Beckford Nature Reserve

Biodiversity Audit

Undertaken on behalf of Beckford Nature Reserve Ltd and in completion of the Master of Science award in Applied Ecology at the University of Gloucestershire.

Acknowledgements

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We are also grateful to Dr. Mark O’Connell for their advice and support throughout the project.

Executive summary

- This report presents the results of a biodiversity audit conducted at Beckford Nature Reserve, Worcestershire, from April until late June 2023. The groups studied here include passerine birds (Order: Passeriformes), reptiles (Class: Reptilia) and arboreal invertebrates.
- Passerine birds were described by 19 species: 6 woodland specialists, 8 woodland generalist and 5 non-woodland species. Spatial variation in the distribution of these species was not prevalent except for the woodland specialist species Goldcrest (*Regulus regulus*) and Wren (*Troglodytes troglodytes*).
- Reptile species were generally absent from the site over the recording period. One record of Slow-worm (*Anguis fragilis*) was made in the south-east section of the site.
- Arboreal invertebrates were described by 1,205 individuals of 79 species in 45 families. True Bugs (Hemiptera), booklice (Psocoptera), spiders (Araneae) and beetles (Coleoptera) were the most abundant families. No spatial variation in their distribution was recorded.
- Recommended aims for management involve providing habitat with high quality and permeability to aid dispersal of species through fragmented and anthropogenically altered landscape.
- Management recommendations are prescribed in three zones: understory vegetation, canopy vegetation and the transition between habitats (ecotone).

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1 Introduction

Habitat fragmentation and anthropogenic alteration of the landscape are two threats facing global biodiversity with implications for the species dispersal, breeding, survival rates, edge effects and species interactions (Haas, 1995; Wilkin *et al.* 2006; Valentine, Apol and Proppe, 2019). Woodland constitutes just 13.0% of land cover area in Great Britain (Forestry Commission, 2011) with wooded areas becoming increasingly fragmented towards the south (Smith and Gilbert, 2003). Fragmented woodland is known to behave akin to island biogeography (Whitcomb, Whitcomb and Bystrak, 1977; Mader, 1984), with species richness being a function of habitat size, background matrix type and the degree of isolation between habitat patches (Galli, Leck and Forman, 1976; Freeman, Olivier and Aarde, 2018; Gardner *et al.* 2019). Furthermore, matrix type and associated permeability influences the ability of individuals of any given species to disperse between suitability habitat patches (Haas, 1995; Desrochers and Hannon, 1997; Biz, Cornelius and Metzger, 2017). Available woodland presents a valuable resource for a variety of taxa including a richness of terrestrial invertebrates (Gunnarsson, 1996; Oxbrough *et al.* 2005; Maleque, Maeto and Ishii, 2009), woodland specialist and generalist bird species (Galli, Leck and Forman, 1976; Freeman, Olivier and Aarde, 2018; Gardner *et al.* 2019) and occasional use by our native reptile species (Edgar, Foster and Baker, 2010). Where the need exists for habitats to be bigger, better and more joined up (Lawton *et al.* 2010), it is important to evaluate the current biodiversity value of available habitat to develop effective site- and landscape-level management strategies.

Here, we present the findings of a biodiversity audit conducted at Beckford Nature Reserve from April until late June 2023 on passerine birds (Order: Passeriformes), reptiles (Class: Reptilia) as taxonomic groups and arboreal invertebrates as a functional group. The aims of this report are two-fold: firstly, to evaluate the biodiversity of these target groups and associated implications for their conservation; secondly, to provide recommendations for positive future management.

1.1 Site details

The study was undertaken at Beckford Nature Reserve (52°01’23”N, 02°02’06”W) located North of Beckford Village on the border of the Watsonian Vice Counties of Worcestershire and West Gloucestershire and the Cotswold Area of Outstanding Natural Beauty (AONB). Historic site use consisted of gravel extraction from 1981 to 1989 prior to current management as a nature reserve by Beckford Nature Reserve Ltd.

Covering a total area of 3.20 hectares (ha), the site is constituted primarily of 1.97 ha of deciduous woodland containing an array of tree species including Alder (*Alnus glutinosa*),

Ash (*Fraxinus excelsior*), Hawthorn (*Crataegus monogyna*), Pendulate Oak (*Quercus robur*), Silver Birch (*Betula pendula*), Sycamore (*Acer pseudoplatanus*), Wild Cherry (*Prunus avium*) and Willow (*Salix spp.*). The woodland surrounds a 1.23 ha lake constituting the central feature of the site.

2 Methodology

2.1 Desk study

A desk study was conducted to identify species historically recorded at the site in the groups studied in this audit with special note being taken of protected and UK Biodiversity Action Plan (UK BAP) species. Beckford Nature Reserve Ltd were consulted for records held by the organisation. Data from publicly accessible databases including the Beckford Nature Reserve website (https://www.beckfordnature.org.uk/sightings.php Accessed: 21 February 2023) and the National Biodiversity Network Atlas (NBN Atlas; https://nbnatlas.org/ Accessed: 6 February 2023) were consulted. These data were collated and filtered to the studied taxonomic groups.

2.2 Phase 1 Habitat Survey

Predominant habitat types of the site and surrounding landscape were surveyed at Phase 1 level utilising the standardised system of alphanumeric codes outlined by the Joint Nature Conservation Committee (JNCC, 2010). Where possible, inaccessible parcels were assessed from a suitable viewpoint utilising binoculars. Phase 1 Habitat Survey data was digitised in Quantum GIS (QGIS; QGIS Association, 2023) to produce a 1:10,000 scale map of habitat cover.

2.3 Survey methodologies

2.3.1 Passeriformes

The survey methodology employed here was adapted from existing standing monitoring guidance utilised by the British Trust of Ornithology (BTO) Breeding Bird Survey (BBS; British Trust of Ornithology, 2018). Four modifications were made for application to this site: (1) reduction in total transect length to 250 meters, (2) reduction in length of individual transect sections to 50 meters, (3) reduction in the distance records were taken from the transect line down to 50 m and (4) reduction in the width of the second distance category from 25 m – 100 m down to 25 m – 50 m. Two transects were established at the site. One of the Northern and Southern side, respectively, with the direction of travel approximately in an East – West direction (Figure 1). Adaptations (1) and (2) were made so that transects covered the entire length of the site in an East – West striking direction. Adaptations (3) and (4) were made to enable surveying within the site boundaries and immediate area outside

the site within minimal overlap between surveying areas. Bird species were identified to species level utilising calls as auditory cues and a pair of Nikon Monarch 5 Mark II 8 x 42 binoculars for visual identification. Vocal activity decreases throughout the morning (Palmgren, 1949). Therefore, surveying was performed in a time window between 30 minutes before and 120 minutes after sunrise to coincide with peak vocal activity. A total of six dawn surveys were conducted between 11th May and 26th June 2023. A minimum period of seven days was allowed between subsequent surveys to maintain independence between samples. Cloud cover (0 – 33%/33 – 66%/ 66% - 100%), precipitation (none/light/showers) and wind conditions (calm/light/breezy) were recorded.

