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Accounting, Accountability, Assurance, Financing and Governance for Rewilding and De-extinction

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Abstract

Purpose – Rewilding and de-extinction are strategies being adopted globally to address an urgent need for biodiversity protection and nature restoration. These strategies require immense funding to finance nature restoration and biodiversity enhancement, and forms of accounting and assurance are required to discharge accountability for the effective use of these funds. This study explores accounting, accountability, assurance, financing and governance for biodiversity protection and nature restoration, focusing on rewilding and de-extinction.

Design/methodology/approach – The study introduces a Special Issue of *Accounting, Auditing & Accountability Journal* devoted to "Accounting and Accountability for Rewilding, De-extinction and Biodiversity Protection" and portrays the contributions in this issue. We also present two case studies: the development of nature (biodiversity) credits by CreditNature to finance rewilding programmes, and the planned de-extinction of the woolly mammoth by Colossal Biosciences.

Findings – There are two key findings. First, we suggest that accounting and finance be universally treated and portrayed as a unified discipline since new developments such as the evolution of nature fintech through the creation of nature credits are inextricably linked to the reporting of, and accounting for, these new forms of finance and their impact on nature and biodiversity. Second, we consider the Task Force for Nature-related Financial Disclosures (TNFD) to accelerate the growth of nature finance. This can be interpreted and portrayed as an emancipatory accounting framework, contributing to engendering the development of nature credits and other forms of extinction finance.

Research limitations/implications – This investigation draws upon publicly available documents relating to the two cases. It lays the groundwork for further research on rewilding and de-extinction for proposing ways to increase the supply of private finance to meet the ever-growing demands for amelioration of the natural environment.

Practical implications – The study demonstrates the potential for the TNFD and other related frameworks for biodiversity and nature accounting to act as an emancipatory force in developing the key fields we identify as vital for rewilding and de-extinction, consequently enhancing biodiversity protection and nature restoration.

Keywords: biodiversity credit; de-extinction; nature credit; nature fintech; rewilding.

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1. Introduction[1]

According to the Annual Risk Report of the World Economic Forum (WEF, 2020), the world is on a dangerous path towards ecological collapse. The rate of biodiversity loss over the past 50 years has accelerated with the safe planetary boundary for the biosphere being dangerously exceeded (Richardson et al., 2023; IPBES, 2019). There is a growing awareness among companies that the resilience of the planet's ecosystems and biodiversity underpins their business resilience. Investors globally are recognising nature risk in their portfolios, with nature-related issues becoming increasingly acknowledged as material to the future financial prospects of businesses and financial institutions (TNFD, 2025). In March 2019, the United Nations (UN) General Assembly formalised the period 2021 to 2030 as the UN Decade on Ecosystem Restoration (UNEP, 2021). The UN's intention was to align the previous decade focusing on its own Sustainable Development Goals (SDGs) with urgent and extensive efforts to restore destroyed and degraded ecosystems. In the EU (European Union), the Natural Restoration Law (the 'Nature Law') was passed on a narrow vote by the European Parliament in July 2023. The law reflects a pillar of the EU biodiversity strategy for 2030, which aims broadly to protect the natural environment and combat climate change (Hermoso *et al*., 2022). It is a tangible representation of the European Green Deal, putting in place recovery measures

[1] Non-standard abbreviations: TCFD: Task Force on Climate-Related Financial Disclosures; TNFD: Task Force on Nature-Related Financial Disclosures; EFRAG: European Financial Reporting Advisory Group; CSRD: Corporate Sustainability Reporting Directive

of 20 per cent of the EU's land and sea by 2030. Environmental rehabilitation will be expanded to all degraded ecosystems by 2050. The aim is to achieve a harmonised approach to addressing biodiversity loss by all Member States, reducing the risk of regulatory arbitrage.

Nature "restoration" refers to "assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed."[2] A closely related term is "rewilding" which has its roots in earlier environmental movements seeking to establish wilderness areas with intact food chains linked by biodiversity corridors (Nogués-Bravo et al., 2016). This approach may be plausible in some settings but is problematic when areas have been fundamentally altered by hundreds of years of human activity, especially with no apparent ameliorisation[3]. The EU's regulations are important, especially given the emphasis placed, not just on protecting existing biodiversity, but on increasing the space necessary to plant and animal species and growing the populations of both (see, for instance, Jepson, 2022). Currently, rewilding lies primarily in the domains of conservation, ecology, and natural science. However, accounting, accountability, assurance, financing and governance have important roles as a collective to play in enabling scientific and ecological efforts and effective outcomes.

Accordingly, this study addresses an emerging and critically underexplored area, concerned with how accounting, accountability, assurance, financing and governance, can enable and support significant biodiversity recovery efforts, particularly through innovative instruments, such as biodiversity credits and nature fintech. Significantly, accounting is positioned as an active lever at the very forefront of ecological restoration, with the potential to become a proactive, enabling instrument for environmental restoration, incorporating the progressive conservation preservation and protection of nature globally. It's a time for walking; not more talking or mere words! Our sustenance, as humans, depends on this potential being realised without delay, with no further illustration of our apparent ignorance or inability to contemplate "accounting for shaping a better world" for humans and nonhumans alike and focusing upon present and all future generations.

The current state of funding allocated for restoration iterates the urgent need to address biodiversity loss from a multi-disciplinary perspective (Karolyi and Tobin-De La Puente, 2023). Deutz et al. (2020) estimate that it may cost almost USD 1 trillion per annum to arrest biodiversity loss by 2030. The financing gap for biodiversity protection (WEF, 2023) and broader efforts to address the climate crisis have been estimated at between USD7 and USD330 billion, respectively (UNEP, 2022). In this context, the UK's Dasgupta Review (2021) calls on financial markets to act urgently to facilitate biodiversity protection and restoration. This will entail developing new financing sources, forms of accounting and modes of accountability (EFTEC Rayment Consulting, 2021). New forms of finance for biodiversity are being developed (Young et al., 2022). Accounting for biodiversity has transitioned from being an academic exercise reflecting on emergent practice to forming part of mainstream practice in the discipline (e.g. Houdet et al., 2021).

[2] See the Society for Ecological Restoration available at: https://www.ser.org/general/custom.asp?page=SERStandards, accessed on 26 January 2025.
[3] For a summary of the discussion on the differences between "restoration" and "rewilding", refer to https://www.irishtimes.com/environment/2023/08/17/the-critical-distinction-between-nature-restoration-and-rewilding/.

Organisations such as the TNFD (2022, 2023) and EFRAG have made significant progress in providing structure for managing, accounting for, and reporting on biodiversity protection and nature recovery (see Financial Stability Board, 2021). Their efforts are complemented by new codes of best practice which integrate biodiversity into contemporary corporate governance (King et al., 2022). According to Atkins and Macpherson (2022, p. 59), "if the benefits of extinction governance are to be fully realised, measures to protect biodiversity must form an integral part of an organisation's business model and operations" (also see King and Atkins, 2016; King et al., 2022).

Based on these rapid developments, it became abundantly clear that a Special Issue (SI) of *Accounting, Auditing & Accountability Journal* was both a timely and vital proposition to address rewilding and de-extinction.[4] Earlier work has highlighted the limitations of conventional accounting systems, including efforts to account for and report on environmental issues such as biodiversity loss (Tregidga et al.. 2014; Gray and Milne, 2018). We take a more optimistic stance grounded in accounting's transformative or emancipatory potential (Gallhofer and Haslam, 2005; Carnegie et al., 2021a, 2021b, 2023, 2024; McNally and Maroun, 2018; Atkins and Maroun, 2018; Maroun and Atkins, 2018).

The papers included in this SI provide alternative positions on how accounting can advance positive change with a specific focus on rewilding. Together with this paper, each contributes to the biodiversity accounting and reporting literature while outlining an agenda for future research to drive the positive change potential of emerging forms of accounting, accountability, assurance, financing and governance. In keeping with this issue's broad-scope theme, the focus is placed upon restoring/rewilding aimed at protecting current biodiversity. We also consider how finance, accounting and accountability are being used to drive efforts aimed at 'de-extinction'.

The remainder of the paper is structured as follows. In the next section, section two, a summary is provided of the evolving field of academic literature on biodiversity (and extinction) accounting and finance. Section three defines the concepts of rewilding and de-extinction, as strategies of biodiversity protection and nature restoration. Section four explores CreditNature's ongoing efforts to develop new forms of nature finance and consider ways of accounting for their use and the case of Colossal's de-extinction of the woolly mammoth. Section five discusses the topics, approaches and potential contributions of papers in this Special Issue. The paper concludes with a discussion and recommendations and calls for further research in section six.

2. The Evolving Academic Field of Biodiversity Accounting and Finance

This contribution is positioned within the swiftly growing academic literature on biodiversity and extinction accounting and finance. The financing, assurance and governance of, and accounting and accountability for, rewilding and de-extinction are interpreted as an emergent, nascent sub-field of biodiversity and extinction accounting and financing. The notion that accounting is more than just a neutral record-keeping mechanism is well-established (Hopwood, 1987; Gallhofer and Haslam, 2005; Carnegie et al., 2021a, 2021b, 2023, 2024). Carnegie, Parker and Tsahuridu (CPT) have redefined accounting as follows, "Accounting is a technical, social and moral practice concerned with the sustainable utilisation of resources and

[44] See: http://www.emeraldgrouppublishing.com/calls-for-papers/accounting-and-accountability-rewilding-de-extinction-and-biodiversity-protection

proper accountability to stakeholders to enable the flourishing of organisations, people and nature" (Carnegie et al., 2001a, p. 69, 2021b).

Accounting as a multidimensional practice, in accordance with its essence, is beyond being a mere technical practice as often narrowly understood and treated in educational and professional arenas. Accounting can operate as an agent of positive change and transformation in the world by blending its technical properties with its key social and moral dimensions and developing imperatives for nature and the natural environment upon which we humans and all non-humans alike are totally dependent for our sustenance. This is expressly not, under any circumstances, an unimportant agenda. This does not entail a radical re-organization of the economies and political systems; the existing financing, accounting, assurance and accountability as well as governance infrastructure can be mobilised to assist with managing the trade-offs between short-term financial performance and long-term sustainable development (e.g. Gallhofer and Haslam, 2005; Atkins and Maroun, 2018; Maroun and Atkins, 2018; Gomes et al., 2024).

(i) The Evolving Academic Literature on Biodiversity and Extinction Accounting

The earliest studies of accounting for biodiversity adopted a natural inventory model, which sought to identify species at risk and then develop a theoretical framework to encompass accounting for biodiversity (e.g. Jones, 1996; 2003). Special issues (SI) of the *Accounting, Auditing & Accountability Journal* are devoted to encouraging and publishing research into accounting for biodiversity (Jones and Solomon, 2013), ecological accounts (Russell et al., 2017) and extinction accounting (Atkins and Maroun, 2018). Each SI dealt with different perspectives on the link between nature and accounting but shared a common "emancipatory" perspective which recognises how accounting and accountability can engender positive change.

Recently several literature reviews of biodiversity and extinction accounting have been published which demonstrate the growing maturity of this research field. Blanco-Zaitegi et al. (2022) identify five differentiated thematic clusters: 1) sustainability, as a motor theme, 2) biodiversity reporting and 3) corporate biodiversity management, as transversal themes, and 4) environmental protection and 5) emancipatory accounting, as isolated themes. Roberts et al. (2021) and Maione et al. (2023) provide extensive literature reviews of the publications exploring accounting for biodiversity and extinction accounting at the time. Studies have been published on a wide range of different extinction accounting contexts from historic studies of accounting and its links with and role in species extinction (McBride et al, 2023) to research which explores extinction and biodiversity accounting by various industrial sectors such as forestry (Corvino et al., 2021), agriculture (Ecim and Maroun, 2024; Lange and Maroun, 2024) and mining (Zhao and Atkins, 2022; Maroun et al., 2018). Broader reporting trends have been considered (Adler et al., 2018; Hassan et al., 2020; Maroun and Ecim, 2024). The extinction accounting framework has also been modified to include de-extinction strategies aimed at increasing biodiversity (Atkins and Maroun, forthcoming).

One of the core debates within the extinction accounting literature focuses on the extent to which disclosures by organisations represent genuine efforts aligned with protecting and/or recovering species and biodiversity or whether they are imbued with impression management,

greenwashing and "greenhushing[5]" (Jollands et al., 2019; Zhao and Atkins, 2021; Cuckston et al, 2022). Concerning the trend of greenwashing, the empirics suggest that efforts to account for, and report on, species have been met with only limited interest from the business community in both developed (e.g. Adler et al., 2018; Hassan et al., 2020) and developing economies (e.g. Usher and Maroun, 2018; Sun and Lange, 2023). What little is reported is mostly generic and does not support the argument that companies are internalising the loss of species as a valid business risk. For example, Boiral (2013) raised issues of authenticity in sustainability reporting. Jones and Solomon (2013) discussed the problems associated with accounting for biodiversity being anthropocentric and potentially characterised by impression management. Boiral (2016) and Boiral and Heras-Saizarbitoria (2017) and Hassan et al. (2020) presented evidence of impression management activities in accounting for biodiversity.

