23 (2025) 51–59

Contents lists available at ScienceDirect

Perspectives in Ecology and Conservation

journal homepage: www.perspectecolconserv.com

Essays and Perspectives

What is the role of fire in rewilding? Synthesising peer-reviewed literature into four thematic discourses

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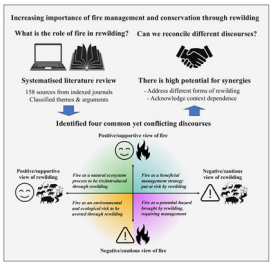
HIGHLIGHTS

- Biodiversity conservation through rewilding should recognise the importance of fire.
- Opinions on the role of fire in rewilding can be synthesised into four discourses.
- Discourses consistently reappear in the expanding body of peer-reviewed literature.
- Common themes imply integrating fire management and rewilding has strong potential.
- Moving forwards requires addressing rewilding definitions and context dependence.

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Biodiversity conservation
Ecosystem functioning
Integrated fire management
Land abandonment
Nature recovery
Rewilding

ABSTRACT

Current conservation strategies must acknowledge the multifaceted role of fire as a key ecosystem process and a socioecological threat. Understanding the role of fire in the context of rewilding is critical due to the need to implement and scale-up nature recovery strategies in the face of altered fire regimes and other anthropogenic pressures. Despite the gradual incorporation of the concept of fire into the rewilding literature, views surrounding fire's contribution to rewilding remain complex and unclear. We have therefore conducted a structured literature review in order to synthesise the main discourses surrounding the role of fire in rewilding so that researchers and practitioners are better aware of the opportunities and risks when considering fire as part of rewilding programmes. By classifying arguments based on their positive/supportive or negative/cautious perceptions towards fire and rewilding and extracting common themes, we were able to identify four broadly distinct discourses describing potential ways in which fire – or fire management – and rewilding could be considered within the landscape: A) fire as an ecosystem process to be introduced through rewilding, B) fire as a socioecological risk to be averted by rewilding, C) fire as a potential hazard brought by rewilding, requiring management, and D) fire as a beneficial management strategy which is put at risk by rewilding. We describe the main themes and common arguments presented by discourses A to D, outlining context and trends in occurrence of sources assigned to each discourse. Better integration of fire and rewilding will require clarifying differences in

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https://doi.org/10.1016/j.pecon.2025.02.002
Received 23 August 2024; Accepted 20 February 2025
Available online 7 March 2025
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rewilding definitions and acknowledging strong context dependence of fire management options, decision-making processes and conservation outcomes. As rewilding strategies expand into areas with diverse fire dependencies, histories, and vulnerabilities, thematic commonalities across fire and rewilding discourses reveal strong potential for synergies between the use of fire and rewilding for conservation.

Introduction

Ecosystems across the world are experiencing changes in fire frequency, fire intensity and burnt area. Increasing occurrence and severity of wildfire is linked to ongoing climate change, and to socioecological factors such as human ignitions, land abandonment and the expansion of the wildland-urban interface (Ganteaume et al., 2021). Fire regimes have been extensively altered through the implementation of fire management strategies historically focused on mitigating fire impacts via fire-suppression policies (Durigan, 2020; Kelly et al., 2023), which can exacerbate the detrimental effects of wildfires by increasing fuel load, continuity and fire severity (Hai et al., 2023). It is important to note that fire in the landscape can be caused by natural or anthropogenic sources, and can have positive and negative impacts at many scales and on different components of social-ecological systems (Rego et al., 2021). For example, fires, in the form of extreme wildfire events, can bring catastrophic consequences to people, biodiversity and ecosystems (Pausas et al., 2008). Wildfires can exacerbate global and local climate change by releasing greenhouse gasses, by permanently shifting landscapes into alternative stable states, and by modifying key biogeochemical processes (Bowman et al., 2013). However, fire also represents an important ecosystem process that is essential to many habitats across the globe. In the form of low-intensity fires within natural regimes, fire has the ability to boost nutrient cycles, limit the extent of landscape change, enhance forest recruitment and regeneration, and act as a climate mitigation strategy (Kelly et al., 2020). Fire can thus provide important benefits to humankind in the form of provisioning, regulating and cultural ecosystem services that can be optimized through adequate regime management (Pausas and Keeley, 2019). Current biodiversity conservation strategies are therefore starting to account for fire's increasingly important role in the Anthropocene, acknowledging its multifaceted ability to act as a key ecosystem process and socio-ecological threat (Kelly et al., 2023).

The restoration of the role of fire in landscapes is becoming an increasingly important conservation priority as anthropogenic pressures alter fire regimes worldwide, impacting biological, chemical, and physical processes across Earth system components, geographical ranges and spatiotemporal scales (Kelly et al., 2023). Still, successful ways of adequately managing fire for biodiversity and ecosystem services remain complex (Bowman et al., 2011). The long-term spectrum of human interactions with the environment and the existence of traditional and indigenous fire practices has been a key factor shaping ecosystems that we now consider natural, allowing for the maintenance of important species that would not survive otherwise (Keeley, 2002). In many cases, loss of species and introduction of new non-native taxa has led to the development of novel, non-analogous ecosystems, where ecological processes have been irreversibly altered (Hobbs et al., 2009). Similarly, the presence of people's homes in seminatural areas surrounding cities, or the existence of land uses like agriculture or forestry essentially prevents fire regimes from developing in a non-anthropogenic way (Ganteaume et al., 2021). Although responsive governance of fire regimes can be achieved through integrated fire management approaches (Kelly et al., 2023), it is now increasingly important to consider how fire management can be implemented alongside novel conservation strategies involving nature recovery and rewilding.