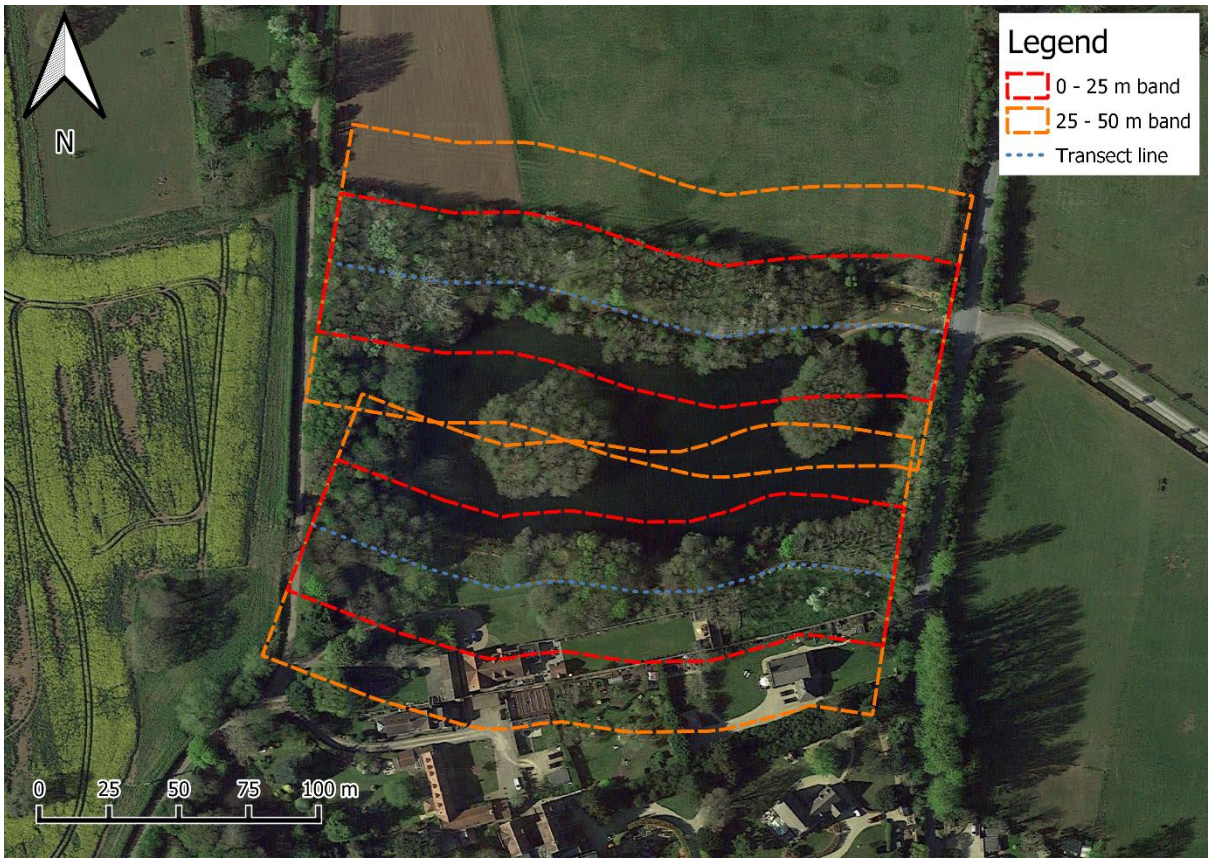

Figure 1: Map of transect methodology utilised for surveying passerine bird species at Beckford Nature Reserve. Two transect lines denoted corresponding to northern and southern sections of the site with areas recordings taken from demarcated.

2.3.1.1 Pilot survey

A pilot survey was performed on 11th May 2023. Surveying commenced at 05:20, within 30 minutes of sunrise, and concluded at 06:10. A walking pace of 0.5 – 1.0 km h^{-1} equating to a total surveying effort in the range of 50 – 60 minutes was determined to be suitable to describe the species present during a single site visit. Therefore, this methodology was unaltered throughout the surveying period except for alterations in surveying start time to account for changes in the timing of sunrise. The results of the pilot survey are incorporated with the overall results.

2.3.2 Reptiles

Ad hoc records suggest potential presence of reptiles, namely Grass Snake (*Natrix natrix*), at the site. Surveys for squamate reptiles were performed from 11th May until 19th June 2023 to establish baseline data on presence/absence of these species at the site. In addition, the spatial variation in the distribution of these species related to proximity to water was examined, noting the association of Grass Snake dietary habitats with freshwater (Gent and Gibson, 1998). Artificial cover objects (ACOs) made of bitumen roofing felt measuring 0.5 m x 0.5 m were placed onsite at the recommended stocking density of between 5 and 10 ACOs per hectare (Froglife, 1999). In total, 15 ACOs were positioned onsite on 27th April 2023 in three distance bands relating to water proximity: 0 – 20 m, 20 – 40 m and 40 – 60 m. Five ACOs per distance band distributed across the site (Figure 2). Fieldcraft was employed for targeted positioning of ACOs in areas suitable for basking reptiles, particularly well sunned areas in deep vegetation (suntraps) or edges of dense vegetation to maximise the probability of species detection (Gent and Gibson, 1998; Sewell *et al.* 2013). ACOs were left for a 14-day period to acclimatise prior to the commencement of recording. Air temperature was measured at the beginning and end of surveying with a standard mercury thermometer in a shaded location 1.5 ± 0.3 m above the ground and allowed to acclimatise to the ambient

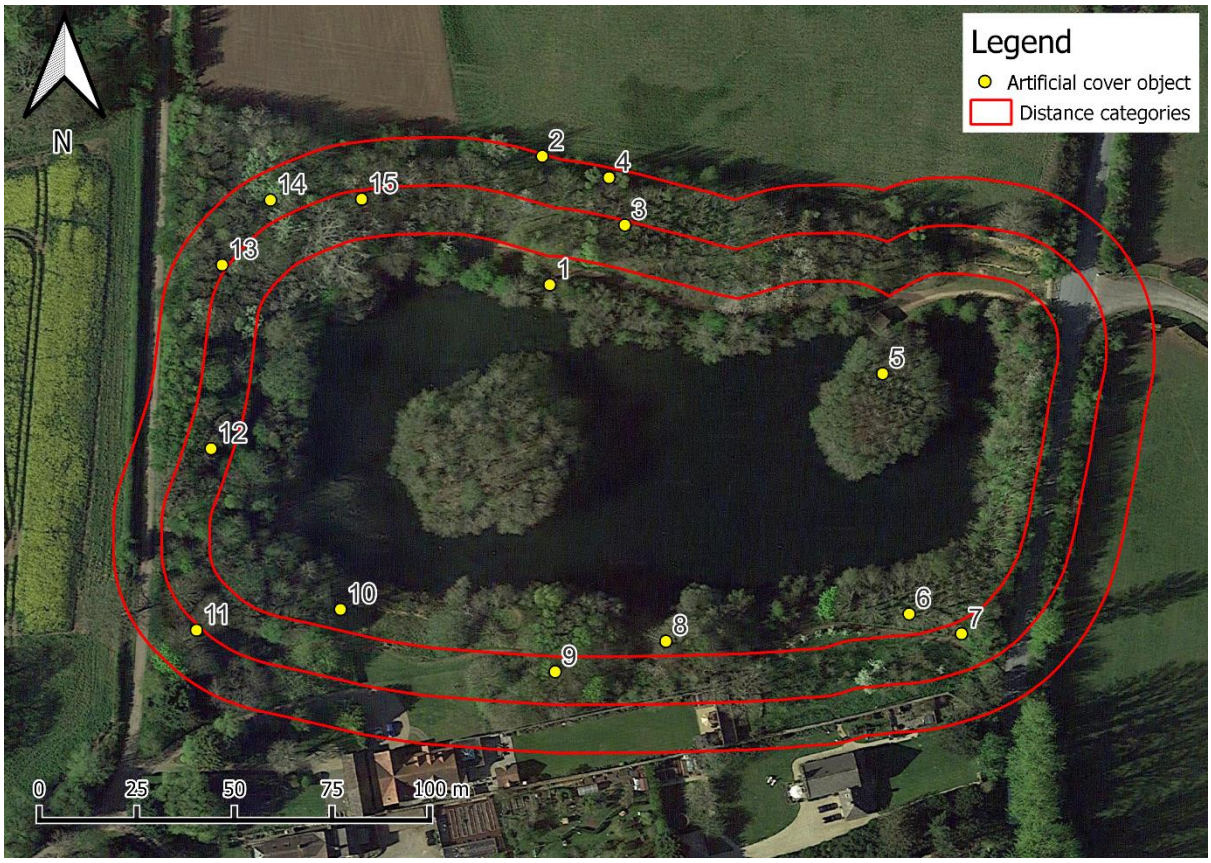

Figure 2: Map denoting the locations of artificial cover objects at Beckford Nature Reserve in place from 27th April until 19th June 2023. 15 ACOs are distributed across the site with 5 per distance category.

conditions over a 10-minute period. Five site visits were performed over the monitoring period to establish 95% confidence in presence/absence based on estimated detection probabilities of squamate reptiles (Sewell *et al.* 2012).

2.3.2.1 Pilot survey

The pilot survey was performed on the 11th May 2023. Surveying commenced at 08:30 and concluded at 10:00, totalling 90 minutes of surveying effort, as per recommended timings (Gent and Gibson, 1998; Froglife, 1999). ACOs were initially examined from a distance with a pair of Nikon Monarch 5 Mark II 8 x 42 close focus binoculars for reptiles basking on top of the mat. On confirmation that no basking animals were present on top of an ACO, it was approached slowly and the mat was briefly lifted to enable the counting of individuals. The ACO was replaced in the same exact position. It should be noted that ACOs numbered 3, 9, 10, 14 had to be relocated due to the vigorous growth of vegetation that completely obscured the ACO from sunlight and had to be relocated. The relocated positions were no greater than one meter from the original position.

2.3.3 Arboreal invertebrates

A stratified random sampling methodology was developed to survey arboreal invertebrate species at the site and examine the spatial composition of the invertebrate community related to proximity to the central lake feature. Three bands of distance to the lake were defined as the strata: 0 – 20 m, 20 – 40 m, 40 – 60 m. Arboreal invertebrates were sampled with an equal number of transects distributed randomly within each of the predefined distance bands. All trees and shrubs present along a transect were surveyed with a constant number of 20 taps to the foliage. Invertebrates were collected in 115 cm x 85 cm canvas beating tray. Specimens were temporarily collected in 60 ml plastic sampling containers for identification and counting. Specimens were released back into the environment once recorded. Results are drawn from four surveys performed from 3rd June until 28th June 2023. A minimum period of seven days was allowed between subsequent surveys to maintain independence between samples.

