costs. 26% ($n = 18$) thought that environmental groups should meet the cost, and 15% ($n = 10$) thought that it was a normal cost of doing business which should fall on landowners.

Respondents overwhelmingly saw their job as part of their identity, and saw themselves as responsible for shaping the landscape to create, a custodian of a landscape that needs careful intervention (Figure 4). Beavers were seen as bringing extra hassle and undermining the ability to be a good land manager. The majority of respondents thought that although beaver reintroduction was not a conspiracy against them, nevertheless those managing beavers did not understand them. The majority also considered that beavers were not the most significant challenge to their lives.

4 | DISCUSSION

Our work explored human–beaver interactions in the context of broader environmental politics and values. It shows that, in Tayside, killing beavers and destroying their dams has been a widespread phenomenon. These continued after beavers became protected, and the introduction of licensed culls and relocation programmes. Such killings demonstrate significant strength of feeling against species reintroduction. The rates of killing are high, given that the population was a few individuals in the early 2000s and around 1000 by 2021. Beavers are fast breeding, reaching sexual maturity at between 1.5 and 2.5 years old, and capable of producing up to 5 infants per year (Campbell, 2010), and the ecosystem, with ample waterbodies and riparian vegetation, and few natural predators,[6] is ideal beaver habitat. As such, killings and dam destruction have not stopped the expansion of beavers, although there were some local declines in some areas of Tayside between 2012 and 2017/18, particularly on the River Isla as it

[6]There are no lynx nor wolves in the UK, a key predator of beaver elsewhere in their range. In the UK, red foxes, otters, and potentially large fish or raptors, are their only predators.

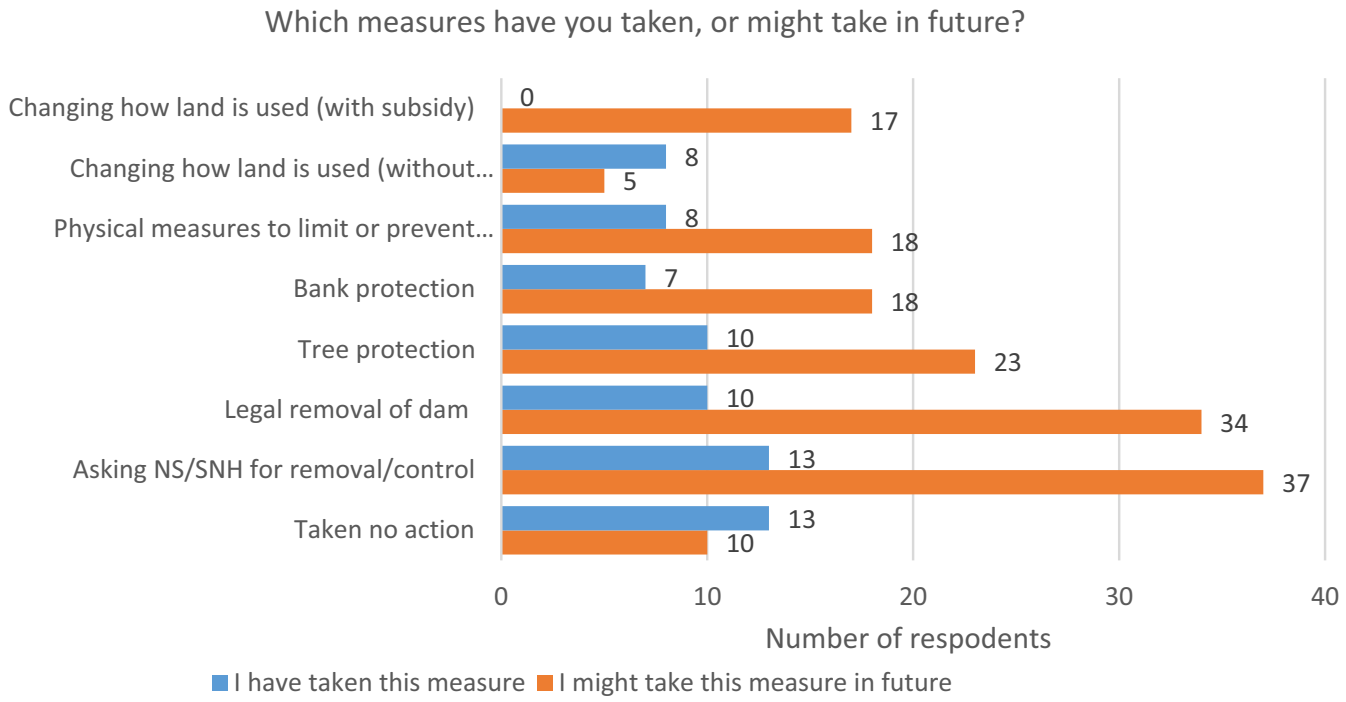


FIGURE 3 Measures taken by land managers to mitigate beaver impacts, and land managers' views on whether they would take such mitigation measures in future (NS, NatureScot; SNH, Scottish Natural Heritage).