Even in cases where extinction accounting is being applied implicitly, nature is framed in anthropocentric terms. A financial-economic discourse is used to explain the case for managing "natural capital" and the benefits of any extinction prevention efforts are framed almost entirely in monetary terms as if there is effectively no other way or means of doing so (Milne et al., 2009; Tregidga et al., 2014). While this type of reporting represents, at least, some endeavour by certain corporates to tackle biodiversity losses, the significant intrinsic value of nature is being overlooked as part of a process which critical scholars describe as reframing biodiversity as a commodity to justify rather than to prevent the loss of species (Gray and Milne, 2018). Cuckston et al., (2022, p. 1) highlight a "risk that businesses may perversely apply natural capital approaches to justify damage to species and ecosystems". These authors add there are risks that the misuse of such thinking and accounting can lead to negative capital impacts. Such risks, therefore, that are not imagined, are prone to be ignored or overlooked. Indeed, such risks are to be adequately identified and properly mitigated with an open-minded, macro understanding of nature and its critical importance to the sustenance of humans and non-humans alike for tomorrow. Moreover, quantitative indicators in this domain premised on augmenting nature to be "nature-positive" can rather, according to Sobkowiak and Cuckston, 2025, p. 1515):

> …. turn this abstract dream into a concrete set of objectives that define our progress or, indeed, lack thereof ... Creating such quantifications involves creating cascades of inscriptions that flow through intersections of network and fluid spaces, of solidity and fluidity.

This serves as a reminder of a much earlier strand in the environmental strategic management literature regarding whether nature should have identifiable status as an express stakeholder itself (e.g. Starik 1995; Wood, 1990; Freeman, 1984). In the context of the vital importance of nature and biodiversity credits, the potential exists for extinction accounting and other financial innovations for funding nature restoration, to be captured by impression management, insidious or otherwise and, accordingly, cannot be precluded. Indeed, nature is the prime candidate now for the most important stakeholder, both today, tomorrow and across the coming decades.

Nevertheless, there is evidence of extinction accounting's emancipatory potential. For instance, Zhao and Atkins (2022) found several examples of Chinese mining companies reporting on the protection of endangered species, suggesting an emancipatory element to the reporting. Maroun and Atkins (2018) showed that there were elements of South African listed company reports

[5] Greenwashing refers to presentation of information in a way which portrays environmental outcomes more favourably than is the case. Greenhushing involves the exclusion of information to avoid drawing attention to unfavourable environmental outcomes.

explaining how certain endangered species were being protected by companies, with species audits tracking increasing populations because of corporate strategies and policies. While not a common practice, some companies are working closely in partnerships with NGOs, environmental bodies and researcher groups to problematise biodiversity and explore possible solutions for tackling key challenges (van Liempd and Busch, 2013; Atkins et al., 2022; Buchling and Maroun, 2023).

Developing trends towards such partnerships, and acceptable commonality underpinning strategies deployed in targeting the conservation, preservation and protection of nature and species, need to be actively encouraged and aptly disseminated. These forms of partnerships and shared understandings have the potential to widen organisational understanding of environmental risks and empower governing bodies to take proactive steps to conserve biodiversity, an outcome which is clearly emancipatory (Atkins et al., 2022). Moreover, that extinction accounting can drive positive change is affirmed by the fact that leading investors are factoring environmental indicators, including those related to extinction accounting, into their engagements with investees[6] and capital allocation decisions (Atkins and Macpherson, 2022). As a result, concluding that every example of extinction accounting is captured by an impression management agenda can be assessed as being overly critical and essentially pessimistic, yet it is desirable to sound alarm bells given the risks involved.

(ii) The Evolving Field of Extinction Finance

Atkins and Macpherson (2022) outline the development of public finance in relation to biodiversity and species protection as well as private finance. They also identify a wide array of financial metrics and targets being developed across financial markets for the measurement and indexing of biodiversity, ecosystems and species. The new developments in the financial markets point to the emergence of 'extinction finance', which is defined as "…the integration of species protection, extinction prevention and biodiversity enhancement into financial market mechanisms" (Atkins and Macpherson, 2022, p.22). The "Rhino Bond" represents one of the first innovations in extinction finance in terms of financial mechanisms and instruments devised to protect, conserve and save a specific keystone species (Okolo, 2022). Indeed, de-extinction bonds and an extinction bond framework have been proposed in recent literature as a means of channelling private finance into biodiversity protection (Macpherson and Biehl, 2022).

In addition to extinction bonds, biodiversity-related ratings can complement broader trackers of sustainability performance (Zubets-Anderson and Lehmann, 2022). Extinction finance is being advanced further by several policy-oriented initiatives, reviews and new frameworks, including the PBAF, the new version of the Equator Principles, the Poseidon Principles, the TNFD, the Dasgupta Review, and the Nature Restoration Law as part of the EU Green Deal. In addition, the Global Biodiversity Framework, adopted at the UN Biodiversity Conference (COP15) in December 2022 includes targets, such as Target 15 and 19, which provide the overarching policy imperative for these other initiatives. All these wide-ranging initiatives have provided the motivation and basis for organisations to explore new ways of integrating nature into financial mechanisms, instruments and tools.

[6] This information disclosure process is also referred to in the academic accounting literature as private sustainability reporting, or private social and environmental reporting (Solomon, 2021; Semenova, 2023).

There is, however, a need for more academic research into biodiversity finance (see Karolyi and Tobin-De La Puente, 2023). Some literature is starting to emerge, although interestingly, it is tending to appear in journals in disciplines other than accounting and finance, such as conservation and ecosystem services (for instance, Irvin-Broque and Dempsey, 2023; Losos, Pfaff and Pimm, 2024; Mair et al., 2024; Nguyen and Jones, 2022; Seidl, Mulungu et al., 2024; Seidly, Cumming et al., 2024). Similarly, in academic accounting research, there has been substantial attention devoted to accounting for biodiversity, conservation and extinction but hardly any publications focusing specifically on rewilding and de-extinction strategies, which should result in nature-positive outcomes but require substantial financing and subsequent accountability mechanisms.

3. Rewilding and De-extinction Strategies

Rewilding and de-extinction are scientific and ecological strategies which are also significant for accounting, accountability, assurance, financing and governance. Both types of strategy require significant funding which necessitates suitable accounting for and reporting on the costs incurred and the benefits for investors and other stakeholders in both financial and ecological terms. This leads us to consider the issue of accountability: "Accountability to whom and for what?". In this section, we provide definitions and an initial present understanding of rewilding and de-extinction strategies from an inter-disciplinary perspective. As part of this, we also deal with some ethical and moral considerations.

(i) Rewilding

Rewilding is a relatively new strategic approach to biodiversity protection and nature restoration. It is a

> … progressive approach to conservation. It's about letting nature take care of itself, enabling natural processes to shape land and sea, repair damaged ecosystems and restore degraded landscapes. Through rewilding, wildlife's natural rhythms create wilder, more biodiverse habitats[7].

Rewilding has also been defined by the International Union for the Conservation of Nature (IUCN) as:

> … the process of rebuilding, following major human disturbance, a natural ecosystem by restoring natural processes and the complete or near complete food web at all trophic levels as a self-sustaining and resilient ecosystem with biota that would have been present had the disturbance not occurred… (Carver et al., 2021; quoted in Weber Hertel and Luther, 2023).[8]

A technical and extensive review of the definitions of "rewilding" and how it may differ from "restoration" is beyond the scope of this paper. For the current study, "rewilding" and "restoration" are understood as "…useful as a way of describing an approach to conservation that seeks to maintain or even increase biodiversity and reduce or reverse past and present human impacts by restoring more functional ecosystems" (Lorimer et al., 2015, p.54).

[7] https://rewildingeurope.com/what-is-rewilding/
[8] See also the following article which seeks to position and define rewilding: https://onlinelibrary.wiley.com/doi/pdf/10.1111/brv.13046

Rewilding includes different conservation efforts to restore natural processes and non-human autonomy within ecological systems so they can self-recover and respond to contemporary environmental conditions.[9] This aligns with the SDGs, especially the emphasis placed on conserving water- and land-based ecosystems to conserve important ecological processes and, as part of this, contribute to improved standards of living for the world's growing population. Rather than being seen, at least potentially, as "anti-globalism" or an effort to reverse completely the effects of industrialisation, rewilding is a "visionary new agenda for conservation" (Jepson and Blythe, 2020, p.45)[10], which balances environmental goals with pragmatism offering nature-based solutions to complex socio-economic challenges and climate adaptation.

Rewilding and restoration efforts may be placed on a continuum. Some initiatives offer relatively modest approaches for reducing adverse environmental impacts and improving existing ecosystems. Others entail native ecosystems operating in the same way as they did before human-related degradation. Rewilding Europe adopts a landscape approach financed by philanthropic foundations and public grants (Atkins et al., 2023). Private estates (e.g. Wildand) are attempting to restore ecosystems for nature-based enterprises. Rewilding real estate companies are emerging that generate investment returns from environmental credits (carbon and nature), forestry and ecotourism. Another example is the charitable organisation, HEAL, which is adopting a land ownership approach, buying or being gifted swathes of land across the UK and rewilding it (Stannard et al. 2022). One method involved in more ambitious efforts to restore or rewild landscapes involves the re-introduction of previously extinct species (Nogués-Bravo et al., 2016). Experiments with aurochs across the EU (a species of extinct prehistoric cattle) present a salient example (Atkins et al., 2023).

The restoration of functional equivalents by means of de-domestication and/or de-extinction pathways to missing large herbivores (auroch, horses and more recently water buffalo) has been central to European rewilding since the mid-1980s. This approach is synonymous with 'Pleistocene Rewilding' (Donlan, 2005), which focuses on introducing functionally equivalent extant species as substitutes for extinct ones (Nogués-Bravo et al., 2016, p.87). Rewilding strategies select past natural baselines for nature restoration and Pleistocene Rewilding draws attention to more ancient natural baselines. It is the concept of 'Pleistocene Rewilding' that links our consideration of accounting for rewilding to strategies of de-extinction.

(ii) De-extinction

De-extinction literally involves bringing species back from extinction into nature of today or a form of "resurrection". Cohen (2014) explains there are three potential avenues leading to species de-extinction. Similarly, Sherkow and Greely (2013) discuss these three approaches to de-extinction as being the most likely to succeed, specifically back-breeding, cloning, and genetic engineering. Cloning involves taking a cell nucleus from an extinct creature and inserting it into the egg from an existing related species. The resultant offspring, therefore, is a direct descendent of the extinct species. The second approach is genetic engineering where there are only DNA fragments of the extinct species rather than an intact cell. In this scenerio, the DNA can be 'sequenced and spliced' into the genome of a closely related species. This form of de-extinction produces a creature very similar but not identical to the extinct one. Third, is

[9] We are grateful to Dr. Paul Jepson for clarifying this point.
[10] See also: ttps://royalsocietypublishing.org/doi/full/10.1098/rstb.2017.0434

the selective breeding approach, essentially finding living animals that carry the most characteristics in common with the extinct species and breeding them 'backwards'. Again, after several repetitions a creature will evolve which is understood as like, but not the same, as the extinct one. This process is as much about 'de-domestication' as de-extinction.[11] In summary, the idea that de-extinction is a realistic possibility may seem far-fetched but it is already happening, as we write this.

The urgent need for corporate action to halt biodiversity loss should be assessed along economic, ecological and moral lines (Atkins and Maroun, 2018; Gray and Milne, 2018). In other words, neither an entirely anthropocentric nor exclusively ecological stance can be taken. Rather, a pragmatic approach is required where costs and benefits of rewilding are considered in financial terms and evaluated further by considering the implications for the environment and other stakeholders. This is fully consistent with the "double-materiality" logic at the heart of the GRI and the EU's CSRD (Corporate Sustainability Reporting Directive). Organisations must consider how biodiversity impacts their financial performance over the short-, medium- and long-term and they must also consider how their operations impact the broader stakeholder community and the environment (e. g. Correa-Mejía et al., 2024).

Operationalising "double materiality" requires a consideration of both risks and opportunities. The economic cost of rewilding is only one part of the assessment. Rewilding projects can lead to new lines of business; differentiate an entity from its competitors; yield additional access to resources and bolster an entity's social license to operate. The ecological case for wanting to rewild the natural environment has been documented by the scientific community and should be complemented by careful consideration of potential challenges and how these can be mitigated (Jepson and Blythe, 2020).

Any rewilding objectives should be supported by a clear plan including suitable and realistic milestones and key performance indicators (KPIs). Activities should be continuously monitored in terms of economic, ecological and social impact to provide a basis for holistic analysis and reflection. This is in keeping with the recommendations of earlier critical scholars who call for the widening of the field of accounting to realise fully its emancipatory potential development (e.g. Gallhoffer and Haslam, 2005; Carnegie et al, 2021a. 2021b, 2023, 2024).

