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Natural capital approaches to decision-making for collaborative landscape governance

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ABSTRACT

This study explores if and how natural capital approaches can support collaborative landscape governance. We selected six initiatives across the UK that have taken varied approaches to working with natural capital. We assessed how they have articulated, described and valued their landscapes and natural systems, and the consequences of doing so. We found that processes of systematically describing natural assets and their benefits can stimulate local investment in ecosystem markets and bring people together to co-produce plans. However, efforts to monetarily value natural capital assets were not always necessary: in some cases, new partners and resources were enroled without monetary valuations. These findings challenge the current emphasis on valuation framings in natural capital approaches. They show how natural capital approaches can help address the simultaneous challenges of connecting disparate priorities and securing new funding sources. This offers insights for international efforts to support collaborative landscape governance that delivers multiple benefits for people and nature.

1. Introduction

Many countries seek to enable collaborative landscape governance that extends beyond individual land-holdings and across large scales (Reed et al., 2016; Peskett et al., 2023a). Expected benefits include: the simultaneous provision of ecosystem services and human well-being across landscapes (Manning et al., 2018); collaboration between relevant actors, which may result in strategy-making and transformative change (Linnenluecke et al., 2017); and the potential to target funding for environmental land management more effectively (Westerink et al., 2017). However, there is also evidence that landscape governance does not always provide 'silver bullet solutions' (Sayer et al., 2015) because it is difficult to implement (Waylen et al., 2023), and it may fail to influence action on the ground or amplify long-standing conflicts (Dwyer and Hodge, 2016; Rollason et al., 2018).

After Opdam et al. (2016), we use the term 'collaborative landscape governance' in this paper to describe landscape planning and decision-making that is based on the engagement of local communities and relevant parties.[1] In doing so, we interpret the ambition to enable and influence landscape governance as a collective action problem (Bodin, 2016), whereby it can be challenging to coordinate and motivate relevant parties to address complex environmental problems at large spatial scales. Some attempts at solutions focus on creating and aligning private incentives, such as through interdependent policy instruments or compensation schemes (e.g. Blackstock et al., 2021; Carmona-Torres et al., 2011). Others emphasise supporting cooperation and collaboration to enable diverse groups to work together to negotiate future land use change, in line with Ostrom's (2000) collective action principles (e.g. Amblard and Mann, 2021), and theories of participation (e.g., Reed et al., 2018) that consider the role of representation, power and process design in facilitating successful collaborative governance. Applied examples of these theoretical approaches include participatory scenario

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[1] In line with calls to decolonise language in research, we use this and a variety of other relevant words and phrases instead of referring to "stakeholders" in the paper, although many of the initiatives reviewed used this terminology (Reed et al., 2024).

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development (Reed et al., 2013a) and other deliberative methods that help to address different forms of uncertainties related to ecosystem services (Barnaud et al., 2023; Raymond et al., 2017), as well as approaches that seek to integrate the valuation of ecosystem services into decision-making (Burdon et al., 2022). Following these theories, environmental governance decisions at landscape scales (which we define as a scale that extends beyond individual landholdings) may be informed purely by local knowledge (Kenter et al., 2011), or may also draw on quantitative or semi-quantitative assessments of the current state of natural assets and the potential ecosystem services they provide society, and other benefits and trade-offs that could arise from changes in land use and management (Eastwood et al., 2024). As such, there are range of approaches that vary in how they produce and use knowledges to represent natural capital, ranging from those focused on deliberating and evaluating plural relationships with nature through to those focused on robustly quantifying and monetising flows of ecosystem services (Raymond et al., 2014).

Termorshuizen and Opdam (2009) argue that, for the effective bottom-up production of knowledge in these contexts, *both* the valuation of local landscape assets *and* collaborative decision-making are required. Opdam et al. (2016: 107) also questioned how information about landscape assets and services can "enable, support and trigger local actor groups to build collaboration and collective action with the aim to ensure sustainable utilisation of what the landscape has to offer". To date, there has been little scrutiny of whether natural capital approaches to decision-making, as we define below, can support landscape governance that incorporates the valuation of natural assets and enhances collaboration. The terminology and framing of natural capital have been endorsed in many countries (Capitals Coalition, 2021) and received significant scientific attention (Comte et al., 2022), with the promise of reorienting conversations to prioritise protecting natural assets (Bagstad et al., 2021). However, there is relatively little documented evidence of working with natural capital approaches in practice (Brandon et al., 2021), and it can be challenging to deliver such approaches at a landscape scale (Spake et al., 2019). Closer examination of natural capital approaches to decision-making is therefore important for understanding and maximising their potential to improve collective action in practice across landscapes.

There is a need for both more evidence about existing experiences and an appraisal of different interpretations of what it means to work in collaborative contexts with natural capital approaches. These interpretations range from approaches that focus on evaluating relationships with place to approaches that emphasise the monetisation of ecosystem services. In this study we respond by examining how natural capital approaches can inform, support and enhance collective action, and whether they facilitate better understanding among different actors about the monetary and non-monetary value of nature. Specifically, we ask:

1. In what ways do natural capital approaches represent, describe and value nature and landscapes?
2. What are the consequences for accessing ecosystem markets?
3. How are local knowledge, values and interests incorporated?
4. What are the consequences for collaboration between communities and other relevant parties across landscapes?

We address these questions through analysing six collaborative landscape-level initiatives that are attempting to employ natural capital approaches to support decision-making.

2. Natural capital approaches

Bateman and Mace (2020) define a natural capital approach to decision-making as one that considers stocks of natural capital assets (renewable and non-renewable resources), not only the flows of services these assets produce, while simultaneously integrating sustainability aspects such as the distribution of benefits that result from decisions. Central to this approach is the act of describing the landscape, its assets and the activities that take place within it. This is typically carried out via several measuring, mapping and valuation methods (see Primmer and Furman, 2024 for a review).

Natural capital approaches generally include the quantification of natural capital assets and the ecosystem services they provide, with the resulting baseline data used to explore future pressures and scenarios (Peskett et al., 2023b). They are similar to ecosystem services approaches, which focus on the functional benefits that ecosystems provide to humans, but natural capital approaches also focus on the underlying assets (or stocks) that generate such benefits (Hernandez-Blanco and Costanza, 2019). The process may include biophysical assessments and valuations, including non-monetary methods to assess shared, cultural values, in addition to more traditional monetary valuations of natural capital impacts and dependencies (Reed et al., 2022a). The resulting representations of nature's values (often quantified, potentially monetised) can help identify different beneficiaries and identify dependencies on nature. They are thus expected to influence and improve decision-making across governments and the private sector (Bateman and Mace, 2020).