2.3.3.1 Pilot study

A pilot study was performed on 19th May 2023. Here, the methodology was tested and sensitivity analysis pertaining to the accumulation of species recorded with an increasing number of transect surveys was carried out. A total of 64 species were recorded from a total of 12 transects (Figure 3). From these results, it was determined that performing 6 transects per survey visit presented an acceptable trade-off between collecting a sample that adequately describes the diversity of species against the allocation of available time

resources required to accurately identify and count sampled individuals on subsequent survey visits (Figure 4).

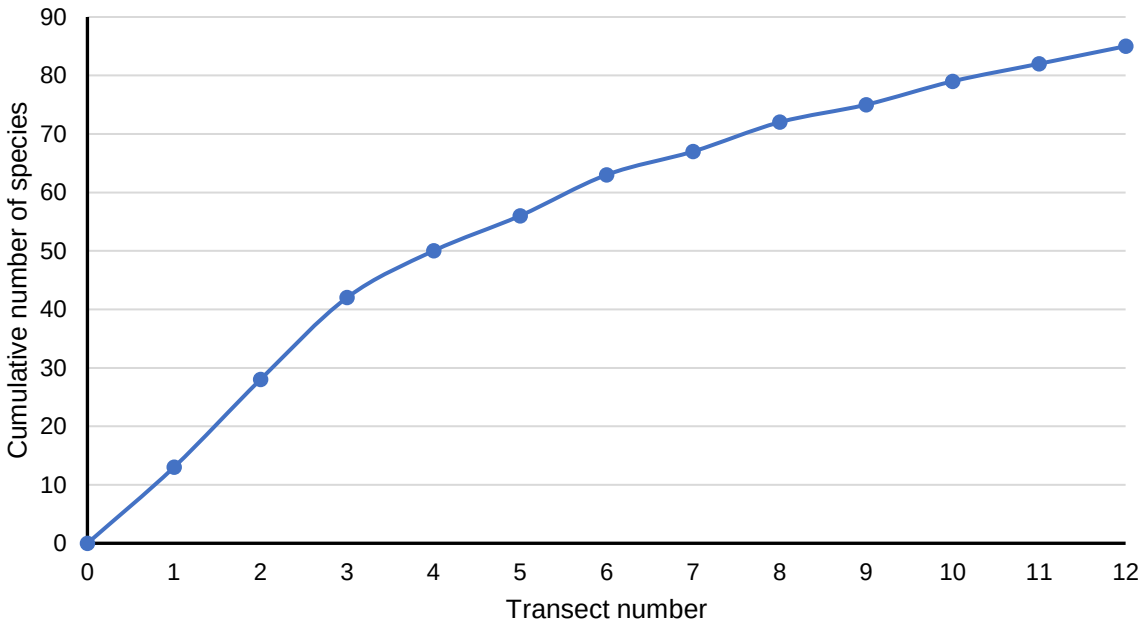

Figure 3: Sensitivity analysis curve describing the accumulation of arboreal invertebrate species identified with increasing number of transect surveys performed during pilot survey.

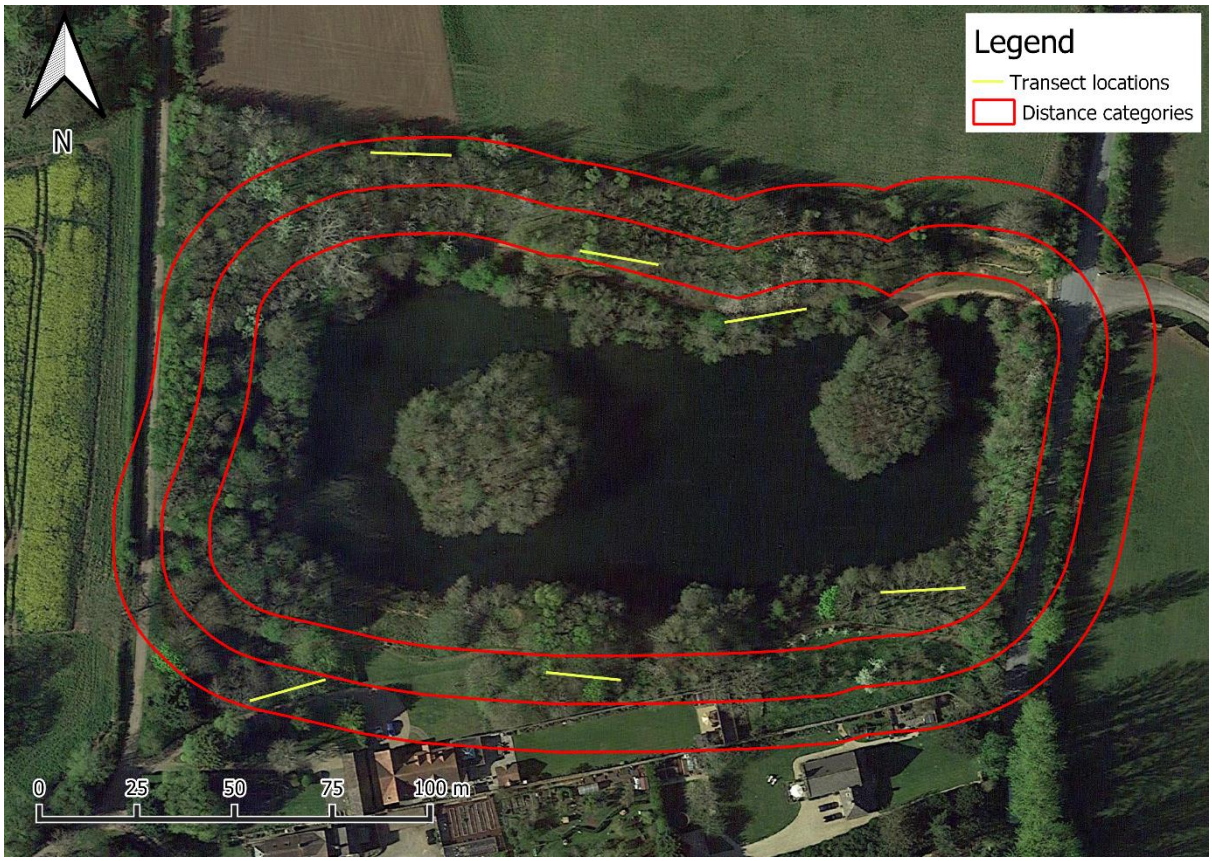

Figure 4: Map of transect locations at Beckford Nature Reserve utilised during arboreal invertebrate surveys. 6 transects are distributed randomly across the site with 2 per distance category.

2.4 Data analysis

The diversity of the studied groups was evaluated with four measures of diversity: (1) species richness, (2) the Shannon-Wiener Diversity Index (*H'*), (3) Shannon's Equitability Index and (4) Sørenson's Similarity Index. Shannon's indices were chosen to enable quantitative pairwise comparisons of diversity between communities (Heip, Herman and Soetaert, 1998). Sørenson's index enables a pairwise evaluation of the similarity in the species assemblage between two communities against the total number of species in each respective community that ranges between 1.0 (perfect similarity) and 0 (no similarity; Krebs, 1985). Báldi (2003) shows that species richness is correlated with the taxonomic richness at both genus and family level. Therefore, diversity index calculations for invertebrate taxa were performed at family level to act as a proxy for species that could not be identified past family level (Derraik *et al.* 2002). Student's t-tests were utilised to query passerine data for significant differences between the abundance of each recorded species in each transect. One-sided analysis of variance (ANOVA) was employed on reptile and invertebrate for pairwise examination of difference between the abundance of recorded species since the number of communities examined was greater than two.

3 Results

3.1 Desk study

All data arising from the desk study is available in Appendix 1. In total, 41 species of passerine birds have historically been recorded at Beckford Nature Reserve with 9 species designated as priority species under the UK Biodiversity Action Plan 2007 (UK BAP). All birds are protected under the Wildlife and Countryside Act 1981, as amended. In addition, 31 recorded species have additional protections under international conventions including the Bern Convention (Appendix 2), the Birds Directive (Appendix 2) and the Convention on Migratory Species (Appendix 2).

3.2 Phase 1 Habitat Survey

Beckford Nature Reserve consists of a parcel of semi-natural broadleaved woodland in a highly anthropogenically managed landscape. The site is situated directly north of Beckford Village that is comprised primarily of buildings and accompanying gardens. Additionally, the site is surrounded predominantly by arable and improved grassland. Woodland parcels in the region are generally small and highly fragmented (Appendix 2; Figure S1). The relatively simple geometry of the habitats produces a low ratio of perimeter to area. Therefore, a substantial proportion of the site is comprised of core woodland habitat relative to the length of edge habitat.