Rewilding is emerging as a popular biodiversity conservation practice that aims to restore human-impacted areas by re-introducing wildlife and ecosystem processes with little or no human intervention (Pereira and Navarro, 2015). Since its original appearance during the 1980s, rewilding has been linked with the introduction of megafaunal species, the desire to set up an open-ended management strategy, and/or the recreation of an ancient 'wild' baseline (Jørgensen, 2015; Lorimer et al., 2015). Rewilding has proved to be a very plastic concept, and as a result, different definitions have developed across the literature (see Table 1). Only recently have there been efforts to unify rewilding perspectives through the creation of a set of guiding principles, as well as a common definition highlighting the need for rebuilding, restoration and achieving a paradigm shift in the relationship between humans and nature (Carver et al., 2021). The development of theoretical frameworks such as the one provided by Perino et al. (2019) has the potential to facilitate the application of rewilding in complex social-ecological systems. By assessing trophic complexity, dispersal and stochastic disturbances such as fire – identified as critical components of ecosystem dynamics – these frameworks advance the conceptualization of rewilding as a restoration approach.

Nonetheless, it is important to note that rewilding has also been

Table 1
Rewilding is a widespread idea that covers a range of diverse yet interrelated concepts. To better inform the reader, we include brief examples of some of the definitions for the most common conceptualisations of rewilding, based on classifications from Jørgensen (2015); Gammon (2018), and Palau (2020). Please note the terminology in this table did not limit our literature search and review synthesis – all possible rewilding concepts could be included in our review, given sources focused on the fields of ecology, conservation, land governance, or environmental sciences.

Cores, Corridors, Carnivores	The creation of core wilderness areas with no human activity. Originating in North America, this concept argues wilderness areas should be connected by corridors to support large carnivores with large home territories (Soulé and Noss, 1998).
Pleistocene Rewilding	The reintroduction of extant Pleistocene megafauna, or ecological equivalents of extinct species known as proxies, to restore lost ecological functions of Pleistocene ecosystems (Palau, 2020).
Trophic Rewilding	Restoration strategy that uses species introductions to restore top-down trophic interactions and trophic cascades to promote self-regulating biodiverse ecosystems (Svenning et al., 2016).
Ecological Rewilding	Restoring ecosystems where human control of ecological processes is reduced, wildlife thrives, disturbance is allowed, and non-extractive services such as carbon sequestration and recreation are provided (Pereira and Navarro, 2015).
Passive Rewilding	Passive management of ecological succession within abandoned landscapes with the goal of restoring natural ecosystem processes and reducing human control (Gillson et al., 2011; Navarro and Pereira, 2012).
Island Rewilding	Restoration of island ecosystems and ecological function through the introduction of extirpated island species or proxies, where pre-human landscapes are taken as baseline (Palau, 2020).
Urban Rewilding	Initiatives or programs that seek to encourage biodiversity, ecosystem function, and the persistence of native species in a range of urban settings (Lorimer et al., 2015).
Human Rewilding	Also known as 'primitivist rewilding'. This is a more social concept arguing for the rewilding of the modern lifestyle by becoming closer to nature and more self-sufficient, liberating oneself from capitalism and domestic life (Gammon, 2018).
Microbiome Rewilding	The restoration of biodiverse habitat in urban spaces that can rewild the environmental microbiome by acting as an ecosystem service and enhancing prevention of human disease (Mills et al., 2017).

negatively associated with the appearance of unforeseen consequences that can become difficult to manage, with the potential exclusion of local people from management objectives and decisions, and with the erasure of cultural legacies within the landscape (García-Ruiz et al., 2020). There is an important gap of knowledge regarding rewilding's conservation effectiveness, its potential to cause societal conflict, and its likelihood to impact biodiversity and ecosystem services through species invasions and ecological feedbacks (Nogués-Bravo et al., 2016). In terms of fire, rewilding of rural areas can be associated with negative socio-ecological impacts of increasing wildfire hazards (Regos et al., 2016). The effect of rewilding on altered fire regimes is particularly relevant given that it has the potential to increase fuel accumulation and continuity, reducing the capacity to control fire (Lasanta et al., 2015). Despite these potential issues, rewilding's popularity is growing, and rewilding projects have been successfully set up in Europe, North America, Siberia, Brazil, Argentina and South Africa (Palau, 2020).

The growing popularity of rewilding and the increasing importance of fire management is leading to the gradual incorporation of the concept of fire into the wider rewilding discourse. Yet, this inclusion has been far from uniform. The views surrounding interactions between fire management and rewilding remain complex and unclear. Different authors offer conflicting arguments that, when considered together, seem counterintuitive and contradictory. This undermines the credibility and conservation potential of integrating rewilding and fire management strategies, as decision-makers presented with such a complex landscape of evidence are less likely to reach consensus and adopt adequate initiatives. Thus, our aim was to synthesise current peer-reviewed literature dealing with rewilding and fire to reveal areas of commonality and difference, so that researchers and practitioners are better aware of the opportunities and risks when considering fire as part of rewilding programmes. In this paper, we explore and untangle the different viewpoints surrounding the role of fire in rewilding through a structured literature review.