Although natural capital is premised as relevant across sectors, it is often associated with private sector trades in voluntary ecosystem markets, enabled by quantifying the flows of ecosystem goods and services. Most common are the purchase of offset credits, which correspond to units of carbon dioxide sequestered (Shinbrot et al., 2022), whilst biodiversity trading also exists in some contexts (zu Ermgassen et al., 2021). Natural capital approaches that include the use of ecosystem markets are often proposed to finance and scale nature-based solutions to climate change and landscape recovery initiatives (Seddon, 2022). However, these developing markets are associated with concerns (Waylen and Martin-Ortega, 2018). These range from greenwashing (intentional misrepresentation of 'green' credentials) through to unintentional consequences for society or other aspects of nature that are not the focus of a trade.

Given that the multiple perspectives of local communities, landowners and other rights holders need to be considered in environmental management decisions at the local level (Blicharska and Hilding-Rydevik, 2018; Tusznio et al., 2020), there are potential tensions within natural capital approaches to decision-making at landscape scales. Firstly, there remains uncertainty in the application of appropriate economic and social valuation methods in these integrative contexts (de Groot et al., 2010). Secondly, any new market-driven projects may generate negative unintended consequences for their surrounding landscapes and communities, leading to trade-offs between ecosystem services (Reed et al., 2013b) or the entrenchment of local power asymmetries (Chausson et al., 2023). Thirdly, the neoliberal values and framings of dominant policy narratives about the role of ecosystem markets in nature recovery may tend to privilege the voices of market actors over the perspectives of local communities, presenting solutions to problems that have been identified and framed by elites without reference to local needs and priorities (Chausson et al., 2023).

In summary it is unclear how natural capital approaches align and encourage the knowledge production and engagement processes necessary to support collaborative landscape governance. Given the potential opportunities but also the concerns associated with natural capital approaches, empirical evidence of working collaboratively with these approaches at larger scales is valuable.

3. Method

This paper is based on qualitative research using primary and secondary data from six case studies of collaborative landscape governance in the UK. The research received prior approval by the Scotland's Rural College Social Science Ethics Committee, and personal data collected were managed in accordance with GDPR. The research was

commissioned to understand the use of natural capital approaches in initiatives working across multiple sectors and landownership boundaries, to inform Scotland's Regional Land Use Partnerships (RLUPs), and reported in (Reed et al., 2022b). The themes analysed and presented in this paper build on the findings in that report.

The research focused on cases in the UK in order to enable learning from landscape-scale initiatives that operate within a UK-level shared institutional and cultural context (albeit subject to devolved regulatory and planning contexts). The UK and its devolved administrations have endorsed efforts to work with natural capital (e.g. Defra, 2018) whilst current academic and policy developments spur interest in landscape-level planning and policy (The Royal Society, 2023).

3.1. Case study selection

We studied six cases of collaborative landscape governance to investigate how natural capital approaches have been used to enhance valuation, decision-making and funding (Fig. 1). First, a list of potential cases was developed and discussed at a workshop with representatives from the research team, the funders and the RLUPs. During the workshop, we co-created criteria for selecting case studies. The criteria included: assessing natural capital assets to inform planning and management; engaging with local communities and other relevant parties; operating at a landscape scale; and sufficient available documentation and access to interviewees. The criteria were used to score each potential case on a Likert scale. Six initiatives were selected from those receiving the highest scores, to represent a range of spatial scales, time horizons, funding models, aims and governance approaches (see Table 1). Although these initiatives and their staff were in the wider professional networks of the research team, the researchers were not involved in any aspect of their delivery.

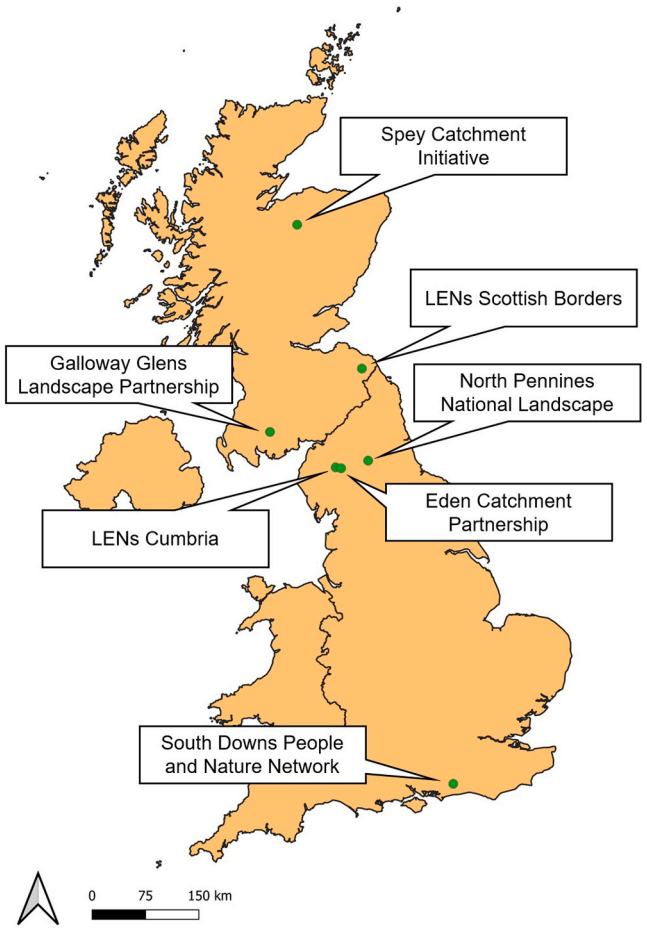

Fig. 1. Map of the case study locations.

Each of the selected initiatives works within an area with numerous habitat types, land uses, land tenures and administrative boundaries (Fig. 2). Some include designated areas within their boundaries (e.g. National Parks), as well as river catchment and other planning partnerships. All initiatives involve a range of partners from across different sectors and with shared interests in working together to deliver multiple benefits. Combined, the initiatives have employed a range of approaches to describe and/or assess their natural capital and ecosystem services, reflecting the diversity of methods and metrics that can be used to support an initiative's desired outcomes. A more detailed description of each case is included in the Supplementary materials.

