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Summary

This report has been commissioned by Bassetlaw District Council (DC) to inform the production of their Draft Local Plan and associated Habitats Regulations Assessment. It comprises the first of a series of reports which will be informed by a range of organisations, including Natural England, the National Trust, the RSPB, and seven Local Authorities. The latter comprise: Bassetlaw DC, Newark & Sherwood DC, Bolsover DC, Mansfield DC, Rotherham Metropolitan Borough Council, Ashfield DC, Gedling Borough Council, and Nottinghamshire County Council.

The report summarises the qualifying features of a range of internationally and nationally important sites for nature conservation located within the confines of the Clumber Park and Sherwood Forest region of Nottinghamshire. This includes Birklands & Bilhaugh Special Area of Conservation (SAC), Sherwood Forest National Nature Reserve (NNR), Budby South Forest RSPB Reserve, and Clumber Park Site of Special Scientific Interest (SSSI).

The report draws on available ecological data from a range of sources to inform our understanding of the status of key habitats and species groups within these sites. Furthermore, it contextualises historic visitor information and existing access infrastructure within these sites and considers the potential impacts of recreation on their qualifying features.

The report also provides information on potential recreational impact pathways within the relevant sites under the following broad headings:

- **Disturbance** (avoidance of breeding habitat, physiological impacts, reduced breeding success);
- **Fire** (resulting in direct mortality, removal of breeding habitat, long term changes to vegetation structure);
- **Contamination** (including litter; nutrient enrichment through dog fouling; pollution from dogs entering water courses; spread of alien species and pathogens, etc);
- **Trampling/wear** (soil compaction, erosion, expansion of path networks);
- **Physical damage** (e.g. breakage or removal of tree limbs following climbing);
- **Harvesting** (e.g. collection of wood, fungi);
- **Grazing issues** (impacts on grazing animals, e.g. worrying by dogs), and;
- **Visitor expectation** (including pressure for facilities and public perceptions of management resulting in difficulties achieving necessary habitat management).

The report forms the initial stage of investigations into the current effects of recreational activity upon the designated sites located within the study area, which will be further informed by two subsequent Recreation Impact Assessments carried out separately for Clumber Park SSSI and Birklands & Bilhaugh SAC later in 2021.

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Cover photograph: Cycle track in Clumber Park - © Graham Hogg (cc-by-sa/2.0)

1. Introduction

Overview

- 1.1 This report was commissioned by Bassetlaw District Council (DC) and is part of a series that relates to understanding the impacts of recreation (arising from new housing development) upon:
 - Clumber Park Site of Special Scientific Interest, and;
 - Birklands & Bilhaugh Special Area of Conservation/Sherwood Forest National Nature Reserve.
- 1.2 The series of reports produced, including subsequent Recreation Impact Assessments (RIAs) for each of the two sites, and associated survey work will be informed by a range of organisations, including Natural England, the National Trust, the RSPB, and seven Local Authorities. The latter comprise: Bassetlaw DC, Newark & Sherwood DC, Bolsover DC, Mansfield DC, Rotherham Metropolitan Borough Council, Ashfield DC, Gedling Borough Council, and Nottinghamshire County Council.
- 1.3 The findings of the RIAs will inform the preparation and implementation of the Bassetlaw DC Draft Local Plan, including proposals for a new Garden Village in proximity to Clumber Park and employment allocations at nearby Apleyhead. They will also inform the Habitats Regulations Assessment of the Local Plan, as well as helping inform other relevant Local Plans, the preparation of masterplan frameworks for housing allocations, and supplementary planning documents (such as the Worksop Central Development Plan Document).

Housing growth and recreation impacts

- 1.4 A challenging issue for UK nature conservation is how to respond to increasing demand for access without compromising the integrity of protected wildlife sites. Areas that are important for nature conservation are often important for a range of other services, including the provision of space for recreation for an increasing population. Such recreation space can be used for a wide variety of activities, ranging from the daily dog walks to competitive adventure and endurance sports.
- 1.5 There is now a strong body of evidence showing how increasing levels of access can have negative impacts on wildlife. Visits to the natural environment have shown a significant increase in England as a result of the increase in population and a trend to visit more (O'Neill, 2019). Issues are varied and include disturbance,

increased fire risk, contamination and damage (for general reviews see: Liley et al., 2010a; Lowen et al., 2008; Ross et al., 2014; Underhill-Day, 2005).

- 1.6 The issues are not however straightforward. It is now increasingly recognised that access to the countryside is crucial to the long-term success of nature conservation projects, for example through enforcing pro-environmental behaviours and a greater respect for the world around us (Richardson et al., 2016). Access also brings wider benefits to society that include benefits to mental/physical health (Keniger et al., 2013; Lee & Maheswaran, 2011; Pretty et al., 2005) and economic benefits (ICF GHK, 2013; ICRT, 2011; Keniger et al., 2013; The Land Trust, 2018). Nature conservation bodies are trying to encourage people to spend more time outside and government policy is also promoting countryside access in general (e.g. through enhancing coastal access).
- 1.7 Therefore, a difficult balancing act is required to resolve impacts associated with recreation, complying with legislation without compromising the ability of people to be outside enjoying sites for recreation.

Aims of this work

1.8 This report has been commissioned to provide a review of available historical data on the important ecological features within each of the relevant designated sites, with particular focus upon the national and internationally important sites. It also includes a review of the available historic data on current visitor numbers, pressures, and mitigation enacted at each, and reviews the various pathways and mechanisms by which recreation may impact them.

Other reports

1.9 The work forms part of a series of reports that relate to understanding the impacts of new development upon Clumber Park Site of Special Scientific Interest and Birklands & Bilhaugh Special Area of Conservation/Sherwood Forest National Nature Reserve. The project as a whole will include visitor surveys, combined with work to understand the impacts of recreation and relevant mitigation approaches. Subsequent Recreation Impact Assessment reports, produced separately for the two focal sites, will detail the results of ecological and visitor survey work carried out in 2021, and provide site-specific information on the current impacts of recreation.

2. Methodology

- 2.1 This report comprises a synthesis of available ecological information (particularly with respect to avian features), historic visitor numbers, and previously identified recreation impacts and mitigation, within National Trust Clumber Park (incorporating Clumber Park Site of Special Scientific Interest) and Budby South Forest RSPB Reserve/Sherwood Forest National Nature Reserve/Birklands & Bilhaugh Special Area of Conservation.
- 2.2 It is important to note that a report of this nature would usually be complemented by a site visit to further inform our understanding of the baseline condition of the study area and local geography. Unfortunately, due to the health and safety considerations/travel restrictions posed by the Coronavirus pandemic, this was not initially possible. The authors have however greatly benefited from conversations with key stakeholders, including the National Trust and RSPB, and several site visits made subsequent to the drafting of the initial report document have helped inform the contents of this finalised report.

Study area

2.3 The study area is located within west central Nottinghamshire, to the south-east of Worksop, and straddles the districts of Bassetlaw and Newark and Sherwood. It incorporates the entirety of the National Trust's Clumber Park site (including Clumber Park Site of Special Scientific Interest), Budby South Forest RSPB Reserve/Sherwood Forest National Nature Reserve (to the south), and the smaller (isolated) Thoresby Estate component of the Birklands & Bilhaugh Special Area of Conservation (see Map 1). Clumber Park falls within the Bassetlaw District Administrative area whereas the other sites identified above lie within the Newark and Sherwood District Council boundary.