We propose that financing decisions be integrated into the emancipatory accounting framework. Considerations include the type of financial or fund-raising instruments which can be used to raise the capital required for rewilding projects; additional risks which arise; mitigation strategies and how financial returns are best reinvested to further restoration efforts. A more effective approach is to rely on existing frameworks, such as the TNFD and TCFD, to ensure that much-needed funding is directed to the rewilding efforts which have the greatest impact gauged from an economic, environmental and social perspective.

From a normative and ethical perspective, both the organisation undertaking the rewilding and the institution providing finance should report on their efforts. This is not about mere political correctness but in the best interests of attaining and demonstrating long-term accountability. Governing bodies should understandability and appropriately be held accountable by investors

[11] Appreciation is expressed to Dr. Paul Jepson for pointing this out.

and other stakeholders for the impact which their organisations have on the environment. Conversely, the financial community cannot operate in isolation. Recognising the aspirations of the Principles on Responsible Investment and Equator Principles will require substantive action coupled with transparent reporting on the outcomes to key stakeholders.

Finally, the accountability-related aspects of rewilding include moral and ethical issues. For example, Bennett et al. (2017) expressed concern about the trade-off between spending scarce resources on conservation versus spending on de-extinction. Their analysis found that even with independent external funding of de-extinction programmes, the ensuing public funding of resurrected, 'de-extincted', species in addition to those requiring conservation would actually lead to fewer existing species being conserved, the outcome of which may be perceived as a net loss in biodiversity. Indeed, these authors indicated that there could be significant sacrifices in the conservation of existing species if resurrected species' care were publicly funded. Potential sacrifices, they suggested, in the conservation of existing species would need to be weighed against any benefits from de-extinction: "Because little is known about the costs of producing viable initial populations of resurrected species, we do not consider this in our analysis, and assume it is covered by a private agency" (Bennett et al., 2017, p.2).

As a result, Bennett et al. (2017, p.3) conclude that, "it is unlikely that de-extinction could be justified on grounds of biodiversity conservation". Scholars have also questioned the rationale for de-extinction (Sandler, 2013; Sherkow and Greely, 2013); the ethics underlying a de-extinction strategy (e.g. Sandler 2013; van Dooren and Rose 2015; Minteer 2014); and the underlying cost-benefit trade-offs.[12] Banks and Hochuli (2017, p.390) note "… extinction plays a prominent role in conservation science", and argue that the extinct are martyrs for the broader conservation cause: "De-extinction threatens the martyr status of this extinct wildlife, which we suggest is ultimately a dangerous idea for conservation". This thinking builds on the notion that extinct (and often iconic) species can become symbols for the conservation cause (Banks and Hochuli (2017, p.392). From the perspective of framing and reframing, reframing a species, which has undergone de-extinction, as extant could result in weakening the ecological incentive for conservation and extinction prevention. In other words, reframing an extinct species, such as the Tasmanian Tiger, as 'being able to be de-extincted' maweakeny the conservation movement to prevent further extinctions.

Five dimensions of the ethics of de-extinction are explored by Cohen (2014): (a) the possible contribution of de-extinction to promoting ecological values, (b) the deontological argument that we owe de-extinction to species we rendered extinct, (c) the question of "playing God" through de-extinction, (d) the utilitarian perspective, and (e) the role of aesthetic considerations in the ethics of de-extinction. De-extinction could result in a certain level of complacency among conservationists and society more generally as if something goes extinct it can be brought back. Furthermore, ecosystems will have evolved and adapted in the absence of the extinct species: evolution is not static. Reframing may be counterproductive if predatory species which previously existed in the landscape are now absent, resulting in the de-extincted species facing no competition or threat to keep its numbers in the previously prevailing natural balance.[13]

[12] De-Extinction Debate: Should We Bring Back the Woolly Mammoth? - Yale E360
[13] GONE: Australian animals extinct since the 1960s. Tim Low, Carol Booth. Invasive Species Council. 2023. https://invasives.org.au/wp-content/uploads/2023/08/Extinctions-Report.pdf

The notion of "proper accountability", as stipulated in the CPT definition of accounting as a multidimensional technical, social and moral practice, serves to underline the importance of morality and ethics in the interplay of accounting, accountability and governance. According to Carnegie and Napier (2023, p. 1), in the *Handbook of Accounting, Accountability and Governance*: "*Accounting performs accountability; accountability nurtures governance; governance presumes accounting*" (emphasis in original). Given this inherent connectivity, they argue that all of accounting, accountability and governance are multidimensional technical, social and moral practice.

In extinction accounting, accountability and governance, should a creature be brought back to nature from extinction, who is accountable for its welfare? Would a woolly mammoth brought back from extinction be 'owned' by whoever carried out the de-extinction? As a formerly extinct creature rather than one which is endangered, would it be protected, automatically or not, by any legal framework, and what key means of avoidance would arise relating to the previous wipe-out of this creature? This is not perceived to be the case with rewilding strategies, unless they involve rewilding once extinct species. We now turn to examining two cases of rewilding and de-extinction, as detailed earlier, how they are financed, as well as the accounting, assurance and accountability aspects of these programmes.

4. Accounting, Accountability, Governance, Assurance and Finance for Rewilding and De-extinction

In this section we consider calls for the urgent development of biodiversity or nature credits to fund rewilding programmes. Biodiversity credits are an innovative form of crypto-asset, which can assist in closing the finance gap for rewilding and nature restoration. A crypto-asset is defined as "…. a private digital asset that uses cryptography[14] and serves as a medium of exchange" (Baker et al., 2023, p.3). Crypto-assets are seen as an investment, the value of which can be unpredictable and highly volatile (Ram et al., 2016). Biodiversity credits are a rapidly evolving form of finance for nature and biodiversity. The biodiversity credit market has grown rapidly with a proliferation of methodologies, project standards and pilot projects (Biodiversity Credit Alliance, BCA, 2025). A biodiversity credit is broadly understood as

> …. a form of tokenized rights or access granted to a service on a blockchain network. They have several use cases typically tied to their implementation, the mechanism design of their service, and the network. Use cases include paying back transaction fees and providing voting rights and a governance framework to members of a decentralized autonomous organization (DAO). In some cases, utility tokens make up the incentive mechanism for a blockchain's consensus algorithm (WEF, 2023).

There is, however, currently no universal definition of a biodiversity credit with these being, rather simply, defined as "…payments for measurable and scientifically verified biodiversity outcomes" (WEF, 2023, p.3). A slightly more detailed definition is that they are seen as:

[14] Cryptography is the process of hiding or coding information so that the only person a message was intended for can read it. There are three types of cryptography: secret key cryptography; public key cryptography and; hash function cryptography.

> … verifiable, quantifiable and tradeable units of restored or preserved biodiversity over a fixed period. A biodiversity credit[15] is an economic instrument that can be used to finance actions that result in measurable positive outcomes for biodiversity (e.g., species, ecosystems, natural habitats) through the creation and sale of biodiversity units. A biodiversity credit represents, "… a unit of biodiversity that is being restored or preserved (WEF, 2023, p.4).

A Biodiversity Credit is a certificate that represents a measured and evidence-based unit of positive biodiversity outcome that is durable and additional to what would have otherwise occurred (BCA, 2024, p.7). For biodiversity credits to achieve their desired outcomes, they need to possess the following characteristics: real and lasting positive impacts on biodiversity; verifiable benefits allowing for independent verification; ability to be quantified, so that the credits can be accounted for, be comparable and possess tradability (WEF, 2023). WEF (2023, p.4) identified at least four ways in which biodiversity credits could deliver value for businesses, namely by: 1) supporting quality assurance for companies buying nature-based carbon credits by delivering biodiversity benefits; 2) enabling companies to assure sustainable access to ecosystem services; 3) demonstrating the company's contribution to the GBF goals, and 4) allowing companies to create products which are combined with nature improvements, which assist customers in meeting demand for nature positive outcomes.

The WEF (2023) also identifies ways in which the biodiversity credit may be ensured of growth (by unlocking scale and impact in biodiversity credit markets), namely by: establishing a business case for purchasers of biodiversity credits; developing high-integrity supply at sufficient scale; consolidating common principles, standards and methods. Although biodiversity credits do offer a much-needed and innovative approach for increasing investment in nature conservation and restoration, the business case needs to be made. The evolution of the biodiversity, or nature, credit markets has been identified as one way to achieve "nature positive outcomes" but, "important barriers to the development of biodiversity credit markets [exist], particularly in the areas of metrics and policy objectives ... Until such obstacles are resolved, it will be very difficult to develop and scale up tradable biodiversity credits" (Karolyi and Tobin-De La Puente, 2023, p.246).

Indeed, it is acknowledged that integrity in biodiversity credits is crucial to their development and successful adoption as the,

> Improper use of biodiversity credits may harm nature and local communities and expose buyers to strategic, operational and reputational risks. Inappropriate use could take the form of greenwashing, particularly where credits are perceived to replace meaningful efforts to avoid and reduce impact on nature. Low-integrity credits that do not achieve significant positive nature outcomes …. may also fail to create long-term value for businesses. If companies make false and misleading claims to consumers, investors and other stakeholders about the uses and outcomes of credit purchases, this may expose them to substantial risks. The use of low-integrity credits can also risk further degradation of nature (WEF, 2022, p.4).

To ensure high integrity and instill confidence in biodiversity credits, ecological measurement that is understandable, transparent and valid is necessary as is a process of verification/assurance (WEF, 2025, as an example). Fortunately, such measurement is

[15] As well as the term biodiversity credit, stakeholders also use the terms 'biocredit', 'biodiversity certificate', 'nature credit' and 'nature token interchangeably (WEF, 2023).

improving, rendering translation into financial terminology and application to the financial markets more achievable,

> Scientific measurement of habitats is becoming more accurate, scalable and affordable due to technologies such as satellite, remote sensing and environmental-DNA, which should complement traditional and local knowledge. Habitat banks (parcels of land where quantifiable gains in biodiversity are generated) are one example where technology could benefit restoration and conservation at the ecosystem level (WEF, 2022, p.15).

The global biodiversity credit market is anticipated to expand to around USD 10.25 by 2033.[16] Recently, 21 High Level Principles have been specified to assist in assuring high integrity in biodiversity credit markets (WEF, 2025). Linked to the development of biodiversity credits is the need to develop accountability mechanisms, frameworks and methods for accounting for biodiversity credits. Accounting for biodiversity credits is in its infancy.

(i) CreditNature's Nature (Biodiversity) Credits

After due consideration, CreditNature was purposively selected as an illustrative case of how accounting and finance are being mobilised to make rewilding "investable", rather than as a representative example of biodiversity credit markets more generally. The case is examined using publicly available secondary data, including company white papers, website disclosures, keynote presentations, press releases, and policy-related documents. Our emphasis was placed on sources associated with and detailing the design of measurement frameworks, verification processes and links to reporting and disclosure requirements. The credibility of the data was assessed through triangulation across multiple sources and by prioritising materials that were either subject to third-party scrutiny (e.g. Accounting for Nature® accreditation) or explicitly intended for external accountability purposes. Analysis focused on how accounting, assurance and governance are constructed to support claims of biodiversity uplift and market integrity, rather than on evaluating the ecological effectiveness of individual projects.

CreditNature Ltd, is a Nature FinTech startup, 'born' out of the Ecosulis Ltd. innovation team to develop a digital nature asset solution to the challenge of 'how to make rewilding investable?'. Co-founded by Cain Blythe and Paul Jepson in November 2022, CreditNature is a response to the aspiration and need to scale rewilding as a nature-based solution to climate change and rural economic decline in the context of international efforts to develop biodiversity credit markets and other nature-based financing mechanisms, linked to the development of nature-related reporting frameworks in finance and to corporate reporting and disclosure (specifically ESG, TNFD, EU CSRD). CreditNature has developed a so-called 'end to end solution' that links a metric framework for quantifying changes in ecosystem integrity called NARIA (Natural Asset Recovery Investment Analytics[17]) framework for monitoring and reporting[18] into units of environmental accounting linked to digital nature assets whose 'production' and integrity are enabled and assured by a digital platform.

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[16] See: https://pollinationgroup.com/global-perspectives/state-of-voluntary-biodiversity-credit-markets

[17] The NARIA Framework is explained in: Jepson, P. et al., 2023. NARIA: Natural Asset Recovery Investment Analytics V2.1. CreditNature White Paper. CreditNature Ltd., Harwell, Oxfordshire. DOI: 10.32071/CN.TD.200723

[18] From this link: http://creditnature.com/press-room/creditnature-achieves-accreditation-from-accounting-for-nature/

Developing nature credits seeks to operationalise express and operationalised advances in function ecology, ecosystem recovery science and practice, biodiversity technologies, and the latest developments in Nature Fintech and De-Fi (decentralised finance).[19] Such links are critical if we, the authors and the readers, are to see genuine and ongoing movement towards a nature positive planet. These new forms of finance, namely Nature Credits (also commonly referred to as biodiversity credits or nature tokens) are also being developed in order to provide companies (and other investors/financial institutions) with the ability to satisfy the requirements of the TNFD and other biodiversity reporting frameworks, as well as to comply with developments such as the EU Nature Restoration Law. This highlights the emancipatory effects of the TNFD in catalysing evolution in financial nature markets.

