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RESEARCH ARTICLE

Areas of Outstanding Nineteenth Century Beauty: Historic landscape characterisation analysis of protected areas in England

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Abstract

1. Establishing and expanding protected areas (PAs) has become a key conservation tool in efforts to halt global declines in biodiversity. Given the ubiquity of past and present human influence, PAs inevitably include landscapes and seascapes with varying levels of human modification.
2. We briefly review the geographical biases in England's terrestrial PA network, noting that landscape-scale PAs (National Parks and Areas of Outstanding Natural Beauty) across England disproportionately occupy rugged upland terrain of low agricultural value as a result of the specific history of PA creation, but that this also biases which historic landscapes compose PAs.
3. We explore these biases using Historic Landscape Characterisation (HLC). Analysis of HLC revealed that PAs in our focal region in northern England are defined by land-use changes and landscape reorganisation processes of the 18th and 19th centuries, primarily that of enclosure. The impact this landscape transformation had on biodiversity should now form a priority for further research.
4. This historic landscape influence on PA designation has resulted in PAs being typically owned by large estates with consequences for their biodiversity, management and wider social impact (e.g. greater wealth inequalities).
5. The results highlight that historic landscape perspectives are useful to address conservation priorities and practices related to the protection of biodiversity and could be especially helpful in understanding the interaction between biodiversity protection and historic land-uses, ownership, management, access and other social impacts.

KEYWORDS
30 by 30, access, archaeology, biodiversity conservation, historic landscape, historic landscape character, ownership, protected areas

1 | INTRODUCTION

The threat of catastrophic biodiversity loss around the globe has prompted international calls for action with a focus on expanding the area of land and sea under protection for biodiversity. The recently announced UN Convention on Biological Diversity post-2020 draft strategy has set a goal of 30% of land and sea to be designated as protected areas (PAs) by 2030 (30 by 30)—to which the UK government announced that it would commit in September 2020 (UK Government, 2020). Subsequently, plans have been released that seek to deliver that goal by expanding the existing network of terrestrial PAs in Britain, which already designate around 28% of Britain's land area. To meet the 30% target in England, two new Areas of Outstanding Natural Beauty will be created and two existing ones will be expanded (UK Government, 2021). However, problems abound in expanding PAs concerning their effectiveness at protecting valued and vulnerable biodiversity, and how the benefits and costs of PAs (hereafter referred to as 'PA') establishment are distributed across wider society in Britain and around the world (e.g. Barnes et al., 2018; Bhola et al., 2021; Coad et al., 2019; Cunningham et al., 2021; DEFRA, 2018; Deguignet et al., 2017; Dudley et al., 2016; Lawton et al., 2010; Lewis et al., 2019; Natural England, 2020; Shwartz et al., 2017; Starnes et al., 2021; Venter et al., 2018). A key component influencing PA location and effectiveness at conserving biodiversity and social impacts is their anthropogenic history, especially in contexts such as Britain where all ecosystems and landscapes have been heavily impacted by long histories of human activities. Here, PAs *necessarily* designate ecosystems with deep historical anthropogenic foundations and present characteristics which influence (often as much or more than ecology and geology) the distribution and quality of biodiversity as well as the practice and management of PA designation. This has knock-on effects in wider society in terms of access, health and wealth inequality which themselves may feedback negatively to biodiversity. It is therefore critical that these anthropogenic histories are more fully considered when assessing PA effectiveness and making plans for their expansion.

Archaeology and historic landscape analysis are key ways that the anthropogenic history of PAs can be quantified and articulated. Although calls have been made to this end (e.g. ESF-COST 2010), the use of historic landscape analysis is largely untapped in biological conservation practice. Yet, it is critical to understanding what landscape PAs are protecting, but also why and how that influences their effectiveness for biodiversity and for people. We apply this archaeological and historic landscape approach here and present a brief overview of some of the key types of PAs in England before presenting analysis of historic landscape character within PAs of a region of northern England asking the following questions:

1. What is the historic landscape character of existing PAs in a case Study Region of northern England?
2. What land-use histories are revealed by Historic Landscape Characterisation (HLC) within PAs? Does it substantially differ between types of PAs and/or between PAs of the same type?
3. Is the landscape history of PAs related to specific historical structures of landownership and land management? How does that impact contemporary public accessibility and the equitability of current plans to improve biodiversity through government funding?
4. How might historic landscape character inform future efforts for expanding PAs?

2 | BRITAIN'S PAS

Britain's network of terrestrial PAs emerged from the priorities of numerous open space pressure groups beginning at the end of the nineteenth century. This culminated in passage of the National Parks and Access to the Countryside Acts (1949) that created Britain's PA network, consisting of National Parks, Areas of Outstanding Natural Beauty, National Nature Reserves and Sites of Special Scientific Interest.[1] The largest of these, NPs and AONBs, are dedicated to the conservation of 'natural beauty' although this has come to be considered as protection for biodiversity (IUCN NCUK, 2012). NPs and AONBs, account for the majority of the terrestrial PA, with 10 NPs and 34 AONBs, which currently encompass 31,785 km^2—around 25%—of the total land area of England, a figure already close to the 30 by 30 target (Figure 1; S2). While NPs and AONBs have been considered to meet the IUCN definition of PAs, they are predominantly working agricultural landscapes and biodiversity protection extends

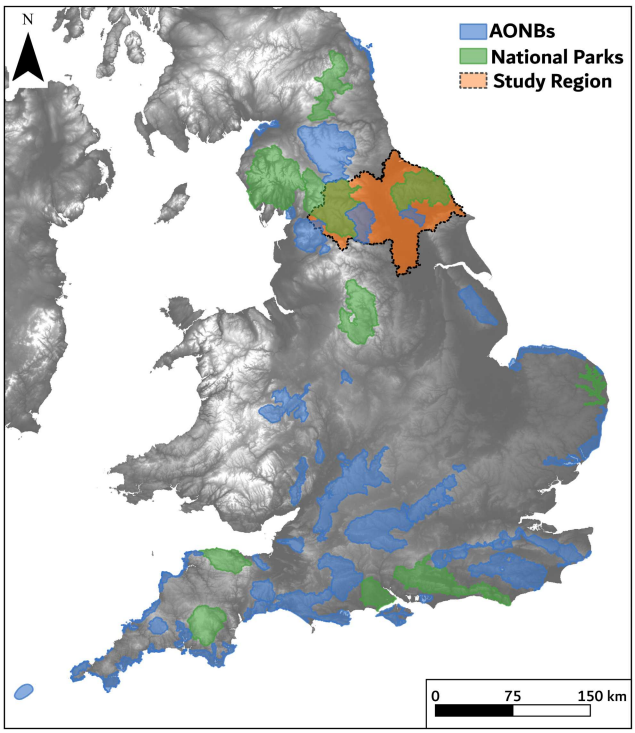

FIGURE 1 England's protected areas (PAs). The Study Region is the area assessed within the North Yorkshire, York and Lower Tees Valley (NYYLTV) Historic Landscape Characterisation (HLC), the extent of which is highlighted in orange.