3.1.1. Eden Catchment Partnership

The Eden Catchment Partnership (ECP) is a catchment-based approach in Cumbria in NW England that works with government, local authorities, utilities companies, businesses and communities to maximise the value of the natural heritage. The catchment is situated between the Pennines and Lake District hills, and the first holistic plan for water management was developed in 2013. The process of developing the plan was led by Eden Rivers Trust, a local conservation charity, and involved a diverse group of relevant parties. The focus on river management has evolved over time, with ECP's structure and the plans it produces reflecting shifting priorities. Following serious flooding of the river in 2015, ECP now focuses on dealing with flooding impacts and developing appropriate management responses. The 2020 Eden Catchment Management Plan includes flood management alongside other ecosystem services and divides the area into six subcatchments with their own action plans. ECP used an ecosystem services assessment to map natural capital assets and develop actions for four ecosystem services: water quality, water quantity, ecological networks and carbon sequestration.

3.1.2. Galloway Glens Landscape Partnership

The Galloway Glens Landscape Partnership (GGLP) is a catchment-based partnership in SW Scotland. A time-limited initiative funded by the UK Heritage Lottery Fund (2018–2023), GGLP developed projects related to heritage, outdoor recreation, education and skills, and natural landscapes. The overarching goal was to encourage sustainable development by connecting residents to their natural and human heritage. Although GGLP emphasised the area's natural assets, equal importance was placed on understanding and promoting how humans have co-produced the current landscape. Five projects emphasised the connections between local communities and nature as central to leveraging action, and a Landscape Character Assessment (LCA) (see Morrison et al., 2018) was conducted at the outset of the project to develop a Landscape Conservation Action Plan.

3.1.3. Landscape Enterprise Networks

Landscape Enterprise Networks (LENs) are designed to help buyers of agricultural products understand the natural assets that underpin sector performance, and channel private investment into sustainable agriculture and nature conservation (Rodgers and Kendall, 2023). In practice, this involves the creation of regional ecosystem markets through geographical partnerships between businesses and land-based organisations, following the stages of the LENs approach: a network opportunity analysis; building an anchor value chain; and growing and formalising the regional network.[2]

Projects typically involve emission reduction or emissions removal activities. By investing in emissions reductions on the farms which supply them, buyers of farm products are effectively cutting their Scope

[2] For a full description of the LENs approach, see the Supplementary materials and https://landscapeenterprisenetworks.com/how-lens-works/.

Table 1
Characteristics of the selected initiatives.

Initiative	Aim	Time horizon	Location	Size (km^2)	Leading actor(s)	Obligation/ powers
Eden Catchment Partnership (ECP)	Identify and prioritise the action(s) needed to manage rivers sustainably whilst improving the natural ecosystem services of the catchment	2013 onwards	NW England	2400	Charitable conservation organisation	Non-statutory
Galloway Glens Landscape Partnership (GGLP)	Drive sustainable economic development by connecting people to their natural and human heritage	2018–2023	SW Scotland	800	Partnership board	Non-statutory
Landscape Enterprise Networks (LENs)	Build business partnerships for resilient landscapes	2017-present	Cumbria, Yorkshire and East England, Borders and Leven (Scotland, under development), and elsewhere in Europe	Various (typically catchment scale)	LENs Operators vary, but tend to be trusted local organisations	Non-statutory
North Pennines National Landscape (NPNL)	Conserve and enhance the North Pennines [through] a statutory management plan	2014–2024	N England	2000	Local authority	Statutory
South Downs People and Nature Network (PANN)	Protect, enhance and create a network of green and blue spaces [through] planning, delivery and management of natural capital assets	Since 2014	SE England	1600	National Park authority	Statutory
Spey Catchment Initiative (SCI)	Integrated catchment-scale management, protecting and restoring natural features [and] raising understanding of the river system	Since 2010	NE Scotland	3000	Charitable conservation organisation	Non-statutory

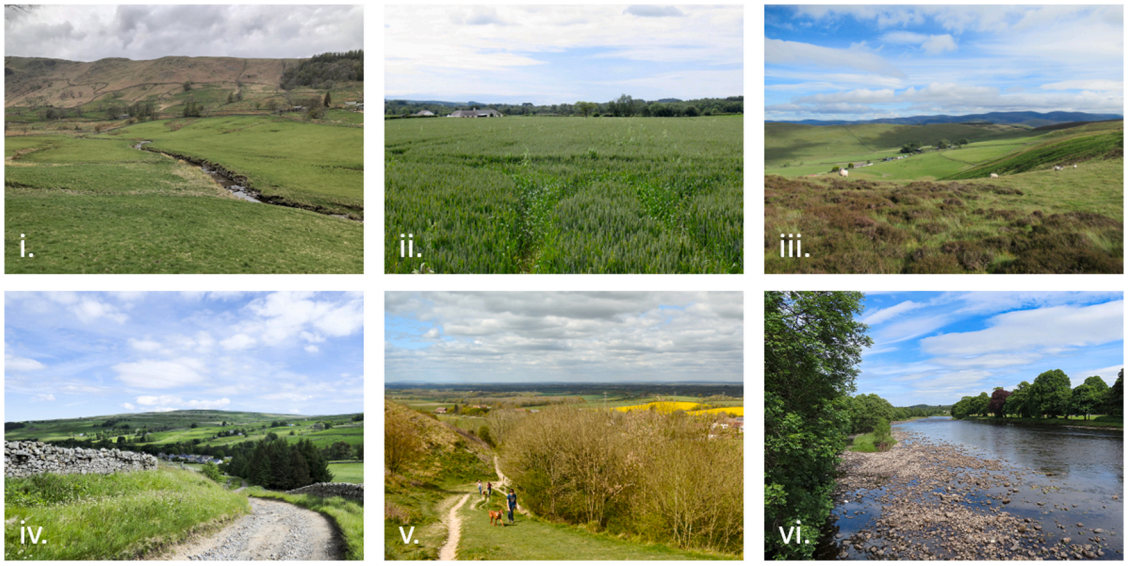

Fig. 2. Representative photographs of the studied landscapes. (i) Eden Catchment Partnership (photo: David Robinson); (ii) Galloway Glens Landscape Partnership (photo: Richard Webb); (iii) LENs Scottish Borders (photo: Alan O'Dowd); (iv) North Pennines National Landscape (photo: Trevor Littlewood); (v) South Downs People and Nature Network (photo: Tee Cee); (vi) Spey Catchment Initiative (photo: Anne Burgess). All photos are licensed under the Creative Commons Attribution-Share Alike 2.0 Generic license.

