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Ecological Solutions and Evidence

RESEARCH ARTICLE

Pragmatic or problematic? The risks and rewards of rewilding with non-native species

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Abstract

1. Ecological replacement (ER) with non-native species is a controversial yet potentially powerful tool for rewilding through the restoration of lost ecosystem function and complexity. However, its appropriate application and associated risks remain contested.
2. We combined a scoping literature review with 24 expert interviews to assess the perceived risks and rewards of this approach. 21 papers covered 13 introductions across 11 locations.
3. Out of 13 introductions, 11 reported increased ecosystem function and/or complexity, yet interviewees also warned of unintended consequences including the disruption of native communities and animal welfare concerns. Crucially, perceptions of risk and reward varied strongly with views of rewilding, values placed on nativeness and tolerances to change and uncertainty shaped by ecological and sociocultural contexts.
4. *Solution*. We propose an organising framework to bring the potential risks and rewards of ER into a single picture, helping conservationists reflect on such perceptions. This aims to foster more pluralistic dialogue to support inclusive, context-sensitive rewilding strategies that clarify not just where and when ER with non-native species is appropriate, but also for whom and what.

KEYWORDS
ecological replacement, non-native species, restoration, rewilding, taxon substitution translocation

1 | INTRODUCTION

There are growing calls for large-scale initiatives that enhance ecological abundance and complexity (Bullock et al., 2022; Svenning, 2020). In the past decade, rewilding has gained traction as a key approach to achieving these aims. It is broadly defined as promoting self-sustaining, self-organising ecosystems driven by natural processes (Carver et al., 2021; Perino et al., 2019; Pettorelli & Bullock, 2023), and seeks to improve resilience through functions such as seed dispersal, nutrient cycling and biological control (Contos et al., 2021; Derham et al., 2018).

Among several recognised distinctions between rewilding and restoration is rewilding's lower fidelity to historical ecological baselines, owing to its stronger emphasis on ecosystem functioning (Moorhouse & Sandom, 2015). Rewilding uses baselines as a guide more than a target, drawing from the past to create new and wilder

futures (Pettorelli & Bullock, 2023). In this regard, one of rewilding's most controversial aspects is its acceptance of ecological replacement (ER) as a possible intervention for recovering ecosystems' functionality (Fernandez et al., 2017). ER is defined as 'the intentional movement and release of an organism outside its indigenous range to perform a specific ecological function … lost through extinction' (IUCN, 2013, p. 3).

Most recently, several European rewilding efforts have begun to employ domestic livestock (some native, others non-native) to recover ecological functions such as herbivory via a model described as 'rewilding lite' (Gordon et al., 2021). To date, however, the broader impacts of non-native species-based ER[1] remain uncertain, and there are concerns that it may not always achieve the desired goals, risking scarce conservation resources being wasted (Moorhouse-Gann et al., 2022; Rubenstein et al., 2006).

Non-native species also tend to lack cultural value and recognition, rendering them vulnerable to social resistance (Schlaepfer et al., 2011). This often stems from concerns that species may become 'invasive'—'negatively impacting native biodiversity, ecosystem services or human economy and well-being' in unforeseeable and undesirable ways (IUCN, 2021, p. 1). This has spurred calls for prioritising the recovery of native species in efforts to restore degraded ecosystem functions (Schlaepfer, 2005). However, the favouring of species' origins over their ecological functions has also led to claims that so-called 'nativist' conservation efforts are unproductive at best and xenophobic at worst (Lemoine & Svenning, 2022; Zerbe, 2023).

We therefore applied a scoping review to clarify 'What have been the impacts of ER to date?'. We then coupled this with expert interviews to identify 'What are the risks and rewards of ER in rewilding?', and subsequently, 'Where and when is ER an appropriate rewilding intervention?'

To structure our findings, we adopted Roberts' (2023) framework, designed to help decision-makers tackle complex challenges by integrating considerations of risk and resilience with reward. Such integrations are increasingly important as environmental managers seek effective methods to accelerate nature's recovery.

2 | MATERIALS AND METHODS

2.1 | Scoping review

We cross-referenced Tricco et al.'s (2018) scoping review guidelines with Haddaway et al.'s (2018) ROSES pro forma, developing the protocol detailed below a priori. We systematically searched seven databases for primary literature: (1) Web of Science Core Collection, (2) Web of Science BIOSIS Citation Index, (3) Web of Science Zoological Record, (4) Scopus, (5) ProQuest Social Science Premium, (6) CAB Abstracts and (7) PubMed (Table S1). We also searched the Bielefeld Academic Search Engine (BASE, 2023) and Overton (2023) for grey and policy literature, respectively. Finally, we asked our interviewees to share any additional literature deemed relevant to the research. We focused on studies using wild non-native species, rather than native or non-native domesticated.