TABLE 1 IUCN PA categories and description (Dudley, 2008). Crofts et al. (2014) identify where the mosaic of UK protected areas fall within the IUCN PA framework

IUCN PA category	IUCN description	UK protected areas
Ia	Strict Nature Reserve: Protected area managed mainly for science	Nil
Ib	Wilderness Area: Protected area managed mainly for wilderness protection	Nil
II	National Park: Protected area managed mainly for ecosystem protection and recreation	Some specific parts of Scottish National Parks, NNRs and Special Areas of Conservation might fall in this category
III	Natural Monument: Protected area managed mainly for conservation of specific natural features	Some SSSIs
IV	Habitat/Species Management Area: Protected area managed mainly for conservation through management intervention	Most SSSIs
V	Protected Landscape/Seascape: Protected area managed mainly for landscape/seascape conservation and recreation	AONBs and NPs
VI	Managed Resource Protected Area: Protected area managed mainly for the sustainable use of natural ecosystems	Some parts of AONBs and NPs

only to certain additional development planning constraints (Crofts et al., 2014; Glover, 2018; see Table 1). In contrast, over 4000 SSSIs extending over 10,995 km^2 in England explicitly target the protection of flora and fauna and make it a criminal offence to damage or remove the biodiversity of interest. Since 1977, there have been guidelines for the designation of SSSIs which set out the ecological criteria a site is required to meet before designation (Bainbridge et al., 2013; Ratcliffe, 1977). The management of SSSIs to maintain the designated biodiversity is then up to the landowner(s), although the management plan is developed by Natural England, England's natural heritage government agency. Ownership is overwhelmingly by private individuals, although some are owned by government agencies and environmental NGOs. Natural England is also responsible for periodic assessments of their condition and at the time of writing, 38.15% of SSSIs are considered to be in the best rated condition (Natural England, 2022).

Previous assessments of the UK PA network effectiveness have often focused on aspects of physical geography and how this relates to their biodiversity (e.g. Oldfield et al., 2004) or the types of biodiversity and their condition (e.g. Cunningham et al., 2021; Starnes et al., 2021). This has revealed that the location and size of PAs are far from randomly distributed around England. Larger PAs, especially NPs, tend to be in more elevated and marginal locations with less productive soils—areas of poor agricultural potential which have been subjected to less intensive arable farming (S2)—something which is paralleled globally in PAs (see Joppa & Pfaff, 2009). However, SSSIs, designated under stricter biological criteria, also reflect this bias, with greater shares of higher elevation protected by SSSI designation compared to lower elevation. Around 50% of land in England over 400 m above sea level is designated as a SSSI, while this elevation accounts for just 2.8% of England's total land area. Only 3.5% of land in elevation less than 200 m above sea level is SSSI designated, but this lower elevation accounts for 86.6% of England's land area (Oldfield et al., 2004: 305–6; Shwartz et al., 2017: 282). It has been suggested that these higher elevations in England are some of the 'only remaining natural or near-natural environments left' (Bainbridge et al., 2013: 24), thus attracting both large and small PA designation. But physical geography alone does not explain the preference for designating these areas. There are also historical trajectories of land-use and ownership in these less intensively farmed areas which play a related, and possibly more influential, part.

This sense of 'natural' in Britain is more accurately described as 'deserted' or 'de-populated', with near ubiquitous evidence for former settlement, enclosure and pastoral activity in uplands as high as 600 metres above sea level across Britain for the most of the past two millennia, and in most cases stretching back to at least the Bronze Age (between approximately 4500 and 2800 years ago; e.g. Costello, 2020; Johnson, 2015; McDonnel, 1988). In addition, the perceived 'natural' openness of these landscapes is heavily dependent on continued management, especially for sheep grazing and grouse shooting (see Evans et al., 2006; Yallop & Clutterbuck, 2008). Cultural values surrounding the concept of 'nature' and 'beauty', rooted in the Picturesque and Romantic movements of the 19th century, explain the aesthetic value attached to rugged and higher elevations regardless of deep anthropogenic influence (e.g. Hourahane et al., 2008; Suckall et al., 2008: 1196–1197). Despite acknowledging the long histories of human impact and that cultural aesthetic values come into play in the location of England's PAs, the specific chronology and process of past land-use in any given locality are very poorly defined when it comes to understanding conservation within PAs for biodiversity or their impacts to wider society, both positive and negative. Historic baselines are rarely established in ecological literature from before the early 20th century (e.g. Ridding et al., 2020), and most date from the 1970s onward (e.g. Cunningham et al., 2021). However, this is long after the last significant phase of landscape replanning and ownership change which occurred in Britain between the 17th and 19th centuries (see below), and which was itself influenced by centuries of earlier landscape development. This landscape history, which still structures most of the English countryside, needs

to be better quantified and articulated with respect to PAs to understand what they designate and protect.

3 | HLC AND THE IMPACT OF IMPROVEMENT

The historic patterns of land-use that have shaped the landscapes of Britain have been mapped and quantified through the development of HLC. HLC is a national initiative supported by Historic England (formerly English Heritage) since 1993 to create a single point of reference for planning decisions that impact the wider historic landscape (Aldred & Fairclough, 2003), as well as informing other landscape and biodiversity conservation decisions (Turner, 2006: 396). It explicitly recognised that 'landscape' and 'character' were increasingly important future land-use through the various statutory frameworks involved in those decisions (Turner, 2018: 38–9). In England, HLC was carried out regionally. Usually, these regions reflected broad geographical and historic boundaries. In two cases, regions were defined by PA boundaries (Cranborne Chase and West Wiltshire AONB and the Peak District NP), and in one case, an HLC was used to help inform a PA boundary (New Forest NP; Fairclough et al., 2002: 78). The HLC methodology used the 1st edition Ordnance Survey map series, surveyed between the 1840s and 1880s, along with other available historic data varying region-to-region, to identify the role of all historic land-use on the character of the present landscape using field boundaries as a primary source of information (Fairlie, 2009). The results are presented in Geographic Information System vector datasets with associated tabulated feature and chronological data which defines the land-use histories responsible for the present character of that locality, usually at 1–3 ha resolution (essentially field-by-field) (Table 2). This methodology now maps over 99% of England's land area; similar mapping exercises have been carried out for Scotland, Wales and Northern Ireland.