Data sources

- 2.4 The report draws on various data sources, including information on designated sites available on the <u>Natural England website</u>. The review of available historic ecological and recreation data has however also been greatly informed by information included in the following documents provided by the National Trust:
 - Nature Conservation Evaluation Clumber Park, Nottinghamshire 2012 Survey (incorporating 1984/2004 surveys) – National Trust;
 - Clumber Park Parkland Conservation Plan (January 2014) National Trust, and;

- Clumber Park, Nottinghamshire Breeding Bird Survey 2012 Tyler Grange (forming an appendix to the previous document).
- 2.5 And by the following reports/publications provided by the RSPB:
 - Sherwood Forest Nightjar Survey 2016 a report by RSPB for the Sherwood Habitats Strategy Group;
 - Managing the Sherwood Resource: planning for the future presentation by Carl Cornish (RSPB), and;
 - Recreational disturbance and Birds of Conservation Concern in Sherwood NCA A report for the Sherwood Habitats Strategy Group.
- 2.6 Additional historic information on key bird species within the study area has also been informed by the results of the most recent national surveys carried out for Woodlark *Lullula arborea* and Nightjar *Caprimulgus europaeus*, in 2006 (Conway et al., 2009) and 2004 (Conway et al., 2007) respectively.
- 2.7 The report also incorporates historic visitor data provided by the RSPB and the National Trust. These data comprise monthly visitor numbers at Clumber Park for the period March 2017 to February 2021, and (partial) weekly visitor numbers at Budby South Forest RSPB Reserve/Sherwood Forest National Nature Reserve for the period August 2018 to August 2020. The results of visitor questionnaire surveys carried out by the RSPB at the latter site in 2017/18 and 2018/19 were also used to inform the review, in addition to a <u>visitor survey carried out within</u> <u>Sherwood Forest Country Park</u> by Nottinghamshire County Council in August 2015.
- 2.8 Finally, a range of other online sources were consulted to provide additional information on visitor infrastructure, numbers, and site use, including the <u>Sherwood Forest Destination Management Plan</u> (2019), OpenStreetmap data, the University of Exeter <u>Outdoor Recreation Tool</u> (ORVal), and the <u>Strava</u> website. The figures provided by ORVal comprise modelling data representative of locations sharing similar features to the site and the local populace in question, rather than count data from specific localities, and should therefore be interpreted accordingly. Strava provides information on the location and intensity of use of routes by self-reporting recreational runners and cyclists.

Analyses

2.9 The information provided in the sources identified above has been synthesised to understand the state of key biodiversity features within the study area, where possible, alongside historic visitor numbers and behaviour. The potential impact pathways of recreation which may be relevant to the study area's ecological

receptors have then been identified, any mitigation already being carried out discussed, and recommendations made for future survey work.

Limitations

2.10 A key limitation throughout has been the apparent unavailability of recent ornithological and visitor date. This absence will be corrected however during works carried out to inform the two subsequent Recreation Impact Assessments.

Map 1: Study area (inset provides wider geographic context)



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3. Designated site information

3.1 The study area incorporates a range of internationally and nationally important designated sites, alongside a number of other conservation/land management-related designations (see Map 2). The following section briefly describes their extents and outlines their qualifying features. Their full citations, and supporting information, are available on the Natural England website¹.

European sites

Birklands & Bilhaugh Special Area of Conservation (SAC)

- 3.2 Birklands and Bilhaugh SAC covers an approximate area of 271.8 ha and comprises a landscape remnant of the historic Sherwood Forest. It is formed from two discrete blocks of woodland habitat; one larger block comprising the southern half of Sherwood Forest National Nature Reserve and another, smaller, block situated to the east and forming part of the Thoresby Estate.
- 3.3 The site is characterised by stands of ancient oak woodland set within wood pasture. It comprises the most northerly site in the UK designated for dry oak woodland habitat (the Annex I habitat is '*Old acidophilous oak woods with Quercus robur on sandy plains'*) and is one of only 4 SAC sites in England that primarily qualify for selection due to the presence of this habitat type. The other sites include Windsor Great Park and the New Forest.
- 3.4 Birklands and Bilhaugh SAC supports one of the largest concentrations of ancient trees (over 500 years of age) in the country. Woodland stands are interspersed with open glades of acid grassland and heathland, which in turn support a characteristic herb layer. The SAC incorporates a continuity of woodland and decaying/dead-wood habitats, which support a notable invertebrate assemblage (particularly of beetles, spiders and flies). The diversity and number of associated woodland fungi present at Birklands and Bilhaugh SAC is also particularly large, and the site also hosts a notable lichen community.

Potential future designations

3.5 The future classification of the wider Sherwood Forest area (including Sherwood Forest NNR and Clumber Park) as a Special Protection Area (SPA), due to its

¹ Natural England - <u>European Site Conservation Objectives for Birklands and Bilhaugh SAC (UK0012740)</u>, <u>Birklands and Bilhaugh SSSI citation</u>, and <u>Clumber Park SSSI citation</u>

breeding Woodlark and Nightjar population, is considered possible by Natural England. It is therefore currently designated as a possible potential Special Protection Area (ppSPA – not shown on Map 2). The ppSPA is not currently subject to the legal protection afforded an SPA, but Natural England nevertheless recommends that a 'risk-based' approach is applied to any plans or proposals which may impact Sherwood Forest's Nightjars and Woodlarks² in light of its potential future status.

National sites

Sites of Special Scientific Interest (SSSI)

Birklands & Bilhaugh SSSI

3.6 Birklands & Bilhaugh SSSI is largely contiguous with Sherwood Forest National Nature Reserve, in addition to incorporating all of Birklands & Bilhaugh SAC. It shares the majority of features with the latter site, comprising a remnant of the historic Sherwood Forest and representing one of the best remaining examples of oak-birch woodland in Nottinghamshire (incorporating an exceptional population of ancient standing oaks). The open woodland also supports areas of acid grassland, as well as a diverse fungal community and important invertebrate assemblage.

Clumber Park SSSI

- 3.7 Clumber Park SSSI comprises one of the largest areas of mixed habitat in Nottinghamshire and consists of discontinuous blocks of habitat completely incorporated within the larger National Trust Clumber Park site. It supports extensive areas of lowland (floristically rich) acid grassland, heath, and mature deciduous woodland characteristic of the English North Midlands, as well as areas of scrub, marsh, streamside vegetation, and lake. The site incorporates areas of oak-dominated deciduous woodland, alongside areas of mixed woodland, which support an exceptionally rich saproxylic beetle fauna. The latter assemblage includes an impressive array of nationally rare and scarce species, and the site is also important for a range of other invertebrate taxa (particularly spiders and moths).
- 3.8 The SSSI also supports a notable and diverse breeding bird community, including Nightjar, Woodlark, Hawfinch *Cocothraustes cocothraustes*, and Gadwall *Mareca*

² Advice Note to Local Planning Authorities regarding the consideration of likely effects on the breeding population of nightjar and woodlark in the Sherwood Forest region

strepera alongside an array of common woodland, heath, and marsh breeding species. The wetland areas on site also host good numbers of wintering wildfowl. The woodland and wetland habitats on site are also particularly important for bats, with the SSSI supporting a number of species with restricted ranges within Nottinghamshire.

Other nearby SSSIs

3.9 Birklands West and Ollerton Corner SSSI is located directly adjacent to Birklands & Bilhaugh SAC and Birklands and Bilhaugh SSSI, forming a contiguous block of designated land. The SSSI is designated for similar reasons, supporting nationally important ancient oak woodland and a diverse invertebrate assemblage. Several other non-contiguous SSSI's are located within proximity to the designated sites within the study area (see Map 2) but are not considered within the scope of this report.

Sherwood Forest National Nature Reserve (NNR)

3.10 Sherwood Forest NNR was designated in 2002 and incorporates the larger, western, component of Birklands & Bilhaugh SAC, as well as the majority of Birklands and Bilhaugh SSSI and Budby South Forest RSPB Reserve. The NNR is jointly managed by Forestry England and the RSPB, in partnership with Nottinghamshire County Council and the Thoresby Estate.