3.3 Passeriformes

A total of 307 individuals originating from 19 species of 16 genera within 12 families were recorded to be present at the site in the period between early May and late June 2023. Of these species, there were 8 woodland generalists, 6 woodland specialists and 5 non-woodland species (Table 1). At a site level, Blackbird (*Turdus merula*; mean: 7.50 ± 0.99; range: 5 – 12), Chiffchaff (*Phylloscopus collybita;* mean: 4.17 ± 0.60; range: 2 – 6) and Wren (*Troglodytes troglodytes;* mean: 9.83 ± 1.05; range: 6 – 13) occurred consistently over the monitoring period and were typically abundant. Conversely, several species including Goldcrest (*Regulus regulus;* mean: 0.67 ± 0.21; range: 0 – 1), Goldfinch (*Carduelis carduelis;* mean: 0.17 ± 0.17; range 0 – 1), Eurasian Jay (*Garrulus glandarius;* mean: 0.17 ±

Table 1: Abundance (mean ± standard error) of passerine species recorded in combined site overview and northern and southern areas of the site sorted in order of total abundance. P-values of two-tailed Student's t-tests for differences between the communities displayed. Significant differences between transects ($p \leq 0.05$) represented in bold.

Taxon	Guild	Total	Northern	Southern	P-value
*Troglodytes troglodytes**	G	9.83 ± 1.05	6.50 ± 0.76	3.33 ± 0.33	**0.003**
Turdus merula	G	7.50 ± 0.99	3.83 ± 1.11	3.67 ± 0.71	0.902
*Delichon urbicum***	N	4.83 ± 3.62	0	4.83 ± 3.62	0.211
Phylloscopus collybita	S	4.17 ± 0.60	1.83 ± 0.40	2.33 ± 0.56	0.484
Corvus monedula	N	3.67 ± 2.38	0	3.67 ± 2.38	0.154
Erithacus rubecula	G	3.50 ± 0.62	1.67 ± 0.56	1.83 ± 0.31	0.799
Parus major	G	3.33 ± 0.71	1.17 ± 0.40	2.17 ± 0.60	0.197
Corvus corone	N	3.17 ± 1.22	0.83 ± 0.48	2.33 ± 0.84	0.153
Sylvia atricapilla	S	2.33 ± 0.67	1.67 ± 0.49	0.67 ± 0.21	0.092
*Corvus frugilegus**	N	2.00 ± 2.00	1.17 ± 1.17	0.83 ± 0.83	0.821
Cyanistes caeruleus	G	2.00 ± 0.68	1.17 ± 0.54	0.83 ± 0.31	0.605
*Turdus philomelos**	G	1.83 ± 0.54	1.33 ± 0.56	0.50 ± 0.34	0.231
Fringilla coelebs	G	1.17 ± 0.54	0.17 ± 0.17	1.00 ± 0.52	0.156
Regulus regulus	S	0.67 ± 0.21	0	0.67 ± 0.21	**0.010**
Aegithalos caudatus	G	0.33 ± 0.21	0	0.33 ± 0.21	0.145
Sitta europaea	S	0.33 ± 0.33	0.33 ± 0.33	0	0.341
Carduelis carduelis	N	0.17 ± 0.17	0.17 ± 0.17	0	0.341
Garrulus glandarius	S	0.17 ± 0.17	0	0.17 ± 0.17	0.341
*Muscicapa striata***	S	0.17 ± 0.17	0	0.17 ± 0.17	0.341

Guilds represent woodland habitat specialisation; S = specialists, G = generalists, N = non-woodland species (DEFRA, 2023).

* = amber list species, ** = red list species as given by Stanbury *et al.* (2021).

0.17; range 0 – 1) and Spotted Flycatcher (*Muscicapa striata;* mean: 0.17 ± 0.17; range: 0 – 1) occurred infrequently or in low abundances whereas species including House Martin (*Delichon urbicum;* mean: 4.83 ± 3.62; range: 0 – 22) and Rook (*Corvus frugilegus*; mean: 2.00 ± 2.00; range: 0 – 12) occurred infrequently but, when present, were abundant (Figure 5).

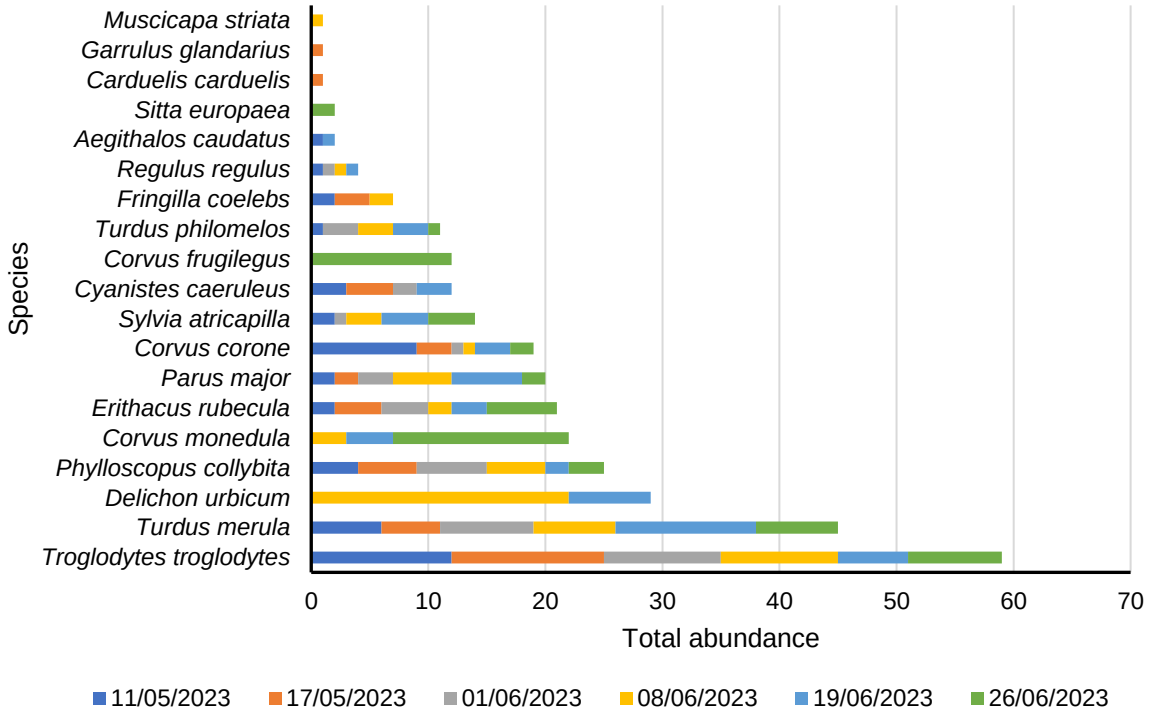

Figure 5: Total abundance of bird species accumulated from repeated surveys over the recording period. Relative contribution of records from each survey date represented by colour coded bars.

The southern part of the site represented a marginally more diverse area than the northern part of the site. This can be attributed to the fact that a greater richness of species was typically hosted in the southern area (mean: 10.33 ± 0.87; range: 7 – 13) than the north (mean: 7.83 ± 0.37; range 6 – 9) with House Martin, Jackdaw (*Corvus monedula*), Goldcrest Long-tailed Tit (*Aegithalos caudatus*), Eurasian Jay and Spotted Flycatcher occurring exclusively in the south. Meanwhile, Eurasian Nuthatch (*Sitta europaea*) and Goldfinch only occurred in the north. Nevertheless, there was a moderately high degree of similarity between both areas (mean: 0.728 ± 0.041; range: 0.556 – 0.857). Furthermore, the distribution of individuals amongst the recorded species (evenness) was comparable across the site (Table 2). Results of Student's t-tests on the abundance of species in each region at the site found that significant differences only exist for Goldcrest ($p = 0.010$) and Wren ($p = 0.003$).

Table 2: Summary (mean ± standard error) of diversity indices species richness, the Shannon-Wiener Diversity Index (*H'*), Shannon's Equitability Index (E_H) and Sørenson's Similarity Index (*S'*) in Northern, Southern and combined communities.

Community	Richness	Diversity (*H'*)	Evenness (E_H)	Similarity (*S'*)
Northern	7.83 ± 0.37	1.803 ± 0.036	0.881 ± 0.019	-
Southern	10.33 ± 0.87	2.009 ± 0.081	0.871 ± 0.026	-
Total	11.50 ± 0.51	2.139 ± 0.048	0.878 ± 0.012	0.728 ± 0.041

3.4 Reptiles

Individuals of Grass Snake and Common Lizard (*Zootoca vivipara*) were absent at all ACO locations across the site during the monitoring period. A single record of Slow-worm (*Anguis fragilis*) occurred on 19th May 2023 at ACO 7 located in the 20 – 40 m distance category with air at 15°C and cloud cover in the range of 60 – 75%. Based on the probability of species detection (Sewell *et al.* 2012), these results suggest that Grass Snake and Common Lizard are absent from the site. On the other hand, Slow-worm has the ability to locate and utilise a part of the site but may occur infrequently and in very low abundances. ANOVA tests could not be effectively applied to these data owing to the minimal amount of data acquired.