One of the outcomes of the HLC mapping programmes was to quantify the broad phases of historic enclosure which had long been identified as a critical transformation across the British countryside (Fairlie, 2009; Johnson, 1996; Williamson, 2000, 2002). Enclosure has a long history in Britain stretching back to the Neolithic (beginning c. 6000 years ago); however, the vast majority of enclosures that remain extant in the landscape and are thus captured in HLC mapping, date from much more recent periods—primarily the last 300–400 years (see Williamson, 2002: 13). The enclosures associated with 'improvement' during the late-18th and early-19th century (AD 1750–1850) removed medieval field systems and enclosed common land erasing earlier features (e.g. Johnson, 2015). Earlier features are occasionally still apparent in the landscape, particularly in western regions, but more recent enclosure, which dominates across most of the country, obliterated and obscures earlier phases and features.

It is beyond the scope of this paper to fully articulate the social, political and economic context of the enclosure and wider improvement movement of the 18th and 19th centuries; however, from the large corpus of historical and archaeological research into the

TABLE 2 Sample data from North Yorkshire, York and Lower Tees Valley Historic Landscape Characterisation (HLC). See Toase (2010) for further information on other attribute data

Description	Unique identifying number for each feature	Original HLC broad type	Specific HLC type	Summary of the specific feature	Earliest likely date for establishment of feature	Latest likely date of establishment of feature	Binary column for features lacking chronological evidence
Heading	HLCUID	BroadType	HLC Type	Summary	YearFrom	YearTo	UnknownDate
Data	HNY1706	Designed landscape	Deer Park	This is the surviving part of a deer park associated with the settlement of Bolton castle. This has intaken land from the moor. The majority of the parks have been enclosed in the post-medieval period meaning that this area is very significant	1066	1539	False

process, three broad and important points emerge for this discussion of the PA network across Britain and in the study area:

1. The use of enclosure became part of the transition to capitalist modes of agricultural production beginning as early as the 15th century. Large-scale enclosure reached a peak in the 18th and 19th centuries to remove the final vestiges of medieval open field system organisation, as well as many earlier phases of piecemeal enclosure (Johnson, 1996; Williamson, 2000).
2. The process of enclosure in the 18th and 19th centuries removed land from common use and put it into absolute private ownership often by legal authority, sometimes acrimoniously, and occasionally violently (Blomley, 2007; Neeson, 1984; Whyte, 2005). Enclosure in this period was overwhelmingly executed at the behest of large landowners, exacerbating fundamental inequalities of land organisation in this period (O'Donnell, 2014).
3. Enclosure was a physical manifestation of an 'improvement' ethic which was widely held among the landed classes and formed part of a wider moral and social imperative (Finch, 2007; Tarlow, 2007; Wade Martins, 2002: 41).

The HLC and other similar mapping efforts across Britain give regionally quantified insight into this process of historic enclosure as well as other historic land-uses. There have been numerous critiques of the HLC approach in different contexts, for example, the neglect of important elements of the 19th-century landscape over less visible, but documented, medieval use (Finch, 2007). Further issues emerge in the designations used which are inconsistent at times between descriptive/chronological (e.g. '19th-century enclosure') and cultural character (e.g. 'estate'). There has also been a tendency to use the 19th-century mapping to characterise landscape elements, but to neglect the impact of 18th- and 19th-century modifications themselves on earlier landscape features. However, the scale of the assessment with a regionally consistent methodology that identifies and maps landscape character reveals many of the basic processes that are responsible for shaping the current landscape. It does so in a way which other landscape character datasets, such as Natural England's Landscape Character Assessments, do not by providing key chronological and descriptive data on changes in landscape composition at relatively fine resolution. Thus, the use of HLC data can quantify and map the human impact on the landscape of PAs and allow for comparisons to be drawn between them and the wider landscape.

4 | METHOD

The North Yorkshire, York and Lower Tees Valley HLC, undertaken by the North Yorkshire County Council between 2005–2010 (Toase, 2010), was selected as the Study Region[2] for this analysis due to its good representation of England's PAs, physical geography and historic landscape. It is situated in the northern half of England, covering substantial upland zones, which are dominant in PA designation, but also large areas of rich agricultural land at lower elevations. For comparison between different types of PAs, NPs, AONBs, NNRs and SSSIs were selected. These have been the subject of PA network analysis before (especially SSSIs and NNRs) and current government plans make clear that two new and two expanded AONBs will be used to meet the 30 by 30 targets, no other PA types will necessarily see expansion (see above). The Study Region contains two entire AONBs, Howardian Hills and Nidderdale (a small portion of the Forest of Bowland is also captured in the HLC region, but is not analysed here as the HLC data captures less than 10% of that PA's area). The Study Region also contains two NPs, the North York Moors and Yorkshire Dales (although part of the Yorkshire Dales NP falls outside the HLC region and is thus not quantified here). In the Study Region, there are also 190 biological or mixed designation SSSIs and 10 NNRs (Figure 2). The structure of the Study Region's HLC data has also facilitated this analysis with specific and well-defined chronological precision for most data points. This combines to form an ideal area to capture the different physical and cultural geographies which are involved in the historic landscape character of PAs in England.

The relevant PAs' boundaries were downloaded from freely available government sources and the Archaeology Data Service (Table 3). These were loaded into QGIS 3.20.1 (QGIS Development Team, 2021) for analysis. All datasets were checked for invalid geometries and any invalid geometries cleaned. Geometries were obtained using the QGIS field calculator for each HLC polygon feature. The PA boundaries were then used to intersect the HLC datasets leaving the HLC data from within each PA boundary separately. If a PA extended beyond the HLC region, the PA polygon was clipped to its extent only within the HLC region, so results present partial data for these examples (highlighted in dataset). With HLC polygon features defined by the PAs boundaries, quantitative comparisons can be made of the different relative compositions of HLC classifications

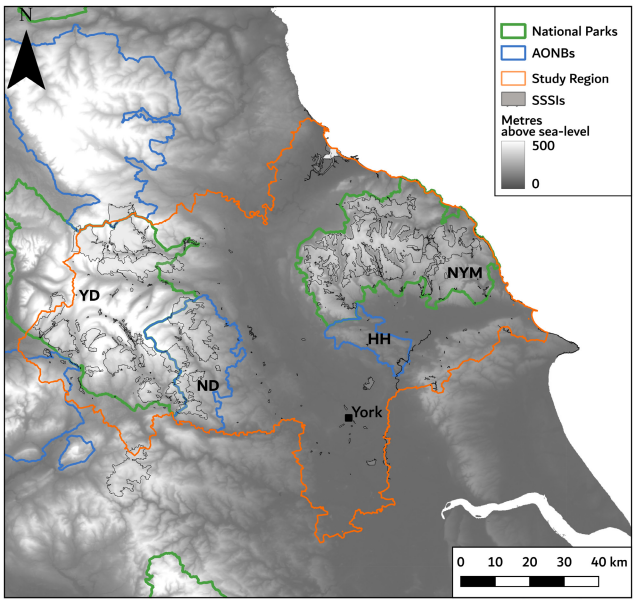

FIGURE 2 Regional location map showing PA designations in the Study Region. NYM = North York Moors NP; YD = Yorkshire Dales NP; HH = Howardian Hills AONB; ND = Nidderdale AONB.