Other designations

National Trust Clumber Park

- 3.11 Clumber Park is a former ducal estate which was once part of Sherwood Forest. It comprises c.1,600ha of parkland and woodland, located either side of Clumber Lake and the River Poulter, and has been owned by the National Trust since 1946. It supports a range of habitats, including mature, semi-natural, woodland, conifer plantations, and heathland, and completely incorporates the smaller Clumber Park SSSI.
- 3.12 Management carried out by the National Trust includes the use of free-ranging livestock to graze areas of wood pasture, and the recent, ongoing, reversion of previously arable areas in the east of the site to semi-natural wood pasture habitat.

Budby South Forest RSPB Reserve

3.13 Budby South Forest RSPB Reserve is largely contiguous with Sherwood Forest NNR and has been fully managed by the RSPB since 2016. It supports all of the important ecological features previously identified for Birklands and Bilhaugh SSSI and Birklands & Bilhaugh SAC.



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4. Review of available ecological data

4.1 The following section outlines the status of the qualifying features of the nationally designated sites located within the study area, and identifies any concerns surrounding recreational impacts upon them, as well as any enacted mitigation, where relevant. Additional information is provided for key associated species groups where available.

Habitats

Birklands & Bilhaugh SAC

- 4.2 Until recently, the historic wood pasture system within the old acidophilous oak woodlands of Birklands & Bilhaugh SAC was slowly reverting to high forest and heathland in the absence of grazing. The institution of sympathetic management and the enactment of recreation mitigation activities (see below) have nevertheless started to reverse this process.
- 4.3 The conservation objectives³ for the SAC are to "ensure that the integrity of the site is maintained or restored as appropriate and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features". This includes maintenance of the extent and quality of the qualifying old oak woodland, as well as the structure and function of its associated communities and supporting processes. Supplementary advice from Natural England⁴ provides further details and targets that specify how the integrity of the site should be maintained. This includes continued functional connectivity with the adjacent Birklands West and Ollerton Corner SSSI, the maintenance of grazing at suitable levels, and the continued protection of the SAC's important ground flora and associated saproxylic invertebrate, fungi, and lichen communities.
- 4.4 Impacts arising from public access and disturbance are identified as the highest priority issue currently impacting the SAC in the Site Improvement Plan⁵, followed by changes in land management, physical modification, air pollution, disease, and invasive species. The previously acute issue posed by the acquisition of Planning Permission for the relocation of the visitor centre has been solved in the time since

³ <u>Natural England - European Site Conservation Objectives for Birklands and Bilhaugh Special Area of</u> <u>Conservation Site Code: UK0012740</u>

⁴ <u>Natural England - European Site Conservation Objectives for Birklands and Bilhaugh SAC (UK0012740)</u> <u>- supplementary advice</u>

⁵ Natural England - Site Improvement Plan: Birklands & Bilhaugh (SIP016)

the document's publication. The recruitment of new veteran trees through appropriate forestry management and protection, alongside the maintenance of soil structure and pH are also identified as essential. Public access/disturbance, changes in land management, air pollution, and invasive species are classified as current pressures already acting upon the SAC. Future threat is posed by physical modification and disease, alongside some additional aspects of land management change and invasive species.

- 4.5 The Site Improvement Plan identifies recreational activity within the SAC as having potential to lead to localised soil compaction, nutrient enrichment, and the direct loss of trees (through both vandalism and due to health and safety concerns). The impacts of these activities upon tree roots and the surrounding soil matrix are of particular concern, as they can cause both physical damage and affect associated mycorrhizal communities. Recruitment within the veteran tree population has also been identified as being of concern, and any negative impact upon tree roots and soil can have important ramifications for this process.
- 4.6 Deep seam coal extraction has recently taken place immediately beneath the SAC, leading to surface fissuring, although the long-term impacts of these events are currently unknown. The spread of invasive species within the SAC is also of concern, with Himalayan Balsam *Impatiens glandulifera* continuing to spread despite intervention, and the management of Rhododendron *Rhododendron sp*. is likely to comprise an ongoing process.
- 4.7 The SAC Site Improvement Plan identified the movement of the then existing visitor centre outside of the SAC boundary, and the mapping of all existing cohorts of native trees as a priority (alongside the protection of recruiting younger trees). This has subsequently been undertaken, with the visitor centre (and associated parking) relocated to the south-eastern boundary of the SAC in 2018. Furthermore, the RSPB have mapped all veteran trees within the NNR and identified the extent of their subterranean root network. Root Protection Areas (RPAs) for the Sherwood Forest NNR, based upon the diameter of trees at breast height, have been produced by the RSPB, and zonation, signage, and path diversions used to mitigate the effects of trampling and soil compaction around veteran trees.

Clumber Park SSSI

4.8 Recent condition assessments by Natural England of the units making up Clumber Park SSSI identified 24.7% of the site as being in "favourable" condition, with the

remaining 75.3% identified as "unfavourable - recovering"⁶. The status of the woodland habitats within the site varies between SSSI units, although the majority are identified as requiring some form of active management. The absence of a sufficient number and diversity of different age classes amongst the woodland's trees is identified as an issue affecting veteran tree recruitment. An insufficient volume of standing and fallen deadwood within areas of woodland is also identified as problematic, although the assessment also states that the associated invertebrate communities are not suffering as a result.

- 4.9 Areas of heathland on site are generally improving thanks to active management, although nitrogen deposition and bracken encroachment remain a problem in certain SSSI units. There is also a higher cover of non-native trees and shrubs in some areas, and prominence of some unfavourable indicator species. The condition of the acid grassland areas on site varies, with some considered to be in favourable condition whilst others are failing. Grazing is nevertheless proving an effective management tool in these areas, although there are still examples of Bramble encroachment in some areas, and there is a larger than ideal proportion of coarse grasses in others as a result of leaf fall from surrounding woodland. Wetland habitats within the SSSI are generally in a favourable condition, although the area of reed swamp surrounding the lake should ideally be increased.
- 4.10 The National Trust have identified a range of issues as proving problematic within the larger encompassing National Trust Clumber Park site, including informal car parking along access roads, damage caused to roots and trees through recreational activity, and the spread of invasive shrub species within the woodland understorey.

Species groups

Saproxlic beetles

- 4.11 Survey and analyses carried out by Natural England (Alexander, K.N.A. 2011) indicated that the important saproxylic beetle assemblage found within Birklands & Bilhaugh SAC/SSSI is still of international significance. However, the study also found that the number of species recorded from the site within the last 50 years is much lower than that from the Victorian era.
- 4.12 It is unclear, however, whether this relates to a real decrease in species richness, as many of the 'missing' species are hard to find even when present and are

⁶ Natural England - Condition of SSSI Units for Site Clumber Park SSSI

associated with decaying heartwood within veteran trees (a habitat type still prevalent on site). Nevertheless, the study also indicated that the loss of some species richness could potentially also be due to increases in the shading of tree trunks and the loss of dead wood in the forest canopy.

Breeding bird assemblage

4.13 Breeding bird surveys carried out across the National Trust Clumber Park site in 2013 confirmed breeding by 60 species, including 9 Red-listed Birds of Conservation Concern⁷ (BoCC) and 10 Amber-listed species. All BoCC species recorded, and the number of pairs of each, are provided in Table 1. They comprise a mix of species associated with clearfell, young plantation woodland, and heath (e.g. Nightjar and Woodlark); mature woodland and scrub (e.g. Hawfinch and Marsh Tit); arable areas (e.g. Yellowhammer and Skylark), and; wetlands and riparian habitat (e.g. Reed Bunting and Gadwall).