We conducted all searches in June 2023 using adaptations of the string in Table S1. To maximise the volume of literature returned, we placed no date range limit on the searches. We only ran the search string in English and used simplified strings for the non-bibliographic databases (BASE and Overton), since they do not allow advanced Boolean searching. We imported all results to Zotero Version 6.0.26 (Zotero, 2023), before linking Zotero with Covidence (Veritas Health Innovation, 2023) to screen all articles at title and abstract level, and those then remaining at full-text level (criteria outlined in Table S2).

2.2 | Interviews

Semi-structured interviews were conducted as they allow flexibility while reducing the opportunities for tangential conversation (Elhami & Khoshnevisan, 2022). Through purposive sampling, we used email to invite participants who had led influential work in the research or practice of rewilding, non-native species or ER across diverse occupations, career stages, locations and disciplines. To explore potential differences in perspectives, participants were classified into two broad groups based on their primary professional role: academics and practitioners. We first introduced the interviewees to our definition of non-native species, rewilding and ER (Table S3), before asking eight questions (Table S4) plus spontaneous sub-questions to gain further detail.

2.3 | Data synthesis and analysis

Literature was synthesised using a qualitative metasummary (Sandelowski et al., 2007). This first entailed extracting the replacement and extinct species names (common and scientific), the reported location and date of the introduction, and its reported rewards and issues (pertaining to the risks) (Table S5). We then calculated the frequency effect of reported rewards, dividing the number of introductions for which increased ecosystem function or complexity was reported by the total number of introductions.

We then conducted a thematic analysis of the interview data using NVivo Release 1.7.1 (QSR International, 2023). We followed Braun and Clarke's (2006) six-step thematic analysis methodology (Figure S1) for a well-established but flexible approach. We grouped relevant codes under risk and reward, using Roberts' (2023) original themes for reward: *opportunity*, *access* and *capability*. Table 1 outlines our adopted definitions for these themes, plus risk and reward more broadly. Themes for risk were generated inductively due to difficulties separating Roberts' (2023) original themes (threats and hazards, vulnerabilities and exposures) in an ecological context. Analysis was conducted alongside the interviews until saturation at which new themes and codes were no longer generated. This suggested that our sample was large enough to provide meaningful insight.

[1]This research focused on ecological replacement using only non-native species. It is herein referred to as simply 'ER'.

TABLE 1 Key definitions used in relation to ER. Opportunity, access and capability are Roberts' (2023) original themes under Reward. Themes for Risk are outlined in the results, having been generated inductively.

Term	Definition
Reward	Any increase in ecosystem function or complexity (following Perino et al. (2019)).
Risk	Any factor that may drive the possibility of negative outcomes (following Roberts (2023)).
Opportunity	The potential benefits of ecological replacement.
Access	The factors required to open the door for ecological replacement.
Capability	The factors influencing how effectively one can exploit access to ecological replacement's opportunities.

3 | RESULTS

3.1 | General patterns across the data

The literature and interviews showed clear convergence. Both highlighted the potential of ER to enhance ecosystem function and complexity, alongside risks to introduced organisms (e.g. maladaptation). There was also agreement on benefits such as invasive species control and native recovery, which may support perceptions of ER as cost-effective. Additional overlaps included the value of large, slow-moving species in reducing invasion risks, potential ecotourism benefits and animal welfare concerns such as poaching and nest disturbance. Nonetheless, both sources highlighted key limitations. Most notably, interviewees called for more long-term, diverse data; an issue reflected in the literature's limited empirical scope and taxonomic focus.

Some important discrepancies also emerged between the datasets. Interviewees frequently raised concerns about replacement species becoming invasive, yet this was only weakly supported in the literature (23% of cases). Concerns about reproduction, dispersal and disease were also prominent in interviews but largely absent from published evidence. Conversely, interviewees focused mainly on ER's vegetation management benefits, while the literature identified a wider range of ecological impacts including nutrient cycling and seed dispersal. Interviews also provided broader insights beyond the literature's ecological focus, highlighting species and site suitability, ethical considerations and socioeconomic factors. Crucially, they emphasised that perceptions of risk and reward are highly context-dependent.

3.2 | Scoping review

Our scoping review retrieved 187 articles (Figure S5). We excluded 128 based on their titles and abstracts; 59 were thus screened at full-text level. We excluded 44 articles (2 non-English, 21 conceptual, 5 unintentional introductions, 4 subspecies introductions, 7 domesticate introductions, 3 proposals, 1 assisted colonisation and 1 MSc thesis directly preceding an included publication). To the remaining 15, we added 6 pre-screened articles from Google Scholar, leading to a total of 21 for review. These papers covered 13 non-native species introductions across 11 locations (Table S5). Six cases were covered by just one paper each, while the most widely discussed introductions—of Aldabra giant tortoises (*Aldabrachelys gigantea*) to Ile Aux Aigrettes and Round Island—were covered by five and six papers, respectively. Approximately 85% ($n = 11$) of cases involved reptiles (5 species of tortoise) as the organism being introduced, with the remaining circa 15% involving invertebrates (43 species of dung beetle) ($n = 1$) and birds (Snares Island Snipe, *Coenocorypha huegeli*) ($n = 1$).