3 emissions, or the emissions embedded/embodied in the inputs to their business.[3] There are three LENs landscapes in England, with two under development in Scotland and more in Europe. Two of the UK landscapes received detailed attention in our study: Cumbria and the Borders of Scotland, which include more than 80 farmers who cover eight percent and two percent of the Scottish and UK dairy output respectively. A 'LENs Operator' acts as the lead partner in each area, engaging trading partners and negotiating transactions that can deliver the nature regeneration or ecosystem services required locally. This lead actor is typically an existing organisation that is already trusted by local businesses, landowners and land managers.

3.1.4. North Pennines National Landscape

The North Pennines National Landscape (NPNL) monitors the delivery of the statutory management plan for the second largest Area of Outstanding Natural Beauty (AONB) in England and Wales. Covering an area situated between the National Parks of the Lake District, Yorkshire Dales and Northumberland in northern England, legislation requires the plan to formulate the policies of local authorities in relation to the

[3] Scope 1 emissions are those generated by a business from on-site operations, such as the combustion of fuels or fugitive emissions escaping from operations. Scope 2 emissions are associated with a business's purchased electricity, which is generated off-site and transmitted through the grid. Scope 3 emissions are 'value chain emissions'', both upstream (embedded in purchased inputs) and downstream (further processing, distribution, end-of-life, etc.).

AONB. Led by Durham County Council, NPNL includes public bodies, statutory agencies, voluntary organisations, other local authorities, famer co-operatives and landowners. The plan focuses on conservation and enhancement of natural beauty and is underpinned by the results of a natural capital assessment of the area's peatlands.

3.1.5. South Downs People and Nature Network

The South Downs People and Nature Network (PANN) in southern England is a co-ordinated and strategic approach designed to help the South Downs National Park Authority and its partners ensure effective functioning of nature. The partnership spans the National Park and is intended to be a catalyst for co-ordinated action, building upon existing partnership working and bringing new partners together. Originally developed within a green infrastructure and ecosystem services framework, members of the PANN have identified 12 Natural Capital Investment Areas (NCIA) in the National Park as a way to focus on 'hotspots' where drivers of change and other issues coalesce and require attention. Bespoke management approaches are then developed for each NCIA.

3.1.6. Spey Catchment Initiative

The Spey river in NE Scotland is one of Scotland's most iconic waterways, renowned for salmon rod fishing and with great significance to wildlife and the Scottish whisky industry. The main stem of the catchment is designated as a Site of Special Scientific Interest and Special Area of Conservation. These designations reinforce the need to develop an integrated approach to managing the water resource, with conservation charity Spey Catchment Initiative (SCI) bringing together a broad coalition of actors to address catchment-wide concerns. Membership of SCI comprises public, private and third sector actors who work together to develop the Catchment Management Plan. The plan is underpinned by several biophysical assessments conducted by partner organisations, and meets the broad principles of a natural capital assessment, but this was not the term that SCI used to describe the approach.

3.2. Data collection and analysis

Eleven individual or group semi-structured interviews were conducted with representatives from five of the case studies, using a common proforma that was designed to understand and discuss the approaches used (see Table 2 and the Supplementary material). This number of interviews is typical for qualitative research in this field (e.g., see Coyne et al., 2021; Melanidis and Hagerman, 2022; Carmen et al., 2023). Emphasis was placed on understanding issues related to design and planning processes, engagement, and the activities related to describing the landscape. We acknowledge the limited number of interviewees from each case study and the potential bias this may introduce in relation to perspectives on the success or failure of processes and outcomes. Those interviewed were primarily in coordinating roles and the number of interviews reflects a pragmatic decision to ensure coverage of diverse cases in the study in the time available. While interviews could also have been conducted with local community members or other representative parties, and provided an ideal avenue for further analysis, it was not feasible within the project's timeline to conduct additional interviews in a manner that would include a representative range of these groups in each case within the current study. We sought to counter this by triangulating the interview data with key planning and management documents related to each case, such as catchment management plans and conservation actions plans (a full list is provided in Table 1), as well as through comparison to the wider academic literature included in the Discussion.

Table 2
Interview and secondary data collection and analysis themes, with associated lines of enquiry (see Supplementary material for a full interview protocol).

Themes	Lines of enquiry
Describing and valuing assets	Context of creation of the initiative (e.g. geographical, sectoral, biophysical, etc.) Aims and scope of the initiative Management structures and the factors influencing the overall management approach Extent of use of natural capital approaches/Factors influencing use of approaches Links between natural capital and drivers of change Translating natural capital assessment(s) into management plan(s)
Generating local investment	Public or private resources used to support the work Benefits for local communities arising from use of natural capital approaches Extent to which natural capital approaches affect management outcomes Distribution of benefits among partners and interests of other parties
Incorporating local knowledge and values	Types of people and organisations engaged Engagement approaches used Benefits and challenges related to engagement

The interview themes were used to structure a qualitative thematic analysis of the transcripts and notes made from the interview recordings (Braun and Clarke, 2006). This analysis also interrogated secondary sources such as overarching management plans (see Table 1), environmental monitoring reports and the initiatives' websites. An interview was not conducted with a representative of the LENs case study because several of the research team had interviewed LENs representatives in previous work. Instead, the analysis of that case study is based on secondary sources, including re-analysis of earlier interviews with LENs representatives on related topics (included in the underlying data in Coyne et al., 2021; Biffi et al., 2022; Reed et al., 2022a).

The data from each case was analysed by the responsible researcher, and the results were added to a common template organised around the three themes in Table 2. Members of the research team presented and discussed the findings from each case in a project meeting, before a comparative thematic analysis of the completed templates was conducted by one of the co-authors, using NVivo12. The first theme explores the range of ways the initiatives collect information about natural capital, and examines the extent to which these helped each initiative to describe and value the natural assets present in the landscape. Linked to this are the ways in which the initiatives explore drivers of change and system interactions, which in some cases enabled them to identify potential risks and opportunities. The second theme includes examples of how and why some of the initiatives have enabled and monetised ecosystem services within their landscapes, while others have chosen not to. The third theme relates to the efforts of the initiatives to incorporate the knowledge and values of communities and other relevant parties into their work, to identify any benefits that arise as a result of these processes for local planning and management related to natural capital. The results are presented below in line with each theme.