Species	Scientific name	Birds of Conservation Concern status	Number of pairs
Bullfinch	Pyrrhula pyrrhula	Amber	1
Cuckoo	Cuculus canorus	Red	4
Dunnock	Prunella modularis	Amber	4
Gadwall	Mareca strepera	Amber	5
Hawfinch	Coccothraustes coccothraustes	Red	1
Kestrel	Falco tinnunculus	Amber	1
Linnet	Carduelis cannabina	Red	1
Marsh Tit	Poecile palustris	Red	3
Nightjar	Caprimulgus europaeus	Red	10
Pochard	Aythya ferina	Red	1
Reed Bunting	Emberiza schoeniclus	Amber	4
Skylark	Alauda arvensis	Red	6
Song Thrush	Turdus philomelos	Red	19
Tree Pipit	Anthus trivialis	Red	6
Tufted Duck	Aythya fuligula	Amber	11
Whitethroat	Sylvia communis	Amber	2
Woodcock	Scolopax rusticola	Amber	10
Woodlark	Lullula arborea	Amber	5

Table 1: Red and Amber-listed Birds of Conservation Concern confirmed as breeding species duringBreeding Bird Surveys carried out across National Trust Clumber Park in 2013

⁷ Birds of Conservation Concern 4: the Red List for Birds

Yellowhammer *Emberhiza citrinella* Red 5

Nightjar and Woodlark

- 4.14 Nightjar and Woodlark comprise part of the breeding bird assemblage for which Clumber Park SSSI is designated. Nevertheless, their probable inclusion as qualifying features within any future citation of the Sherwood Forest ppSPA means that they have been considered in more detail below.
- 4.15 Nightjars are a migratory species which return to the UK in mid to late May. The species nests on the ground, and mainly breeds within areas of heathland, clearfell, and young conifer plantations within the Sherwood Forest area. The most recent targeted surveys, carried out by the RSPB in 2016, estimated that there were 66 Nightjar territories within the Sherwood National Character Area (Cornish et al. 2019). The Dukeries (incorporating Clumber Park) and Sherwood Forest accounted for >60% of the territories located. Additional historic information on Nightjar distribution comprises records from the 2013 Tyler Grange surveys within National Trust Clumber Park (summarised in the previous section), and the results of the last national survey for the species (carried out in 2004). All of these data are presented in Map 3.
- 4.16 In terms of the species' area of occupancy; Nightjars were found in 9 x 1km squares which intersected with the National Trust Clumber Park site, and 6 x 1km squares that intersected with Sherwood Forest NNR during the most recent surveys (see Map 3). The localities in Clumber Park largely incorporate the locations of the 10 occupied territories identified in the Tyler Grange 2013 surveys there, although no birds were recorded from the extreme south-east of the site during the 2016 surveys. Historic records also exist for the extreme south-western corner of Clumber Park. A similar number of territories overall were identified in the 2016 surveys as during the 2004 national survey, although these were spread across a larger number of 1km squares (i.e. suggesting the species has become less densely distributed within the landscape).
- 4.17 Map 3 indicates that Nightjars within Clumber Park are largely associated with non-priority habitat types, which are likely to comprise areas of plantation forestry and clearfell. The species is more closely associated with areas of heathland in Sherwood Forest NNR, although plantation forestry is largely absent from the site. The long-term distribution of the species, in Clumber Park at least, will likely mirror ongoing aging and management within plantation forest stands.

- 4.18 Previous studies carried out within Sherwood Forest have indicated that Nightjar populations and densities were lower in more disturbed areas of the site (Lowe et al. 2014), indicating that disturbance can have negative impacts upon territory establishment, leading to the avoidance of otherwise suitable areas of habitat. Lowe et al however found that disturbance had no obvious impact upon breeding success, i.e. while disturbed areas were avoided, within the areas birds did choose to nest there was no evidence that disturbance had an effect on breeding success.
- 4.19 Although outside the scope of recreation. it is also important to consider that Nightjars breeding within the study area may still forage within areas of habitat located outside of its boundary. The impacts of novel housing (including habitat loss/degradation, cat predation, etc) removed from the immediate study area may therefore nevertheless still be felt by the Nightjar population breeding within it.
- 4.20 Woodlark is also a ground-nesting species and requires areas of open and bare ground with a short grassy sward within which to forage. The species is largely associated with areas of heathland, forestry clearfell and young plantations, and former industrial sites within the Sherwood Forest area. Information on the species distribution within Clumber Park and Sherwood Forest NNR/Birklands & Bilhaugh SAC is relatively scant, with the last national survey (carried out in 2006) and the 2013 Tyler Grange surveys within Clumber Park the only datasets available at the time of writing (see Map 3). Update surveys were carried out across the Sherwood Forest area by the RSPB in 2018, but the results have yet to be published (C. Cornish, pers. comm.).
- 4.21 Nevertheless, it is apparent that the species is scarcer than Nightjar within Clumber Park, with 5 pairs of Woodlark identified there during the 2013 surveys. This is comparable with the 4 territories identified within Clumber Park during the last national survey. The species is largely associated with areas of deciduous woodland and heathland within Clumber Park but is much more strongly associated with heathland in Sherwood Forest NNR (although admittedly based on much older data). It is not currently possible to comment on local population trends in the absence of recent census data.

Map 3: Distribution of Nightjar and Woodlark records from recent historical surveys



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5. Review of existing access infrastructure and historic visitor information

5.1 The following section provides information on the location and extent of existing access infrastructure present within the study area, which has been gleaned from remote datasets, previously published reports, and conversations with relevant site managers and staff. Information on visitor numbers and origins is also provided, although this has again been synthesised from disparate data sources (with caveats provided where necessary).

Access infrastructure

Car parks

- 5.2 The National Trust confirm that 2 formal parking locations are situated within their Clumber Park site, with an additional 8 formal locations around the site's perimeter identified in the OpenStreetmap dataset (see Map 4). Of the 2 parking locations identified within NT Clumber Park, 1 comprises the main car park and the other an overflow location within the Event Fields. Additional parking is associated with the recently opened (2019) Clumber Park Lodges holiday park, located within the Clumber Park study area boundary, adjacent to Clumber Park SSSI.
- 5.3 The National Trust have previously identified (often high levels of) informal parking as a major issue along many of the main access routes within Clumber Park. This has been identified as a major issue along several stretches of Lime Tree Avenue in particular. Appraisal of aerial imagery, and conversations with National Trust staff, also indicate that informal parking within laybys and pull-ins on the site's periphery is commonplace. The National Trust recognise that parking impacts are an important issue in areas supporting sensitive habitats and have therefore made efforts to control parking and minimise impacts in key areas. This has been further acknowledged in a recent Master Planning exercise, which identifies an aspiration to move the main visitor car park to an open area in the middle of the site in the future (currently paused due to financial constraints).
- 5.4 5 formal parking locations are identified in the OpenStreetmap dataset on/in proximity to the south-eastern perimeter of Sherwood Forest NNR, whilst none are found in close proximity to the Thoresby estate component of Birklands & Bilhaugh SAC. Furthermore, the previously centrally located main Sherwood Forest NNR/Budby South Forest RSPB Reserve car park and visitor centre were recently relocated to the south-eastern border of the NNR, to reduce any negative impacts associated with their presence in the centre of the site.

5.5 The size/capacity of both the formal and informal parking locations, and their locations relative to one another, will have implications for the level of recreational pressure exerted within their vicinities. So too will opening hours and the locations of pay versus free parking, or variations in parking costs at the same locality (e.g. free parking for members only within the National Trust Clumber Park formal car parks).