In a keynote conference speech by Dr. Paul Jepson (Jepson, 2024), he introduced CreditNature's solution including key design principles and underpinning theory and science. He explained that from the outset that they recognised that advances in various areas of technology offered a means to deal with the dynamic complexity of nature (socio-ecological systems) as well as to address limitations in carbon credit markets relating to double counting, quantification, verification and transparency. Further, he described CreditNature's organisational belief that a future Nature Fintech must conversely 'make nature fit for finance and finance fit for nature', meaning[20] that it must initiate a transformation in the mind-set of financial professionals and asset owners from maximising monetary returns to maximising collective well-being (of humans and non-humans).

CreditNature's solution is digitally produced 'Nature Investment Certificates' (NICs) that represent a fractional one-hectare investment in a programme of ecosystem restoration activities within a defined area. A NIC 'yields' nature credits and these represent a point uplift in ecosystem condition across the restoration area measured using the NARIA Ecosystem Condition Index (N-ECI) and achieved within the NIC investing period. Owners of NICs have the right to report (redeem) Nature Credits in their CSRD. The solution is also designed to support debt instruments such as nature-related performance bonds, where the N-ECI represents an investment Key Performance Indicator (KPI). In the future, NICs and Nature Credits could possibly qualify as crypto utility assets as defined in the EU directive on Markets in Crypto Assets (MICA) and their value lies in the reporting quality which is a factor of their integrity (robustness against 'green washing and 'junk asset' critiques) and associated recovery story. The EU's recent Nature Credit Roadmap (European Commission, 2025) complements strongly the approach CreditNature is adopting.[21]

In January 2023, CreditNature's solution was chosen by ScotGov's[22] Civtech programme to accelerate under one of its innovation challenges, namely, 'How can biodiversity credits be designed in a way that provides simplicity for projects and buyers, and enables investment in Scotland's nature?'[23] This led to an approximately £500k public innovation procurement, working closely with Scot Gov nature finance policy officials, to develop a technology platform and draft ecosystem recovery code to create a nature market infrastructure that would enable market access for landholders, provide finance relevant insight for buyers and investors,

[19] De Fi refers to the development and replication of financial products and services enabled on a blockchain platform while not requiring incumbent third party financial institutions.
[20] This was mentioned by Dr. Paul Jepson in his keynote – there is no transcript of this remark.
[21] See: https://ec.europa.eu/commission/presscorner/detail/en/ip_25_1679
[22] Scot Gov refers to the Scottish Government
[23] https://www.civtech.scot/civtech-8-challenge-6-simplifying-and-enabling-investment-in-scotlands-nature

introduce new levels of community and democracy, reduce transaction costs and assure all steps in the process using digital verification processes. A commitment to develop this 'born digital' recovery code was included in the Scottish Government's Natural Capital Market Framework (Nov 2024).[24]

This includes the world's first accredited ecosystem condition index and ecological land management rating that assess the impact of land management on the ecosystem process quantified in the ECI. The ECI adopts a three-level architecture inspired by the Human Development Index dimensions and indicator approach. CreditNature subsequently aligns it with an indicator framework developed independently by Czúcz et al. (2021) to implement the Ecosystem Accounting (EA) protocol of the UN for System of Environmental and Economic Accounting (UN SEEA). The N-ECI specifies key ecosystem dimensions of land assets, identifies data sources that can indicate their condition and translates data into metrics that represent a meaningful proxy of the dimension on a scale of 0-100. The NARIA terrestrial ECI (V1.0) measures the condition of four higher-order natural processes that, by means of interaction, give rise to the recovery of ecosystem integrity. These metrics are as follows: landscape connectivity (process of dispersal); vegetation spatial diversity (natural disturbance processes); trophic function (trophic cascades), and bird trait diversity (processes of niches becoming available and occupied).

Metrics are designed to accommodate accelerating developments in environmental sensor technologies and data science. Following a rigorous year long process working with Accounting for Nature® the method was accredited in April 2023 calculating Econd's®12 (AfN-METHOD-E-01) under their rigorous method standard (v4.1) for units of ecological accounting. The method is accredited for use in 38 European ecoregions, 13 that co-evolved with megafauna and on lands where ecosystem condition has been degraded by human activities over time (see Jepson, 2023). The terms 'integrity' and 'intactness' are both used in discussing biodiversity, according to Jepson et al., (2023) but, specifically, "[E]cosystem integrity refers to the condition of a system and its capacity to sustain and recover functions and processes" (Jepson et al., 2023, p.6).

NARIA includes two assessment analytics. These are the ECI (Ecosystem Condition Index) and the EMI (Ecosystem Management Rating). The ECI measures four dimensions of ecosystem integrity and generates an ecosystem integrity score from 0 to 100 for a defined area of land. This can be used to demonstrate a percentage uplift per acre from a baseline figure. During his keynote address, Dr. Jepson presented the architecture of the CreditNature platform. He described how it was informed by the Interwork Alliance standards for tokenisation, contractual extensions, workflows, and analytics for voluntary ecological markets,[25] the open source Hedera Guardian platform[26] as well as participation in the Biodiversity Credit Alliance digital working group.

In essence, the platform comprises a series of workflows that translate the processes of environmental data capture and project design and delivery into steps and the standards and protocols that govern nature markets into protocol that 'co-create' these steps. Each step is verified (or validated) automatically and/or with humans 'in the loop' and assigned a unique digital identifier creating digital trust chains that decentralise the process and enable rapid,

[24] https://www.gov.scot/publications/natural-capital-market-framework/
[25] https://www.gbbc.io/initiatives/open-learning-forum?topic=IWA
[26] See, for instance, https://hedera.com/guardian

robust and cost-efficient auditing. These workflows are translated into user-interfaces that bring the desired simplicity and ease of market access to land holders and the investors.

The Ecosystem Condition Index underlying the NARIA framework can be updated every two to three years but as more efficient monitoring and measurement systems are developed, this updating process will become more frequent and the monitoring and verification more dynamic (Jepson, 2024). The EMR measures the impact of human land management activities (which may be interpreted as ecosystem engineering by humans) against each of the EII metrics to produce an A to G rating on the capacity of an area to maintain/recover ecosystem integrity. To ensure that biodiversity credits have integrity, verification/assurance is necessary, and this is an important aspect of the NARIA framework, as highlighted here: "Third-party providers can bring their own measurement frameworks – for example CreditNature's NARIA framework quantifies changes in ecosystem integrity into units" (WEF, 2015, p.15).

The crux of the potential success of any attempt to create biodiversity credits that businesses and investors will purchase rests in a large part on assurance of measurements and integrity, thereby "[B]uying biodiversity credits from a reputable biodiversity crediting programme with robust third-party verification can provide greater assurance that the underlying project is well-designed and delivers positive outcomes for nature and people. Reputable biodiversity crediting and verification is still nascent but should be based on robust and scientifically accepted standards" (WEF, 2022, p.16). The following relevant and informative disclosure appeared in a CreditNature press release:

> Following a rigorous year-long process, working closely with Accounting for Nature® ("AfN")[27] and their panel of leading scientists, CreditNature have pioneered a method that will help companies to evidence the nature positive impact of investments and align with reporting and disclosure requirements of the Taskforce on Nature-related Financial Disclosure ("TNFD") Guidelines, the EU Corporate Sustainability Reporting Directive ("CSRD"), and other global frameworks. By adopting this method, businesses can report on the impact their investments in nature have achieved and disclose attested and impactful ESG outcomes.[28]

Figure 1 below seeks to demonstrate the interconnectivity of various disciplines involved in CreditNature's nature credits.

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[27] "Accounting for Nature® is an independent expert-driven, not-for-profit standard-setting body that has set the first globally consistent Standard for measuring, certifying and communicating changes in the condition of environmental assets of vegetation, soils, fauna, water, microorganism and ecosystems. Accounting for Nature® is used to inform investment, policy and management decisions in natural capital. These include carbon co-benefits, green bonds, environmental offsets and impact investments" from Scaling Financial Investment into Natural Capital - CreditNature at the following link http://creditnature.com/press-room/creditnature-achieves-accreditation-from-accounting-for-nature/

[28] From the Press Release 24th April 2024 at Scaling Financial Investment into Natural Capital - CreditNature

Figure 1: CreditNature, an Interdisciplinary Approach

Financial Indexes, Metrics (Information and Analytics for Financial Decision-Making)	➔	**Finance, Nature Fintech**	➔	**Ecology, Conservation, Ecosystems, Biodiversity**
NARIA framework EII EMR		Biodiversity credits, Nature Tokens, Nature Credits		Rewilding projects: Scottish Highlands
			➘	**Accounting, Reporting, Extinction Accounting, Accounting for Biodiversity** EU CSRD TNFD BD Protocol Accounting for Nature (working with CreditNature)

From this discussion, as can be deduced, ensuring the integrity of these biodiversity credits is part of a complex 'assurance' process. We suggest that the NARIA framework could potentially be used by assurance providers as the criteria for a formal verification of ecological conditions and the translation of ecological indicators into metrics which can be used in a financial context in biodiversity reporting. This assurance process is critical to the success of these credits as it provides the confidence potential purchases need to verify uplift in ecosystem condition attached to their purchase. Elucidation of the interdisciplinary nature of CreditNature's approach is provided in Figure 1. These developments are the sort of innovations foreseen as new forms of 'extinction finance' and 'extinction metrics' and as such constitute part of the *Species Protection Action Plan for the Financial Markets* (Atkins and Macpherson, 2019). They bring together finance, accounting, assurance and accountability so as to enable the financing of nature restoration.

(ii) Accounting, Accountability and Financing for De-extinction: Colossal Biosciences

As discussed earlier, another related approach to addressing ongoing ecosystem and biodiversity collapse is de-extinction. For this study we decided to explore the efforts of Colossal Biosciences (henceforth Colossal) to bring woolly mammoths back from extinction. The Colossal case is analytically significant due to the scale of private investment involved, the high-profile nature of the initiative, and the absence of formalised accountability mechanisms comparable to those emerging in rewilding and biodiversity finance.

The case draws exclusively on publicly accessible secondary data, including company website materials, press releases, investor announcements, media reports and financial databases. Data collection involved an iterative review of sources to identify disclosures relating to financing, governance arrangements and public accountability narratives. Given the private ownership structure and limited mandatory reporting obligations, the analysis treats gaps, opacity and reliance on promotional disclosures as analytically meaningful but are not assured by us. Rather than attempting to verify scientific claims, the analysis focuses on what is disclosed, to whom, and with what implications for accountability in the context of de-extinction.

Colossal are adopting the scientifically challenging but seemingly realistic approach to de-extinction of using genetic engineering combined with a whole range of other scientific specialist disciplines. Colossal is a recently created US company, founded by George Church and Ben Lamm. Colossal states, on its website (at the time of writing) that it is the first and only de-extinction company in the world and continue, stating: "[D]e-extinction involves using genetic engineering techniques to recreate extinct species by inserting their DNA into the genomes of closely related living organisms".

Colossal explains that its approach is interdisciplinary as it calls on inputs from the following disciplines: genetic engineering; AI and machine learning; embryology; stem cell reprogramming; conservation and animal husbandry; exogenous development. Interestingly, from our perspective, the company does not mention finance and accounting, which may suggest a lack of importance or interest in these fields as disciplines in their own right may exist. Perhaps society generally, and academia specifically, may not view accounting and finance as a time-honoured academic discipline or as not having a capability for dealing with de-extinction? Should one or both of these suppositions be valid, this allows at least the potential material contribution of financing and accounting to be obscured and sidelined. Where do the immense funds come from in financing such extensive, interdisciplinary de-extinction programmes? As acknowledged by Shapiro (2020, p.14): "Many technical hurdles stand in the way of de-extinction. While science will eventually find a way over these hurdles, doing so will require significant investment in both time and capital". We can observe that, from the scientists' perspective, financing is viewed as a 'hurdle' rather than as an enabler contributing to an interdisciplinary approach which includes accounting and financing.[29]

Colossal explains that its focus is on 'keystone species'[30] which play an invaluable role in maintaining the health of their ecosystems: woolly mammoth, thylacine (Tasmanian tiger) and dodo. However, it may also be argued that these are high profile, charismatic species. The importance of accounting for keystone species has been outlined in relation to the extinction accounting framework (Atkins and Maroun, 2018). The woolly mammoth is a keystone species classified as an 'ecosystem engineer'. Indeed, scientific research has identified the woolly mammoth as one of the most important keystone species and its reintroduction could assist in reducing global warming. When the mammoth became extinct, as a direct result of human activity, the largest 'biome' on the planet, the 'mammoth steppe' went from being grassland to forest and tundra. As the tundra thaws due to anthropogenic climate change, it is also releasing greenhouse gases thereby contributing to the warming. Grassland, which would have been the original landscape when mammoths roamed, effectively keeps the carbon in the ground. These areas of Siberia are now being restored to grassland to contribute to slowing down global warming. The reintroduction of woolly mammoth following their imminent de-extinction may assist in reconverting the tundra and forest to grassland.[31]

[29] Not wanting to labour this point it does seem ironic that interdisciplinary accounting research represents a substantial body of work in the accounting and finance discipline whereas it seems interdisciplinary scientific research does not include accounting and finance.
[30] A keystone species was first described as one which has a disproportionately large effect on its natural environment relative to its abundance (Paine, 1969).
[31] De-Extinction Debate: Should We Bring Back the Woolly Mammoth? - Yale E360

The specific technology employed by Colossal is 'CRISPR' (the CRISPR-cas9 gene editing tool), a biological engineering technology. CRISPR-based genetic engineering and other technologies can be used to reproduce close approximations (not clones) of extinct species' genomes in order to restore the species to life. The 'Vertebrate Genomes Project' (VGP) aims to effectively provide a 'back-up' of critical and keystone living species. Thus far, Colossal have, with the VGP, successfully sequenced the entire Asian elephant genome. This is the first time a mammal's genome has been sequenced since the human genome project of some 20 years ago. Colossal partnered with VGP in 2021 and is providing them with funding to sequence the genomes of Asian, African bush and African forest elephants for preservation purposes. The Colossal website states that these genomes will be made publicly available for research without restrictions.[32] Another species Colossal are planning to bring back from extinction is the Tasmanian tiger. The role of human activity, farming, exploitation in the extinction of the Tasmanian tiger has been the subject of a recent accounting paper (Morton and Tsahuridu, 2023).