3.5 Arboreal invertebrates

A total of 1,205 invertebrates were sampled over the monitoring period in June 2023 comprised of 79 species of 45 families within 16 orders. Over 75% of the total number of individuals belong to the orders Hemiptera (49.5%), Psocoptera (22.7%), Araneae (11.3%) and Coleoptera (7.5%; Figure 6) with the majority being described by 7 families. Notably, the Hemipteran families Psyllidae (17.1%), Aphididae (16.1%) and Miridae (12.4%); Liposcelis (18.0%) and Mesopsocidae (4.7%) for Psocoptera; Theridiidae (5.7%) of the Araneae; and

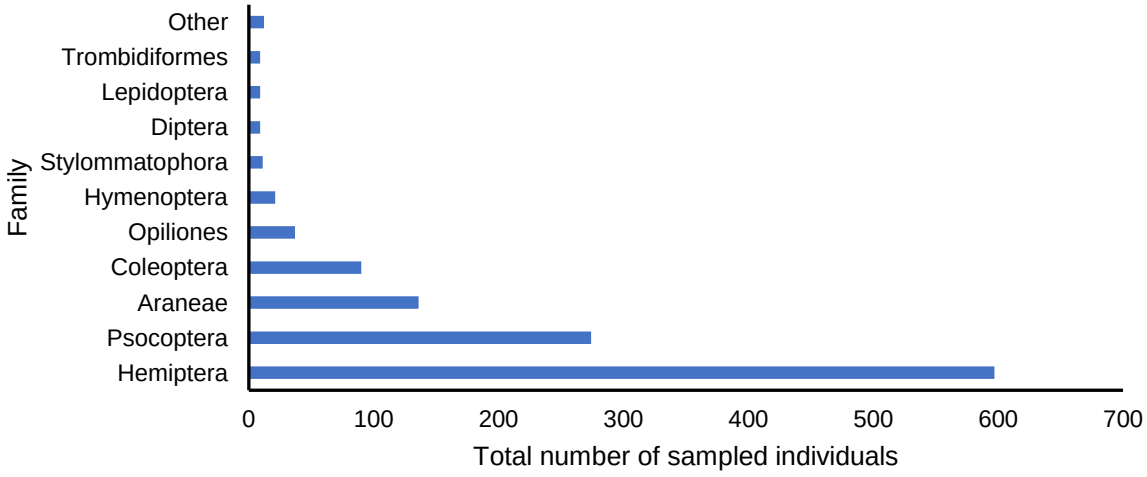

Figure 6: Cumulative number of arboreal invertebrate individuals sampled over the recording period constituting the ten most populated taxonomic orders.

the Coleopteran family Coccinellidae (3.2%). 21 species are designated as Least Concern under the GB Red Data Book. No UK BAP species were recorded.

Family level richness and diversity was comparable in all three distance-based communities. On average, the community in closest proximity to water had slightly greater diversity that tended to experience a small decrease with increasing distance from water. This can be

Table 3: Summary of family level diversity of invertebrate taxa represented by the total number of species in each community (richness), the Shannon-Wiener Diversity Index (*H'*), Shannon's Equitability Index (E_H) and Sørenson's Similarity Index (*S'*).

	Community		
	0 – 20 m	20 – 40 m	40 – 60 m
Richness			
Mean ± SE	19.25 ± 0.74	18.25 ± 1.56	16.75 ± 0.89
Minimum	17	15	15
Maximum	21	23	19
Shannon's Diversity			
Mean ± SE	2.318 ± 0.048	2.224 ± 0.095	2.153 ± 0.077
Minimum	2.162	2.080	1.969
Maximum	2.396	2.545	2.383
Evenness			
Mean ± SE	0.784 ± 0.007	0.769 ± 0.020	0.765 ± 0.022
Minimum	0.763	0.706	0.718
Maximum	0.799	0.812	0.809
Similarity			
0 – 20 m			
Mean ± SE	-	0.666 ± 0.014	0.622 ± 0.029
Minimum	-	0.632	0.571
Maximum	-	0.700	0.718
20 – 40 m			
Mean ± SE	0.666 ± 0.014	-	0.637 ± 0.068
Minimum	0.632	-	0.412
Maximum	0.700	-	0.762
40 – 60 m			
Mean ± SE	0.622 ± 0.029	0.637 ± 0.068	-
Minimum	0.571	0.412	-
Maximum	0.718	0.762	-

attributed to the mean richness of invertebrate families being greatest in this community (Table 3). The families Liposcelis, Mesopsocidae, Aphididae and Miridae were typically the most abundant. However, they typically never dominated their respective communities as denoted by a high degree of evenness in each community. There were no significant differences in the distribution of invertebrate families between the communities examined here (ANOVA: $p \geq 0.05$).

4 Discussion

4.1 Conservation implications

4.1.1 Passerines

The results of this audit have shown that the site hosts a good richness of passerine birds relative to the size of the site with 11.50 ± 0.51 species recorded across the entirety of the site. However, small woodland habitats (≤ 4.0 ha) typically have a lower richness of species than medium (4.0 ha < a ≤ 25.0 ha) and large (25 ha <) woodlands (Gardner *et al.* 2019). Nevertheless, these small patches of woodland preset valuable assets to aid the dispersal of passerine birds, particularly woodland specialists, between larger areas of woodland provided the smaller patch has suitable foraging resources (Tjernberg, Johnsson and Nilsson, 1993). At a species level, it has been shown that species-specific responses to habitat structure and the composition of flora are demonstrated across this taxonomic group (Hewson *et al.* 2011). Generally, the diversity of woodland species increases towards later successional stages with greater complexity in vertical habitat structure (MacArthur and MacArthur, 1961; Helle and Mönkkönen, 1990). Species richness is further benefitted by a mixed understory structure that provides a diversity of microhabitats that fulfil foraging niche requirements (Hewson *et al.* 2011). The only significant spatial variation in distribution existed for the woodland specialist species Goldcrest and Wren. The distribution of these species tends to be most significantly influenced by the floristic composition of tree species. For example, Goldcrest generally have a preference for coniferous stands but, amongst broadleaved trees, being most closely associated with Sycamore, Chestnut and Hawthorn (Hewson *et al.* 2011). Therefore, the variation in the distribution of these species may be attributed to small scale variation in the distribution of tree species.

4.1.2 Reptiles

The complete absence of most native reptile species observed over the recording period is an outcome that should not be entirely unexpected since woodland habitats are those not typically favoured; although, increased use can be seen in adversely hot or windy conditions (Reading and Jofré, 2009; Edgar, Foster and Baker, 2010). However, the single occurrence of Slow-worm, combined the historical sightings of Grass Snake, conveys the possibility that

reptiles are capable of locating and traversing into and out of the habitat. Given that Grass Snake is one of the most mobile of our native reptiles (Madsen, 1984; Reading and Jofré, 2009; Elmberg *et al.* 2019), there is potential that this species is capable of utilising the site to disperse to suitable feeding or egg-laying sites.

4.1.3 Arboreal invertebrates

Woodlands and their canopies are capable of supporting a diverse variety and abundance of invertebrates; spiders, in particular (Oxbrough *et al.* 2005; Crowley *et al.* 2023). The majority of species of the order Araneae recorded here are those that construct webs in their hunting strategy, including the families Araneidae, Tetragnathidae and Theridiidae. Spiders can be seen as biological indicators of habitat quality since these species are inherently linked with those at both lower and higher trophic levels (Gunnarsson, 1996; Gunnarsson and Wiklander, 2015). A diverse and complex vegetation structure is correlated with the abundance and diversity of invertebrates at lower trophic levels (Mata *et al.* 2017) and thus has a direct influence on those species that predate on them (Nentwig, 1980; Gunnarsson, 1996). Beyond fulfilling trophic niche requirements, a diverse vegetation structure fulfils structural requirements for many species. For example, providing the correct conditions for web-building spiders (e.g., Theridiidae) or active-hunting species (e.g., Philodromidae; Uetz, 1991).

4.2 Management recommendations

The results of this audit have found that little spatial variation exists in the distribution of species recorded at the site. Therefore, from these results and the small area the site covers, we propose that the site can be viewed as a single unit and the management recommendations provided hereafter can be generally applied to all available woodland habitat. We recommend the primary aim of management be to create a high-quality patch of woodland habitat within this highly fragmented and anthropogenically altered landscape to aid ease of locating this patch by species from the background matrix and enable mobility into and out of the patch (Lawton *et al.* 2010; Mortelliti, Amori, and Boitani, 2010). Within these recommendations, we identify three distinct but not unrelated zones where management interventions can be targeted to promote the interests of the studied groups. These zones pertain to the understory, the canopy and the interface between habitats at the site boundaries (ecotone).