Access routes

5.6 A large number of access routes, located across all three component parcels of the study area, are identified in the OpenStreetmap dataset (see Map 4), although relatively few of these comprise Public Rights of Way (PRoW). Nevertheless, both Clumber Park and Sherwood Forest NNR are bisected by a number of footpaths and bridleways, whereas the eastern Thoresby Estate component of Birklands & Bilhaugh SAC doesn't incorporate any PRoWs. Access routes on the northern perimeter of Clumber Park link directly with nearby Worksop, whilst much of the access infrastructure on the southern periphery of Sherwood Forest NNR is located in close proximity to the adjacent town of Edwinstowe.

Map 4: Access and formal parking infrastructure



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Visitor numbers

Total visitor numbers

- 5.7 Estimates of the total number of annual visitors at each of the three study area component sites/parcels were produced using a range of data sources (see Table 2). These included modelling data provided by ORVal (see Section 2.8), as well as absolute counts of visitors from National Trust and RSPB parking locations, paywall localities, and visitor centres. The estimates for Clumber Park, in particular, varied considerably, with the ORVal estimate being >3 times larger than that calculated using National Trust visitor data. This discrepancy is probably due to the non-site-specific attributes of the modelling approach used but may also potentially be attributable to some underestimation of the scale of informal parking and access within the National Trust site.
- 5.8 The number of estimated annual visitors to Sherwood Forest NNR/Budby South Forest RSPB Reserve were similar for both the ORVal and RSPB visitor data, suggesting something in the region of 200,000 visitors a year (excluding ambiguous data from the Sherwood Forest Destination Management Plan). This suggests that the site has a much lower draw to visitors when compared with Clumber Park to the north.
- 5.9 Information on annual visitor numbers to the smaller, eastern, Birklands & Bilhaugh SAC component within the Thoresby Estate was generally lacking, with the ORVal figure provided for a single access point on the site's northern periphery potentially comprising an underestimate for the entire site.

Annual variation

- 5.10 The National Trust data for Clumber Park were provided as monthly totals for the period March 2017 to February 2021, whereas the RSPB data comprised weekly counts for the period August 2018 to August 2020. Visitor numbers at Sherwood Forest NNR/Budby South Forest RSPB Reserve showed relatively little inter-annual variation, with a decrease in visitors during 2020 the only real deviation noted in the National Trust Clumber Park dataset (see Table 3).
- 5.11 The 2020 visitor data from both sites spanned the start of the ongoing Coronavirus pandemic and included the period of the first national lockdown in spring 2020 (during which no visitors were officially logged). The mean number of weekly/monthly visitors, and the upscaled number of daily visitors per year, for 2020 have therefore been calculated excluding those spring lockdown

weeks/months in order to make the mean values comparable with the previous 2 years of data.

5.12 The data indicates that Clumber Park is visited by at least 3 times the number of people that visit Budby South Forest RSPB Reserve/Sherwood Forest NNR over the course of a typical year

Table 2: Total annual visitor numbers at each of the three survey area component sites provided in differing data sources

Study area component	ORVal data	Sherwood Forest Destination Management Plan (2019)	National Trust visitor data (3 year mean: Mar 2017 – Feb 20208)	RSPB visitor data (extrapolated 3 year mean: 2018 – 2020)
NT Clumber Park	2,143,967	-	661,187	-
Sherwood Forest NNR/Budby South Forest RSPB Reserve	158,641	400,000 ⁹	-	204,035
Birklands & Bilhaugh SAC (Thoresby Estate eastern component only)	245	-	-	-

⁸ Visitors are tracked from March through to February of the following year as one year's data by the National Trust.

⁹ Note that it is not completely clear whether this also includes other areas within the wider Sherwood Forest area.

Table 3: Visitor numbers at National Trust Clumber Park and Budby South Forest RSPB Reserve/Sherwood Forest NNR for the period 2017 to 2020. Note that the National Trust data has been split into its respective calendar years.

Year	Natio	onal Trust Clum	ıber Park	Budby South Forest RSPB Reserve / Sherwood Forest NNR								
	Period data available (monthly breakdown)	Total visitors	Mean no. monthly visitors/year	Period data available (week commencing)	No. weeks	Total visitors in relevant period	Mean no. weekly visitors in relevant period	Upscaled mean no. daily visitors/year				
2017	March to December	569,135	56,914	-	-	-	-	-				
2018	Entire year	658,443	54,870	13/08/18 to 24/12/18	20	84,216.7	4,210.8	601.6				
2019	Entire year	664,107	55,342	31/12/18 to 23/12/19	52	202,351.0	3,891.4	554.4				
2020	Entire year	346,225 ¹⁰	38,469 ¹¹	30/1219 to 31/08/20	36	102,112.4	3,646.9 ¹²	521.0				

¹⁰Includes zero figure monthly counts during spring lockdown (March to May inclusive). National Trust indicates that counts for 2020/21 are potentially unreliable.

¹¹Calculated after exclusion of spring lockdown closure period (March to May inclusive) during which no visitors were logged.

¹²Calculated after exclusion of spring lockdown period (23rd March to 17th May) during which no visitors were logged.

Variation across the year

- 5.13 Fine scale (weekly) visitor numbers were provided by the RSPB for Budby South Forest RSPB Reserve/Sherwood Forest NNR, with monthly visitor numbers provided for Clumber Park by the National Trust. These data are presented separately for each year of the respective datasets in Figure 1 and Figure 2.
- 5.14 Despite the availability of only a single full year of data from Budby South Forest RSPB Reserve/Sherwood Forest NNR (2019), several distinct peaks in weekly visitor numbers can still be identified on an annual basis. Small peaks in weekly visitor numbers can be seen over the festive period, and again during February half term, during the Easter holidays, and over the week incorporating the late May spring Bank Holiday weekend.
- 5.15 The extremely large peaks seen in the data for Budby South Forest RSPB Reserve/Sherwood Forest NNR in late August 2018 and early August 2019, comprising 2.5 to 3 times the typical weekly number of visitors, corresponds with the annual, week-long, Robin Hood Festival held within the NNR. This event clearly attracts a much larger number of visitors to the site during this period.
- 5.16 The data for 2020 exhibits some obvious differences to that provided for the other 2 years. Most obvious is the complete absence of weekly visitor records between the end of March and mid-May, and the absence of the extreme late summer peak in visitor numbers seen in other years. The latter was due to ongoing Coronavirus concerns and the related cancellation of the Robin Hood Festival 2020, whilst the absence of spring data was related to the closure of the visitor centre during the spring lockdown period.
- 5.17 Nevertheless, it is important to note that a smaller peak in weekly visitor numbers was still apparent in August 2020, coinciding with the summer holidays. Furthermore, the absence of visitor records for spring 2020 does not mean that no one visited the site during the lockdown period, as it is highly likely that the site was frequently used for recreation during this period by local people living in the surrounding area at least.
- 5.18 The monthly data from Clumber Park shows similar variation across the year, with peaks over the Easter/early spring and July/August holiday periods in each year for which data was available. Smaller upticks are also noticeable over the festive season. Importantly, the figure also highlights the much larger number of visitors recorded at Clumber Park in comparison to Budby South Forest RSPB Reserve/Sherwood Forest NNR. This is particularly noticeable during the spring and August peak periods, the latter coinciding with the Robin Hood Festival within

Sherwood Forest NNR, during which approximately double the number of visitors visit Clumber Park. The impact of the coronavirus pandemic on the 2020 dataset is also apparent, with a total absence of visitor data between March and May, and a reduced number of monthly visitors also apparent in December (following the introduction Tier system and the lead-up to the January 2021 lockdown period).