New broad type	New broad type definition
Estates and Designed Landscapes	Land composed of castles, country houses and other elite residences, along with their planned and designed landscape features including gardens, deer parks and orchards
Fieldscape	Fields used for arable or grazing agriculture defined by enclosures including stone walls, hedges, fences and ditches
Pasture and Lowland Commons	Land specifically used for pasture and land used in common, historically used for pasture, with some retaining this land-use
Woodland	Land defined by tree cover
Moorland	Land defined by heather dominated moorland and blanket bog peatland
Water	Rivers, open freshwater water, estuarine and coastal features
Settlement, Industrial and Other	Cities, towns and villages, roads, extractive industrial, other industrial, military installations and other urban and suburban features

TABLE 3 New broad type definitions. For which specific Historic Landscape Characterisation (HLC) types have been categorised into these groups see S1

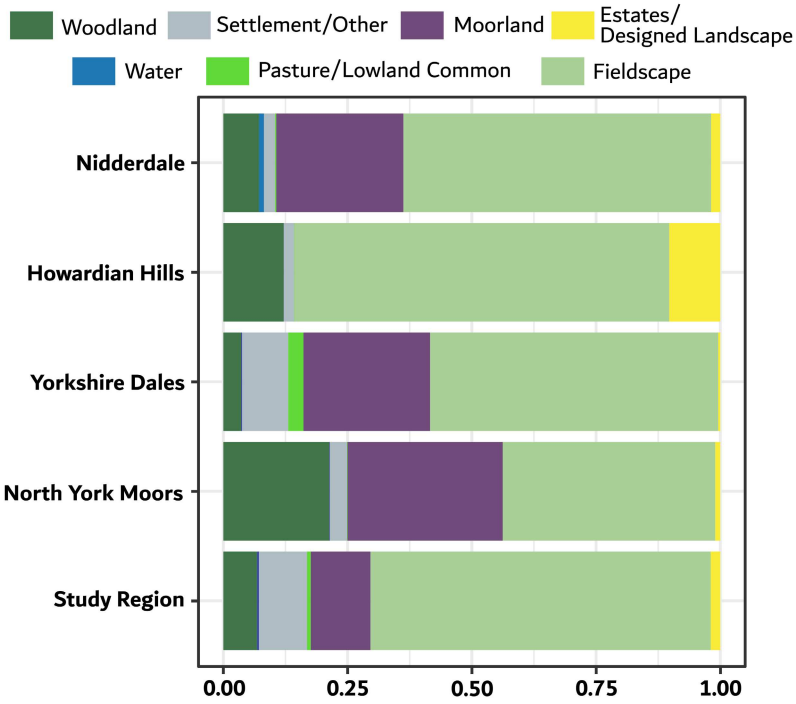

FIGURE 3 Proportion of land in each new broad type for the National Parks (Yorkshire Dales and North York Moors) and AONBs (Nidderdale and Howardian Hills) in the Study Region which is also displayed for comparison.

within and between different PAs boundaries. Additional figures were produced using R v.4.1.0 (R Core Team, 2021) with packages RASTER (Hijmans, 2021), GGPLOT2 (Wickham, 2016), STRINGI (Gagolewski, 2021), TIDYR (Wickham, 2021) and DPLYR (Wickham et al., 2021).

The Study Region HLC has a two-level hierarchy, a 'Broad Type' and a 'Specific Type', defined explicitly by the HLC documentation (Toase, 2010). The Broad Type classifications by which the HLC was initially defined were not well suited to discussing biodiversity. For example, one of the Study Region's Broad Types is 'Unenclosed Land' which was mostly composed of historic landscapes of upland moorland Specific Types, but also included some Specific Types of lowland commonland. These are very disparate ecologically, so new Broad Types have been defined, and then existing Specific Types grouped into the new Broad Types. These new Broad Types have aimed to be more ecologically coherent and identify the key historic landscape character types which impact on PA designation (Table 3; S6). Chronological information for each unique feature within the Study Region's HLC were then grouped by 'YearTo' value (Table 2) into three categories; pre-18th century (dates up to AD 1699), 18th–19th century (AD 1700–1899) and 20th century to present (AD 1900–2005). A fourth chronological category of 'Undefined' was included calculated from the 'Undefined chronology' attribute.

5 | RESULTS AND DISCUSSION

The HLC analysis identifies three primary Broad Types of historic landscape within the Study Region's PAs—Fieldscape, Moorland and Woodland, and our discussion will focus primarily on Fieldscape and Moorland (Figure 3). The HLC analysis of the large PAs in the

study area confirms the national bias towards upland zones with three of the four large PAs in the study area containing greater than average quantities of Moorland and Woodland which are present in more upland zones. The exception is the Howardian Hills AONB (see below for further discussion). In all cases however, they remain substantially composed of Fieldscape, the structure of which overwhelmingly dates from the 18th and 19th centuries (see below). In the SSSIs and NNRs, we see single Broad Types more commonly dominate the entirety of PAs, and this reflects the nature of SSSI and NNR designation which tend to focus on specific habitats (e.g. Newby Moor SSSI designates an area of Moorland and Semerwater SSSI designates a lake and surrounding landscape—Figures 4 and 5). However, taken collectively, the smaller PAs designate historic landscapes with similar biases to the large PAs, and are mostly composed of Fieldscape dating to the last few centuries with varying levels of Moorland and Woodland reflecting their typically upland setting.

6 | PROTECTING LANDSCAPES OF HISTORIC ENCLOSURE: AREAS OF OUTSTANDING NINETEENTH CENTURY BEAUTY

Fieldscapes dating to the 18th and 19th centuries comprise no less than one-third of any of the large PAs (Table 4). Overall, the quantity of Fieldscape in the larger PAs is similar to the Study Region average, but where the PAs substantially differ from the region as a whole relates to the proportion of 20th century to present Fieldscape. PAs systematically avoid the designation of Fieldscape whose character dates from the 20th century. These later Fieldscapes still predominantly reflect the boundaries of 18th–19th enclosure, but are characterised by substantial historic field boundary loss, generally removed to facilitate mechanised agriculture in the post-war period. This can also be seen in The Howardian Hills AONB which is an exception to this pattern and actually contains a greater quantity of 20th century to present Fieldscape than regional average (see below for further discussion of Howardian Hills AONB).