Methods

We conducted a structured review of peer-reviewed literature to identify common arguments and discourses surrounding the role of fire in rewilding. Structured literature reviews, also known as systematised or rapid literature reviews, are examples of review methods that include elements of a systematic review but do not aim for complete comprehensiveness (Grant and Booth, 2009; Clarke and Crane, 2018). Our structured review was based on the environmental sciences review method proposed by Mengist et al. (2020). Mengist's PSALSAR method (Protocol, Search, Appraisal, Synthesis, Analysis, Report) was adapted by streamlining the screening and appraisal steps, and by analysing the text with a more interpretative approach, identifying common themes and arguments rather than systematically extracting all information provided by the papers. We gathered relevant peer-reviewed articles dealing with rewilding and fire using the Web of Science, PubMed, Scopus, JSTOR, SOLO (Search Oxford Libraries Online), and Google Scholar online databases. We searched for all sources published before 31st December 2023 that contained terms relating to fire ('fire', 'wildfire', 'burn', 'burning') and rewilding ('rewilding') within their titles, abstracts, key words, and where possible, main text. We did not define a start date, in order to capture all available sources ever published before the last full-year cut-off. We also searched for equivalent terms within articles in Spanish ('fuego', 'quema', 'incendio' & 'resilvestración', 'renaturalización', 'rewilding'), Portuguese ('fogo', 'queima', 'incêndio' & 'reselvagização', 'renaturalização', 'rewilding') and French ('feu', 'brûlage', 'incendie' & 'reénsauvagement', 'rewilding') to broaden our search and include further potential sources. We applied a resource-type filter to our initial searches in databases providing the option to only search for articles, including reviews (Scopus, JSTOR, SOLO and Google Scholar).

Our initial searches yielded 3680 sources including duplicates (25 search results in PubMed, 47 in Scopus, 100 in Web of Science, 109 in SOLO, 956 in JSTOR and 2443 in Google Scholar). We then screened sources by simultaneously removing duplicates and excluding papers that i) were not relevant to the fields of ecology, conservation, land governance, or environmental sciences, ii) were not published in indexed, peer-reviewed journals, iii) did not use fire or rewilding terms to discuss ecology or conservation themes but in unrelated contexts like 'camp fire' or 'the world is on fire', and iv) did not directly relate rewilding with fire by mentioning rewilding and fire without causal or contextual connection. We did not exclude sources within indexed, peer-reviewed journals based on article types, thus including editorials, reviews, research articles or opinion pieces, which allowed us to incorporate more subjective texts. We found a total of 158 suitable articles, published between 2005 and 2023, linking rewilding and fire (Table S1). All 158 of the papers were found in Google Scholar, 34 of them were found in SOLO, 33 of them in Web of Science, 31 in JSTOR, 25 in Scopus and 11 in PubMed (see Fig. S1 for details on overlap across databases). Most articles were written in English, with only four papers in Spanish (Serrano-Montes et al., 2017; García et al., 2023; Guerisoli et al., 2023; Velilla-Gil and Guallart-Moreno, 2023), three in French (Barraud et al., 2019; Rayé, 2022; Corson et al., 2023), and none in Portuguese.

We then reviewed and analysed the sources by reading through each article and flagging each time fire and rewilding were mentioned within an argument. We then identified and interpreted each line of argument, and summarised them into individual, paper-specific viewpoints relating to the role of fire in rewilding. Sources often contained more than one line of argument relating to fire and rewilding and these could correspond to the same or different viewpoints. For example, the lines of argument provided by Perino et al. (2019) reveal two distinct viewpoints as authors explain that "Rewilding actions aim to release ecosystems from continued and controlled anthropogenic disturbances […] allowing natural fire and pest regimes", yet "Rewilding can also have undesired consequences for people. Natural disturbances such as fires or floods may threaten humans and human infrastructure".

For each viewpoint, we then classified its position towards fire and rewilding as positive/supportive or negative/cautious based on the arguments, evidence and statements presented. Viewpoints were thus sorted into a matrix depending on them highlighting the advantages and drawbacks of rewilding as a conservation strategy, and on them highlighting the potential benefits or hazards of fire in the landscape. Viewpoints highlighting the advantages of rewilding and providing arguments supporting its implementation were assigned a positive/supportive stance whereas those focusing on potential drawbacks or arguing against such initiatives were given a cautious/critical stance. In the case of fire, sorting viewpoints into positions was more nuanced. Viewpoints with a positive/supportive position towards fire referred to the benefits brought by the presence of fire in the landscape or to the advantages of managing, restoring, or maintaining fire regimes. Viewpoints with a negative/cautious position mentioned the potential hazards brought by fire *per se*, or focussed on the risks of altering, changing or maintaining fire regimes.

Sorting viewpoints into this matrix allowed us to identify that many of them shared similar themes and lines of reasoning across sources, making up common groups that we were able to synthesise into four main discourses. It is important to note that sources could belong to more than one discourse category; if a paper presented different individual viewpoints, these were separately sorted into the positive/negative matrix. It is also important to consider that viewpoints were interpreted independently from the rest of the papers' contents. This means that authors could actually take different or more nuanced positions towards rewilding and fire when considering their studies as a whole; we did not aim to deny these, but to specifically focus on positions when just considering interactions between rewilding and fire. We recognise that sources assigned to each discourse present complex arguments; by classifying them into discourses we attempt to highlight points of synergy and commonality across papers.