4. Results

4.1. Describing and valuing assets

All the initiatives systematically collected, and in many cases mapped, information about their landscape's natural assets and ecosystem services, as well as interactions of these. This was done in diverse ways: two cases used specific methods such as LCA (NatureScot, 2023) and the bespoke LENs approach (see a full description of this approach in the Supplementary materials), while the other cases produced various types of natural capital and ecosystem services assessments, without following a specific guidance or process (Table 3).

All initiatives described and assessed natural capital in the landscape using secondary data, mostly biophysical, provided by their partner organisations and other public sources. For example, Eden Catchment Partnership (ECP) assigned scores to their existing biophysical datasets from partners to create natural capital maps showing opportunities to manage ecosystem services. The focus was on understanding ecosystem

Table 3
Approaches to describing and valuing assets, and main data sources.

Case study	Approach(es) to describing and valuing assets	Data the approach is based on	Key documents
Eden Catchment Partnership (ECP)	Ecosystem services assessment focussed on ecosystem processes; assessment of likely cost of interventions.	Secondary	Eden Catchment Plan (ECP, 2020)
Galloway Glens Landscape Partnership (GGLP)	Landscape character assessment (LCA); collecting data on local priorities through engagement; assessment of values of specific activities (e.g. fisheries).	Secondary	Landscape Conservation Action Plan (GGLP, 2017)
Landscape Enterprise Networks (LENs)	Three-stage LENs approach: network opportunity analysis; identifying and building a value chain; risk analysis.	Secondary	Internal documentation and LENs website
North Pennines National Landscape (NPNL)	Ecosystem approach; natural capital assessment.	Primary and secondary	Area of Outstanding Natural Beauty (AONB) Management Plan (NPNL, 2018)
South Downs People and Nature Network (PANN)	Mapping and auditing natural assets; ecosystem services mapping; natural capital accounts.	Secondary	People and Nature Network: Evidence and Action Report (South Downs National Park Authority, 2020)
Spey Catchment Initiative (SCI)	Collaborative development of a catchment management plan; biophysical assessments	Secondary	SCI Catchment Management Plan (SCI, 2016, 2023)

processes at the landscape level, rather than on natural capital assets. Galloway Glens Landscape Partnership (GGLP) evaluated ecosystem services in the landscape using a LCA, from which they developed their Conservation Action Plan. The LCA used secondary data from partners that related to landscape types, landownership, access, the extent and quality of different habitats, the status of key protected/iconic species, traditional livestock practices, statutory designations and river environments. However, neither ECP nor GGLP undertook a comprehensive assessment of natural capital assets within their boundary to quantify *total* stocks of natural capital across the landscape.

The Catchment Management Plan developed by Spey Catchment Initiative (SCI) drew upon a broad base of existing statutory assessments and plans, including the River Basin Management Plan, a Flood Management Plan, habitat assessments and fish surveys. The plan also identified potential trade-offs and synergies between ecosystem services, and included maps of water quality and land classifications. South Downs People and Nature Network (PANN) conducted assessments of habitat condition, connectivity of priority habitats, and ecological status of water bodies. They mapped and audited natural assets using the EcoServ-GIS tool (Winn et al., 2018), using Earth Observation data where relevant, and also incorporated information from local plans, strategic initiatives and other datasets to report on six themes. The LENs landscapes conducted a 'network opportunity analysis' to identify which sectors and businesses in a region are most dependent on a landscape's natural assets and ecosystem services. This process also identifies which landscape assets underpin landscape 'performance', where there are cross-overs in interest for assets, and where there are natural capital investment opportunities (see Section 4.2). Only the North Pennines National Landscape (NPNL) also invested in primary data collection efforts to assess natural capital in the landscape: mapping the extent and condition of peatlands, with two years of conducting peat depth, vegetation and bird surveys, as well as remote sensing data and drone footage, to create an interactive online map.

All initiatives identified drivers of change when describing their landscapes. In practice, this involved approaches that focussed on both historic and current drivers, and likely future drivers such as those related to climate change. Most of the initiatives used their analysis of drivers of change to identify *risks* in their landscapes and catchments, which they then work to address in practice. NPNL and its partners commissioned research to examine the drivers of change that they need to respond to in their statutory management plan. These include climate and other environmental drivers, social/behavioural drivers and carbon market drivers. Similarly, GGLP identified 'forces of change' in their management plan, including climate, ecology, human population and behaviour, transport, agricultural change, energy and forestry. SCI also identified key risks in the catchment that had not already been addressed by other plans (e.g. under the Water Framework Directive). ECP focussed its analysis of drivers of change on water quality and phosphate when identifying risks to rivers and priority ecosystem services.

The South Downs PANN identified and prioritised 'hotspots for environmental interventions' where multiple drivers of change intersect and which they could focus on for strategic investment. Termed 'Natural Capital Investment Areas' (NCIAs), these areas were prioritised on the basis of regional evidence, which included existing strategies and Local Plans from local authorities, feedback from a questionnaire sent to local authority partners, a review of primary datasets, and inputs from a Technical Working Group, Steering Group, and workshop. The creation of NCIAs allows local-level, bespoke planning for each area, set within a wider strategic, landscape context. The LENs landscapes also identified 'hotspots' where drivers of change coalesced, and perceived these as potential locations for investment opportunities by the companies exposed to the identified business risks (e.g. negative impacts on supply chains or infrastructure). The LENs entity typically identified business and environmental drivers of change in its role as 'demand aggregator' and then brought interested businesses together to co-procure ecosystem services.

It is evident that natural capital approaches provide diverse and dynamic ways to represent, describe, and value nature and landscapes. The case studies reveal a range of structured and context-specific strategies, which highlights the adaptability of these approaches to different geographical and organisational needs. A common thread across all initiatives is the reliance on leveraging existing datasets, and the integration of drivers of change into many of these approaches demonstrates a forward-looking perspective that aligns with a need to identify and address key risks and opportunities, and opportunities for investment.

4.2. *Generating local investment in ecosystem markets*

Based on the approaches described above, there was some variation in the extent to which the initiatives generated local investment. Four initiatives had enabled one or more of the partners or local landowners to monetise the ecosystem services present in the landscape, generating income from carbon offsetting, insetting, or the delivery of other ecosystem services to private buyers. The initiatives facilitated payments for ecosystem services in several ways and with varying levels of proactive involvement, ranging from signposting opportunities for investment via intermediaries and advisors, to actively approaching and negotiating with investors on behalf of landowners and other beneficiaries in the partnership.