It might be expected that agricultural fields of relatively recent origin (set out in the 18th and 19th centuries) would not comprise such a great proportion of SSSI and NNRs given their stricter biological criteria for designation, especially 'naturalness'. However, this does not seem to be the case. The HLC analysis identified that 104 of 190 SSSIs (54.7%) in the Study Region are made up of 80% or greater Fieldscape and there is a clear dominance of Fieldscape dating from the 18th and 19th centuries which comprises 82.1% of the 22,549 ha of Fieldscape designated by SSSIs in the study area. Only 14 SSSIs are composed of more than 80% Fieldscape dating from before the 18th century. Although this is a disproportionately greater amount given the rarity of survival of Fieldscape from before the 18th century—27.1% (14,449 ha) of all pre-18th century HLC types in the Study Region is designated by SSSIs compared to just 5% of the Study Region's 18th- and 19th-century Fieldscape. Less surprisingly, just 12 SSSIs designate Fieldscape mostly dating from the 20th century to present which is a significantly disproportionate under representation of this chronological period of Fieldscape in the study area. This points to the importance of deeper historical land-uses for biodiversity. Fieldscapes of the 18th and 19th centuries are dominant across the PAs analysed, and it would require contextually specific research to determine the degree of change to biodiversity these historic land-use changes had, probably ranging from minimally impacted to major ecological change.

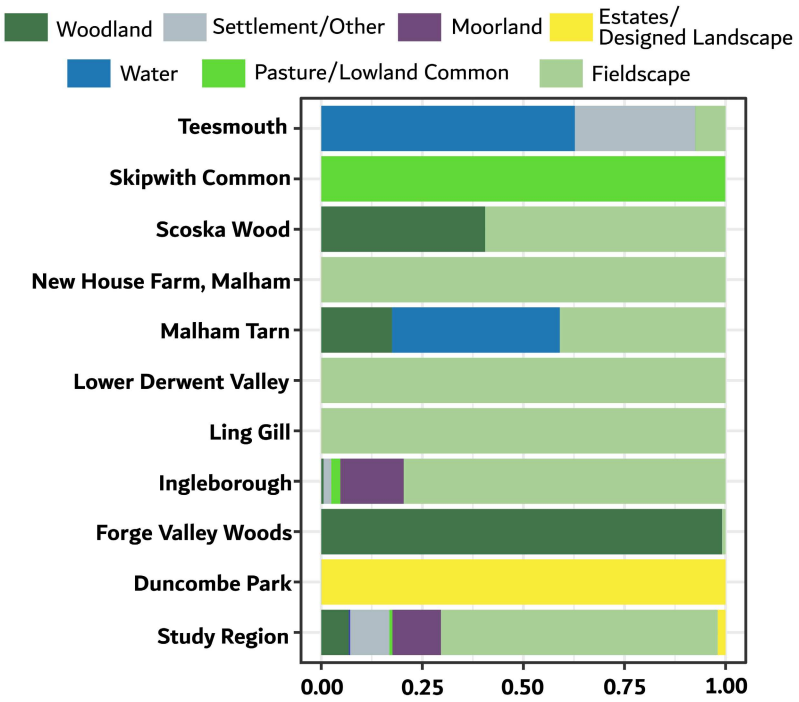

FIGURE 4 Proportion of land in each new broad type for individual National Nature Reserves (Study Region included for comparison).

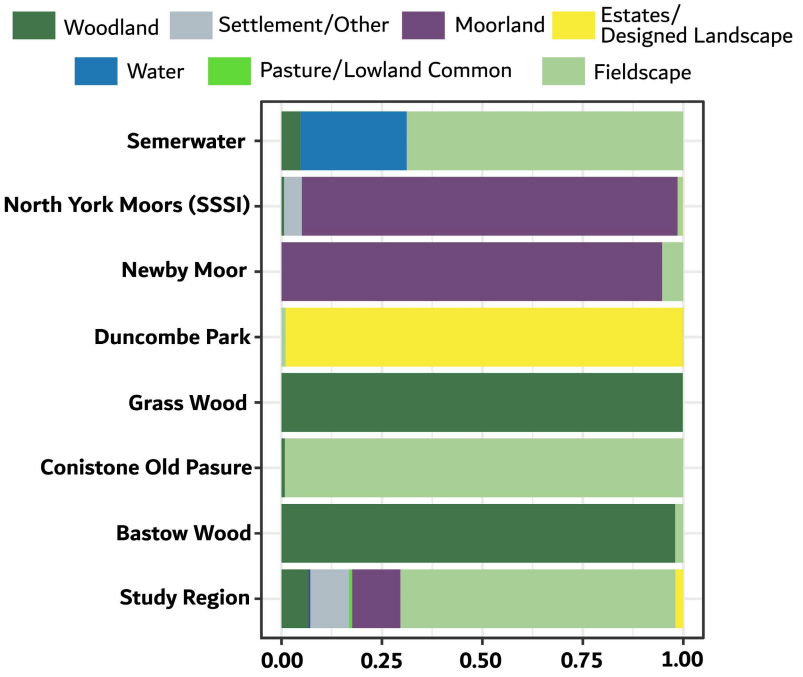

FIGURE 5 Proportion of land in each new broad type for selected SSSIs (Study Region included for comparison).

TABLE 4 Percentage of PAs' area by Fieldscapes in the study area. Note the relatively small proportion of 20th-century Fieldscapes in three of the four large protected areas (PAs). *Small quantities identified, but round to zero

PA	North York Moors	Yorkshire Dales	Howardian Hills	Nidderdale	Study Region
20th century to present Fieldscape	7.0	0.0*	32.7	2.9	22.5
18th- to 19th-century Fieldscape	34.5	50.3	38.5	50.3	40.8
Pre-18th century Fieldscape	0.0*	1.6	4.1	7.9	0.0*
Period	**Percent of Total PA area**				

Regardless of the past changes from medieval and early modern land-uses to the later enclosure movement, areas of 18th- and 19th-century Fieldscape clearly harbour important biodiversity in the present (see Dover, 2019; Jefferson, 2005). There is undoubtedly diversity underlying this dominance of 18th- and 19th-century Fieldscape, which may be in part or in whole responsible for important diversity and thus often protected by the Study Region's PAs. However, the survival of this biodiversity is dependent on patterns of more recent historic agrarian practices and persistent land management that continues to be framed and shaped by recent historic enclosure and its attendant built environment (e.g. Gaskell & Tanner, 1998). Both large and small PAs are most often defined by Fieldscape boundaries even if they are not themselves primarily composed of Fieldscape (Figure 6). Thus, PA designation and management is exercised within landscape patterns of primarily 18th- to 19th-century enclosure, maintenance of which is key to ongoing protection of existing biodiversity. This places an onus in the management of SSSIs and NNRs (and to some degree NPs and AONBs) on ownership or control of specific parcels of land mostly defined in the 18th and 19th centuries. It is also the case that by expanding PAs to meet quantity targets such as 30 by 30, 18th- to 19th-century enclosure will comprise a majority of the newly designated areas. Given the aversion to designation of 20th century–present Fieldscape and very few upland zones not already designated in England, 18th- and 19th-century Fieldscape is undoubtedly going to be targeted for new and expanded PAs. For example, the announced Yorkshire Wolds AONB would appear to a perfect example as it is a region known for the quality and quantity of survival of primarily late 18th- and early 19th-century field boundaries and consolidated farm landscape organisation that transformed a primarily pastoral landscape to an arable one (Gleave, 1962). That so much of the PA network is either composed of, or defined by, 18th- to 19th-century Fieldscape highlights that it is critical to develop a better understanding of how and when valued biodiversity changed as a result of this major landscape transformation in the 18th and 19th centuries.