We conducted an in-depth analysis of relevant web pages to explore the financing sources for Colossal and for their de-extinction projects. The investors' identities are generally available although finding them was not an easy task. Furthermore, the various series of financing are available on investment websites and in financial news articles. The latest available figures at the time of writing suggest that the company has attracted total funding to date of $228.04MM, as summarised in Table 1 in the Appendix. Our research showed that Colossal Biosciences is funded by 37 investors (Crunchbase).[33] However, it seems that the Series C funding in 2023 was aimed to boost valuations in anticipation of an IPO.

"Colossal Biosciences, referred to widely as the world's first de-extinction company, announced an oversubscribed $150M Series B financing in January 2023 led by United States Innovative Technology Fund ("USIT"), with participation from Breyer Capital, WestRiver Group, Bob Nelsen, Animal Capital, Victor Vescovo, In-Q-Tel, Animoca Brands, Peak 6, BOLD Capital, and Jazz Ventures, among others".[34] Further tables (Tables 2, 3 and 4) presented in the Appendix summarise the investors which could be identified from a thorough search of the internet, the universities involved in the de-extinction programme and the conservation partners working with Colossal.

The first technology spinout from Colossal was "FORM BIO" – a software platform which appears to have been lucrative, so far, for the company. This is an AI-based computational biology platform which is already it seems bringing in substantial funding to the company. To date, however, we have not been able to identify how much funding is involved from publicly available sources. Having considered the financing of Colossal and their de-extinction programme we also wondered whom Colossal are accountable to and in what ways they may demonstrate accountability in relation to species they bring back from extinction. These are complex questions. How can there be any accountability for something which does not exist? When they create this effectively new creature whose is it? Theirs? This seems to be the case

[32] It is interesting that Colossal have far-reaching intentions, as stated on their website, which have very little to do with de-extinction, "Today, the woolly mammoth. But tomorrow – maybe the cure for blindness, eradication of tumours and elimination of diseases"

[33] https://www.crunchbase.com

[34] See: http://www.businesswire.com/news/home/20230131005411/en/Colossal-Biosciences-Secures-150

for the three dire wolves, recently brought back by Colossal from extinction after 12,500 years, which are being kept in a secret location.[35]

Colossal Biosciences is a privately-held company and is not publicly traded on the NYSE or NASDAQ. According to a recent media article, "Colossal is nowhere near going public, which means retail investors don't have front-door access to the company".[36] The company is, therefore, not bound in the same way as publicly-listed companies by accounting regulations and their website may represent one of the primary sources of information. Perhaps the main way in which the company is discharging accountability through disclosures to interested parties. Recently it has been announced in the media that Colossal aims to produce a multi-year docuseries on their de-extinction efforts for woolly mammoth, dodo and thylacine. Possibly, we can interpret this series of films as a further form of public accountability to stakeholders. It may, on the other hand, also be interpreted by some as a form of greenwashing and impression management in public reporting.

As a means of analysing and presenting our findings from exploring the accounting, accountability and financing of rewilding and de-extinction, using two current case studies, we provide a summary in Table 5. This table depicts a summarised "compare and contrast analysis" of the accounting, accountability and finance for the two organisations.

Table 5 Comparing Accounting & Finance for Colossal and CreditNature

	De-extinction: Colossal	**Rewilding: CreditNature and Nature Credits**
Financing	Venture capitalists Private investors Entrepreneurs	Nature (biodiversity) credits
Accounting:	Colossal is a private company: no mandatory reporting Website disclosures/docuseries	CreditNature: Website disclosures Investors (companies buying credits) will account for digitial assets (nature credits) in annual reporting
Accountability	Accountability for extinct creatures is unprecedented After de-extinction who 'owns' the woolly mammoth, or the dire wolves, who is accountable for their welfare, and to whom?	Accountability to investors: clear chain of accountability by means of NARIA framework, effectively an assurance mechanism: identifiable, verifiable and measurable improvements in biodiversity from investment High Integrity, verifiable and assured Accountability to public: for improvements/uplift in biodiversity/nature

Following the analysis of the two cases of rewilding and de-extinction we now turn to discuss the papers included in this Special Issue.

5. The Papers in this Special Issue

The papers in this Special Issue represent developments in accounting for biodiversity and extinction accounting interspersed with issues of species accounting, accounting for rewilding, from all corners of the world and in a wide variety of settings. For example, geographically, the papers focus a wide range of regions including: the Chinese context, studying Hong Kong

[35] The de-extinction of these three wolves was announced in a sensational way, with not any warning, in April 2025. See: http://edition.cnn.com/2025/04/07/science/dire-wolf-de-extinction-cloning-colossal/index.html.
[36] Curry (2021).

(Zhang et al., 2026); Sweden (Gullberg and Haverno, 2026); Latin America, specifically Chile (Fox et al., 2026); Mauritius (Roberts and Pariagmaraye, 2026) and Pakistan (Farooq et al., 2026). Further, the papers in this Special Issue embrace a broad range of topics including: the dimension of time in emancipatory extinction accounting (Gullberg and Haverno, 2026); the application of extinction accounting to a highly urbanised environment (Zhang et al., 2026); species and biodiversity accounting in the wine industry (Fox et al., 2026); the integration of stakeholders into biodiversity accounting (Azizi et al., 2026); conceptual development (Powell, 2026); future research avenues (Pigatto et al., 2026); afforestation efforts (Farooq et al, 2026) and species restoration (Roberts and Pariagmaraye, 2026). We now explore these papers in more detail. The dimensions and themes covered by the papers are summarised in Figure 2 below.

Figure 2
Dimensions and Themes covered by Papers included in this Special Issue

Geographic Region	Country	Sector	Themes	Methodological Approach and any Data Analysed
Far East	Hong Kong, China *Zhang et al., 2026*	Public sector Government NGOs	Urban biodiversity conservation Extinction accounting	Interpretive analysis of Hong Kong Biodiversity and Action Plan and annual reports from Hong Kong government agencies
South East Asia	Pakistan *Farooq et al., 2026*	Billion Tree Afforestation Project	Brings out social, moral and technical elements of accounting Transformative potential of accounting	Interpretive extended case method Semi-structured interviews
Latin America	Chile *Fox et al, 2026*	Corporate Wine Industry	Nature at the centre of accounting Species preservation Biodiversity protection	Multi-cited ethnographic design Analysis of reporting by one company: Case Study
Europe	Sweden *Gullberg and Haverno, 2026*	NGO	Relevance of time (and urgency) to accounting for biodiversity Emancipatory extinction accounting	Case Study of WWF Sweden Analyses annual reports and social media communications
Africa and the Middle East	Mauritius *Roberts and Pariagmaraye, 2026*	Rewilding and conservation	Mauritian kestrel Rewilding of a species near extinction	Case Study Longitudinal, historical Semi-structured interviews
Non-specific	Global *Azizi et al. (2026)*	n/a	Stakeholder engagement approach to biodiversity	Biodiversity literature and stakeholder engagement literature review
	Global Pigatto et al. (2026)	n/a	Focus on biodiversity measurement, biodiversity offsetting, extinction accounting and biodiversity reporting	Structured critical literature review Setting a future research agenda
	Powell (2026)	n/a	'Flourishing' of nature Non-human focus	Conceptual approach Capabilities approach

Zhang et al., (2026) elucidate the challenges of biodiversity conservation in metropolitan contexts by means of exploring extinction accounting in the highly urbanised city of Hong

Kong. The study investigates the motivations, strategies, and institutional dynamics of Hong Kong's government entities and NGOs in biodiversity conservation, deploying interpretive content analysis. It examines the role and application of extinction accounting as a means of governance to address biodiversity loss in the context of rapid urbanisation. The authors do so by evaluating the Hong Kong Biodiversity Strategy and Action Plan (HKBSAP) and annual reports from selected Hong Kong government agencies, thereby rendering an analysis of the challenges and opportunities for urban biodiversity conservation within constrained metropolitan settings. Previous research has largely focused attention on extinction accounting in corporate settings; its application in public sector contexts is under-explored. The study addresses biodiversity loss in the context of rapid urbanisation, highlighting the ways in which institutional dynamics and power disparities influence biodiversity conservation efforts. The findings depict a significant divergence in extinction accounting approaches between government and NGO bodies where, "government entities prioritise quantifiable, urban planning driven metrics, while NGOs emphasise ecocentric values and grassroots engagement" (Zhang et al., 2026, p. X). More generally, according to the authors, their "actionable recommendations provide scalable, evidence-based strategies that empower policymakers and practitioners to strengthen biodiversity stewardship in cities worldwide" (2026, p. X).

Azizi et al., (2026) develop a conceptual framework that is intended to bridge biodiversity accounting and stakeholder engagement, involving a diversity of stakeholders and, in the process, propose a future research agenda for enhancing corporate biodiversity management (CBM). This study deploys systematic literature of biodiversity accounting and the stakeholder engagement literature. Stakeholder accountability is focused upon as a prime orientation for enhancing CBM and the framework proposed by the authors integrates stakeholder engagement into biodiversity accounting. They propose future research propositions intended to foster holistic integration of stakeholder engagement into biodiversity. Further, the authors argue "while there is consensus on the importance of stakeholder engagement, only a few studies have addressed its relevance to biodiversity accounting and CBM" (Azizi et al., 2026, p. X). Among the study's key findings, the authors "reveal that biodiversity accounting remains formative and faces significant challenges related to measurement, data availability, governance, and stakeholder integration" (Azizi et al., 2026, p. X). They refer to the absence of standardised, reliable indicators as well as the practical problem of insufficient or inadequate data, which "impeded the development of transparent and holistic biodiversity accounting systems" (Azizi et al., 2026, p. X). Rather, current corporate reporting practices often rely heavily on financial values and traditional financial reporting approaches, which are hinderances based on limited understanding of the complexity and relevance of biodiversity protection. Such key concerns are contributing to continuing tensions in effectively addressing biodiversity.

The study by Gullberg and Haverno (2026) explores how time – as temporal viewpoints – is mobilised in accounts of biodiversity to appreciate more the role of time in framing biodiversity performance. This study, therefore, introduces a time-aware stance, intended to augment the emancipatory extinction accounting literature. It involves examining the annual reports of, and social media communication, by WWF Sweden, to illuminate the role of time in framing biodiversity performance. The analysis is organised around the idea of accounting as a process of framing, combined with the concept of time rationalities of Chakhovich (2013, 2019), emphasising the importance of account-givers' temporal viewpoint, shedding light on shortcomings of biodiversity accounting. This temporal viewpoint relates to an account-giver's orientation (from past, present or future) towards events and affects how performance is evaluated. In this investigation, five different roles of time are identified: time as trend, urgency,

expectation, snapshot and journey. Each of these roles reflects a viewpoint from either the past or the present. In addition, one potential role is identified: time as imagination, building on a viewpoint from the future. The strengths and shortcomings of each of these roles are addressed to demonstrate the potential for applying a time-aware stance in the framing and reporting of biodiversity performance. In extending the understanding of time in sustainability accounting through practical guidelines on how to mobilise time in emancipatory extinction accounting as well as through the conceptualisation of a time-aware stance, this study is concerned with elucidating shortcomings of biodiversity accounting.