Generating revenue from ecosystem services was the main focus of the LENs landscapes. The extent to which payments were conditional on the delivery of ecosystem services varied across the studied LENs landscapes, and were most tightly coupled in trades with water companies to deliver improved water quality outcomes. Co-development of the

scheme with farmers ensured that the interventions were easy to implement while also reflecting variations in land types, scale of landholdings and management practices. In some LENs landscapes, separate demand aggregators were appointed to connect with farmers and other landowners across a landscape. In the Cumbrian LENs, farmers suggested that despite their limited input to the design of interventions, they preferred private investment via LENs to publicly-funded agri-environment schemes (Coyne et al., 2011). The main reasons for their engagement in the schemes were the additional, stable income for activities that were flexible and compatible with their existing management, and the opportunities to improve environmental outcomes and animal health. Although LENs is able to work with offset markets, climate outcomes tended to be procured by businesses with suppliers in the LENs landscape, seeking to reduce emissions within their own supply chains as part of their Scope 3 emission reduction targets (i.e., insetting).

NPNL also prioritised revenue generation from ecosystem services and turned the recommendations from their natural capital assessment into a plan that successfully unlocked private sector funding for large amounts of peatland restoration, via the Peatland Code. They worked with two private water companies that were concerned about the amount of sediment arriving in their reservoirs and water colour issues in their treatment works: the partnership made the case to the water companies that investment in peatland restoration could reduce water colour problems and they worked with the companies to tackle the issues at source in the upper parts of the catchment. NPNL was also able to persuade the Environment Agency (EA) that investment in peatland restoration on the moors could reduce flood risk downstream in the cities of Newcastle and Durham, and the partnership subsequently worked with the EA to facilitate peatland restoration. Making business cases like this to groups with varying interests enabled the partnership to scale-up funding for a wide range of activities that both benefitted relevant groups in the area and generated public goods. At the time of the research, NPNL was seeking to develop future schemes, including biodiversity monitoring via a 'Wilder Carbon standard' (see wildercarbon.com), and an approach whereby payments for other ecosystem services could be stacked on top of carbon finance. This would require projects to demonstrate that finance was required from the additional ecosystem services to make them financially viable, for them to meet the additionality criteria of the ecosystem markets they participate in. In this case, the scale of potential investment is in the millions of pounds, although much of this investment is unlikely to be retained within the partnership as landowners are investing their own capital where possible, to retain carbon rights.

For other case studies, seeking investment in natural capital or ecosystem services focussed only on discreet projects. ECP funded reductions in phosphate in river water via United Utilities, and funded wider river restoration activities through investment by National Rail. However, the majority of the work of ECP was funded from public sources. SCI leveraged private sector funding for certain projects, such as work with The Macallan whisky brand to part-fund a re-connection of a small river with the floodplain, and a habitat enhancement project. The South Downs PANN funded a pilot project to enable a finance officer within the Park Authority to develop a set of natural capital accounts and combine these with the application of earth observation data to monetise ecosystem services. The guiding plan for the South Downs PANN provided a common framework to attract and guide investment in natural capital, particularly through engagement between the South Downs National Park Authority and established Local Nature Partnerships (LNPs): the PANN report has enabled these local partnerships to make use of the natural capital evidence base to develop natural capital investment strategies for two of the LNPs.

For GGLP, valuation was used indirectly to inform business cases to leverage public funding and prioritise work in certain systems. At the time of the research, there had been no direct payments for ecosystem services within this case.

Overall, the variety of approaches and outcomes in accessing ecosystem markets revealed notable implications for generating investment in ecosystem services. While initiatives like LENs and NPNL prioritised private sector funding through tailored schemes such as carbon insetting and peatland restoration, others, like ECP and SCI, leveraged discrete investments or public-private partnerships for targeted projects. Success often hinged on presenting compelling business cases to diverse stakeholders, aligning environmental benefits with their priorities, such as improved water quality or reduced flood risks. However, there were some limitations in relation to scaling up investment or retaining funds within the initiatives.

4.3. Knowledge, values and interests

To shape the approaches to managing and monetising natural capital and ecosystem services, all of the studied initiatives reported strong local buy-in and sought to understand the values that all relevant parties placed on the natural environment. All initiatives attempted to consult as widely as possible on their planning processes, either directly or via trusted intermediaries, with some using existing analysis tools to identify a full range of relevant parties with different interests and levels of influence. This was seen as important where several relevant parties were in conflict on some issues prior to the establishment of the initiative (e.g. in GGLP). Engagement tended to take place in two phases: an initial phase of setting up, visioning and planning the work of the partnership, to explore the view of local communities and other relevant parties; and a second stage of focussed engagement with key partners only.

The initial planning process carried out by South Downs PANN involved public consultation and co-creation of a regional vision and high-level principles with relevant parties. These were informed by discussions on natural functions of the landscape and ways to achieve multiple benefits, and engagement methods included a Citizens Panel survey, workshops, pop-up consultation stalls and consultation events targeting hard-to-reach groups. SCI's Catchment Management Plan was developed through public consultation, working groups and workshops, to ensure that a range of values and perspectives were incorporated. Thereafter, external inputs to the operation of the partnership were indirect, via partner organisations.

Trust was a key factor in successful engagement with the collaborative initiative, and it was common to build on pre-existing bilateral relationships to support the work. NPNL is a longstanding partnership and so has long-term, trusting relationships with a range of relevant parties, including landowners and community/outdoor access groups. These groups have engaged in deliberative monetary valuation and qualitative research to value the full range of ecosystem services from peatland restoration and identify different ecosystem market models that could layer payments for multiple ecosystem services on top of carbon finance. SCI drew on its existing relationships on a more *ad hoc* basis, working with Scottish Water on specific issues yet not involving them in the Catchment Management Plan development process. In some cases, the collaborative initiative itself was deemed to be inclusive and not in need of additional input from communities or other relevant parties. Both ECP and NPNL formally include over 20 statutory agencies, local government, private, non-government, community and academic institutions in their governance structure.