Figure 1: Weekly visitor numbers to Budby South Forest RSPB Reserve/Sherwood Forest NNR between 2018 and 2020



Figure 2: Monthly visitor numbers to NT Clumber Park between March 2017 and December 2020

Visitor routes

- 5.19 Detailed information on the spatial use of sites within the study area is currently lacking. Some indication of how busy particular routes within the sites are can however be identified from data held on the Strava website (with the caveat that this data primarily refers to self-reporting runners and cyclists). Map 5 indicates that a network of more heavily used routes crosses all three component parcels of the study area. Nevertheless, there appears to be a higher density of such routes within Clumber Park, with larger relative areas of the other two parcels receiving lower levels of use. Within the RSPB Reserve/NNR the network appears to be denser in proximity to the Visitor Centre on the site's south-eastern flank.
- 5.20 The routes identified within the Thoresby Estate component of the SAC are noteworthy, as the absence of PRoW and public vehicular access should preclude recreational activity on site. It is however unclear from the Strava dataset who is responsible for the routes identified, although it is considered probable that they comprise a mix of Estate inhabitants/staff and holidaymakers staying within the Sherwood Hideaway, as well as (potentially trespassing) locals.

Honeypot locations

5.21 Information provided by the National Trust and RSPB indicate that, at least historically, certain localities within their relevant jurisdictions have acted as 'honeypot sites' and consequently been subject to increased levels of visitation. This includes the "Major Oak", located within Sherwood Forest NNR, which (until recent management interventions) was a focal point for recreation within the area. Similarly, the old Sherwood Visitor Centre, which operated between 1976 and 2018, was located within the centre of Sherwood Forest NNR, leading to a concentration of visitors within the heart of the site.

Map 5: More heavily used routes identified on Strava website



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Visitor origins, frequency, and behaviour

- 5.22 Data from 290 visitor interviews carried out by the RSPB at Budby South Forest RSPB Reserve/Sherwood Forest NNR, in January and March 2017/18 and across the year in 2018/19, indicated that >80% of visitors to the site had travelled from home that day, and that approximately a third of visitors lived within 10 miles of the interview location. More than 90% of interviewees had accessed the site by car, with 44% living within a 30 minute driving distance and a further 19% living within an hour's drive. Although only available for part of the study area, this information suggests that the majority of visitors are likely to be of local origin.
- 5.23 Data from 289 visitor interviews carried out by Nottinghamshire County Council within Sherwood Forest Country Park (incorporating Sherwood Forest NNR) in August 2015 showed that 86% of interviewees had already visited the site previously. The largest single proportion of respondents (27%) indicated that they visited the site 3 times year. Nevertheless, approximately one fifth of respondents stated that they visited the site at least once a week, with approximately 12% of them visiting at least 2 to 3 times per week.
- 5.24 The latter interviews also indicated that a larger relative proportion of visitors to the site were elderly, and that the main reason for visiting was for a family day out and/or to entertain children. The latter piece of information is not unexpected, given the time of year during which the interviews were carried out, but it may not necessarily hold true for other periods across the year. Furthermore, the majority of interviewees (80%) considered the use of a peak season car parking charge reasonable, suggesting that site users may be amenable to other changes in parking locations/charging in the future.

6. Potential impacts of recreation

6.1 In this section we consider how recreation can impact the relevant interest features of the designated sites detailed in Section 3. Interest features may also be impacted by other factors such as climate change, atmospheric pollution, and natural processes, and in some cases these may interact with recreation impacts.

Impact pathways

- 6.2 We identified the main pathways through which recreational activities may impact on the designated features, drawing on our experience, reviews of the literature, and discussion. This includes other general reviews of recreation impacts undertaken at a national level (e.g. Lowen et al. 2008; Liley et al. 2010).
- 6.3 We can summarise recreational impacts under the broad headings listed below. There can also be interactions between the different impacts (e.g. fire may open up new routes).
 - Disturbance;
 - Fire;
 - Contamination;
 - Trampling/wear;
 - Physical damage;
 - Harvesting;
 - Grazing issues, and;
 - Visitor expectation.

Disturbance

6.4 Disturbance occurs where human activity influences an animal's behaviour or survival. By far the majority of the literature (and there are thousands of studies), focuses on birds (Brawn et al., 2001; Hill et al., 1997; for general reviews see Hockin et al., 1992; Lowen et al., 2008; Showler, 2010; Steven et al., 2011; Whitfield et al., 2008). Disturbance can also affect mammals, herptiles (see Edgar, 2002 for review) and invertebrates.

General principles

6.5 The presence of people in the countryside will influence wildlife in many ways. For many species, the people or their pets (e.g. dogs) are a potential threat and as such it is to be expected that the response will be to modify behaviour, for example fleeing. The relative trade-off as to when to change behaviour and respond to the threat will relate to the perceived scale of the threat and the costs

involved (e.g. lost foraging time). This perspective can be used to understand the behavioural responses to people and led one author to describe human disturbance as predation-free predators (Beale & Monaghan, 2004).

- 6.6 With people (and their pets) viewed as potential predators, there is clearly a greater threat posed (and therefore a greater behavioural response) when, for example, there are more people, in larger groups (Beale & Monaghan, 2004, 2005) or when people approach directly (Smith-Castro & Rodewald, 2010) or faster (Bellefleur et al., 2009).
- 6.7 The presence of people may also draw particular predators, for example a study in America showed the Crow (corvid) populations were centred around campgrounds (Marzluff & Neatherlin, 2006) while Kays *et al.* (2017) used camera traps to show a range of predators actively selected human-made paths. As such the presence of people may also influence the distribution and abundance of predators with a knock-on effect for potential prey species.

Impacts

- 6.8 Disturbance can therefore have a range of different impacts, potentially affecting distribution, breeding success and health. Impacts can be chronic, for example otherwise suitable nesting habitat being completely avoided (e.g. Liley & Sutherland, 2007) or more short-term in nature, for example birds becoming alert and then resuming the initial activity (e.g. Fernandez-Juricic et al., 2001). Birds might be temporarily displaced from particular locations and such behavioural responses will have some energetic costs, even if only very short term in duration. Impacts can also include direct mortality, for example through increased predation associated with disturbance (e.g. Brambilla et al., 2004).
- 6.9 There are also examples of direct predation by pet dogs, for example dogs were recorded as predators of nests and incubating adult Ringed Plovers *Charadrius hiaticula* on Lindisfarne (Pienkowski, 1984). Some studies have shown evidence of accidental trampling of nests and young, including herptiles (Edgar, 2002) and birds (Durwyn Liley & Sutherland, 2007). Much harder to measure and record are physiological effects, for example related to stress, and these may in turn affect fitness. While studies are limited, there is evidence of physiological effects in terms of increased heart rate (Ellenberg et al., 2013) and stress-hormones (Thiel et al., 2011).
- 6.10 As such the presence of people may affect birds and other wildlife in a range of ways that are not always easy to measure or record. Many people simply assume

disturbance to relate to birds taking flight or fleeing, but in reality these behavioural responses are likely to be only part of a much wider picture.

Types of access

- 6.11 Disturbance has been shown to occur with a range of different types of activities, for example Steven *et al.* (2011), in their review of disturbance impacts to birds listed the following activities and research findings:
 - Standing/observing: 15 studies, 14 showing negative effects of disturbance;
 - Touring/walking/hiking: 51 studies, 45 showing negative effects of disturbance;
 - Running: 6 studies, 6 showing negative effects of disturbance;
 - Cycling/Mountain bike riding: 3 studies, 3 showing negative effects of disturbance;
 - Dog walking: 11 studies, 11 showing negative effects of disturbance, and;
 - Horse riding: 0 studies, 0 showing negative effects of disturbance.
- 6.12 More recent studies have highlighted emerging activities such as drones (Mulero-Pázmány et al., 2017).
- 6.13 It is often difficult to separate different types of activities as at many sites multiple activities tend to overlap in space and time. Nonetheless, dogs are often identified as having a disproportionate effect (Banks & Bryant, 2007; Cavalli et al., 2016; Lafferty, 2001; D. Liley & Fearnley, 2012; Taylor et al., 2007; Thomas et al., 2003); dogs are likely to be perceived as a greater threat (i.e. as a predator), will actively chase birds and are able to track wildlife by smell.