Crucially, 11 of the 13 introductions (85%) were reported to have resulted in rewards of increased ecosystem function and/or complexity (Table S5) such as improved nutrient cycling (Doube, 2018), seed dispersal (Griffiths et al., 2011) and invasive species control (Moorhouse-Gann, 2017). Some risks were also reported, such as poaching, predation by invasive species (Samour et al., 1987; Stoddart et al., 1982), competition with native species (Moorhouse-Gann, 2017) and stress caused to replacement organisms by the introduction process (Griffiths et al., 2012). Detail on all reported risks and rewards can be found in Table S5.

Studies varied from short-term (6 months (Burney et al., 2012) or 1 year (Griffiths et al., 2013)) to longer-term (up to 7 years (Moorhouse-Gann et al., 2022)). Spatial scales of the introduction sites ranged from small enclosures of 8×8 m (Griffiths et al., 2013) to entire islands (Hunter et al., 2013; Miskelly et al., 2012).

3.3 | Interviews

We interviewed 24 out of 71 invited participants (41 practitioners and 30 academics); a 34% response rate (62.5% practitioners and 37.5% academics). About 54% worked at a senior level (director/professor), and all were from varied disciplines and locations. High diversity was not achieved in every regard, given the male: female ratio of 19:5 (Figures S2–S4). We piloted questions with two academics who had relevant knowledge. All interviews were conducted remotely in June 2023 by the first author (AC). Interviews lasted for a mean time of 34 min and 37 s (standard deviation: 9 min and 9 s).

We identified a total of nine themes relating to ER (Figure 1). These included three themes for risks—Risks to the resident species and recipient system (1), Risks to people (2), Risks to the replacement organisms (3),—three for rewards—Opportunity (4), Access (5), Capability (6),—and three relating to the reflexivity of its decision-makers, that is individuals' ability to evaluate how context influences their own perspectives—Concept of rewilding (a), Perceived value of nativeness (b), Risk tolerance (c). Themes related to reflexivity are labelled differently as they reflect higher-level considerations that fundamentally influence how individuals define and perceive risks and rewards.