After identifying the discourses, we briefly describe their general social-ecological context, main themes, and common arguments, and outline their popularity across time and geographical location by plotting publication trends along time and mapping discourse occurrence across national boundaries. Finally, we highlight ways of moving forwards towards a better understanding of the different roles of fire in the rewilded landscape.

Results: common discourses around the role of fire in rewilding

We identified four main groups of viewpoints presented by individual sources, synthesising them into four discourses. These can be summarised as: A) 'Fire as an ecosystems process to be (re)introduced through rewilding'; B) 'Fire as a socioecological risk to be averted through rewilding'; C) 'Fire as a potential hazard brought by rewilding, requiring management'; and D) 'Fire as a beneficial landscape management strategy put at risk by rewilding' (see Fig. 1). The following sections describe the common concepts and arguments covered by each discourse, as well as their prevalence across time and geographical contexts.

Discourse A: "Fire as an ecosystem process to be (re)introduced through rewilding"

This first discourse surrounding rewilding and fire was found in 46 papers (equivalent to 29% of sources, see Fig. 2). Discourse **A** has consistently appeared in peer-reviewed sources since 2009 (Fig. 3), generally focusing on locations and ecological contexts where fire is naturally and historically present (Fig. 4), for example, North American prairies (Fuhlendorf et al., 2009), Australia (Sweeney et al., 2019), Argentina (Mata et al., 2021) and Mediterranean Europe (Navarro and Pereira, 2012). This discourse views fire as a natural process that strengthens ecosystem functioning by creating dynamic disturbances, limiting woody encroachment of abandoned areas, maintaining fire-adapted communities, and enhancing biodiversity through the creation of a patch-mosaic landscape (Fuhlendorf et al., 2009). Sources engaging with this discourse are supportive of rewilding as a conservation initiative, focusing on the 'ecological rewilding' facet when talking about rewilding and fire in relation to function.

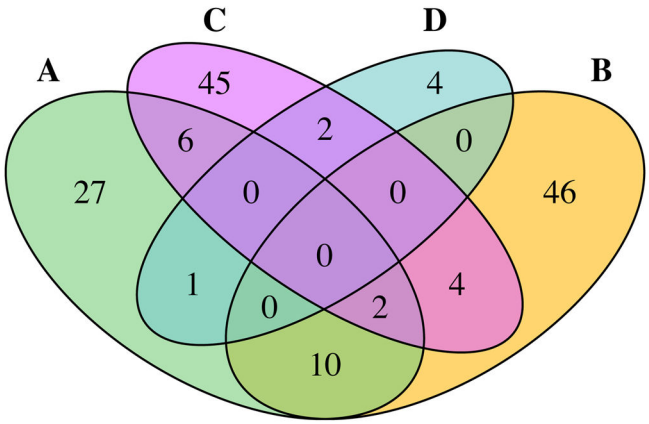

Fig. 2. Venn diagram illustrating the number of sources classified as belonging to discourses **A** to **D**, including those identified as belonging to multiple discourses. Numbers in the intersections indicate sources overlapping in discourses **A** to **D**.

The viewpoints and arguments classified as belonging to this first discourse focussed on ecological rather than social dimensions of rewilding and fire. They are generally supportive of restoring fire regimes within rewilded landscapes, arguing that fire should be restored as an intrinsic natural process or because fire acts as a nature-based management tool that can allow for ecological rewilding goals to be achieved (Swaisgood et al., 2019). For example, Sweeney et al. (2019) argue that fire dynamics play an essential role in shaping the Australian landscape, and Svenning (2020) find the re-introduction of fire into the