Fox et al., (2026) examine an approach to biodiversity accounting and reporting set in the Chilean wine industry. The approach developed by the entity is premised on "developing its authentic reporting identity, including how its biodynamic certification process influenced its production process, and sustainability accounting and reporting" (2026, p. X). The authors undertake this study by conducting an analysis using multi-cited ethnographic (MSE) design. Their study presents a means of developing and applying biodiversity accounting and reporting that is portrayed as being consistent with the wine producer's reporting identity. The findings of the study point to the difficulties of traditional accounting reporting systems for facilitating sustainable outcomes. What is now considered as important for producing sustainable outcomes both today and tomorrow, such as biodiversity and species preservation, is exposes as difficult to make transparent by means of existing, present-day traditional approaches to materiality in sustainability reports. It is shown in this investigation "how organisations can develop an authentic reporting identify that is built on biodiversity first" (2026, p. X), especially on initially contemplating effective and impactful biodiversity reporting in an industry, expressly in the context of winemaking. This is characterised by the authors as an alternative accounting and reporting approach "that places nature at the center of accounts, for which quantification is a secondary priority to the relationships therein" (2026, p. X). These findings offer much to contemplate in nature-orientated accounting and reporting, particularly for biodiversity and, most significantly, for the conservation, preservation and protection of nature globally.

The conceptual study of Powell (2026) takes a dynamic, aspirational perspective on accounting to release itself to actively prioritise, enable and facilitate the flourishing of nature, permitting the discipline internationally to play a vital role in biodiversity protection and restoration, making wild animals or nonhuman species visible. Presently, this is not perceived as the focus of the discipline of accounting operating under the dated motto as "the language of business". Specifically, the author, drawing on the Capabilities Approach as interdisciplinary research, introduces "an accounting framework for nonhuman flourishing that encompasses flourishing of ecological collectives, including ecosystems and species, and individual wild animals" (2026, p. X). This proposed framework identifies opportunities for accounting to support nonhuman flourishing across ecological levels. Moreover, the notion of *flourishing*, as presented in the multidimensional definition of accounting (Carnegie *et al*., 2021, p. 69), where accounting is positioned as a multidimensional technical social and moral practice, has received little attention to date in accounting research, thereby serving as a further contribution of this study. The author adopts the challenges of Bebbington and Unerman (2018), who called for researchers to examine the Capabilities Approach in accounting as a means of emphasising and enabling the flourishing of nature, and further contributes to making animals visible in accounting as proposed by Vinnari and Vinnari (2022). She argues there is "much scope to build upon existing practices and develop new practices and approaches to support the flourishing of nature" (2026, p. X).

The investigation by Pigatto et al (2026) constitutes a critical examination of research in the broad arena of business and economics. The authors undertook a structured literature review (SLR) across two fields, first, the accounting, business, and management field and, second, the economics, econometrics, and finance field. The study focusses attention on the following four key topics, identified as "biodiversity measurement, biodiversity offsetting, extinction accounting, and biodiversity reporting" (2026, p. X). The authors identified four transformative redefinitions as avenues for further research, stated as "(1) the opportunities and pitfalls of biodiversity and ecosystem measurement; (2) the need to move on with biodiversity reporting; (3) accounting for conservation and rewilding; (4) accounting for the sixth mass extinction" (2026, p. X). They believe their review "extends beyond mapping extant research to uncover ideas, thoughts, beliefs, the conditions of power, and the dominant ideologies that are shaping the field of biodiversity accounting" (2026, p. X). The results are different across each of these two fields. Pigatto et al (2026. p. X) reported that accounting journals "tend to be dominated by research on biodiversity reporting". Alternative, economics journals "are populated with a plethora of industry-specific case studies" particularly in agricultural and agro-forestry, fishery and conservation sectors. The authors identify several limitations of their study, especially in respect to the methodological choices that made in designing their investigation.

"In the land of the dodo, endangered endemic species such as the Mauritian kestrel are pulling out of a dramatic death dive to star in an extraordinary story of last-gasp survival" (Kinsella, 2026).[37] In this study by Roberts and Pariagmaraye (2026, p, XX), the need to understand stakeholder dynamics in rewilding initiatives within the context of the global nature crisis". Her case study examines the Mauritius Kestrel (*Falco punctatus*), a species rescued from near extinction, offering key insights into, and important understandings of, sustainable rewilding practices. Roberts and Pariagmaraye (2026) also identify various vital factors that are necessary to drive the effectiveness of conservation initiatives of significant importance, thereby providing timely, actionable guidance for essential future species protection. The study employs a qualitative longitudinal case study approach, focusing on the Mauritian Kestrel rewilding project during the period more than 50 years from 1973 to 2024. Semi-structured interviews were deployed for data collection purposed through with key stakeholder groups, as supplemented by stakeholder mapping. The author identities four critical factors for the success of necessary rewilding initiatives. These are stated as follows: "Resources, focusing on the sustainable management of financial and non-financial assets; trust, stakeholder dynamics, addressing conflicts, collaboration, cultural considerations, and community engagement; and time, highlighting the necessity of a long-term perspective to ensure the success of species reintroduction and prevent extinction" (Roberts and Pariagmaraye 2026, p. XX). There is no option but to develop a rigorous and robust literature which aids in contributing to the vital success of rewilding projects.

Farooq et al (2026) examine the accounting practices in a large-scale afforestation project in the Provincial government of Khyber Pakhtunkhwa (KP), Pakistan. The project, known as the Billion Tree Afforestation Project (BTAP) focuses on understanding "how accounting mediates accountability, participation, and ethical stewardship in environmental governance" (Naveed et al, 2026, p. XX). The study adopts an interpretive extended case methodology, informed by Carnegie et al.'s (2021) tripartite conceptualisation of accounting as a multidimensional technical, social and moral practice, complemented by using institutional and stakeholder

[37] See, Back from the brink: the Mauritius kestrel - Animalogic

perspectives. Data was obtained by undertaking 29 semi-structured interviews, after developing a stakeholder map to secure a balance representation, combined with applicable project documentation, available archival material as well as from making field observations.

The results confirm the accounting practices examined in BTAP as simultaneously operating as technical practice, social process and impacts, and moral purpose and framing. According to the authors, "technically, it enabled monitoring and accountability and supported legitimacy claims", … Socially, "accounting structured participation and trust", … Morally, "religious and ethical narratives helped mobilise stewardship" (2026, p. XX), Simultaneously, for each of these dimensions of accounting, the authors observed: Technically, accounting "exposed tensions between bureaucratic demands for precise reporting and field-level realities"; Socially, "participatory arrangements sometimes became tokenistic when decision authority remained centralised"; Morally, the religious and ethical narratives observed were "at times redirecting attention away from institutional accountability". They argued, "these dynamics show accounting's performative, contested, and potentially transformative role in environmental governance" (p. XX) and, accordingly, "extends sustainability accounting theory by theorising how technical, social, and moral dimensions interact and generate tensions in practice" (p. XX).

6. Concluding Comments and Pathways for Further Research

In this study we have discussed the urgent need for financing for rewilding programmes as well as the financing of de-extinction programmes. Associated with the financing is the need for accountability and governance, and the production of accounts to demonstrate the way funds are used and the extent to which the programmes are successful. Furthermore, the assurance around funds' investment is a critical element to the success of rewilding strategies as well as their chains of accountability. As such, accounting and financing are core aspects of any rewilding or de-extinction programmes.

Given the complexity of rewilding and de-extinction strategies and initiatives, interdisciplinary approaches are needed to address biodiversity collapse and species extinctions. An interdisciplinary approach needs to include and incorporate the discipline of 'accounting and finance', as accounting, accountability and finance for rewilding and de-extinction are crucial to their success. Indeed, our discussion suggests 'accounting and finance' is perhaps not viewed as an academic discipline from the perspective of other disciplines although none of the scientific and ecological developments discussed here could function without accounting and finance. Further, we argue 'accounting and finance' should be perceived as a unified discipline. Our consideration of biodiversity and nature credits and their links to the TNFD, for example, highlight the integral and inseparable nature of accounting and finance and their interlinkages.

Our discussion shows that rewilding and de-extinction are extremely different from an accounting, accountability and financing perspective. De-extinction may be seen as a high profile, sensational approach to addressing ecosystem and biodiversity collapse which is attracting celebrity and high-risk capital. The associated accounting and accountability for de-extinction seem opaque, lacking in transparency due mainly to the corporate ownership structure and lack of public listing. Rewilding is inspiring the development of nature fintech in the form of biodiversity credits for purchase by companies and other institutions. We suggest

that it is likely that chains of accountability and accounting need to be explored which are attached to the purchase of biodiversity credits including engagement with the TNFD. There is also room for the development of theoretical frameworks to interpret and understand the integration of accounting and finance into rewilding, de-extinction and biodiversity protection, possibly bringing theory from different disciplines.

Accounting for (nature) fintech is a rapidly evolving area of finance, accounting and accountability. There are also significant ethical and moral issues involved in rewilding and de-extinction that have been explored to some degree but which require further research and discussion and debate in the evolving literature. Indeed, there are ethical and moral issues relating to both rewilding and de-extinction that could be further researched, especially in relation to accounting and finance. Concerns have been raised in the ecological and conservation literature about funds being diverted to rewilding that could be used elsewhere,

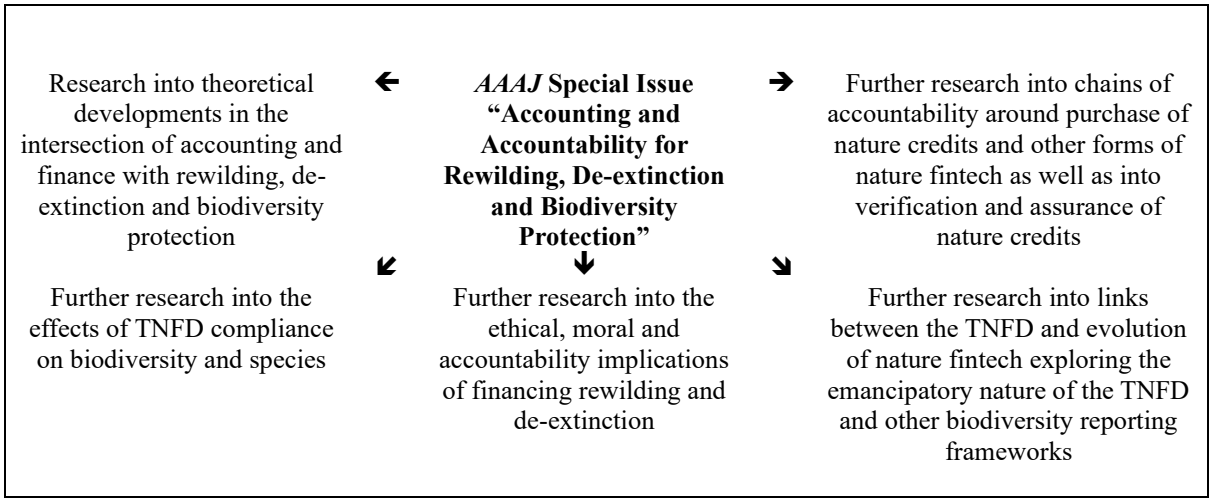
"[T]o our minds, rewilding as a conservation discipline consists of significant unknowns in the ecological and socio-economic realms, and the risk-to-reward ratio is often unknown. If nothing else, rewilding could take limited funds from other arenas of conservation" (Nogués-Bravo et al., 2016, p.87). There are also concerns raised in the literature about whether there has been adequate consideration of the cost-benefit analysis regarding rewilding projects (Sandon et al., 2013; Pereira and Navarro, 2015). Further research into the use of funds and the accountability for their use in rewilding and de-extinction would assist in clarifying these issues. It may be useful for researchers to explore stakeholders' views of rewilding and de-extinction strategies and their attitudes towards the financing of these as well as issues of accountability, morality and ethics. There is also a need for researchers to explore the implementation of the TNFD and the extent to which the framework is resulting in uplifts in ecosystem integrity and biodiversity conservation through investment in products such as biodiversity credits. It will be interesting to assess the extent to which the TNFD represent an emancipatory accounting framework that is leading to transformational outcomes for biodiversity and species.

As seen in this study, the financing gap for rewilding strategies and nature restoration is somewhat immense and new financial instruments are necessary to entice private finance into the area. However, these strategies need research to be undertaken in order to enhance their effectiveness and to garner supply of finance from investors and companies. Research is needed urgently to explore ways of successfully marketing biodiversity credits and other forms of nature fintech and biodiversity finance to encourage investors as well as the corporate sector to purchase these new instruments and ensure a substantial and continuous flow of finance.