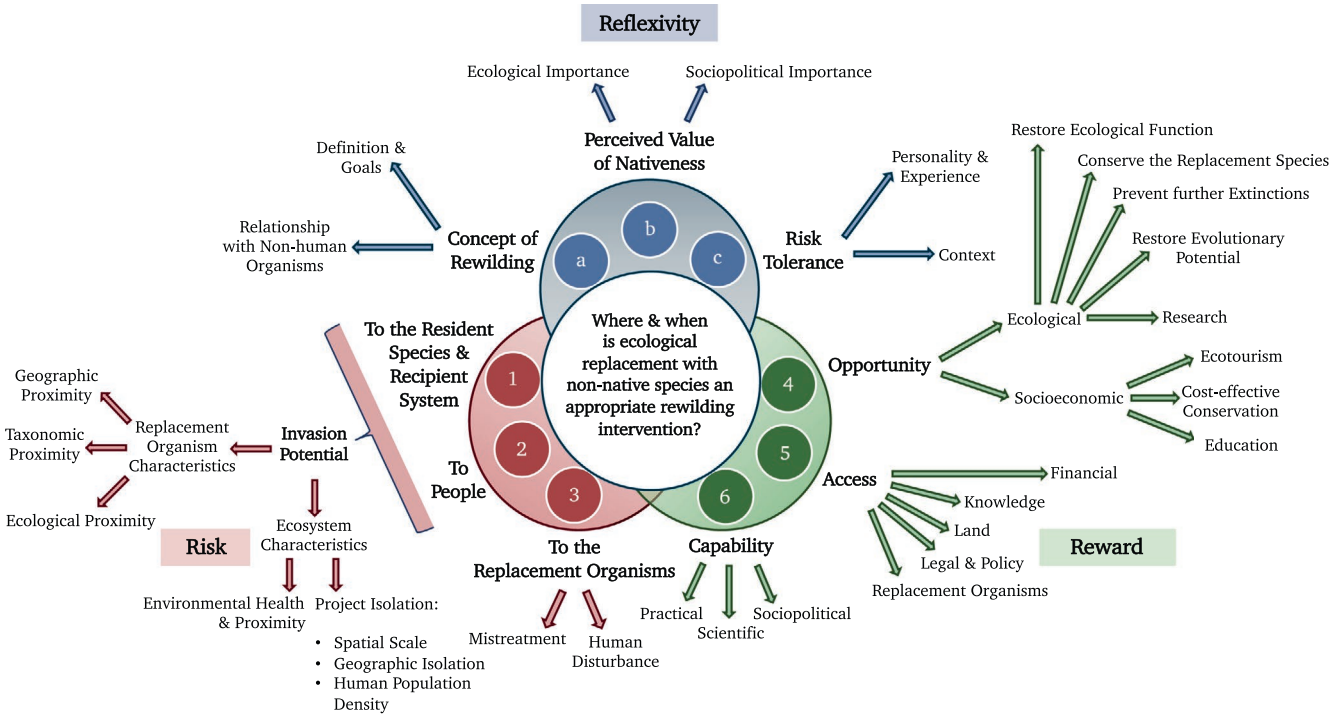

FIGURE 1 The six themes (1–6) of risk and reward in relation to ecological replacement, plus three themes (a–c) for reflexive consideration that influence the constitution and perceived importance of each risk and reward. All themes were identified through the scoping review plus interviews with 24 conservation academics and practitioners. Codes (e.g. 'Context', 'Socioeconomic') are directly connected to themes (e.g. 'Risk Tolerance', 'Opportunity'). Some codes have sub-codes, labelled on the outer set of arrows. Framework and figure adapted from Roberts (2023).

3.3.1 | Theme 1—Risks to the resident species and recipient system and Theme 2—Risks to people

Interviewees highlighted risks to the resident species and recipient system and to people. 83% of participants highlighted the potential of non-native organisms to develop invasive character as '*one of the main risks that this introduction might have*' (Participant C, academic). Participants expressed concerns around replacement organisms exhibiting high rates of reproduction and dispersal, causing them to '*spread beyond the region under rewilding*' (Participant V, academic). Thus, participants placed significant emphasis on '*the risk that a non-native species may do unexpected or negative things*' (Participant F, practitioner) such as '*outcompete native species*' (Participant N, practitioner) or '*bring disease or parasites that wouldn't ordinarily be in the system*' (Participant N, practitioner). About 54% also mentioned a '*need to think about reversibility*' (Participant A, practitioner), suggesting that '*you need an off switch if something goes wrong*' (Participant B, academic). However, Participant L (academic) highlighted that reversing ER can be practically challenging because you need '*the political and community support to undo it*', which can be difficult because '[the community] *might be invested*' in the replacement organisms and so '*the idea of shooting them or recapturing them may not be acceptable*'.

Participants emphasised that the potential for invasive impacts depends on both the traits of the introduced species and the characteristics of the recipient ecosystem. They identified ecological similarity to the extinct species as the most important trait of candidate replacements (92%), followed by geographic and taxonomic proximity (each cited by 42%). For recipient ecosystems, participants highlighted resilience (33%) and isolation (38%), referring to its spatial scale, geographic isolation and human population density. To reduce the risks of ER introductions, participants noted that the recipient ecosystem '*has got to be as closely matching as possible to the ecosystem of the species that you're going to introduce*' (Participant A).

Participants also suggested that the reversibility of ER interventions could be increased by using '*large-bodied non-flying organisms with relatively low dispersal abilities*' because they are generally '*easier to control or manage than small-bodied things that have high dispersal abilities and high reproductive rates*' (Participant G, academic). This corroborates the scoping review results, with 71% of cases using tortoises. Participant O (academic) took this one step further and suggested using sterile or juvenile organisms to ensure that '*there's no chance of them going off and creating a malfunctioning population*'. While a low dispersal ability and ecological similarity to extinct species can increase ER's rewards through opportunities, access and capability, these characteristics primarily stood out as key to reducing risks, which appeared the most common starting point for thinking about ER across both the interviews and the literature.

3.3.2 | Theme 3—Risks to the replacement organisms

About 50% of participants highlighted risks to the welfare of the replacement organisms themselves. These were most commonly believed to arise from introductions into inappropriate habitat, with 38% suggesting the need for '*an ecosystem which is not so degraded that there will be welfare implications for the animal*' (Participant D, practitioner). Less frequently mentioned (8%) were risks of human disturbance to the replacement organisms. For example, Participant A noted that their ER project '*had one* [tortoise] *that's been stolen*'. Mistreatment was mentioned by 21%, referring to whether the organisms are treated as machines designed to support human objectives, or allies with whom we work to create co-benefits. Participant K (academic) expressed concern here, saying that '*we treat those organisms like they are little automatons, you take them from their home and you dump them somewhere … in your fenced reserve all so that you can have your little rewilding project and make the world how you think it should be*'. This was built on by Participant P (academic), who stated '*I prefer to give others the respect that I want to be granted myself*' when speaking on translocations and the use of non-human organisms for human-created goals.