4.2.1 Understory management

Public access to this site should not be viewed as any less importance than promoting the biodiversity of the site, and thus dictates periodic management of the woodland understory be performed to maintain suitable accessibility. To balance public interests with enhancing

biodiversity, it is recommended that the management of the woodland understory be undertaken on a rotational basis. The primary aim of this management strategy is to avoid complete clearance of the understory and provide a range of vegetation ages to maintain a degree of habitat stability and ensure suitable foraging habitat is always present (Slagsvold, 1977; Heyman, 2010). Furthermore, employing a rotational vegetation clearance is necessary to provide areas with a greater volume of vegetation necessary for invertebrates; notably True Bugs (Hemiptera; Mata *et al.* 2017) that were the most abundant group of invertebrates recorded. The assemblage of bird species in a woodland environment is known to respond to management interventions over a relatively short period (Slagsvold, 1977; Rodewald and Smith, 1998; Camprodon and Brotons, 2006; Heyman, 2010). This enables a rapid assessment of the effects of interventions on the community and devise adaptations to management as necessary.

4.2.2 Canopy management

Spiders were one of the most abundant groups of invertebrates recorded over the study. A pre-requisite for web construction is the availability of attachment points and it is believed that increased heterogeneity in vegetation structure provides more of these points for web construction; in addition to a greater variety of ambush spots required by active hunters (Uetz, 1991), including species of the family Philodromidae recorded at this site. Encouraging diverse vegetation promotes the diversity of herbivorous invertebrates that directly influences the density of prey for spider species (Nentwig, 1980; Gunnarsson, 1996). The assemblage of insectivorous bird species can be expected to respond to this management due to the inherent trophic link between invertebrates and these birds (Gunnarsson, 1996; Gunnarsson and Wiklander, 2015).

It is recommended to avoid extensive removal of tree biomass at any one time to maintain habitat stability for woodland specialist invertebrates and prevent replacement by open-habitat species (Siira-Pietikäinen, Haimi and Siitonen. 2003). Periodic thinning and coppicing of trees as required can be utilised to encourage a diversity of specialist and generalist species (Maleque, Maeto and Ishii, 2009). Furthermore, maintaining a diversity of tree ages enhances the diversity of forest spider species (Oxbrough *et al.* 2005). Timings of management are recommended to take place between the months of September and February to prevent undue disturbance to breeding and nesting birds. The length of the rotational management period is subject to review of the rate of vegetation growth at the site to evaluate the frequency of coppicing required (Forest Research, 2023).

4.2.3 Ecotone management

Considering the low abundance of Slow-worm and absence of other reptiles inhabiting the site observed during this study, should the managing organisation be interested in promoting reptile interests, it is recommended that management for this taxonomic group consider the connectivity between adjacent habitats beyond the site boundaries. Ideally, a diverse age structure of scrub and trees should be created along the interface between habitats (ecotone), particularly those with a south-facing aspect. Here, we identify two zones that may enhance reptile habitat from favourable management. Firstly, the interface between the site and adjacent herbaceous grassland habitat located at the northern site boundary. Secondly, the southwestern portion of the site (Figure 7). These locations were chosen because they do not interface with roads immediately to the East and West. Therefore, providing the opportunities for favourable management without putting individuals locating the patch at exposure to risk from vehicles (Shine and Koenig, 2001). Scrub and tree management should be performed on a rotational basis to avoid complete removal of suitable habitat. Timing of management is recommended to occur between mid-September and February to prevent disturbance during bird nesting season (Edgar, Foster and Baker, 2010).

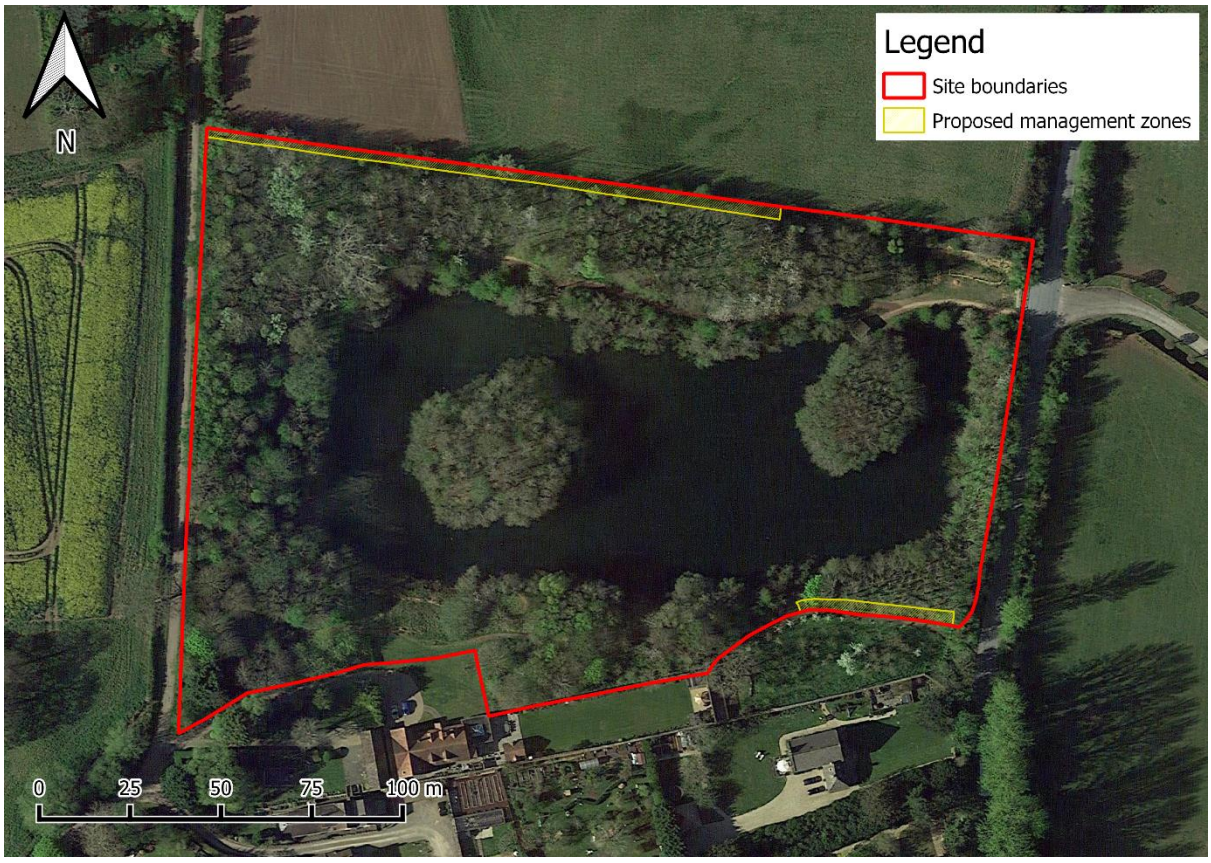

Figure 7: Map of proposed management zones for more specialised management interventions to enhance permeability of site boundaries for reptile species.

Where possible, it is recommended to maintain a few mounds of waste material arising from vegetation cutting near the site boundaries as potential egg-laying sites. These should be located where they receive either full or partial sunlight to provide the conditions necessary for sustained decomposition and egg incubation (Edgar, Foster and Baker, 2010). Enabling successful egg-laying is a good way to promote permanence at the site since repeated and communal use of nest sites is a common behaviour in several species of snake, including Grass Snake (Brown and Shine, 2005; Edgar, Foster and Baker, 2010).

5 Conclusion

The fragmentation of woodland habitats, particularly in Southern England, makes remaining patches of woodland a valuable commodity for biodiversity. This audit of Beckford Nature Reserve has revealed that the site hosts a good diversity of passerine bird and arboreal invertebrate species with little to no spatial variation. Thus, enhancement of these features should take a higher priority than those pertaining to reptiles given the absence of most species from this taxonomic group. It has been proposed that the woodland habitat present can be viewed as a single unit and that management strategies to promote persistence and enhancement of present features studied here can be generally applicable across the site and divided into three zones corresponding to the understory, canopy and ecotone. Future studies of biodiversity will be required at this site as it continues to mature to evaluate the effectiveness of management interventions and adapt these accordingly.

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Appendices

Appendix 1: Desk study data

(*continued overleaf*)

Table S1: Desk study data passerine, reptile and terrestrial invertebrate species historically recorded at Beckford Nature Reserve noting the year the species was last recorded, GB Red Data list status, UK BAP information and international conservation status. All data correct at time of recording.
LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered. CMS = Convention on Migratory Species.