7 | PROTECTING 19TH CENTURY 'NATURAL BEAUTY'

Upland Moorland is the second major component of PA landscape in the study area. The North York Moors NP is composed of 31.2% Moorland and the Yorkshire Dales NP 25.4%, while Nidderdale

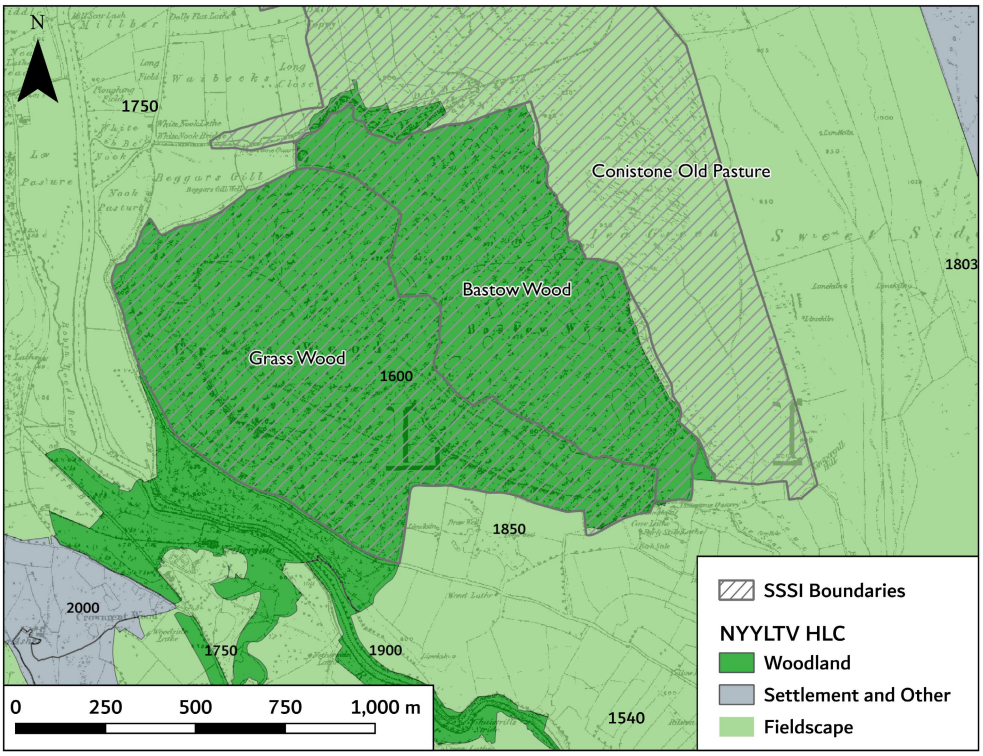

FIGURE 6 Boundaries of three SSSIs in the Yorkshire Dales NP, which form a contiguous group, projected over the 1st edition OS (Yorkshire Sheet 134, surveyed 1848–1850) showing how they are defined by historic field boundaries. Grass Wood SSSI and Bastow Wood SSSI are designated for the same mixed-broadleaf forest while Conistone Old Pasture SSSI is designated for its base-rich grassland. All three SSSIs are bounded by (and in the case of Conistone Old Pasture composed of) field enclosures dating to the 18th to 19th centuries (year to dates from HLC data shown labelled on map). © Crown copyright 2021.

AONB is composed of 25.6% Moorland. The Howardian Hills AONB contains no land identified in the Study Region's HLC as Moorland. The quantity of historic Moorland would have been greater as much of the Woodland in this area is 20th century conifer plantation in areas of former Moorland, and some marginal moorland was brought into cultivation during the second world war. In the Study Region, only 10 SSSIs are composed of greater than 80% Moorland; however, they comprise nearly half (42.3%, 53,387 ha) of all the area in the Study Region designated as biological SSSIs. This is primarily from the exceptionally large North York Moors SSSI, which alone is 44,162 ha. Moorland historic landscape character makes up 64.7% (81,612 ha) of the total SSSI designated area in the Study Region. These areas have a much greater share of undefined chronology in the Study Region's HLC dataset—for example, North York Moors SSSI is 89% 'undefined' chronologically. This is owed in greater part to the HLC methodological reliance on boundary types for chronological relationships, and few exist in these open areas. Although these areas of Moorland are not themselves physically enclosed in the same way as Fieldscape, they owe their character to the same historic processes which affected the 18th- and 19th-century enclosure of fields and common land. Furthermore, they also reveal the ways in which 'natural' and 'naturalness' in England's PAs has become entwined with the practices of relatively recent reorganisation and management of this landscape which has also consolidated patterns of ownership primarily dating to the 19th century.

Areas of Moorland may be perceived as being 'natural' or 'wild', in part due to being physically open and less densely populated compared to adjacent or near-by population centres, but again, this emerges from a relatively shallow chronology of human activity. These Moorland areas are former common grazing and depopulated post-industrial landscapes, which have been closely managed for shooting over the past two centuries as part of large estates (Evans et al., 2006; Robertson et al., 2017; Sotherton et al., 2008). Moorland in the region's NPs and in Nidderdale AONB survives in greater part due to being specifically set aside for this purpose (Done & Muir, 2001; Simmons, 2003: 113–87). The creation and maintenance of this type of landscape included the continuation of grazing by sheep and burning, part of an older pastoral tradition of land management stretching back in some cases perhaps to the Bronze Age (Davies & Dixon, 2007: 43). However, key to their present condition, and thus the biodiversity protected in these landscapes, is that far fewer people now live their day-to-day lives permanently or seasonally here. Yet, they remain closely managed by large estates. This situation owes itself in substantial part to the development of shooting sports, especially for grouse, which was the *raison d'être* for northern English and Scottish upland estates from the later part of the 18th century, but primarily from the mid-19th to early 20th century, and was part of an overall consolidation of land owning in these upland areas (Done & Muir, 2001). This ownership pattern continues as these Moorland areas remain dominated by the very

largest landowners in the country (Shrubsole, 2019), as does the land management for shooting, with managed Moorland burning occurring more frequently within PAs compared to outside them (Douglas et al., 2015). While three of the four large PAs in the Study Region have about the same (Yorkshire Dales NP and Nidderdale AONB) or less (North York Moors NP) than the Study Region's average quantity of Estates and Designed Landscapes, their historic landscape is still dominated by the decisions and management of large estates and landowners (Figure 3).