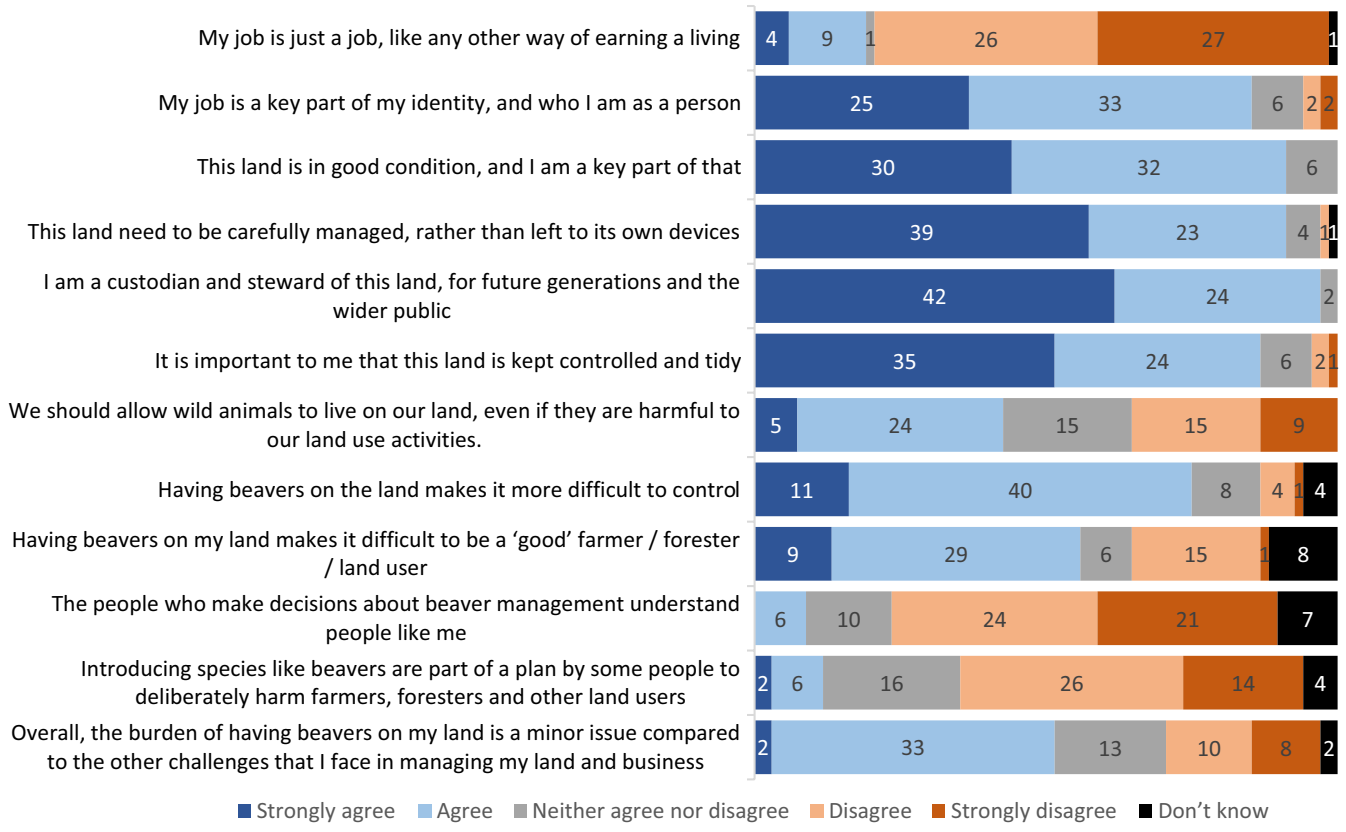


FIGURE 4 Respondent's views on relation values and environmental politics.

meanders around arable and fruit farms around Coupar Angus (Campbell-Palmer et al., 2021), which could be attributed to killings. Beaver ranges and populations in the UK continue to expand, through reproduction, relocating problem animals, and further covert and official releases. As beavers have few natural predators, and reintroductions of large predators are not currently politically viable in the UK, we can expect beaver expansion to continue. As yet, there is little discussion on what the maximum desirable range and population might be, and how to manage beavers in the long term.