Common name	Taxon	1 x 1 km OSGR	Year	GB Status	UK BAP	International Status
Blackbird	*Turdus merula*	SO9736	2023	LC		Birds Directive App. 2.2
Blackcap	*Sylvia atricapilla*	SO9736	2022	LC		
Blue Tit	*Cyanistes caeruleus*	SO9736	2023	LC		Bern App. 2
Bullfinch	*Pyrrhula pyrrhula*	SO9736	2014	LC	BAP 2007	
Carrion Crow	*Corvus corone*	SO9736	2022	LC		Birds Directive App. 2.2
Chaffinch	*Fringilla coelebs*	SO9736	2022	LC		
Chiffchaff	*Phylloscopus collybita*	SO9736	2022	LC		
Coal Tit	*Periparus ater*	SO9736	2022	LC		Bern App. 2
Dunnock	*Prunella modularis*	SO9736	2022	LC		Bern App. 2
Fieldfare	*Turdus pilaris*	SO9736	2022	CR (Breeding), LC (Non-breeding)		Birds Directive App. 2.2
Goldcrest	*Regulus regulus*	SO9736	2022	LC		Bern App. 2
Goldfinch	*Carduelis carduelis*	SO9736	2022	LC		Bern App. 2
Great Spotted Woodpecker	*Dendrocopos major*	SO9736	2023	LC		Bern App. 2
Great Tit	*Parus major*	SO9736	2023	LC		Bern App. 2
Greenfinch	*Chloris chloris*	SO9736	2022	EN		Bern App. 2
Grey Wagtail	*Motacilla cinerea*	SO9736	2015	NT		Bern App. 2
House Martin	*Delichon urbicum*	SO9736	2022	VU		Bern App. 2
House Sparrow	*Passer domesticus*	SO9736	2022	LC	BAP 2007	
Jackdaw	*Corvus monedula*	SO9736	2022	LC		Birds Directive App. 2.2
Eurasian Jay	*Garrulus glandarius*	SO9736	2022	LC		Birds Directive App. 2.2
Lesser Redpoll	*Acanthis cabaret*	SO9736	2015	LC	BAP 2007	Bern App. 2
Linnet	*Linaria cannabina*	SO9736	2022	NT	BAP 2007	Bern App. 2

Long-tailed Tit	*Aegithalos caudatus*	SO9736	2022	LC		
Magpie	*Pica pica*	SO9736	2023	LC		Birds Directive App. 2.2
Pied Wagtail	*Motacilla alba*	SO9736	2015	LC		Bern App. 2
Raven	*Corvus corax*	SO9736	2022	LC		
Redwing	*Turdus iliacus*	SO9736	2022	CR (Breeding), LC (Non-breeding)		Birds Directive App. 2.2
Reed Bunting	*Emberiza schoeniclus*	SO9736	2010	LC	BAP 2007	Bern App. 2
Robin	*Erithacus rubecula*	SO9736	2023	LC		Bern App. 2
Rook	*Corvus frugilegus*	SO9736	2022	NT		Birds Directive App. 2.2
Sand Martin	*Riparia riparia*	SO9736	2015	LC		Bern App. 2
Siskin	*Spinus spinus*	SO9736	2016	LC		Bern App. 2
Skylark	*Alauda arvensis*	SO9736	2022	LC	BAP 2007	Birds Directive App. 2.2
Song Thrush	*Turdus philomelos*	SO9736	2022	LC	BAP 2007	Birds Directive App. 2.2
Spotted Flycatcher	*Muscicapa striata*	SO9736	2009	LC	BAP 2007	Bern App.2; CMS App. 2
Starling	*Sturnus vulgaris*	SO9736	2023	VU	BAP 2007	Birds Directive App. 2.2
Barn Swallow	*Hirundo rustica*	SO9736	2022	LC		Bern App. 2
Treecreeper	*Certhia familiaris*	SO9736	2022	LC		Bern App. 2
White Throat	*Curruca communis*	SO9736	2015	LC		
Willow Warbler	*Phylloscopus trochilus*	SO9736	2015	LC		
Wren	*Troglodytes troglodytes*	SO9736	2023	LC		Bern App. 2
Grass Snake	*Natrix natrix*	SO9736	2010		BAP 2007	Bern App. 3
10-spot Ladybird	*Adalia decempunctata*	SO9736	2015			
2-spot Ladybird	*Adalia bipunctata*	SO9736	2015			
22-spot Ladybird	*Psyllobora vigintiduopunctata*	SO9736	2008			
7-spot Ladybird	*Coccinella septempunctata*	SO9736	2015			
Angles Shades	*Phlogophora meticulosa*	SO9736	1999			
Tree Damselbug	*Himacerus apterus*	SO9736	2008			

Brimstone	*Gonepteryx rhammi*	SO9736	2015	
Buff-tailed Bumblebee	*Bombus terrestris*	SO9736	2015	
	Capsus ater	SO9736	2008	
	Liocoris tripustulatus	SO9736	2008	
Comma Butterfly	*Polygonia c-album*	SO9736	2016	LC
Common Blue Butterfly	*Polyommatus icarus*	SO9736	2015	LC
Common Carder Bee	*Bombus pascuorum*	SO9736	2015	
	Anthocoris nemorum	SO9736	2008	
Common Field Grasshopper	*Chorthippus brunneus*	SO9736	1999	LC
	Philaenus spumarius	SO9736	2008	
	Nabis rugosus	SO9736	2008	
Darkling Beetle	*Lagria hirta*	SO9736	2008	LC
Dotted Beefly	*Bombylius discolor*	SO9736	2008	LC
Common Earwig	*Forficula auricularia*	SO9736	2008	LC
	Neocrepidodera ferruginea	SO9736	2008	LC
	Longitarsus jacobaeae	SO9736	2008	LC
	Chalcoides aurea	SO9736	2008	
	Oedemera noblis	SO9736	2008	
	Anthocoris confusus	SO9736	2008	
	Anthocoris nemoralis	SO9736	2008	
Gatekeeper	*Pyronia tithonus*	SO9736	2015	LC
	Leptopterna dolobrata	SO9736	2008	
	Stenodema laevigatum	SO9736	2008	
Green-veined White	*Pieris napi*	SO9736	2015	LC
	Pterostichus madidus	SO9736	2008	LC
	Scolopostethus thomsoni	SO9736	2008	
Common Groundhopper	*Tetrix undulata*	SO9736	2008	LC
Harlequin ladybird	*Harmonia axyridis*	SO9736	2008	

Holly Blue	*Celastrina argiolus*	SO9736	2015	LC
	Apis mellifera	SO9736	2008	
	Platycheirus scambus	SO9736	2008	
Kidney Spot Ladybird	*Chilocorus renipustulatus*	SO9736	2008	
Large White	*Pieris brassicae*	SO9736	2015	LC
	Aphrophora alni	SO9736	2008	
	Volucella zonaria	SO9736	2008	
	Phyllodecta laticollis	SO9736	2008	
	Eupteryx aurata	SO9736	2008	
	Oncopsis flavicollis	SO9736	2008	
	Brachypterus glaber	SO9736	2008	
Marbled White	*Melanargia galathea*	SO9736	2015	LC
Meadow Brown	*Maniola jurtina*	SO9736	2015	LC
Meadow Grasshopper	*Pseudohorthippus parallelus*	SO9736	1999	LC
	Carcina quercana	SO9736	2008	
	Cameraria ohridella	SO9736	2008	
	Anthrenus verbasci	SO9736	2008	NA
	Halyzia sedecimguttata	SO9736	2008	
Peacock	*Aglais io*	SO9736	2015	LC
Pine Ladybird	*Exochomus quadripustulatus*	SO9736	2008	
	Meligethes aeneus	SO9736	2008	
	Rhopalus subrufus	SO9736	2008	
Red Admiral	*Vanessa atalanta*	SO9736	2015	LC
	Catocala nupta	SO9736	2015	
	Myrmica rubra	SO9736	2008	
	Sphaeroderma rubidium	SO9736	2008	
Red-tailed Bumblebee	*Bombus lapidarius*	SO9736	2016	
Ringlet	*Aphantopus hyperantus*	SO9736	2016	LC

Silver Y Moth	*Autographa gamma*	SO9736	1999		
Silver-washed Fritillary	*Argynnis paphia*	SO9736	2018	LC	
Small Heath	*Coenonympha pamphilus*	SO9736	2015	NT	BAP 2007
Small Tortoiseshell	*Aglais urticae*	SO9736	2015	LC	
	Coccidula rufa	SO9736	2008		
	Lasius platythorax	SO9736	2008		
	Orius vicinus	SO9736	2008		
	Paradromius linearis	SO9736	2008	LC	
	Aridius nodifer	SO9736	2008		
	Orius majusculus	SO9736	2008		
	Tachyporus chrysomelinus	SO9736	2008	LC	
	Haliplus heydeni	SO9736	2008		
	Tychius picirostris	SO9736	2008		
	Hemicoelus fulvicornis	SO9736	2008	LC	
	Rhagonycha fulva	SO9736	2008	LC	
Speckled Bush-Cricket	*Leptophyes punctatissima*	SO9736	2008	LC	
Speckled Wood	*Pararge aegeria*	SO9736	2022	LC	
	Ceropales maculata	SO9736	2008		
	Tomocerus longicornis	SO9736	2008		
	Bombus hypnorum	SO9736	2015		
	Anaspis rufilabris	SO9736	2008	LC	
	Catapion seniculus	SO9736	2008		
	Apion assimile	SO9736	2008		
	Trichosriocalus troglodytes	SO9736	2008		
	Tychius melitoti	SO9736	2008		
	Sitona lineatus	SO9736	2008		
	Agapeta hamana	SO9736	2013		
	Agriphila geniculea	SO9736	2013		