Identifying vulnerable species

6.14 Virtually all bird species will respond negatively to the presence of people if approached too closely and ground-nesting birds as nests will be particularly vulnerable to trampling (and there is a risk of flushing and predation of chicks by dogs). High levels of access will deter breeding birds and render otherwise suitable habitat unavailable. For both Nightjar and Woodlark studies have shown recreation use affects the distribution of birds within sites, such that busy areas are avoided (Liley *et al.* 2006; Mallord *et al.* 2007; Lowe, Rogers & Durrant 2014). For Nightjar there is also evidence of breeding success being lower on busier sites and busier parts of sites (Murison 2002). For woodlarks at least, there are clear population-level impacts as a result of the presence of people (Mallord *et al.* 2007).

Fire

- 6.15 Wildfire is a much greater issue on heathland than in wet habitats and woodland, as these are less flammable. The incidence of wildfire has been shown to increase with proximity to housing (Tantram et al., 1999). It tends to be most common in the summer months (Rose & Clarke, 2005) when it is most harmful. Uncontrolled fires can kill many reptiles, and on heathland sites re-colonisation from adjacent unburnt areas can take from 5–25 years (see Underhill-Day, 2005).
- 6.16 Similarly, the impact on invertebrates can last many years (see Underhill-Day, 2005). On heathlands, fire can result in the loss of shallow peat soils (see review in Liley et al. 2010). Depending on the vegetation type and burn intensity, wildfires may result in a temporary shift from heathers to grasses (Bullock & Webb, 1995) or to birch woodland soils (see review in Liley et al. 2010). Summer wildfires also remove breeding and foraging habitat for a range of species. Fires can also open up new access routes by reducing the height of vegetation.
- 6.17 Wildfire may decrease nutrient build up through the removal of the organic litter layer, but this is done more constructively during controlled burns carried out in winter for habitat management purposes. Some fires are a consequence of arson, others are results of barbeques and campfires.

Contamination

- 6.18 Dog fouling is a widely recognised issue in low-nutrient semi-natural systems. The resulting increase in nitrogen and phosphorus changes vegetation communities, encouraging bulky competitive species at the expense of less vigorous species adapted to low-nutrients situations. Due to their low nutrient status, heathlands and acid grassland are particularly vulnerable. A change from typical heathland species to rank species-poor grassland communities is common along and on the margins of paths and tracks and around car parks.
- 6.19 Urination is also an issue, particularly where dogs scent-mark the base of trees. This can result in the loss of lower plant communities in the affected area. The ammonium in urine is toxic in quantity and may also harm the tree bark and potentially the cambium layer. The build-up of nutrients may also damage mycorrhizal associations.
- 6.20 Contamination may also result from persistent veterinary compounds that are transferred into the aquatic environment by domestic animals (mostly dogs and ridden horses). These may include worming treatments and external parasite treatments. A further consideration is that of sunscreen and other personal care

products, in locations were people may access open water. Personal care products containing oxybenzone and octinoxate are being banned from some areas of the world where they are thought to be contributing to the disruption of marine ecosytems. In freshwater systems, carbon-based and nano-particulate UV filters have been shown to negatively impact invertebrates (e.g. (Schmitt et al., 2008) and may impact algae and fish through DNA damage, bio-accumulation of harmful chemicals, and lower quality and quantity of food sources at the base of the food web.

- 6.21 Run-off from roads may also add contaminants to water bodies, and a further issue relating to the contamination of permanent water bodies is the stocking, both officially and unofficially, with fish which results in detrimental turbidity, eutrophication and herbivory.
- 6.22 Littering is also a problem related to recreation pressure. In most cases this is unsightly rather than damaging to the relevant interest features within the study area (although it can impact small mammals, lizards, and some bird species through being trapped in bottles or cans, becoming tangled in fishing lines, or ingesting lead weights). However, some litter can be a serious problem if ingested by livestock (e.g. plastic bags, inappropriate or contaminated food, etc.).
- 6.23 The spread of exotic species can also be associated with recreation pressure. For example, there is an issue with people introducing non-native carnivorous plants such as Pitcher Plant *Sarracenia purpurea* into valley mires and water lilies into ponds. Additional footfall and dogs entering water bodies may increase the spread of species such as New Zealand Pigmyweed *Crassula helmsii*. A sensitive issue is the ornamental species that may be introduced at 'in memoria' sites, including those where funeral ashes/caskets are sited.

Trampling

- 6.24 Trampling can directly damage plants, lead to loss of vegetation and/or a change in plant species composition, and cause compaction or poaching of the substrate, with implications for plant species composition. The level of trampling that will cause damage depends on a variety of factors including soil type and moisture content, aspect and slope, season, microclimate, behaviour of walkers etc (e.g. walking up or down the slope) and the vegetation type (see Liley *et al.* 2010 for a review). Due to this range of factors, it is difficult to predict thresholds at which significant vegetation change will occur.
- 6.25 In supressing plant growth and creating bare ground, trampling can also result in conditions suitable for scarce heathland specialities that would otherwise be

outcompeted by more vigorous species. Bare ground is also required for a large number of invertebrates (particularly bees and wasps). There is a balance between sufficient trampling to create and maintain bare ground, and excessive wear (e.g. from horses or mountain bikes) that continually disturbs the substrate and damages or destroys any colonising species. Heather-dominated communities are particularly vulnerable to trampling, which can shift communities towards grassland.

- 6.26 In general, woodland ground floras are susceptible to trampling as many woodland species have adapted to shady conditions with large leaves and thin cell walls. Excessive trampling by people, for example at honeypots and along tracks, can result in the localised loss of ground flora. The survey area is of particular significance for its veteran trees, which can be negatively affected by trampling. Trampling resulting in compaction around the roots will have a detrimental effect on roots and associated soil fungi and can lead to tree death in veteran trees, which may be preferentially approached. Climbing of trees may also lead to damage.
- 6.27 Trampling can also be an issue in and around waterbodies, including permanent, ephemeral and seasonal pools and running waters. Although a degree of trampling in the margins of pools can create ideal conditions for some specialist species, continued trampling (for example from dogs and people on the bankside or entering the water) can stir up the sediment, reducing water quality and damaging aquatic plants. Excessive trampling will result in the loss of fringing vegetation and the creation of worn, compacted edges.
- 6.28 Soil compaction and erosion issues are not only related to footfall. Bicycles can damage soils and vegetation more than foot passage (Martin et al., 2018) and the impact of a horse plus rider is even greater in terms of ground pressure (see Liddle, 1997 for review). Vehicles parking on road verges are a particular issue, leading to localised damage alongside some roads. Repeated wear will result in bare edges and a loss of vegetation, likely to be of particular concern for those verges with specialist flora.

Physical damage

6.29 Physical damage can occur either through targeted or accidental vandalism, or as a result of health and safety considerations. Within old woodland sites damage can occur to tree limbs after people climb or swing upon them, or alternatively via compaction of decaying wood inside accessible hollow trunks. Cracks and breaks in tree trunks and limbs caused by vandalism, or as the result of disease, can also

lead to the requirement for individual trees, or a part of them, to be removed within amenity areas due to health and safety concerns.