8 | PROTECTING LAND-OWNING ECONOMIC AND SOCIAL STRUCTURES

The continuing presence and influence of large landowners in PAs is seen more clearly in the Howardian Hills AONB which has an exceptionally high proportion of historic landscape character of 'Estates and Designed Landscape' which comprises 10.3% of the AONB (the Study Region average is 1.9%; see also Toase, 2010: 135). Yet, because HLC-Specific Types do not consistently recognise ownership types, this severely under-represents the influence of large estates in this landscape. The actual extent of the land within the Howardian Hills AONB that was owned and managed as part of large estates over the 18th and 19th centuries probably exceeded 90%, with the Howard's at Castle Howard, by the Feversham's at Duncombe Park, the Worsley's at Hovingham, the Wombwell's at Newburgh Priory and the Fairfax's at Gilling Castle (Figure 7). It was the large landowners who were best placed to effect large-scale enclosure programmes which account for so much of this working agricultural landscape (Howardian Hills AONB is 75.4% Fieldscape). This influence extended similarly over Woodland which would have also formed a critical part of the overall estate landscape (comprising 12.2% of Howardian Hills AONB). It was decisions taken within these historic estates that are responsible for the pattern and character of protected biodiversity in the present. While today these estates are smaller than their fullest extent in the 19th century, they still exert considerable influence over the landscape and its community through extensive land ownership (although this can be difficult to quantify).

We can see how this pattern of ownership articulates with PA management at Duncombe Park NNR/SSSI, located in the North York Moors NP. Duncombe Park provides a very clear case of an estate landscape that includes 18th- to 19th-century fields, woodland and designed landscapes and how its highly valued biodiversity is influenced by past and present estate management. This NNR and SSSI is composed entirely of Estates and Designed Landscapes dating primarily from the 18th century (which itself was influenced by an earlier late medieval deer park) and harbours the mature native

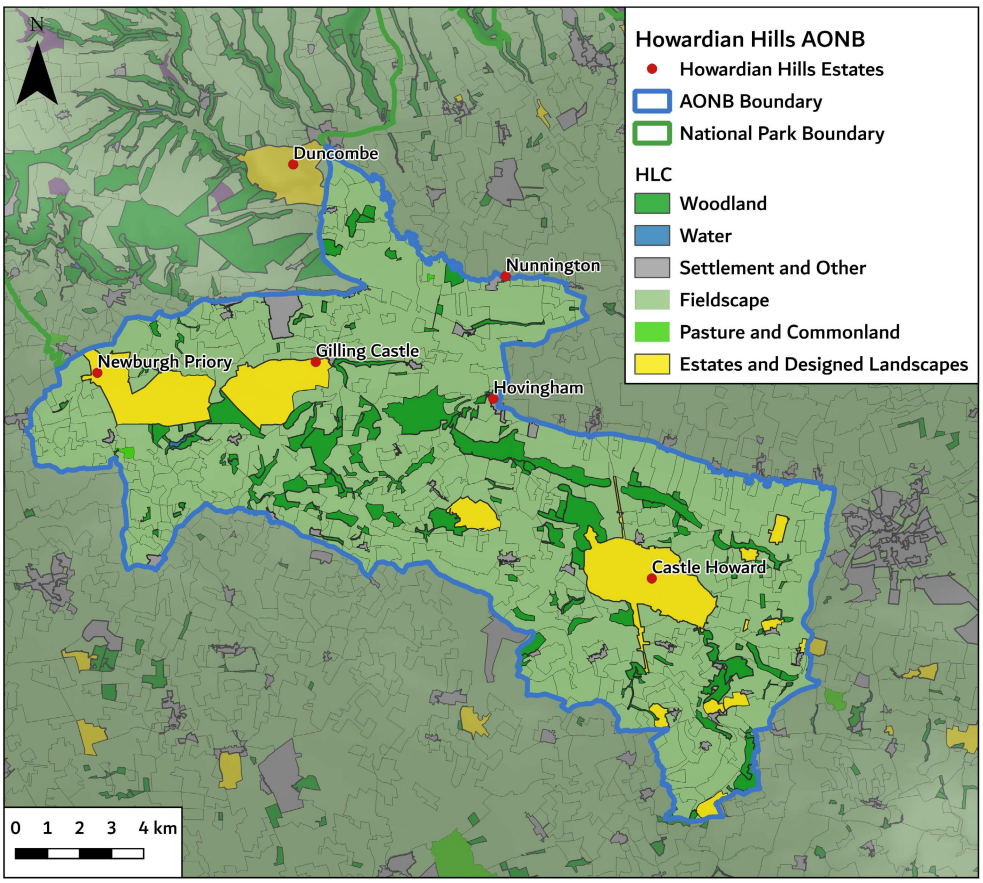

FIGURE 7 Howardian Hills AONB and southern part of North York Moors NP with major estate houses plotted.

tree species which support the insect biodiversity noted prominently in the SSSI citation (Natural England, 1985). It is suggested in the SSSI citation document (ibid.) that consistent land management by the estate has been (and will be) key to the important biodiversity designated here. This is potentially a major positive aspect of large landowner influence on biodiversity protection via PAs, they allow positive management strategies to be maintained or swiftly implemented at scale. However, there remain various, not necessarily aligned, interests across privately owned land designated as various types of PA. Very substantial portions of the large PAs are owned by large estates (in the past and present), thus valued biodiversity and access to it is often owned and managed by a very particular socio-economic group.