Our survey shows that beaver killings and dam destruction take place in a context of widespread hostility towards beavers, although views were heterogeneous, and some land managers had positive views of beavers. Respondents tended not to see beavers as good for them personally, though there are more mixed views on whether they are good for people in the broader area, and for nature. Most people wanted beaver numbers to decrease, with some particularly forthright qualitative responses, such as wanting outright elimination of beavers. There is a belief that most people want beaver numbers reduced. Some indicated that beavers might be acceptable in places where there was no conflict with higher value, flood-prone farmland, such as upland and upstream areas. This opposition may, at least in part, be seen as a rational response to the damages caused by beavers. A slight majority of respondents reported beaver damage, particularly tree damage and eroded river banks, which is problematic when growing crops or keeping livestock on riparian fields.

A majority of respondents thought that beavers do not belong to the region, and that they are not native. A species 'belonging' appears largely synonymous with 'native' for our respondents, although this is not always the case with other introduced or reintroduced species (Fischer et al., 2011). Our method was unable to explore why beavers were not considered native, but it should not be assumed that this is because respondents are unaware of historical presence of beavers in the region. Rather than ecological ignorance, these views are based on particular understandings of what is appropriate, or not, in the landscape. Elsewhere in the UK, the residents of west Wales recognised that beavers had lived locally in the past, but the social and ecological changes in the intervening centuries were so significant that they no longer fitted, and thus no longer native (Holmes et al., 2022). Such a view contrasts with the views of rewilding advocates, who consider that centuries or even millennia of absence is not long enough to cancel out a species' 'native' status (Jørgensen, 2019). Interpreting respondents views that beavers are not native in the light of the literature on resistance to conservation (Holmes, 2007), beaver killing and dam destruction are not solely about the direct impact of beavers, but also an implicit political statement that these animals do not belong in the landscape.

Consistent with other studies of farmers' environmental values, respondents considered their self-identity as tied into their occupations, seeing themselves as custodians of the land, carefully controlling, tidying and co-creating it (Burton, 2004; Chapman et al., 2019; Holmes et al., 2022). Beavers were generally seen as making landscapes more difficult to control, disrupting managers' relationships with the land. Many felt beavers made it difficult for them to be good land managers. Such views are consistent with other case studies, where land managers oppose species reintroduction because it disrupts their multifaceted relationship with the land (Fry, 2023; Ojalammi & Blomley, 2015).

Our research has four important implications for how we think about coexistence with reintroduced species. First, our work shows that local resistance can harm species reintroduction. Whilst in our study, local opposition was fatal for individual beavers but it did not fatally undermine conservation, in other cases, such as with slower-breeding species, such killing could undermine a reintroduction to the point of failure (Holmes, 2007). Local support is not a prerequisite for successful conservation in every instance (Brockington, 2004), but it does make conservation easier. Those advocating for reintroductions should take note.

Second, our work shows that opposition to reintroductions is only partly based on narrow, economically rational, ideas of damage mitigation. Rather, it is also about how people value the landscape, what and who belongs in it, and how they think decisions should be made. Thus, it is not enough to attempt to create co-existence with reintroduced species by focusing solely on damage mitigation, but rather the environmental values of local people also matters. A key part of opposition is how reintroduced species can disrupt land managers' relationships with landscapes, and related ideas of identity, sense of self, and role in maintaining particular landscape forms. Thus, reintroductions may be particularly problematic when they involve species that are very ecologically disruptive, and when they are valued precisely for these disruptive qualities, such as in rewilding.