A focus was often on giving local communities and other relevant parties (especially land managers) significant power over the co-creation of projects that were designed to meet their needs. All of the initiatives fostered knowledge sharing between their members and other relevant parties, with approaches ranging from workshops and interviews to longer-term mechanisms such as working groups and online platforms. Some partnerships used valuation methods to understand the value of their natural capital to other relevant parties in more depth. For example, GGLP engaged with relevant parties to refine plans and co-produce projects, including assessments of both the value of fisheries to the local economy and economic opportunities for peatland carbon

finance via the Peatland Code. LENs landscapes explored the value placed on natural capital by local investors and land-based organisations (often farmers) via price negotiations to reach a price point at which transactions can be agreed. In these cases, other relevant parties such as local communities were not consulted unless the interventions would affect them or if they were linked to the investment (e.g. via local authorities investing in flood risk alleviation).

Specific methods or governance arrangements were also adapted to meet the needs of different groups. For example, the LENs landscapes typically shared knowledge of investment opportunities and co-created procurement propositions via workshops with potential investors, but used a trusted intermediary to elicit feedback from land-based organisations via one-to-one conversations, workshops and surveys to co-create the interventions that could deliver outcomes for investors and the design of the scheme. Others created sub-groups within the initiative's governance structure to organise and deliver tasks or work-streams. For example, ECP created 'sub-catchment groups' to enable focussed meetings where those interested in a certain area are more likely to join and contribute to specific discussions that are relevant to them.

There were some barriers to involvement in these partnerships, such as for tenants who may be constrained by the decision-making powers of the owners of the land they manage, or the existence of regulations that constrain activities in some locations (e.g. designated sites). It was thought that some parties who engaged with ECP would have been more interested in finding data that would help them to measure the natural capital assets of their individual landholding. There were also some compatibility issues between the goals or operational context of the relevant parties and the opportunities offered by the collaborative initiative, such as in relation to the length of contracts within LENs initiatives.

5. Discussion

Below we discuss the attributes of natural capital approaches and the consequences for collaborative landscape governance.

5.1. *Providing a common framework for collaboration*

Common to all initiatives was an emphasis on understanding how natural capital assets support flows of ecosystem services, consideration of future drivers of change, and how the initiative could protect/enhance these assets and services. Structuring collaboration around natural capital appeared in many cases to consolidate actors' understandings of how ecosystem services may interact in response to interventions, and whether these would lead to multiple benefits or unintended consequences. The initiatives also used several tools to support their assessments, such as open access natural capital mapping (NPNL), scenario planning (SCI), and drivers of change theory (PANN). The common framework provided by a natural capital approach and associated tools appears to have had immediate shared benefit for those already active in the initiative, by generating information about local assets as part of a collaborative planning process (Opdam et al., 2016). This is important given the breadth in scope of collaborative landscape governance, where defining objectives for new policies or interventions can be particularly challenging, leading both to confusion among partners and negative knock-on effects on implementation (Peskett et al., 2023a).

Natural capital approaches also appear to have assisted implementation of participatory, place-based processes, which are advocated by some for understanding and enhancing natural capital, especially via mapping of ecosystem features, benefits and values (Oteros-Rozas et al., 2015; Kibler et al., 2018). By using these assessments to identify groups interested or impacted by changes in ecosystem service provision, it was possible to ensure more inclusive representation of interests, which has been shown to be a key predictor of the quality of decisions arising from participatory processes in the environmental governance literature and participation theory (Newig and Fritsch, 2009; De Vente et al., 2016; Newig et al., 2018; Reed et al., 2018). All of the cases illustrate how these approaches provided a formal structure to facilitate these complex processes.

Interestingly, we did not find the conceptual basis of natural capital approaches to pose a particular barrier for engagement with land managers and other groups, despite its roots in neoliberalism and datafication of nature, as some research suggests (Read and Cato, 2014). All the initiatives were able to engage extensively with relevant parties, which might suggest that natural capital framings were compatible with the perspectives of those the initiatives engaged with. However, the cases highlighted how all went beyond the natural capital framing to express the wider ethos of a natural capital approach through the co-production of plans that met multiple objectives. Information and perspectives from partners, communities and other relevant parties were therefore often integrated with, or presented alongside, other evidence. It is possible that this pluralistic approach to evaluating and integrating multiple (and often incommensurate) values played a significant role in successful implementation, rather than relying on monetary valuation methods that integrate values into a single value indicator or metric (such as GBP or USD). This has some parallels with debates about the utility of deliberative and pluralistic, non-monetary approaches to the valuation of nature (Kenter et al., 2016), and post-normal science and transdisciplinary approaches to the management of natural resources (Ainscough et al., 2018). It also has parallels to theoretical debates over the role of context in determining outcomes from collaborative environmental governance processes (e.g., Vella et al., 2021; Bell and Reed, 2021), which emphasise the need for reflexivity and adaptation to context to achieve multiple goals, including the objectives of local actors (De Vente et al., 2016; Reed et al., 2018) and avoiding the marginalisation of alternative perspectives (Hafferty et al., 2025).

Overall, the cases supported both the valuation of assets and collaboration identified as necessary by Termorshuizen and Opdam (2009). However, whilst the approaches provided a common framework and helped improve engagement, they did not overcome some barriers to participation. For example, tenant farmers in LENs landscapes may be constrained in their participation by the decision-making powers of landowners, or how regulations may constrain certain activities in some locations. This highlights that broader policy and legal hurdles may be higher-order controls on the ability of a natural capital approach to promote collaboration. It also supports theoretical assertions that even the best designed processes that include wide representation of relevant parties can lead to limited engagement or dysfunctional outcomes, if power dynamics are not carefully managed (Cooke and Kothari, 2001; Reed et al., 2018). Whilst the approaches helped clarify goals of the initiatives, they did not necessarily overcome all differences between the goals or operational context of the relevant parties and the opportunities offered by the initiative. Similar issues have been highlighted in research on ecosystem service assessments, which can create conflicts among communities or between investors and communities (Wickberg et al., 2024). These can be particularly problematic in the context of natural capital projects, given the inherent power imbalance between investors and communities (Ingram et al., 2025). Political ecology and political economy perspectives in particular, highlight issues of injustice, carbon colonialism, corporate control and power asymmetries (MacKenzie, 2009; Kosoy and Corbera, 2010; Berbés-Blázquez et al., 2016; Newell and Taylor, 2018; Battersby et al., 2022), which can significantly shape how governance practices emerge and how knowledge is built, negotiated and accepted (Van der Horst and Evans, 2010). It is worth noting again that those interviewed for this research were primarily in coordinating roles, and interviews with more marginalised members of the communities engaged in each initiative may have further emphasised conflicts between groups and goals within the initiatives.