Grazing issues

- 6.30 Livestock grazing is an integral part of the management within Clumber Park and plays a key role in shaping habitats. There are several pathways through which recreational pressure can impact on grazing livestock: worrying, road accidents (although many may not be due to recreation), transfer of diseases, feeding and petting livestock, damage to infrastructure and visitor perceptions and expectations. Any increase in visitor pressure is likely to exacerbate all of these.
- 6.31 Livestock worrying is generally considered to be a particular issue with sheep, but young calves and foals are also vulnerable to dog attacks. Dogs will approach and chase all livestock and this can be dangerous, for example when animals run towards people. Where young animals are killed, injured or threatened, adult livestock may be more likely to react badly to the presence of dogs, endangering both dogs and people. Attacks may be carried out by dogs escaping from properties adjacent to the study area, in addition to those being exercised within it.
- 6.32 Dogs are also an issue for the welfare of livestock through the transfer of pathogens, such as *Neospora* from dogs to cattle through dog faeces (causing abortion in infected cattle). While dogs are a particular issue, other activities can also alarm livestock. In addition to increasing the potential for accidents, this can interfere with livestock management, and recreational pressure can also result in the displacement of livestock.

Harvesting

- 6.33 Removal of deadwood is a major threat to saproxylic (deadwood) invertebrates (Kirby, 2001; Alexander et al., 2005g; Alexander et al., 2005h; Alexander et al., 2005i; Alexander et al., 2005j). This micro-habitat is often removed for health and safety reasons, and deadwood is also collected by children for den-making, in which it is generally propped vertically against a branch or similar. Repeated and protracted den-making in popular areas can result in the removal of significant amounts of deadwood from the woodland floor, greatly reducing its value for invertebrates.
- 6.34 There has been concern about the impact of harvesting fungi in other UK protected sites (e.g. the New Forest) in the light of apparent increases in commercial harvesting. Long-term research from Switzerland found that the trampling associated with harvesting reduced the abundance of fruiting bodies

affecting species diversity, but that cutting and picking themselves did not significantly reduce the overall abundance or diversity of fungi (Egli *et al.* 2006 and references therein). Given a lack of knowledge about the abundance of spores required to maintain populations, a 'closed season' was recommended by the authors. A reduction in fruiting bodies could also impact on invertebrates associated with fungi.

6.35 There are some also particular issues associated with fishing, relating to stocking (see under contamination) and also trampling damage around the edge of water bodies (see trampling).

Perceptions

- 6.36 Perception influences visitor behaviour and shapes their expectations. For example, well-maintained infrastructure is more likely to result in careful and considerate use of and respect for car parks, bins, etc. and also signs and their messages. In less well-maintained situations the reverse is more likely to be the case. Where visitor expectations and understanding are not aligned with the rural nature of a site, conflict can arise. This is a component of some of the previously discussed issues, such as the harassment of livestock. It may also be an issue if visitors are not comfortable with some elements of traditional land-use on site, particularly with respect to livestock grazing.
- 6.37 Visitors who consider the study area first and foremost as a recreational destination may be less willing to take into account requirements dictated by land use or wildlife (such as keeping dogs under control). Increasing visitor use can lead to the expectation that certain areas should be primarily available for recreational pursuits or to a lack of willingness to see changes required for conservation or pastoral purposes, particularly changes that might result in a perceived loss of amenity.
- 6.38 Perceived visitor requirements can also influence management decisions, for example, surfacing heathland paths (to the detriment of specialist species that exploit the bare ground habitat) or creating additional routes, board walks etc for recreational purposes. The use of verges for parking leads to vegetation loss, soil compaction and, as such sites become more widely used, the creation of unofficial car parks.

Overview of different impacts

6.39 In Table 4 we provide an overview of the different impact pathways and the interest features within the study area which are potentially vulnerable to that

impact. Clearly the impacts identified vary in severity, likelihood of occurrence (risk), and some affect particular interest features while others are more general. While there are some marked differences between the issues raised, we have refrained from ranking or scoring them. This is because some issues are likely to vary in their severity or risk in both time and space, for example wildfires are only likely to start in particular weather conditions.

6.40 Some impacts will depend on the status of the species concerned. Furthermore, some of the issues might, on their own, be considered of relatively little consequence when broken down and discussed on an individual basis, as a single occurrence in one part of the study area. Yet it is the overall impact of all the issues in synergy that needs to be considered, in the context of how access is spread across the study area, all year round.

Table 4: Potential vulnerability of key habitats and species/species groups to recreational pressure. Brackets indicate potential vulnerabilities/pathways (e.g. changes in invertebrate nectar source availability associated with nitrogen enrichment from dog fouling)

Feature	Relevant designation	Disturbance	Fire	Trampling	Physical damage	Contamination	Changing perceptions	Harvesting
H9190 Old acidophilous oak woods with Quercus robur on sandy plains; Dry oak-dominated woodland	SAC		\checkmark	\checkmark	~	\checkmark	\checkmark	
Lowland dry acid grassland	SAC/SSSI		\checkmark	\checkmark		\checkmark	\checkmark	
Lowland heathland	SAC/SSSI		\checkmark	\checkmark		\checkmark	\checkmark	
Waterbodies and associated wetland habitats	SSSI			\checkmark		\checkmark	\checkmark	
Breeding bird assemblage of mixed habitats	SSSI	\checkmark	\checkmark				\checkmark	
Nightjar	ppSPA/SSSI	\checkmark	\checkmark	(√)			\checkmark	
Woodlark	ppSPA/SSSI	\checkmark	\checkmark			(√)	\checkmark	
Bats (tree-roosting)	SSSI	(√)	\checkmark		\checkmark			
Broad-leaved woodland/saproxylic invertebrate species	SAC/SSSI		\checkmark		\checkmark	(√)	\checkmark	
Fungal communities	SAC/SSSI		(√)	\checkmark	\checkmark		\checkmark	\checkmark
Lichen communities	SAC/SSSI		(√)		\checkmark	\checkmark	\checkmark	

7. Summary and further work

- 7.1 The study area incorporates several important sites for nature conservation, including areas of old oak woodland of international value, alongside nationally important heathland, acid grassland, and wetland habitats. Furthermore, these habitats, in combination with extensive areas of plantation woodland, support important avian, invertebrate, and fungal assemblages. This includes populations of Nightjar and Woodlark which potentially contribute to nationally important populations across the Sherwood Forest region. Nevertheless, recent survey data for key taxa (e.g. breeding birds) is currently unavailable, with updated survey work recommended to inform the subsequent Recreation Impact Assessment reports.
- 7.2 Of the three component blocks of the study area, the available data indicates that both National Trust Clumber Park and Sherwood Forest NNR comprise important visitor attractions in the region, although data on the smaller Thoresby Estate component of the study area is largely lacking. Nevertheless, visitor data provided by the National Trust and RSPB suggest that, outside of key points in the year (e.g. during the annual Robin Hood Festival), Clumber Park receives a larger number of visitors than Sherwood Forest NNR. Information from historic visitor surveys carried out within Sherwood Forest also indicate that the site is used on a frequent basis by local people for recreation activities.
- 7.3 There is already recognition that some of the key issues affecting the designated sites within the study area result from visitor activity. Furthermore, although this report focusses upon potential recreation effects, it is important to highlight that local housing growth could have a wider suite of impacts upon some of the study areas qualifying features. For species such as Nightjar, that can roam widely in the landscape at night to forage, urban growth may have other particular implications associated with habitat fragmentation, changes in local predator numbers (e.g. cats), artificial lighting, etc.
- 7.4 Some important mitigation interventions have already been carried out in recent years, including the relocation of the long-established Sherwood Forest visitor centre outside of the Birklands & Bilhaugh SAC boundary and ongoing parking management within National Trust Clumber Park. Nevertheless, further work is required to identify exactly how and why

visitors use the sites within the study area, and what effect increasing housing in surrounding districts may have upon visitor numbers. Nevertheless, the information incorporated within this report provides a useful review with which to inform the design of future survey work, highlight the key issues, and provide comparison with the results of future surveys.

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