3.3.3 | Theme 4—Opportunities

In alignment with the literature, 79% of participants believed that ER could effectively support the restoration of lost ecosystem function. Participants also mentioned ecological opportunities such as helping '*improve the conservation status of the organism you're moving*' (Participant L), '*stall other species extinctions*' (Participant O) or '*[restore] evolutionary potential*' (Participant L). However, these always came second to restoring ecosystem function and were each mentioned by no more than 13%. Participants believed that ER provides socioeconomic opportunities too through ecotourism, education and more cost-effective conservation, but these were mentioned less frequently (by only 29% altogether).

3.3.4 | Theme 5—Access

Regarding access, participants most frequently (54%) mentioned legal and policy barriers. Participant R (academic) noted that '*in every nature conservation treaty or national law, the provisions on non-native species are always to prevent the introduction*'. Frequent concerns that '*the bureaucratic approach that most of these projects have is very limiting*'. (Participant C) made Participant A's statement that '*we need to reduce government regulatory processes*' unsurprising.

3.3.5 | Theme 6—Capability

Lastly, participants highlighted the need for practical (50%), scientific (83%) and sociopolitical (88%) capability to access ER's opportunities. Regarding scientific capability, participants believed that rewilders often lack the depth of ecological understanding required to predict ER's impacts. Participant Q (practitioner) said '*know your system, know your species. That's the rule*', yet others implied that sticking to this rule is challenging as '*we still know very little*' (Participant M, practitioner) and may not '*have anywhere near the* [sufficient] *level of knowledge for wild species*' (Participant H, academic). Consequently, participants underscored the need for '*really intensive monitoring*' (Participant O) '*of what's happening in the ecosystem and to the target species, and making sure that you can respond and adjust your management if necessary*' (Participant R).

Participants underscored sociopolitical capability with the need for cultural acceptance of ER. This was illustrated by claims that ER must contribute to '*a good and fair rewilding project for the environment and the society that is living in that area*' (Participant C) and that it must support '*places where people can make a living, that supply food more broadly, and where we might encourage sustainably maximizing biodiversity*' (Participant S, academic). Participants highlighted the need for clearer rewilding-based communication and education to increase such acceptance, saying that otherwise, '*it could be confusing at different levels of society: leaders, politicians, communities*' (Participant J, practitioner).

3.3.6 | Reflexive considerations: Theme a—Concept of rewilding; Theme b—Perceived value of nativeness; Theme c—Risk tolerance

Crucially, participants frequently noted that ER's risks and rewards are highly context-dependent. Some believed reward to be '*partly a human construct*' (Participant L), '[depending] *on context and where we're thinking about it*' (Participant F). Participants took similar positions with respect to risk, stating, for example, that '*whether and what kind of habitat change is acceptable or not is a totally social issue*' (Participant H). It was clear from the interviews that the perceived risks, rewards and appropriateness of ER vary across different individual, sociocultural and theoretical contexts. This was best summarised by Participant L, who commented that '*a lot of it is philosophical decisions anyway, there's not necessarily a right or a wrong, and how unwise a decision is, is often a perception*'.

Therefore, alongside risk and reward, and in place of Roberts' (2023) third element—resilience, which was too easily conflated with reward in the context of ER—we also identified three themes related to reflexivity (labelled a–c, Figure 1): how people define rewilding, the extent to which they value species' nativeness, and what their risk tolerance is. These themes appeared to significantly influence people's constitution and perceived importance of risks and rewards.

4 | DISCUSSION

Our findings showed that ER has the potential to offer varied rewards, most notably the restoration of lost or degraded ecosystem

functions, and possibly with weaker risks than are often anticipated. Crucially, our interviews revealed that risks and rewards are not objectively defined, but can instead be heavily shaped by underlying values and goals. There is no universal answer regarding whether it is right or wrong to employ ER; the legitimacy of the approach depends on contested perspectives. Acknowledging this diversity is key to advancing more inclusive, transparent and context-sensitive rewilding strategies (Gardner & Bullock, 2021).

To support this, we propose an organising framework (Figure 1) that collates the potential risks and rewards of ER into a single picture (Themes 1–6) and encourages more reflexive decision-making that considers how definitions of rewilding, attitudes towards nativeness and risk tolerances (Themes a–c) shape our judgements about whether, when, for who and for what ER may be appropriate.

4.1 | The impacts of ER to date

Current evidence suggests that ER has generally increased ecosystem function and complexity, for example through invasive species control and improved recovery of natives and endemics. However, some negative impacts have been observed, including poaching and nest disturbance affecting replacement organisms, as well as occasional risks such as invasive plant dispersal and impacts on native species, though these appear less frequent than might be expected.

These conclusions are based on a limited and uneven evidence base. The scoping review identified relatively few empirical studies and a narrow range of introduction events. Most evidence comes from tortoise introductions (85% of cases), allowing comparatively stronger inference for this taxon. In contrast, dung beetle and bird introductions were each represented by only one study. Studies also tended to focus on different outcomes, meaning that few impacts have been examined in depth.