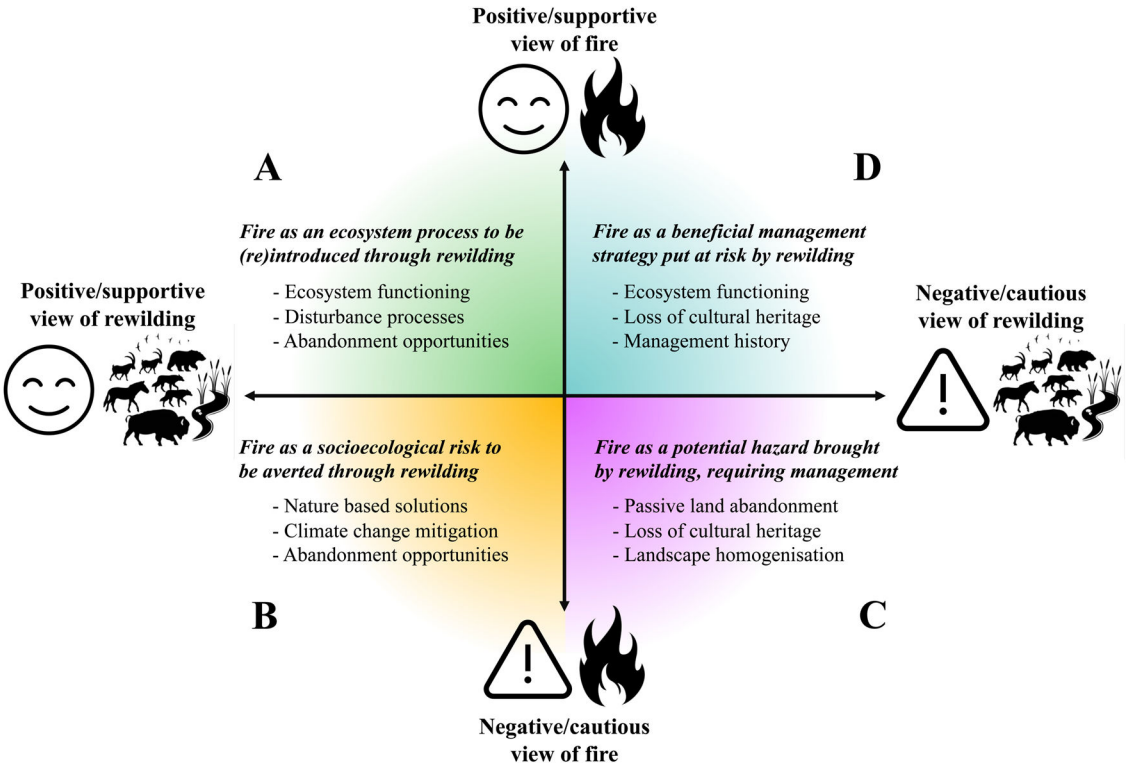

Fig. 1. Thematic framework describing the four main ways in which the role of fire in rewilding is conceptualised within the indexed, peer-reviewed literature. Discourses **A** to **D** are represented in each quarter, which includes some of the main themes, concepts and ideas associated with them.

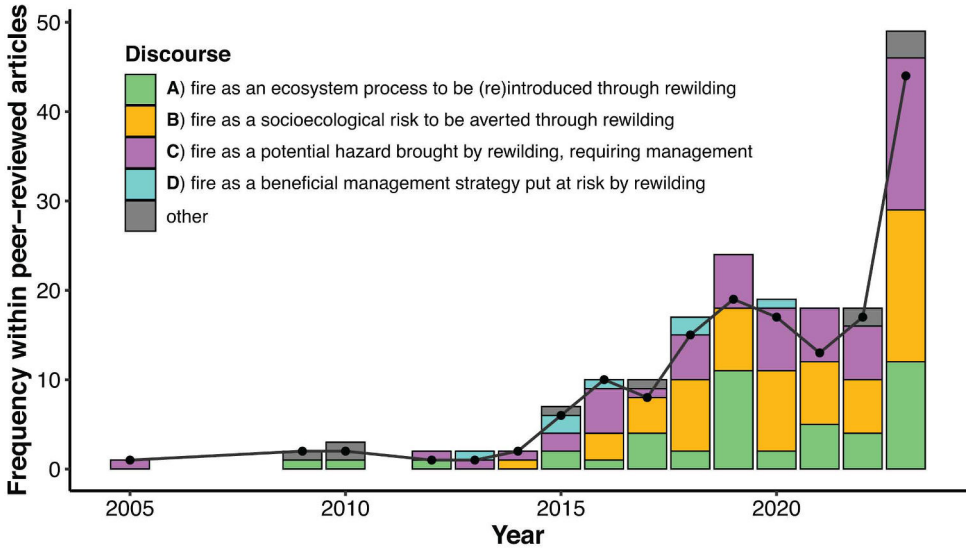

Fig. 3. Yearly occurrences of discourses **A** to **D**. Other minor discourses are represented in dark grey. Black dots and lines represent the trend in total number of sources published each year – bars above black points indicate sources covered more than one discourse.