Third, our work also shows that attitudes and actions of local land managers towards reintroduced species reflects their views on the institutions who supposedly govern those species. In Tayside, land managers tend to lack faith in formal or official land management approaches and institutions. As with other studies of reintroduced species (e.g. Fry, 2023; Pinkerton et al., 2019), there is a widespread belief that those managing beavers do not understand land managers (Figure 4). A minority believe that beaver reintroduction is part of a wider conspiracy against land managers. Whilst this belief may be an exaggeration and expression of frustration rather than sincerely held view, it nevertheless should be recognised as part of the conservation politics. It reflects an insider-outsider dynamic common in rewilding and conservation, whereby conservationists and officials are talked about as out-of-touch urban elites, who look down on those living in nature (Fry, 2023; Pinkerton et al., 2019; Von Essen et al., 2015). A lack of faith in individuals and institutions managing beavers and related issues will lead to these other, informal responses, as seen with illegal killing of wildlife elsewhere in Europe (O'Rourke, 2014; Von Essen et al., 2014). Our data indicate that land managers may support the presence of other wildlife and species reintroduction, particularly if there is consultation, local consent or careful trials. Consistent with the wider literature on human–wildlife

interactions (e.g. Pooley et al., 2021), there is more likely to be support for reintroductions if the species is seen as a legitimate part of the landscape, and the institutions and policies managing those species are seen by land managers as legitimate. Here, outreach or education schemes may help create a sense of legitimacy, and foster coexistence, although value shifts in conservation are slow and hard to engineer (Manfredo et al., 2016).

Fourth, following the previous point, our work supports the idea that the manner in which species are reintroduced matters for future coexistence. Covert reintroductions do not allow for building of formal and informal institutions, strategies or discourses that might support coexistence, or for discussions that allow the reintroduction process to develop legitimacy amongst stakeholders. Instead, landowners are not consulted or informed, and the absence of institutions or policies to manage the reintroduced species may leave land managers to deal with the consequences of the reintroduction without support or guidance. As our case shows, a lack of institutional support generates discontent (Coz & Young, 2020). Reintroduced species remake law and territory, bringing new actors in the species and new regulations and legal geographies within their range (Ojalammi & Blomley, 2015). In cases such as this, where legal protection for the species came after the reintroduction, land managers can find themselves subject to greater regulation, but without a full prior consultation process. Consequently, covert reintroductions may be more problematic, at a local level, than formal reintroductions. However, as Thomas (2022) shows, covert beaver reintroductions have forced the hand of governments in the UK to consider more formal reintroductions of beavers and other species. Thus, whilst covert reintroductions may create antagonism at a local level, this might be offset by reimagining the place of species in broader political and public discourse. In other places where beavers were covertly introduced (e.g. the River Otter in England, the Spanish Pyrenees and Belgium), they were ultimately allowed to remain in place (Auster et al., 2021; Cockerell, 2023; Vaccaro & Beltran, 2010).

5 | CONCLUSION

Our research shows that covert and illegal killing of beavers, and destruction of beaver dams, is widespread, with many incidents and perpetrators, albeit with a large margin of error due to the methods we use. These killings and dam destructions continued after May 2019, when beaver became protected, and government introduced measures to mitigate beaver damage. Such incidents appear to be grounded in dissatisfaction with official routes for beaver management, the covert manner of beaver introduction, and the way beaver behaviour challenges land managers relationships with their land. Given the values and broader rhetoric expressed by respondents, these acts are not solely about mitigating beaver damage but are expressions of dissatisfaction about the presence and management of beavers, and how these clash with the values and identity of land managers.

Drawing on the wider literature on species reintroductions, politics of conservation, and on environmental values, our research shows the importance of considering opposition to reintroductions, and how it might play out. First, it shows how acts of resistance have the potential to damage reintroductions, albeit with limited impact in our case study. Second, it shows the importance of considering the environmental values of those who are to live alongside the reintroduced species. Third, it shows how processes of reintroduction, and attitudes towards institutions responsible for governing reintroduced species, can shape attitudes to reintroduction. Overall, our work shows the need for a deep social science engagement with species reintroduction, and how it is experienced by human populations, one that goes beyond the material impacts and ways to mitigate these, and into broader questions of how people value and engage with their landscape at large, and ultimately coexist with wild species.

AUTHOR CONTRIBUTIONS

George Holmes conceived the project, led the design of the methodology, led the analysis and wrote up the findings. Katherine Fox and Gabriel Rowland assisted with designing the methodology, and led data collection, and assisted in writing up the findings.

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CONFLICT OF INTEREST STATEMENT

There are no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

All data presented here are based on the survey described in the methodology. This is not publically available, in order to protect respondents' anonymity, and in keeping with our research ethics approvals.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Data S1. Beaver survey.

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