Despite these limitations, all reviewed introductions reported at least some positive outcomes. The range of observed benefits highlights the potential of ER and helps explain growing interest in its application. To strengthen the evidence base, future research should include a broader range of taxa, alongside more detailed and long-term monitoring.

4.2 | The risks and rewards of ER

Limited empirical data make it difficult to robustly assess the risks and rewards of ER. As a result, insights from this study rely on alignment between the literature and expert interviews, which together provide helpful indications of likely outcomes.

The most consistent potential reward of ER was the restoration of ecosystem function and complexity, including improved nutrient cycling, vegetation management and niche availability. This is supported by both empirical studies and expert perspectives, as well as in agricultural rewilding contexts using livestock (van Dooren et al., 2025). Such convergence suggests that ER can meaningfully contribute to rewilding goals.

The primary risk concerns the potential for introduced species to become invasive, despite limited direct evidence in ER contexts. Differences between perceived risks (interviews) and documented evidence (literature) may reflect careful planning and mitigation in past introductions, suggesting these risks can, in some cases, be managed. Additional risks include animal welfare concerns, legal barriers and environmental conditions unsuitable for introduction. These have also been noted in studies of semi-wild or domestic surrogates (Lovász et al., 2025; Theunissen, 2019; van Dooren et al., 2025), indicating system-level challenges that may require regulatory and legislative solutions.

The economic impacts of ER remain underexplored. Potential tourism benefits, for example, were cited by only one paper (Stoddart et al., 1982) yet were identified by several interviewees. Expert dialogues have also cited potential tourism impacts of ER using livestock, albeit alongside wider opportunity costs such as potentially negative impacts on farm yields and subsidy incomes (van Dooren et al., 2025). More explicit research on the financial impacts of ER on landowners and communities would therefore be beneficial.

Although risks exist, current evidence suggests that they should not outweigh the potential ecological benefits to the point of preventing action. The imbalance between perceived risks and rewards of ER may explain the limited implementation and evidence base to date. Advancing understanding of ER will require both further application and continued research to test its ecological and economic viability.

4.3 | The appropriateness of ER

The central finding from our interviews was that even if the impacts of ER were clearly understood, whether an individual considers those impacts to be risks or rewards, and, therefore, whether they consider ER to be an appropriate rewilding intervention, is heavily influenced by three core themes: How they define rewilding in the first place, the extent to which they value species' nativeness, and what their risk tolerance is.

4.3.1 | Definition of rewilding

Central to the divergent views on ER were contrasting understandings of rewilding and human–nature relationships, which can be broadly placed along a spectrum. On one end, several interviewees aligned with a wilderness-based view of rewilding, advocating minimal human intervention and prioritising nature's autonomy (Deary & Warren, 2019; Ward, 2019). Participant U (academic) described this as '*restoring the traditional landscape*', while Participant E (academic) emphasised the need to focus on native species alone, believing that '*if we're the ones making the decision about what species should fill a certain niche, then this is a way of playing God*.', and that given space and time, extant native

species could adapt to '*fill empty niches*'. From this perspective, ER can be seen as artificial and incompatible with rewilding (Mallon & Stanley Price, 2013; Ridder, 2007).

Some went even further, questioning the legitimacy of rewilding altogether. For example, Participant P argued that intentional introductions reflect '*human arrogance … to abduct a bunch of plants and animals and chuck them out and make it fit better into some kind of fantasy picture that people like*'. These views favoured passive relationships with non-human organisms, often supporting the idea of letting existing non-native or feral species remain and function as de facto replacements which may offer low-intervention alternatives to formal replacement efforts (Participant K; Lundgren et al., 2020; Clark et al., 2021; Raimundo, 2022). It is clear, therefore, that how someone defines rewilding can fundamentally shape whether they perceive ER to be an appropriate intervention, irrespective of the potential rewards it may generate.

4.3.2 | Perceived value of nativeness

Both the literature and interviews reflected longstanding concerns that non-native species may cause ecological and social harm, with research historically emphasising negative impacts (Cuthbert et al., 2022; Dueñas et al., 2021; IPBES Secretariat, 2023; Sax et al., 2022), while often overlooking potential benefits. One participant suggested that non-native species could be more prone to human resistance '*since they have not been operating in the* [recipient] *area for a long time*' (Participant C), implying that non-native species are generally perceived to lack cultural value and so are less likely to be well-received (Schlaepfer et al., 2011).

However, most interviewees also challenged this blanket framing, aligning with growing calls for a more nuanced view of non-native species (Sax et al., 2022; Schlaepfer, 2018). A key theme was the prioritisation of ecological function over origin. Participants emphasised that functional proximity—the functional similarity between the replacement organism and the extinct species— is more important than geographic or taxonomic proximity. Evidence in the literature also supports this, finding that replacement organisms are more likely to thrive when their new environment closely matches their native one (Griffiths et al., 2012).