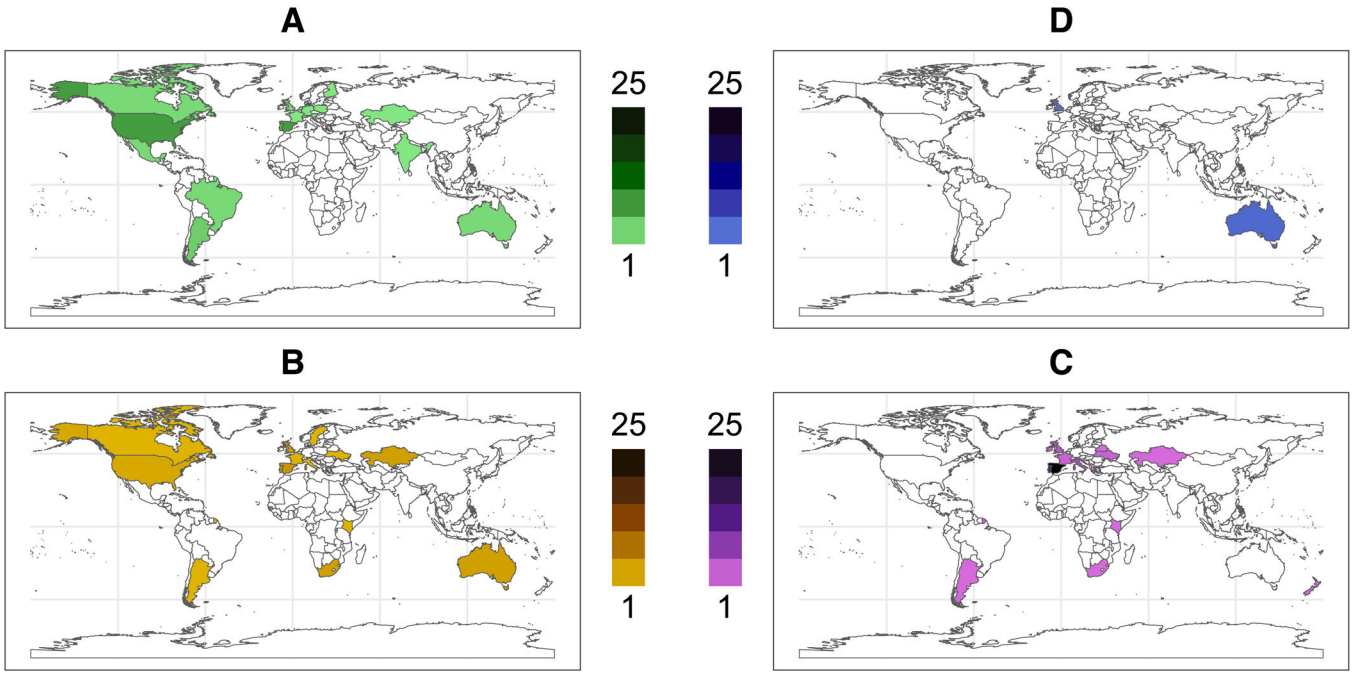

Fig. 4. Geographical distribution of peer-reviewed sources dealing with discourses **A** to **D**. These maps include sources with well-defined national context(s), either focusing on one or multiple case study locations or covering one or more specified nations. Country shading indicates number of sources, and white indicates no identified sources so far. Please note sources making reference to broader geographical contexts – focusing on regional, biome or global settings – are not represented within these maps to allow for consistent mapping. Representing geographical locations in the country-level also allows for a more adequate and concise representation of trends in socioecological factors and research efforts.

landscape is necessary for the reestablishment of natural hydrological patterns. Torres et al. (2018) consider the presence of natural fire regimes as an indicator of successful rewilding action and propose the restoration of fire processes and fire-adapted vegetation. Fuhlendorf et al. (2009) highlight how key species like tallgrasses (*Andropogon gerardii*) are adapted to survive and thrive with fire and introduce the concept of 'pyric herbivory', highlighting the importance of interactions between fire and grazing.

Discourse B: "Fire as a socioecological risk to be averted through rewilding"

This second discourse on the role of fire in rewilding appeared in 62 sources or 39% of papers (Fig. 2). Becoming increasingly popular since 2014 (Fig. 3), it is the most common discourse in cumulative terms. Sources engaging with discourse B tend to focus on systems where fire is naturally or anthropogenically common (Fig. 4), but also on areas with presence of large herbivores such as Kazakhstan (Saavedra et al., 2023), Kenya (Young et al., 2021) and South Africa (Gordon et al., 2023). Furthermore, discourse B is associated with broader geographical

contexts, as it appears in 32 sources that give more focus to ecoregional, continental or global scales (Table S1).

By highlighting the risks of wildfire and altered fire regimes, discourse B frames rewilding as a promising wildfire mitigation strategy that can achieve conservation benefits whilst minimising and mitigating negative consequences of fire in a more natural and cost-efficient way (Pereira and Navarro, 2015; Serrano-Montes et al., 2017; Johnson et al., 2018). The use of rewilding as a mitigation strategy appears to be driven by increasing urgency of global change in the form of more intense and frequent wildfires, and also by the growing appeal of more natural management strategies. Malhi et al. (2022) have recently proposed the use of rewilding as a potential nature-based solution that could efficiently control fire-related emissions in suitable fire-prone landscapes.

Discourse **B** is generally linked with the definitions of 'trophic rewilding' and 'ecological rewilding'. In this view, rewilding can regulate altered fire regimes and reduce impacts of fire and wildfires through the reintroduction of large herbivores, the recovery of ecosystem processes that regulate fire, or through a management-based transition away from fire-dependent land uses. For example, the reintroduction of large herbivores has the potential to reduce fire intensity and burnt area as herbivores reduce fire permeability by opening up the landscape and removing fuels through the consumption and trampling of vegetation (Rouet-Leduc et al., 2021). Herbivores regulate altered fire regimes by promoting frequent, low-intensity fire regimes needed to maintain services within open ecosystems. Wildfire risks can also be reduced by rewilding through the restoration of ecological functions related to vegetation and hydrology (Carroll and Noss, 2021; Preti et al., 2022) or through the replacement of land uses associated with burning and environmental degradation (Li et al., 2017; Klaar et al., 2020).

Discourse C: "Fire as a potential hazard brought by rewilding, requiring management"

The third discourse surrounding rewilding and fire was found in 59 papers (37% of publications, see Fig. 2), initially appearing in 2005 (Höchtl et al., 2005) and remaining popular ever since (Fig. 3). Sources engaging with discourse C focus on contexts of high wildfire incidence and risk (Fig. 4). Discourse C is especially common within sources from in the Iberian Peninsula, respectively appearing in 14 and 25 papers centred in Portugal and Spain. This third discourse highlights the potential risks and impacts of wildfire and altered fire regimes, conceptualising the role of fire in a more cautious way. Rewilding is perceived as potentially harmful to people and landscapes because it enhances incidence and impacts of wildfires. Rewilding takes the form of 'passive rewilding', as an outcome that is intimately linked with land abandonment (e.g., García-Ruiz et al., 2020; Campos et al., 2021). Authors argue that rewilding leads to revegetation, homogenisation, and accumulation of fuel loads within the landscape, increasing wildfire hazards (Navarro and Pereira, 2012). Furthermore, they also explain how land abandonment and rewilding lead to losses of cultural landscapes, livelihoods, investments, and infrastructure, exacerbating the lack of capacity to control fire (Lasanta et al., 2015).