In all, the consideration of rewilding and de-extinction as multidisciplinary strategies requiring cross- and intra-disciplinary efforts in the existing literature discusses a wide array of disciplines but somewhat overlooks the academic discipline and discipline in practice of 'accounting and finance'. As we evidence in this study, finance is seen as a constraint or an obstacle rather than an enabling discipline. Accounting is seen as a necessary outcome but not part of a multidisciplinary solution. We feel it necessary to emphasise that as part of the multidisciplinary raft of solutions addressing biodiversity collapse and species extinctions, finance is as critical a life-giving force as the disciplines genetic engineering or conservation. It is the life-blood feeding and underpinning de-extinction and rewilding strategies, as an enabling force. Similarly accounting, accountability and assurance are core to the ultimate

success of any rewilding or de-extinction programmes. Particularly, forms of emancipatory extinction accounting are necessary to ensure the required transformation in business practices. While this may be a challenge for accounting, this is also a prime opportunity for enhancing the relevance and capabilities of the accounting profession, "… to enable the flourishing of organisations, people and nature" (Carnegie, et al., 2021a, p. 69; 2021b, 2023, 2024).We hope that this contribution as an opening paper and this SI will call academic researchers in accounting and finance to explore further the ways in which accounting and finance can enable rewilding and de-extinction and contribute to saving species, ecosystems, biodiversity and ultimately Planet and People. Avenues for further research suggested above are summarised in Figure 3 below. More work needs to be done and urgently. The stakes are high; we are out-of-time to fiddle or procrastinate.

Figure 3
Avenues for Further Research into Accounting, Accountability and Financing of Rewilding and De-extinction



References

Atkins, J. F. and Macpherson, M. (Eds.) (2022) *Extinction Governance, Finance & Accounting: Implementing a Species Protection Action Plan for the Financial Markets*, Routledge, UK.

Atkins, J. F. and Maroun, W. (2018) "Integrated Extinction Accounting and Accountability: Building an Ark", *Accounting, Auditing & Accountability Journal*, Vol. 31 No. 3, pp. 1-41.

Atkins, J. F., Atkins, B. C., Maroun, Barone, E. and W., Gozman, D. (2022) "Conservation through Conversation? Therapeutic Engagement on Biodiversity and Extinction between NGOs and Companies", *Business Strategy and the Environment*. 13th June, pp.1-17.

Atkins, J. F., Atkins, B. C., Maroun, W., Norton, S. D., Zhao, L. (2023) "Accounting and Finance for De-extinction and Rewilding: The Case of Auroch 2.0", conference paper presented at *Invited Seminar, Exeter University*, 4th October.

Atkins, Jill F. and Macpherson, M., (2019) "Developing a Species Protection Action Plan – An Integrated Approach for Taxonomies, Reporting and Engagement for the Financial Services Sector" (May 29th).

Atkins, J. F and Maroun, W. (forthcoming) "Integrating Rewilding and De-Extinction into the Extinction Accounting Framework", chapter in Lehman, G. (Eds.) *Accountability, Philosophy and the Natural Environment*, Edward Elgar.

Azizi L, Bärsch S, Braun V, Junge L, Lin Feuer Y, Sassen R, Adam N (2025) "Bridging biodiversity accounting and stakeholder engagement: towards an integrated paradigm for enhancing corporate biodiversity management". *Accounting, Auditing & Accountability Journal*, Vol. ahead-of-print No. ahead-of-print. https://doi-org.cardiff.idm.oclc.org/10.1108/AAAJ-11-2023-6758

Baker, H. K, Benedetti, H., Nikbakht, E. and Smith, S. S. (2023) "Cryptoassets: An Overview", chapter one in Baker, H. K, Benedetti, H., Nikbakht, E. and Smith, S. S. (2023) *The Emerald Handbook on Cryptoassets: Investment, Opportunities and Challenges,* Emerald Publishing Limited, Bingley, UK.

Banks, P.B. and Hochuli, D.F., 2017. Extinction, de-extinction and conservation: a dangerous mix of ideas. *Australian zoologist*, *38*(3), pp.390-394.

Bennett, J., Maloney, R., Steeves, T. *et al.* Spending limited resources on de-extinction could lead to net biodiversity loss. *Nat Ecol Evol* 1, 0053 (2017). https://doi.org/10.1038/s41559-016-0053.

BCA (Biodiversity Credit Alliance) (2024) "Definition of a Biodiversity Credit", Issue Paper No.3, May, *BCA*.

Blanco-Zaitegi G, Álvarez Etxeberria I, Moneva JM: Biodiversity accounting and reporting: a systematic literature review and bibliometric analysis. Journal of Cleaner Production 2022, 371:133677.

Boiral, O. (2013) Sustainability reports as Simulacra? A counter–account of A and A+ GRI reports. Accounting, Auditing & Accountability Journal, 26 (7), 1036–1071. http

Boiral, O. (2016). Accounting for the unaccountable: Biodiversity reporting and impression management. *Journal of Business Ethics*, 135, 4, 751-768.

Boiral, O. and Heras-Saizarbitoria, I. (2017). Managing biodiversity through stakeholder involvement: Why, who, and for what initiatives? Journal of Business Ethics, 140, 403–421. ht

Buchling, M. & Maroun, W. 2023. Biodiversity reporting practices of the South African national parks. *Social Responsibility Journal,* 19 (1)**,** 138-165.

Büchling, M., and W. Maroun. 2021. "Accounting for Biodiversity and Extinction: The Case of South African National Parks." Social and Environmental Accountability Journal 41 (1/2): 66–97.

Carnegie, G.D. and Napier, C.J. (2023), *Handbook of Accounting, Accountability and Governance*, Cheltenham and Northampton: Edward Elgar Publishing

Carnegie, G., Parker, L. and Tsahuridu, E. (2021a), "Its 2020: what is accounting today?, *Australian Accounting Review*, Vol. 31 No. 1, pp. 65-73, first published 22 November 2020.

Carnegie, G., Parker, L. and Tsahuridu, E. (2021b),"Redefining accounting for tomorrow", *IFAC website*, 6 April.

.

Carnegie, G.D., Gomes, D. and McBride, K. (2023), "COVID-19 and accounting as multidimensional technical, social and moral practice: a framework for future research", *Meditari Accountancy Research*, Vol. 31 No. 1, pp. 1-26.

Carnegie, G.D., Gomes, D., McBride, K., Parker, L.D. and Tsahuridu, E. (2024), "How accounting can shape a better world: framework, analysis and research agenda", *Meditari Accountancy Research*, Vol. 32 No. 5, pp. 1529-1555.

Correa-Mejía, D. A., Correa-García, J. A. & García-Benau, M. A. 2024. Analysis of double materiality in early adopters. Are companies walking the talk? *Sustainability Accounting, Management and Policy Journal,* 15 (2)**,** 299-329.

Carver, S., Convery, I., Hawkins, S., Beyers, R., Eagle, A., Kun, Z., et al. (2021). Guiding principles for rewilding. Conservation Biology 35 (6), 1882–1893. doi: 10.1111/ cobi.13730

Cho, C. H., Laine, M., Roberts, R. W., & Rodrigue, M. (2015). Organized hypocrisy, organizational facades and sustainability reporting. Accounting, Organizations and Society, 40, 78–94. ht

Cohen, S. (2014) "The ethics of de-extinction", *NanoEthics*, 8 pp.165-178, http:dx.doi.org/10.1007/s11569-014-0201-2

Corvino, A., Bianchi Martini, S., & Doni, F. (2021). Extinction accounting and accountability: Empirical evidence from the west European tissue industry. *Business Strategy and the Environment, 30*(5), 2556-2570. doi:10.1002/bse.2763

Cuckston, T., Russell, S.L. and Bebbington, J., (2022), *Risks of perverse outcomes from accelerating natural capital thinking: a reflection*, available at: https://wevaluenature.eu/sites/default/files/2022-04/We_Value_Nature_Natural_Capital_Thinking_Briefing_Paper.pdf

Curry, R. (2021) "Want to bring back woolly mammoths? How to invest in Colossal", Market Realist, September 16th. http://marketrealist.com/p/how-to-invest-in-colossal-mammoths/

Dasgupta, P. (2021), The Economics of Biodiversity: The Dasgupta Review. Abridged Version. (London: HM Treasury).

Delord, J. 2014. Can we really re-create an extinct species by cloning? A metaphysical analysis. Pp. 22-29 in *The ethics of animal re-creation and modification: reviving, rewilding, restoring* edited by M. Oksanen and H. Siipi. Pagrave Macmillan, London

Deutz, A. et al., (2020) *Financing Nature: Closing the Global Biodiversity Financing Gap,* The Paulson Institute, The Nature Conservancy and the Cornell Atkinson Center for Sustainability,

Donlan, J. (2005). Re-wilding North America. Nature 436, 913–914.

Ecim, D. & Maroun, W. 2024. Chapter 5 - Biodiversity considerations in the marine aquaculture and fisheries industries. *In:* ATKINS, J. (ed.) *Protecting natural capital and biodiversity in the agri-food sector.* 82 High Street, Swaston, Cambridge, UK: Burleigh Dodds.

EFTEC, Rayment Consulting (2021) The Finance Gap for UK Nature; https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2021/10/The-Finance-Gap-for-UK-Nature13102021.pdf

European Commission (2025) Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Roadmap towards Nature Credits, European Commission, Brussels, Belgium, 7th July, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52025DC0374.

Farooq, M.B., Seddiqi, K.N. and Ali, M. (2026) "Accounting approaches and challenges in large-scale afforestation projects: insights from the Billion Tree Afforestation Project KP Pakistan", *Accounting, Auditing & Accountability Journal.*

Financial Stability Board. 2021. Task Force on Climate-related Financial Disclosures 2021 Status Report. Available: https://www.fsb.org/wp-content/uploads/P141021-1.pdf [Accessed 24 January 2022].

Fox, K., Gamble, E. and Munoz, P. (2025) "Developing an Authentic Reporting Identity: An Accounting Approach to biodiversity and Species Preservation", *Accounting, Auditing & Accountability Journal*.

Gallhofer, S. & Haslam, J. 2005. *Accounting and emancipation: some critical interventions,* London, Routledge.

Gray, R.H. and Milne, M. (2018), "Perhaps the Dodo should have accounted for human beings? Accounts of humanity and (its) extinction", Accounting, Auditing & Accountability Journal, Vol. 31 No. 3.

Gullberg, C. and Haverno, E. (2025) "Tick Tock, It's Biodiversity o' Clock: Introducing a Time-aware Stance for Emancipatory Extinction Accounting", *Accounting, Auditing & Accountability Journal.*

Hassan, A., Roberts, L. and Atkins, J. (2020) "Exploring factors relating to extinction disclosures: what motivates companies to report on biodiversity and species protection?" *Business Strategy and the Environment,* 19(3), January, pp.1-18.

Hermoso, V., Carvalho, S.B., Giakoumi, S., Goldsborough, D., Katsanevakis, S., Leontiou, S., Markantonalou, V., Rumes, B., Vogiatzakis, I.N. and Yates, K.L. (2022). The EU

biodiversity strategy for 2030: opportunities and challenges on the path towards biodiversity recovery. *Environmental Science and Policy,* Vol. 127, pp. 263-271.

Hopwood, A. G. 1987. The archaeology of accounting systems. *Accounting, Organizations and Society,* 12 (3)**,** 207-234.

Houdet, J., Addison, P., Deshmukh, P., Ding, H., Finisdore, J., Grigg, A., O'Gorman, M., Quétier, F., Atkins, J., Sparg, S. & Vincentz, R. 2021. Biological diversity protocol. Available: https://www.nbbnbdp.org/uploads/1/3/1/4/131498886/biological_diversity_protocol__bd_protocol_.pdf [Accessed 5 March 2021].

https://www.paulsoninstitute.org/wp-content/uploads/2020/10/FINANCING-NATURE_Full-Report_Final-with-endorsements_101420.pdf.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Global Assessment Report on Biodiversity and Ecosystem Services, 2019, https://www.ipbes.net/global-assessment.

Irvine-Broque, A. and Dempsey, J. (2023) 'Risky business: Protecting nature, protecting wealth?', Conservation Letters, 16(4).

Jepson, P. (2024) "Accounting for a Nature Positive Future: The Design, Prospect, and Challenges of Digital Nature Assets", Keynote Speech at the Inaugural Conference of the EEEAGER Group at Cardiff University, April 12th.

Jepson, P. and Blythe, C. (2020) *Rewilding: The Radical New Science of Ecological Recovery,* Icon Books Ltd., London, UK.

Jepson, P. et al., (2023) NARIA: Natural Asset Recovery Investment Analytics V2.1. CreditNature White Paper. CreditNature Ltd., Harwell, Oxfordshire. DOI: 10.32071/CN.TD.200723

Jepson, P.R. (2022) "To capitalise on the Decade of Ecosystem Restoration, we need institutional redesign to empower advances in restoration ecology and rewilding", People and Nature, 4(6), pp.1404- xxxx

Jollands, S., Burns, J. and Milne, M.J. (2019), "Natural capital accounting: revisiting the elephant in the boardroom", *CIMA Research Executive Summary*, Vol. 15 No. 1, April, Association of International Certified Professional Accountants.

Jones, M. J. (1996). Accounting for biodiversity: A pilot study. *British Accounting Review*, *28*, 281-303.

Jones, M. J. (2003). Accounting for biodiversity: operationalising environmental accounting. *Accounting, Auditing & Accountability Journal*, *16*(5), 762-789.

Jones, M. J., & Solomon, J. F. (2013) Problematising accounting for biodiversity. *Accounting, Auditing & Accountability Journal*, *26*(5), 668-687.