These debates are further complicated by contestation around the concept of nativeness itself. Scholars and participants alike questioned whether 'native' and 'non-native' are ecologically meaningful categories or socially constructed labels shaped by historical and cultural perspectives (Hettinger, 2001; Sagoff, 2005). As Chew and Hamilton (2011) highlight, the concept of nativeness often reflects normative judgements rather than ecological realities yet continues to heavily guide practical conservation decisions. Participant H alluded to the problem this creates, saying, '*I think it's contextual, but when do you become native?*'. Some went even further, asserting that '*the idea that there's some difference between species defined as native and not native is a human fantasy*' (Participant P) and that '*these terms* [native and non-native] *have been created to order the thoughts of academics, not to deliver ecosystem restoration or rewilding*'. (Participant F).

Despite concerns about invasion risks, the literature suggests that negative impacts of ER are relatively rare and often outweighed by functional benefits (e.g. Griffiths et al., 2011; Moorhouse-Gann et al., 2022; Waibel et al., 2013). This points to a disconnect between perceived and evidenced risks, raising questions about how far concerns around nativeness are empirically grounded versus socially embedded. Risks of invasive species are worthy concerns in certain contexts, such as where predator traits complement prey vulnerability (Savidge, 1987), where suitable prey are abundant (Grosholz et al., 2000), where introduced species compound existing environmental pressures (Bialic-Murphy et al., 2020) or where opportunities for introduction events are high (Battini et al., 2021). However, our scoping review broadly revealed that, in the context of ER, negative impacts of replacement organisms are rarely evidenced (e.g. Moorhouse-Gann et al., 2022) and often outweighed by the benefits of restoring lost ecosystem functions (Griffiths et al., 2011; Waibel et al., 2013). The findings of this study, combined with those of the wider literature, encourage a broader reassessment of whether perceived values of nativeness and subsequent concerns about invasion risks are truly grounded in evidence across all contexts, or are instead sometimes driven only by empty assertion.

4.3.3 | Risk tolerance

Regardless of the available data, ER using non-native species inevitably involves risk and uncertainty. As 67% of interviewees noted, conservation decisions are rarely made with complete information. This may explain why most introductions in our scoping review occurred on small islands, with simpler ecologies, making it easier to predict the outcomes of ER. Yet how uncertainty translates into risk is often subjective. As Participant G put it, '*the tricky part is deciding when you have sufficient research*', while Participant H suggested it '*just comes down to personality difference*'.

Risk tolerance is also shaped by context, understood not only ecologically, but also in terms of cultural background, institutional constraints and personal experience (Lecuyer et al., 2022; McWherter, 2022). While 52% of participants viewed ER as a last resort, their willingness to accept its risks depended on the urgency they envisioned. Participant J said, '*I think that exotic species should be the very last option … but this is probably because I have never been exposed to such a critical situation*'. These findings highlight the need for more research on how diverse contextual factors shape conservation risk assessments (Tulloch et al., 2015).

Participants' concerns about the welfare risks to replacement organisms reflect growing ethical debates in rewilding (Thulin & Röcklinsberg, 2020). Participants worried about introducing organisms into unsafe or unsuitable habitats and treating them as instruments of human intention rather than as sentient co-participants in ecological recovery. Participant K captured this

sentiment: '*we treat those organisms like they are little automatons, you take them from their home and you dump them somewhere*'. There are also welfare considerations with the release of animals handled by humans, both in captivity or during translocation from other geographical areas. In these contexts, rewilding may cause suffering to the replacement organism during translocation (Thulin & Röcklinsberg, 2020). These concerns align with broader calls for respectful, justice-oriented approaches that recognise non-human agency in ecological restoration (Duffy & Sands, 2026). Without these approaches, low tolerances for the risks of such suffering could heavily limit the uptake of ER.

Ultimately, it is clear that concepts of rewilding and values of nativeness shape how individuals define the risks of ER, yet whether those risks are deemed acceptable depends on a more complex constellation of contextual factors.

4.4 | Limitations

While our study sheds light on important perceptions surrounding the risks and rewards of ER in rewilding, it has several limitations. First, our scoping review likely excluded many introductions occurring on private lands, particularly those unreported due to legal, financial or reputational concerns (Rissman et al., 2019). Second, the literature base remains limited. Only 21 articles met our inclusion criteria, with half focusing on just two high-profile cases. This narrow scope limits the ability to draw generalisable conclusions about the ecological outcomes of replacement efforts, especially given the widespread lack of long-term monitoring and limited data on population dynamics or species interactions (e.g. Doube, 2018; Griffiths et al., 2013). Third, by reviewing only English-language literature, our findings reflect language biases, potentially excluding relevant research conducted and published in other regions. Similarly, although we aimed to capture a range of perspectives through interviews, the diversity of our participants, particularly in terms of gender, practitioner experience, regional representation and cultural background, was limited (Figures S2 and S3). Concerns regarding invasion risk, uncertainty and animal welfare, as well as recognition of ecological opportunities, were expressed by both academic and practitioner participants nonetheless. Finally, some interview responses may have been shaped by social desirability bias (Krumpal, 2013). Participant E highlighted this, commenting that '*a lot of people seem hesitant to say negative things about non-native species because of some idea that … it somehow makes you a right-wing nationalist*'. Such dynamics can reduce the openness of discourse both in interviews and published literature, making it harder to reach consensus on a highly polarised topic.