As well as exposing the risks associated with rewilding and fire, sources within discourse **C** provide management recommendations that could help tackle the impacts of wildfire in rewilded landscapes. Authors that are more critical of rewilding as a passive, hands-off concept emphasise the need for human interventions (Lasanta et al., 2015; Nogués-Bravo et al., 2016). However, other sources propose that fire resilient landscapes could be achieved through controlled fire and grazing, relating to integrated fire management. For example, Fernández-Manjarrés et al. (2018) suggest rewilding abandoned landscapes could be compensated with fire prevention measures like grazing by megaherbivores, while Regos et al. (2016) and Campos et al. (2021), propose undertaking prescribed fire management aimed at creating small burned areas could control the effects of unplanned fires. This reveals how some sources sorted into discourse C – underpinned by its reference to the fire hazards brought by rewilding – incorporate themes ecological lines of reasoning similar to those presented by other discourses, and develop more supportive positions towards rewilding and fire. Still, grazing remains separate from rewilding (as rewilding is conceptualised passively and not trophically) and is instead linked with traditional extensive agricultural practices.

Discourse D: "Fire as a beneficial management strategy put at risk by rewilding"

The fourth discourse surrounding the role of fire in rewilding appeared in only seven sources (4.4% of papers, Fig. 2), focussed within Australia and the United Kingdom (Fig. 4), as well as at the European and global scales. Discourse D frames fire as a beneficial management strategy but views rewilding as a risk to fire management and landscapes. The sources' positions towards rewilding are generally cautious, with Davies et al. (2016) highlighting how rewilding could threaten valuable ecosystems, local history and cultural heritage, and Klop-Toker et al. (2020) pointing out that rewilding projects in Australia would still require ongoing human intervention to maintain fire-dependent landscapes. The use of fire is endorsed by highlighting the ecological, cultural and socioeconomical benefits of planned burning. Since sources tend to focus on specific areas where fire is used to preserve cultural landscapes, there are fewer papers that engage with this discourse. Still, discourse D has periodically reappeared within indexed literature (Fig. 3).

This discourse is linked with the concepts of 'ecological' and 'passive' rewilding and with the issue of adequately and equitably preserving cultural landscapes such as heathlands, peatlands and the Australian outback, which are maintained by traditional burning (Lorimer et al., 2015; Davies et al., 2016). Sources engaging with discourse D acknowledge how people, fire and rewilding can have multifaceted roles within the landscape. Reed et al. (2013) recognise that fire in British uplands can take the form of both prescribed burning and harmful wildfires, whilst Bliege Bird and Nimmo (2018) highlight the importance of conserving nature, but also of recognising and restoring lost ecological function of people on landscapes achieved through hunting or using fire. The sources question the use of natural baselines that ignore traditional management practices for rewilding and restoration.

Other discourses of the role of fire in rewilding

Aside from viewpoints engaging with the four main discourses surrounding the role of fire in rewilded landscapes, we identified further arguments that did not align with the discourses presented above. These arguments were identified in 10 sources (6.3% of papers), sharing themes with our main discourses but also including distinct lines of reasoning. These perspectives could be synthesised in five minor discourses that could still be sorted into the two-way positive/negative matrix depending on their support or caution towards fire and rewilding (Fig. S2): 'fire as a natural process whose restoration is inappropriate in the context of rewilding', 'fire as a threat to the success and environmental potential of rewilding', 'fire as an opportunity for livelihoods and research in the context of rewilding', 'fire as an important biodiversity dynamic in novel rewilded landscapes', and 'wildfires as a process to fight against rewilding and its consequences' (Table S2). Since these discourses were identified only in a small number of papers – maximum four sources for the 'fire as a threat to the success and environmental potential of rewilding' discourse – we consider them additional academic perspectives at present.

These other discourses were identified in sources with national contexts in Africa, Europe and the Americas, as well as in papers with broader European and global scopes (Table S2, Fig. S3). Sources engaging with these additional discourses show little overlap with the main discourses (Fig. S4) but revealed common themes and lines of evidence despite arriving at different conclusions. For example, even

though Atkinson (2009) recognises the importance of fire and herbivory in North American prairies, they point out the controversies and complexities of rewilding, concluding complete rewilding and fire restoration are inadequate. Similarly, Torre et al. (2023) highlight the potential of wildfire to control passive rewilding and land abandonment, being amenable to the presence of natural or prescribed fires. These additional discourses appear to differ from the main ones in terms of agency and causality; instead of fire being restored, mitigated, promoted or threatened by rewilding, fire itself is framed as the agent that can reverse the consequences of rewilding (Torre et al., 2023) or threaten rewilding outcomes (Tanentzap et al., 2023). These additional discourses can also be characterised by more neutral positions towards fire and rewilding, which can be presented as opportunities or important ecosystem processes (Stevens et al., 2022).

Discussion: moving forwards

Overall, our structured synthesis and review has revealed divergent perspectives on the relationship between fire and rewilding in peer-reviewed literature which we have grouped into four main discourses based on a series of common observations and arguments from different contexts. Our aim was not to force or limit the arguments brought forward by authors, but to bring together a complex landscape of opinions and evidence for future applications. By synthesising and summarising thematic differences and commonalities among discourses, we aim to advance research and practice relating to the use of fire and rewilding. We thus intend this paper to act as a tool for researchers and practitioners that facilitates access to relevant literature, helping them identify which considerations to focus on depending on their challenges and context.