5.2. Systematic approaches to handle the demands of inclusive systemic planning

There were also tangible benefits for implementation plans developed in the cases, by helping to prioritise 'hotspots' where specific management actions would benefit the natural environment and the interests of local communities and other relevant parties. This helped identify specific locations for investing in and enhancing natural assets, and making the associated synergies and trade-offs apparent, for input to deliberative decision-making processes (c.f. Kenter et al., 2016). Given the complexities of landscape governance, there are potentially significant benefits of this more systematic approach to help make a systemic approach practicable. This structure for promoting a holistic approach is particularly helpful in the context of dynamic ecosystems in which the condition of natural assets and their associated functions depends on a variety of economic, political and other human pressures (Bateman and Mace, 2020). The approach could support collaboration between existing groups within a landscape, as well as identify and eventually enrol additional relevant parties, for example linked to specific locations targeted for restoration (Farrell et al., 2022) or to identify risks (Causon et al., 2022).

However, the systemic character of a natural capital approach appears fragile. Firstly, it relies on the ability of the initiatives to contextualise and respond to the different priorities and interests of specific actors, which helps them to pre-empt and manage conflicts of interest. This is by no means guaranteed and has significant resource implications that we discuss below. Secondly, the self-interest of some actors can present a challenge. This was illustrated by ECP where it was thought that levels of interest from relevant parties would be much higher if natural capital data collection and analysis processes and outcomes were to relate explicitly to an actor's own landholding (see Section 3.3). Parallels can be drawn here with other research on how natural capital approaches encourage local actors to value natural assets and ecosystems services in financial terms, yet with unintended outcomes that result in the actors' expectations not being met (Fletcher et al., 2019).

Perhaps more fundamentally, the case studies show how resource constraints have affected implementation of the approach. Implementation of large-scale, multi-actor processes that also consider multiple functions of landscapes can be extremely costly (Rowbottom et al., 2022). It is well-known that collaborative initiatives must invest time and effort into collaboration and information exchange, as essential prerequisites for any type of collaborative initiative (Waylen et al., 2023). This is likely to limit the extent to which new approaches can drive innovation (Eckersley and Tobin, 2019) and highlights the need for institutional support to allow landscape-scale collaborations. In practice, this appears to be playing out in some of the cases. All but one of the processes relied on secondary rather than primary data, due to resource and time limitations. Where resources do not allow new, detailed studies, it may be more appropriate to avoid generating valuation or other metrics that lack robustness but are costly to produce (Guerry et al., 2015).

5.3. Enhancing access to new partners and funding sources

Ultimately, collaborative landscape governance requires the meaningful input of many groups (Opdam et al., 2016), who can help to decide as well as also resource actions. The natural capital framing is often associated with enroling new private sector actors in nature and landscape management (Meyfroidt et al., 2022). However, this had not (yet) occurred for any of the initiatives, with the exception of those linked to LENs. Similarly, monetary valuations were not always seen as useful by the initiatives, and monetary valuations of natural capital assets were created in some but not all cases.

At the time of our research the landscape-scale initiatives predominantly relied on financial or in-kind contributions from partners, which were mostly derived from the public sector. This is instructive in terms of current global aspirations, and those of UK and devolved policy, for natural capital approaches to help bridge the nature finance gap (e.g. Defra's £1 billion per year by 2030 nature finance target, 2023), illustrating the change that is still required for these to deliver at scale on this challenge. However, there was evidence that natural capital assessments in some cases led to identification of beneficiaries who might eventually provide new revenue streams to support nature (e.g. North Pennines and the South Downs). Tracking how these business relationships evolve would be a useful subject for future research.

Whether or not monetary valuation is worthwhile and productive may depend on the rationale of the actors participating in a partnership or transaction, ranging from an aim to generate a return on investments, to a reduction of operational risk, or the provision of a new services. A company considering investment in a landscape – e.g. to reduce flood risks to their infrastructure – will seek credible information, but not necessarily prices, in order to be convinced. As such, understanding what makes information relevant, credible and salient (Cash and Belloy, 2020) to specific partners may be required, to help decide whether or not to invest in monetary valuation, and which valuation methods to use. Understanding and theorising the dynamic processes of production and use of different knowledges will be an important subject for future research, tracking influences and consequences for power and interests (Chausson et al., 2023), as well as the ultimate consequences for nature. In the interim, we suggest that natural capital approaches should not always entail monetisation of ecosystem services and benefits; any efforts to do so should not supplant efforts to engage and build relationships between different societal groups.

6. Conclusion

This study shows it can be feasible and productive to work with natural capital approaches in support of landscape governance that incorporates the valuation of natural assets and enhances collaboration. These approaches – as illustrated by our cases – can facilitate a better understanding of stocks of natural resources, ecosystem services and drivers of change, aiding in the prioritisation of management actions and hotspots for intervention. They may help identify new funding opportunities from diverse sources, including public and private investments. Choosing the most apt approach for a particular situation will depend on fit with pre-existing coalitions, constraints and the priorities and concerns of relevant parties. Doing so should be expected as an iterative process of co-producing shared plans, identifying and enroling new external parties, and reducing marginalisation of alternative views. It entails considering how different components (assets) of nature yield ecosystem services, and how this could change in future; but this does not necessarily entail a commitment to monetary valuations or new primary data collection. In line with collaborative approaches to collective action and theoretical debates around participation and engagement in the environmental governance literature, the approaches we studied in the UK also show that perceived success is highly context-specific and requires inclusive engagement with local communities and other relevant parties.

Future research could therefore usefully explore the applicability of such approaches beyond the UK in different geographical and socio-economic contexts, especially in the Global South, testing the extent to which the approach can be adapted to these very different contexts. Assessing the generalisability of our findings will be valuable to help understand how and when natural capital approaches can facilitate collaborative landscape governance. However, regardless of whether or not natural capital is quantified and monetised, a focus is always needed on social process of collective action and the evaluation of benefits of nature for different actors.

CRediT authorship contribution statement

Jayne H Glass: Writing – review & editing, Writing – original draft,

Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Kerry Waylen:** Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Mark S Reed:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Leo Peskett:** Writing – review & editing, Methodology, Formal analysis. **Brady Stevens:** Writing - review & editing, Investigation.

Declaration of Competing Interest

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

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2025.104133.

Data availability

Data will be made available on request.

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