Karolyi GA, Tobin De La Puente J (2023) "Biodiversity finance: a call for research into financing nature", *Financial Management*, 52:231-251.

King, M. and Atkins, J. (2016),*The Chief Value Officer. Accountants Can Save the Planet*, Abingdon Oxo: Greenland Publishing.

King, M., Atkins, J. & Maroun, W. (2022), Extinction governance: establishing a framework for extinction accounting, accountability and finance. *Extinction governance, finance and accounting. Implementing a species protection action plan for the financial markets.* First ed. Milton Park, Abingdon, Oxon, United Kingdom: Routledge.

Ladle, R. J., Jepson, P. and Whittaker, R. J. (2005) "Scientists and the media: the struggle for legitimacy in climate change and conservation science." *Interdisciplinary Science Reviews,* 30, no. 3, pp. 231-240.

Lange, Y. & Maroun, W. 2024. Chapter 3: Avocado cultivation and biodiversity challenges. *In:* ATKINS, J. (ed.) *Protecting natural capital and biodiversity in the agri-food sector.* 82 High Street, Swaston, Cambridge, UK: Burleigh Dodds.

Lorimer, J., Sandom, C., Jepson, P., Doughty, C., Barua, M. and Kirby, K. J. (2015) "Rewilding: Science, practice, and politics", *Annual Review of Environment and Resources*, 40: 39-62.

Losos, E.C., Pfaff, A. and Pimm, S.L. (2024) 'Tackling debt, biodiversity loss, and climate change', Science, 384(6696), pp. 618–621.

Lunney, D. 2013. Is a grumpy ecologist an oxymoron? Pp. 95-105 in Grumpy scientists: the ecological conscience of a nation, edited by D. Lunney, P. Hutchings and H.F. Recher. Royal Zoological Society of NSW, Mosman, Australia http://dx.doi.org/10.7882/FS.2013.018

Maione, G., Cuccurullo, C., & Tommasetti, A. (2023). An algorithmic historiography of biodiversity accounting literature. *Accounting, Auditing and Accountability Journal*, *36*(6), 1665-1694.

Mair, L. et al. (2024) 'Corporate disclosures need a biodiversity outcome focus and regulatory backing to deliver global conservation goals', Conservation Letters, p. e13024.

McBride, K., Sagitova, R., Cam, O. (2023). "As bad as bad can be": accounting for species extinction in the North Pacific. *Accounting, Auditing and Accountability Journal*, 36(*6*), 1574-1605.

McNally, M.-A. & Maroun, W. 2018. It is not always bad news: Illustrating the potential of integrated reporting using a case study in the eco-tourism industry. Accounting, Auditing & Accountability Journal, 31 (5): 1319-1348.

Maroun, W. & Ecim, D. 2024. Biodiversity reporting by United Kingdom (UK)-listed companies: A review of extent, content and readability of disclosures. Business Strategy and the Environment, 33 (8), 7800-7824.

Milne, M., Tregidga, H. & Walton, S. (2009) „Words not actions! The ideological role of sustainable development reporting", *Accounting, Auditing and Accountability Journal,* 22**,** 1211-1257.

Minteer, B. 2014. Is it right to reverse extinction? Nature 509: 561. http:dx.doi.org/10.1038/509261a

Morton E and Tsahuridu E (2023) Moral framing and the thylacine: A historical example of shifting frames. Accounting History. Vol.28(4), pp.550-576.

Nguyen, M. and Jones, T.E. (2022) 'Building eco-surplus culture among urban inhabitants as a novel strategy to improve finance for conservation in protected areas', Humanit Soc Sci Commun. 2022;9(1):426. doi: 10.1057/s41599-022-01441-9. Epub 2022 Nov 29. PMID: 36466704; PMCID: PMC9708145.

Nogués-Bravo D, Simberloff D, Rahbek C, Sanders NJ. Rewilding is the new Pandora's box in conservation. Curr Biol. 2016 Feb 8;26(3):R87-91. doi: 10.1016/j.cub.2015.12.044. PMID: 26859272.

Okolo, N. (2022) "The wildlife conservation bond: Exploring new market mechanisms for protecting endangered species", chapter 17 in Atkins and Macpherson (2022) pp.372-391.

Paine, R. T. (1969) "A note on trophic complexity and community stability", *The American Naturalist*, 103 (929) 91-93.

Pereira, H.M. and Navarro, L., eds. (2015). Rewilding European landscapes (New York: Springer).

Pigatto et al. (2026) “A critical evaluation of research into accounting for biodiversity and ecosystems to inform future research pathways”, *Accounting, Auditing & Accountability Journal.*

Powell, L. (2026) The role of accounting in enabling the flourishing of nature: opportunities and challenges, *Accounting, Auditing & Accountability Journal.*

Ram, A., Maroun, W. & Garnett, R. 2016. Accounting for the Bitcoin: Accountability, neoliberalism and a correspondence analysis. *Meditari Accountancy Research,* 24 (1)**,** 2-35.

Roberts, L., Hassan, A., Elamer, A., & Nandy, M. (2021). Biodiversity and extinction accounting for sustainable development: A systematic literature review and future research directions. *Business Strategy and the Environment, 30*(1), 705-720. doi:10.1002/bse.2649

Russell, S., Milne, M. J. & Dey, C. 2017. Accounts of nature and the nature of accounts: Critical reflections on environmental accounting and propositions for ecologically informed accounting. *Accounting, Auditing & Accountability Journal,* 30 (7)**,** 1426-1458.

Sandler, R. 2013. The ethics of reviving long extinct species. Conservation Biology 28: 354-360. http:dx.doi.org/10.1111/ cobi.12198

Seidenstein, T. & Maroun, W. 2025. Assurance and Its Contribution to Sustainable Development. *In:* HOMI, K., KOJI, M., JOHN, W. M. & JANE, N. (eds.) *For the World’s Profit: How Business Can Support Sustainable Development.* New York: Brookings.

Seidl, A., Cumming, T., et al. (2024) ‘Investing in the wealth of nature through biodiversity and ecosystem service finance solutions’, *Ecosystem Services,* 66, p. 101601

Seidl, A., Mulungu, K., et al. (2024) ‘Financing mechanisms to bridge the resource gap to conserve biodiversity and ecosystem services in Brazil’, *Business Strategy and the Environment*, 32(3), pp. 2554–2566.

Shapiro, B. (2015) How to Clone a Mammoth: The Science of De-extinction, Princeton University Press, Princeton, New Jersey, USA.

Sherkow, J.S. and Greely, H.T. 2013. What if extinction is not forever? Science 340: 32-33. http:dx.doi.org/10.1126/ science.1236965

Smith, S. S. (2023) “The Cryptoasset Auditing and Accounting Landscape”, chapter two in Baker, H. K, Benedetti, H., Nikbakht, E. and Smith, S. S. (2023) *The Emerald Handbook on Cryptoassets: Investment, Opportunities and Challenges,* Emerald Publishing Limited, Bingley, UK.

Sobkowiak, N. and Cuckston, T., (2025), “Solidity and fluidity in the quantification of nature recovery: wild bird indicators in the UK”, *Accounting, Auditing & Accountability Journal,* Vol. 38 No. 5, pp. 1499-1517.

SSRN: https://ssrn.com/abstract=3398308 or http://dx.doi.org/10.2139/ssrn.3398308

Stannard, J., Needham, H. and Millie, S. M. (2022) “Heal rewilding: A landowning model for species recovery”, chapter 5 in Atkins and Macpherson (2022), pp.103-114.

Sun, Y. & Lange, Y. 2023. Implementing biodiversity reporting: insights from the case of the largest dairy company in China. *Sustainability Accounting, Management and Policy Journal,* 14 (1)**,** 75-100.

Taskforce on Nature-related Financial Disclosures (TNFD), Recommendations of the Taskforce on Nature-related Financial Disclosures, September 2023, https://tnfd.global/wp-content/uploads/2023/08/Recommendations_of_the_Taskforce_on_Nature-related_Financial_Disclosures_September_2023.pdf.

TNFD: Nature-related Risk and Opportunity Management and Disclosure Framework Beta v0.3; 2022. [online] Available at: ⟨https://framework.tnfd.global/wp-content/uploads/2022/11/TNFD_Management_and_Disclosure_Framework_v0–3_B.pdf⟩

TNFD (2025) *TNFD Status Report*, September, Taskforce on Nature-related Financial Disclosure (TNFD).

Tregidga, H., Milne, M. & Kearins, K. (2014) "(Re)presenting 'sustainable organizations'". *Accounting, Organizations and Society,* 39**,** 477-494.

UNEP (2022) *State of Finance for Nature* 2022, https://www.unep.org/resources/state-finance-nature-2022.

United Nations Environment Programme (UNEP) (2021). Becoming #GenerationRestoration: Ecosystem restoration for people, nature and climate. Nairobi

Usher, K. & Maroun, W. 2018. A review of biodiversity reporting by the South African seafood industry. *South African Journal of Economic and Management Sciences,* 21 (1)**,** 1-12.

van Dooren, T. and Rose, D.B. 2016. Keeping faith with the dead: Mourning and de-extinction. Australian Zoologist in press http:dx.doi.org/10.7882/AZ.2014.048 W

van Liempd, D., & Busch, J. (2013). Biodiversity reporting in Denmark. *Accounting, Auditing and Accountability Journal*, *26*(5), 833-872.

Weber Hertel, S. and Luther, D. (2023) "The role of social and political factors in the success of rewilding projects", Frontiers in Conservation Science 4:1205380. doi: 10.3389/fcosc.2023.1205380

World Economic Forum (WEF) (2023) *Biodiversity Credits: Demand Analysis and Market Outlook, Insight Report*, December, World Economic Forum (WEF) and McKinsey & Company Sustainability

World Economic Forum (WEF) *High-Level Governance and Integrity Principles for Emerging Voluntary Biodiversity Credit Markets*, 2022, https://www3.weforum.org/docs/WEF_Biodiversity_Credits_Markets_Integrity_and_Governance_Principles_Consultation.pdf.

World Economic Forum (WEF). (2020, January), *Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy*, p. 8. Retrieved from: https://www.weforum.org/reports/nature-risk-rising-why-the-crisis-engulfing-nature-matters-for-business-and-the-economy.

World Economic Forum (WEF) (2025) *High-Level Principles to Guide the Biodiversity Credit Market*, White Paper, May, WEF.

Young, D., Aboobakar, A., Curtis, T., Draisey, Z., Fitton, R., Grundmann, L., Higgs, R., Howard, B., Macedo, C., McAleese, L., Pinkerton, V., Shah, R., Tremolet, S., and Twining, S., (2022) *Financing Nature Recovery UK: Scaling Up High-Integrity Environmental Markets across the UK.*

Zhang, R., Zhao, L., Kopnina, H., Noronha, C., Hughes, A. C. (forthcoming) "Biodiversity conservation, extinction accounting and the metropolis: the case of Hong Kong", *Accounting, Auditing & Accountability Journal,* 2025-09, p.1-26, DOI: 10.1108/AAAJ-10-2023-6710

Zhao, L. and Atkins, J. (2021) "Assessing the Emancipatory Nature of Chinese Corporate Reporting on Conservation and Biodiversity", *Social and Environmental Accountability Journal,* Vol.41(1-2), pp.8-36

APPENDIX

Table 1: Colossal Funding Rounds[38]

13th November 2023	Venture Round – CB	No information on investors	
6th July 2023	Series B – CB	1 investor	
31st January 2023	Series B – CB	13 investors	$150MM
3rd October 2022	Venture round – CB	1 investor	
9th March 2022	Series A – CB	19 investors	$60MM
6th May 2021	Seed round – CB Seed-1 Seed-2	17 investors	$18.04MM[39]

Table 2: Investors in Colossal

Investor
Animal Capital
Animoca Brands
At One Ventures
Bold
Boost VC
Breyer Capital
Carnrite Ventures
Charles Hoskinson
Climate Capital
Draper Associates
Elisa Mantanari
Global Space Ventures
IQT IN-Q-TEL
Jazz Venture Partners
KittyHawk Ventures
Paris Hilton
Peak 6 – 'PEAK 6'
Peter Thiel
PROOF Fund
Robert Nelson
Sahin Boydas
The North Dakota Development Fund (NDDF)
Thomas Tull
Tony Robbins
Tudor Investment Corporation
Untamed Planet
US Innovative Technologu VSTT
Victor Vescovo
WestRiver Group
Winkle Voss Capital Management

Table 3: University Partners

Harvard University
University of Alaska Fairbanks
University of California Santa Cruz

[38] This is information available publicly on the funding rounds as at the time of finalising this paper.
[39] Information drawn from https://forgeglobal.com/colossal-biosciences-ipo/

Cornell University
The Rockerfeller University
The University of Melbourne

Table 4: Conservation Partners

Aussie Ark
Elephant Havens
Re:wild
Wildark
International Elephant Foundation .org
World Elephant Day
SAFE: Saving Animals from Extinction
VGP – Vertebrate Genomes Project
Save the Elephants
IUCN
SSC Species Survival Commission