Geographical context is an important factor contributing to the diversity and complexity of viewpoints present in the literature. Differences in location, scale and historical context of sources – within and across the different discourses – are particularly important with regards to determining the opportunities and risks of fire within rewilding efforts. Although sources grouped within each discourse show some degree of consistency in terms of context and scale, distinct ecosystem processes, landscape patterns, governance structures and socio-ecological systems mean proposed conservation strategies will be entirely context-dependent and difficult to scale up and replicate. Rewilding and fire have different connotations depending on the historical legacies of different landscapes, their flammability, vulnerability, and the current use of fire. These perceptions influence the ways in which researchers and stakeholders engage with rewilding and fire management strategies, determining success beyond biophysical limits. The limited reflection on the traditional use of fire outside the context of discourse D is noteworthy, reflecting rewilding's tendencies towards hands-off principles and avoidance of active management, as well as its link with nature recovery in more urbanised and industrialised countries. Integrating rewilding with indigenous and traditional management should become a key priority as rewilding becomes a more established conservation approach in the Global South (Root-Bernstein et al., 2017).

The expanding popularity of rewilding strategies is reflected by the increasing abundance of literature dealing with rewilding and fire (Fig. 3), having reached 44 sources published yearly in 2023. Higher incidence of sources has also been accompanied by growing geographical spread (Fig. 4), with sources centred in 30 countries, as well as papers covering continental, biome and global scales. The accumulation of rewilding and fire case studies has also been accompanied by an increase in the number of sources presenting viewpoints that were classified into more than one discourse – highlighting how more authors acknowledge nuance in the interactions between fire and rewilding as a multifaceted conservation issue – as well as sources that were assigned to other less prominent discourses. As the body of literature surrounding fire and rewilding grows, we expect more papers to incorporate emergent themes and arguments coalescing into novel discourses. Monitoring the emergence of new discourses will enhance the potential to identify innovative developments in the discussion surrounding the role of fire and rewilding.

Notwithstanding the future development of novel perspectives, discourses A to D have consistently reappeared in the peer-reviewed literature, maintaining common themes and positions towards rewilding and fire over the past two decades. We suggest that consistent differences in the perceptions of rewilding and fire arise in part due to different conceptualisations of fire and the existing range of rewilding definitions (Table 1). Rewilding's lack of fixed definitions is a beneficial factor contributing to its appeal and flexibility as a management approach, but this ambiguity can nonetheless cause confusion, as different framings of rewilding will lead to very different management interventions and socioecological outcomes. More clarity could be achieved by consistently providing a definition for rewilding or by classifying rewilding concept(s) using frameworks like those provided by Jørgensen (2015). It is also important to distinguish that fire can be framed as extremely catastrophic wildfire events but also as an important ecosystem process. Recognising fire-dependencies and vulnerabilities across systems will allow us to better identify how the impacts of altered fire regimes will interact with rewilding in different contexts (Kelly et al., 2023).

Incorporating such diversity, nuance, and context-dependency was a considerable challenge in developing the proposed framework. We believe our discourses allow for a more concise and cohesive synthesis of the opinion landscape, but acknowledge the trade-offs of categorisation. Such compromises are exemplified by papers (e.g., Regos et al., 2016) that emphasise the risks or rewilding in terms of extreme fires while simultaneously proposing active fire management as a means to enhance conservation through rewilding. We would thus like to highlight that sorting of papers into positive/supportive and negative/cautious should not be seen as definite, but as a continuous spectrum of opinions allowing for exceptions. We also encourage readers willing to engage with relevant sources to acknowledge the context presented by papers as a whole, as well as the wider body of literature in order to avoid any potential biases and misrepresentations. For example, recognising that rewilding can be intimately linked with the processes of revegetation and land abandonment – but acknowledged only sometimes – could allow us to identify a more common view of rewilding as a threat to fire regimes (discourse **D**). We therefore invite colleagues to refine and build upon our suggested framework to better capture the complexities of rewilding and fire interactions, and hope our work provides a sound base on which to tether a more structured debate.

Indeed, the need for a clear, nuanced and balanced conversation surrounding the role of fire in rewilding is becoming increasingly important as the need for fire management and nature recovery increases. Acknowledging the existence of different facets of rewilding and fire – and of different ways in which fire can be integrated within rewilding – will allow researchers and practitioners to be better aware of the opportunities and risks when considering fire as part of rewilding programmes, helping reconcile fire and rewilding perspectives that recognise trade-offs, synergies, and their context dependencies. Further engagement with other less common viewpoints and broader public discourses, for example by incorporating grey literature, could provide an even better way of understanding the direct and indirect links between rewilding and fire strategies. Indeed, there is strong potential for synergies presented by the use of fire and rewilding as conservation strategies, as sources with very different perceptions and backgrounds can still present examples of common themes and arguments, like, for example, the suggestion to use integrated grazing and prescribed fire strategies as ways of reducing environmental risks. Reaching common solutions from different positions and perspectives will allow for the socioeconomical and ecological potential of rewilding and fire management to be more accurately acknowledged, helping maximise welfare and conservation outcomes to better tackle the ongoing biodiversity

crisis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This research did not receive any specific grant from funding agencies in the commercial, public or not-profit sectors. We thank Professor Yadvinder Malhi, Professor Marc Macias Fauria, Professor Jamie Lorimer and Dr Filipa Soares for their thoughtful comments that helped define the scope of this paper. We also thank Dr Adrián Regos Sanz and our other (anonymous) reviewer for their detailed comments that helped improve the quality of the manuscript.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.pecon.2025.02.002.

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