4.5 | Recommendations

Based on our findings, five recommendations are suggested:

First, greater reflexivity among environmental actors is encouraged when making decisions about ER (Thomas et al., 2022). Recognising how personal, ecological and geographic contexts shape perceptions of risk and reward, and making these assumptions more explicit, could foster more transparent and productive dialogue across differing perspectives.

Second, embracing the plurality of rewilding is important. Assessments of ER would benefit from placing greater emphasis on ecological function alongside, rather than being strictly constrained by, notions of nativeness, while acknowledging that values and goals in rewilding are often contested. Participant M's comment that '*rewilding is not about trying to recreate the past, it's about trying to create a wilder future, using lessons from the past*' is supported by literature calling for rewilding to restore lost ecological processes that enable a more ecologically dynamic future (Moorhouse & Sandom, 2015; Pettorelli & Bullock, 2023). Rejecting the role of non-native species within this future (while embracing that of native species) risks contradicting not only the promotion of nature's intrinsic values, but also the concept of ecological dynamism—a core principle of rewilding (Carver et al., 2021).

Third, further research is needed to build a stronger long-term evidence base across a wider range of taxa. In this context, initial trials may benefit from focusing on lower-risk species (e.g. large-bodied, slow-moving or sterile organisms), which allow for more reliable monitoring while minimising potential ecological risks.

Fourth, increased attention to the economic and ecosystem service implications of ER would strengthen cost–benefit analyses. Better understanding trade-offs, such as opportunity costs versus potential gains like ecotourism, could help landowners and managers to make more informed decisions that are economically viable.

Finally, future research should more explicitly engage with Indigenous perspectives, recognising the importance of cultural and ontological diversity in shaping views on species introductions and ER. This is essential to avoid marginalising these perspectives in decisions that have significant implications for different landscapes. Building on Derham et al. (2025), co-developing rewilding approaches with Indigenous communities can support more ethically grounded and culturally informed approaches to ER.

5 | CONCLUSIONS

This study highlights both the potential and the contention surrounding ER using non-native species in rewilding. While such approaches may offer a pragmatic means of restoring lost ecological functions within urgent timeframes, their application must remain conditional on careful evaluation of risks, capabilities and governance to avoid unintended harm. Divergent perspectives, rooted in differing ecological philosophies and values around nativeness, emerge as key sources of disagreement, underscoring the need for more open, reflexive and inclusive dialogue across the rewilding community. By proposing a framework that integrates ecological, ethical and practical considerations, this paper aims to support more transparent and context-sensitive decision-making. Ultimately, in

the face of accelerating environmental change, progress will depend on collaboration, adaptive thinking and a willingness to engage with novel approaches, ensuring that efforts to restore ecological complexity are both responsible and effective.

AUTHOR CONTRIBUTIONS

Alex Collins conducted this research as part of his MSc studies, under the supervision of Mohammad S. Farhadinia and Nathalie Pettorelli. Alex Collins conducted the interviews, scoping review and data analysis and wrote the initial draft. All authors participated in reviewing and editing the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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DATA AVAILABILITY STATEMENT

Data from this study are not publicly available due to confidentiality and the anonymisation of interview responses.

ETHICS STATEMENT

All participants gave informed consent via a written consent form prior to participation. The research was approved by the University of Oxford's Central University Research Ethics Committee.

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SUPPORTING INFORMATION

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

Table S1. Scoping search details and results across different search engines.

Table S2. Criteria used to screen articles (returned by the search string) for relevance.

Table S3. Definitions presented to interview participants at the beginning of the interviews.

Table S4. List of the core interview questions.

Table S5. Key characteristics and findings of all introductions of non-native species for ecological replacement found in the literature. There were 21 papers in total, with 5 discussing more than one introduction.

Figure S1. The six steps of Braun and Clarke's (2006) thematic analysis methodology.

Figure S2. The percentage of our sample from each discipline, split into academic (A) or non-academic (NA). We asked participants for their discipline at the start of each interview and grouped them into these broad categories. There were no NA specialists in nature restoration law, ecological ethics, or human geography.

Figure S3. Spatial distribution and abundance of all 24 interview participants.

Figure S4. Spatial distribution and abundance of all 71 interview invitees.

Figure S5. ROSES flow diagram outlining the results of the scoping literature search.

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