If the expansion of PAs in England to meet 30 by 30 targets follow previous designation structures and patterns (and the announcement of two new AONBs and the expansion of two others, suggests it already has), it follows that additional funding and support to improve the PA network for biodiversity will flow through and to private landowners, especially large ones (Shwartz et al., 2017: 283–4). Indeed, such a scheme has recently been announced. Defra has launched funding available for landowners and managers to pursue climate, biodiversity and heritage projects within protected landscapes (DEFRA, 2021). Although there is scope within this fund to improve access to PAs for the wider public, it remains the case that landowners are likely to see the greatest financial benefit from this and other similar schemes, and thus the income stream sustains and perhaps enhances inequities to the owners of valued biodiversity. While typically explored in developing countries, wealth inequalities are linked to biodiversity declines (Berthe & Elie, 2015; Hamann et al., 2018; Holland et al., 2009). In the UK, this has played out through the historic landscape in both the specific ownership and management of land which harbours valued biodiversity, but also in a wider sense about for whom biodiversity is protected (cf. Pieraccini, 2015: 560–2; Suckall et al., 2008). This works in both directions when using spatial designations. In identifying what is valuable, they also can imply undesignated areas are therefore not valuable which can have negative impacts to biodiversity (Hazen & Harris, 2007: 282–3). It is already understood that access to biodiversity and 'green space' more broadly within England is framed by inequalities along ethnic, social and economic lines, most likely exacerbated by the COVID-19 pandemic (Natural England, 2020). These issues will not be addressed through simply expanding the existing PA network which is likely to uncritically reinforce social and economic inequalities maintained through PA designation and management, especially in relation to property ownership in part forged in the 18th and 19th centuries (Pieraccini, 2015: 567–8). This kind of archaeological analysis has potential to substantially highlight the historic landscape dimension of access, ownership and wealth inequalities with respect to biodiversity that have arisen and can arise through the designation of PAs across the countryside. In concert with other critical approaches to PA effectiveness (e.g. Cunningham et al., 2021; Isaac et al., 2018), this is likely to improve strategies for protecting biodiversity in PAs.

9 | CONCLUSION: PROTECTING CURRENT AND FUTURE BIODIVERSITY

In Britain's PAs, the landscape itself, as well as many of their management practices and patterns of ownership can trace their current structure and character back only to the 18th and 19th centuries. We have shown through the analysis of HLC in a region of northern England how the processes of this relatively recent history of land-use changes, primarily that of enclosure, dominate the character of PAs. This improves the understanding of what anthropogenic landscapes PAs have designated, often for their 'natural' qualities, and are now valued for biodiversity. More deeply integrated analysis of historic landscapes and their influence on the protection of biodiversity through PAs is useful and required. Although recent research indicates initial PA locations in Britain were chosen well and PAs have provided conservation benefit (Critchlow et al., 2022), expansion along the same lines and inclusion of protected landscapes (e.g. AONBs) as areas for biodiversity protection are likely to miss many priority areas for a range of species (Cunningham et al., 2021). In the universally anthropogenic environments of Britain, to protect a wide array of species, it follows that a wide array of landscape types and historical land-use trajectories must be designated. Protecting a diversity of different landscape types, which are heavily or even mostly products of historical land-use trajectories, has been shown to mostly not be the case at present. This is something which the HLC datasets for Britain are uniquely suited to identifying, quantifying and analysing.

The dominance of 18th- and 19th-century enclosure within the PAs of the Study Region also demands further research on how that fundamental landscape transformation impacted biodiversity in the past. Numerous studies have shown how land-use changes can have variable effects on biodiversity often dependent on scale—with increased species richness at the local level, but homogenisation at regional and supra-regional scales (e.g. Danneyrolles et al., 2021; Finderup Nielsen et al., 2019). Yet, this process remains very poorly resolved in the context of 18th- to 19th-century enclosure in Britain and requires significant future research to test it. Rolling out the approach used in this paper across all of Britain would be beneficial to quantify the far-reaching impacts of 18th- to 19th-century programmes of enclosure. This could identify important inter-regional trends that explain biases and other aspects of the PA network in Britain (including further understanding the bias in the timing and purpose of designations themselves). These trends and biases may have lasting effects moving into futures for biodiversity change dominated by climate change (Critchlow et al., 2022). While the present-day landscape of England is dominated by a few historic land-use processes, they mask an underlying land-use diversity which could have had legacy effects on biodiversity which remain mostly or wholly unknown. The connection to recognised historic phenomenon is usually based on inference—archaeological features identified attest to changes, but the casual link between those changes and present biodiversity are only rarely confidently established beyond site-specific scales. This will require greater

interdisciplinary research which combines archaeological and historical evidence with modern ecological evidence.

Our analysis also highlights the historic and contemporary influence of large landowners in the ownership and management of PAs in England. While large-scale ownership may provide advantages in the ability to implement management at scale, our analysis shows it may also reduce the heterogeneity of the landscapes and types of management across PAs. This may also be further constrained or compromised by compatibility with financial costs and commercial interests. Great influence by few individuals over the management of PAs may also mean that a smaller variety of views are represented when considering the future of biodiversity in these landscapes, for example attitudes to rewilding or towards novel species communities formed as species disperse in response to climatic and other large-scale drivers. Recent research identifies greater diversity of participation in PAs management and governance as not only desirable from a social and economic perspective, but also results in better biological outcomes, while highlighting the tension in implementing landscape change on a large scale (e.g. Oldekop et al., 2015; Pieraccini, 2015; Ward, Holmes, et al., 2018; Ward, Stringer, et al., 2018; Palfrey et al., 2021: 11). We conclude from our analysis of the historic landscape character of the Study Region that expansion of the Study Region's and England's PAs without acknowledging and addressing the outsized influence of large landowners may exacerbate some inequalities in the ownership and access to biodiversity and green space more generally in the future as we move towards the protection of 30% of Britain by 2030.

AUTHOR CONTRIBUTIONS

Michael J Stratigos: Conceptualisation, Data Curation, Formal Analysis, Methodology, Visualisation, Writing—Original Draft Preparation, Writing—Review & Editing. Caroline Ward: Writing—Original Draft Preparation, Writing—Review & Editing. Jack Hatfield: Data Curation, Visualisation, Writing—Original Draft Preparation, Writing—Review & Editing. Jonathan Finch: Conceptualisation, Writing—Original Draft Preparation, Writing—Review and Editing.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

In addition to being available as a supplementary file, S1, it has been deposited in the University of York's research data repository *Research Data York*. This has been given a DOI of https://doi-org/10.15124/e1352043-d9ef-4bc0-95e1-f05262302233 and adheres to FAIR data principles.

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ENDNOTES

[1] This legislation has been substantially updated by the Wildlife and Countryside Act (1981), the Countryside and Rights of Way Act (2000) and the Natural Environment and Rural Communities Act (2006). Other types of PA designation were also subsequently set up by various UK and EU laws. These extended PA designations to marine areas, as well as the introduction of European designations from 1973 onwards, in particular Natura 2000, and by international treaty such as the Ramsar Convention. These different designations could be similarly interrogated, although this falls outside the scope of this article. And again, these PAs frequently designate the same localities and are not mutually exclusive with NPs, AONBs, NNRs and SSSIs.

[2] Hereafter, the area captured by North Yorkshire, York and Lower Tees Valley HLC will be referred to as the Study Region.

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SUPPORTING INFORMATION

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

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