	Agriphila straminella	SO9736	2013	
	Agriphilla tristella	SO9736	2013	
	Celypha lacunana	SO9736	2013	
	Chrysoteuchia culmella	SO9736	2013	
	Cochylis dubitana	SO9736	2013	
	Eudonia mercurella	SO9736	2013	
	Helcystogramma rufescens	SO9736	2013	
	Perinephela lancealis	SO9736	2013	
	Scoparia subfusca	SO9736	2013	
	Udea olivalis	SO9736	2013	
	Udea prunalis	SO9736	2013	
	Limax cinereoniger	SO9736	2008	LC
	Cidaria fulvata	SO9736	2013	
	Laspeyria flexula	SO9736	2013	
	Yponomeuta evonymella	SO9736	2013	
	Plemyria rubiginata	SO9736	2013	
	Opisthograptis luteolata	SO9736	2013	
	Noctua fimbriata	SO9736	2013	
	Cepaea nemoralis	SO9736	2008	
	Habrosyne pyritoides	SO9736	2013	
	Spilosoma luteum	SO9736	2013	
	Phalera bucephala	SO9736	2013	
	Oxychilus cellarius	SO9736	2008	
	Cilix glaucata	SO9736	2013	
	Lomographa temerata	SO9736	2013	
	Hemithea aestivaria	SO9736	2013	
	Eilema lurideola	SO9736	2013	
	Eupithecia vulgata	SO9736	2013	

	Mesapamea secalis	SO9736	2013		
	Neuroterus quercusbaccar	SO9736	2008		
	Mythimna pallens	SO9736	2013		
	Cabera pusaria	SO9736	2013		
	Craniophora ligustri	SO9736	2013		
	Apamea monoglypha	SO9736	2013		
	Pandemis heparana	SO9736	2013		
	Xanthorhoe ferrugata	SO9736	2013		BAP 2007
	Eilema griseola	SO9736	2013		
	Clausilia bidentata	SO9736	2008		
	Xestia triangulum	SO9736	2013		
	Cosmia trapezina	SO9736	2013		
	Arion subfuscus	SO9736	2008		
	Ennomos fuscantaria	SO9736	2013		BAP 2007
	Emmelina monodactyla	SO9736	2013		
	Eriophyes leiosoma	SO9736	2008		
	Aceria erineus	SO9736	2008		
	Aceria pseudoplatani	SO9736	2008		
	Coprinus disseminatus	SO9736	2008		
	Axylia putris	SO9736	2013		
	Ochropleura plecta	SO9736	2013		
	Aceria macrochelus	SO9736	2008		
	Liposthenus glechomae	SO9736	2008		
	Jaapiella veronicae	SO9736	2008		
	Aceria macrorhynchus	SO9736	2008		
	Iteomyia caprae	SO9736	2008		
	Eriophyes inangulis	SO9736	2008		
	Araneus diadematus	SO9736	2008	LC	

	Helix aspersa	SO9736	2008		
	Oxychilus draparnaudi	SO9736	2008		
	Arion ater	SO9736	2008		
	Limax maximus	SO9736	2008	LC	
	Trichia hispida	SO9736	2008		
	Leiobunum rotundum	SO9736	2008		
	Dicranopalpus ramosus	SO9736	2008		
	Scythropia crataegella	SO9736	2013		
	Scoliopteryx libatrix	SO9736	2013		
	Notodonta dromedarius	SO9736	2013		
	Monacha cantiana	SO9736	2008		
	Archips podana	SO9736	2013		
	Xanthorhoe quadrifasiata	SO9736	2013		
	Noctua pronuba	SO9736	2013		
	Noctua janthe	SO9736	2013		
	Abraxas grossulariata	SO9736	2013		
	Acronicta leporina	SO9736	2013		
	Cylindroiulus punctatus	SO9736	2008	LC	
	Pleuroptya ruralis	SO9736	2013		
	Alcis repandata	SO9736	2013		
	Caradrina morpheus	SO9736	2013		BAP 2007
	Nudaria mundana	SO9736	2013		
	Deroceras reticulatum	SO9736	2008		
	Pisaura mirabilis	SO9736	2008	LC	
	Hepialus sylvina	SO9736	2013		
	Yponomeuta padella	SO9736	2013		
	Neuroterus anthracinus	SO9736	2008		
	Biston betularia	SO9736	2013		

	Ditula angustiorana	SO9736	2013		
	Mesoligia literosa	SO9736	2013		
	Discus rotundatus	SO9736	2008		
	Phragmatobia fuliginosa	SO9736	2013		
	Eilema complana	SO9736	2013	R	
	Ligdia adustata	SO9736	2013		
	Xestia c-nigrum	SO9736	2013		
	Scotopteryx chenopodiata	SO9736	2013		BAP 2007
	Agrotis puta	SO9736	2013		
	Neuroterus numismalis	SO9736	2008		
	Idaea biselata	SO9736	2013		
	Eurrhypara hortulata	SO9736	2013		
	Diarsia rubi	SO9736	2013		BAP 2007
	Mythimna impura	SO9736	2013		
	Aegopinella nitidula	SO9736	2008	LC	
	Neuroterus albipes	SO9736	2008		
	Hypena proboscidalis	SO9736	2013		
	Abrostola tripartita	SO9736	2013		
	Evarcha falcata	SO9736	2008	LC	
	Metellina sp.	SO9736	2008	LC	
	Xestia xanthographa	SO9736	2013		
	Trichia striolata	SO9736	2008		
	Pheosia tremula	SO9736	2013		
	Ourapteryx sambucaria	SO9736	2013		
	Rhytisma acerinum	SO9736	2008		
	Oligia latruncula	SO9736	2013		
	Idaea trigeminata	SO9736	2013		
	Xestia ditrapezium	SO9736	2013		

	Hoplodrina alsines	SO9736	2013	
	Trichoniscus pusillus	SO9736	2008	LC
	Acentria ephemerella	SO9736	2013	
	Enoplognatha sp.	SO9736	2008	
	Pterophorus pentadactyla	SO9736	2013	
	Cepaea hortensis	SO9736	2008	
	Lomographa bimaculata	SO9736	2013	
	Porcellio scaber	SO9736	2008	LC
	Camptogramma bilineata	SO9736	2013	
	Acasis viretata	SO9736	2013	

Appendix 2: Phase 1 Habitat Survey and target notes

Target Notes

OSGR 1 x 1 km: SO9736

1	SO977360	19/04/2023 DG	Woodland; Broadleaved; Semi-natural. *Fraxinus excelsior* dominant. Ground flora dominated by *Hedera helix*. Two young *Populus nigra* present by water edge.
2	SO977360	19/04/2023 DG	Woodland; Broadleaved; Plantation. Dominated by *Pyrus sp.* Species-poor ground flora and mown sward. *Bellis perennis* frequent.
3	SO976360	19/04/2023 DG	Woodland; Broadleaved; Semi-natural. *Cornus sanguinea* locally dominant. Ground flora dominated by *Hedera helix* and *Anthriscus sylvestris.*
4	SO976360	19/04/2023 DG	Other tall herb or fern; Ruderal. Ground flora containing *Ranunculus sp., Primula vulgaris* and *Dipsacus sp.* Most well-sunned area onsite. Potentially good for basking reptiles.
5	SO975360	19/04/2023 DG	Woodland; Broadleaved; Semi-natural. No dominant tree species apparent. Ground flora dominated by *Anthriscus sylvestris*. Burrows present.
6	SO977361	19/04/2023 DG	Artificial exposure; Quarry. Exposure from historic mineral extraction. Designated SSSI. Potentially suitable for solitary bees and Riparia riparia.
7	SO981361	19/04/2023 DG	Standing water; Eutrophic. Water-filled extraction pit. Previously used for gravel extraction. Marginal broadleaved vegetation including *Salix sp.* and *Alnus glutinosa.*

8	SO979359	19/04/2023 DG	Amenity grassland; Mown. Parcel of *Salix sp.* scrub to south with ground flora dominated by *Urtica dioica.* Grades into mixed woodland towards east.
9	SO979360	19/04/2023 DG	Standing water; Eutrophic. Marginal vegetation including *Juncus sp., Typha sp.* and pollarded *Salix sp*. on east bank. Conifer plantation on west bank.
10	SO975358	19/04/2023 DG	Grassland; Improved. Graveyard with mown sward. Headstones potentially good for lichens and Coccinellidae sp. colonies.
11	SO970362	19/04/2023 DG	Running water; Eutrophic; Stream. Dense overshading scrub and marginal pollarded Salix sp.
12	SO973360	19/04/2023 DG	Arable land. Scattered mature trees including *Quercus sp*.
13	SO974360	19/04/2023 DG	Grassland; Improved. Horse-grazed. Scattered trees including *Quercus sp.* Parcel of dense scrub in northeast.
14	SO974363	19/04/2023 DG	Intact hedge. Aesculus hippocastanum scattered in northward direction. Tree trunks hosting fungi.

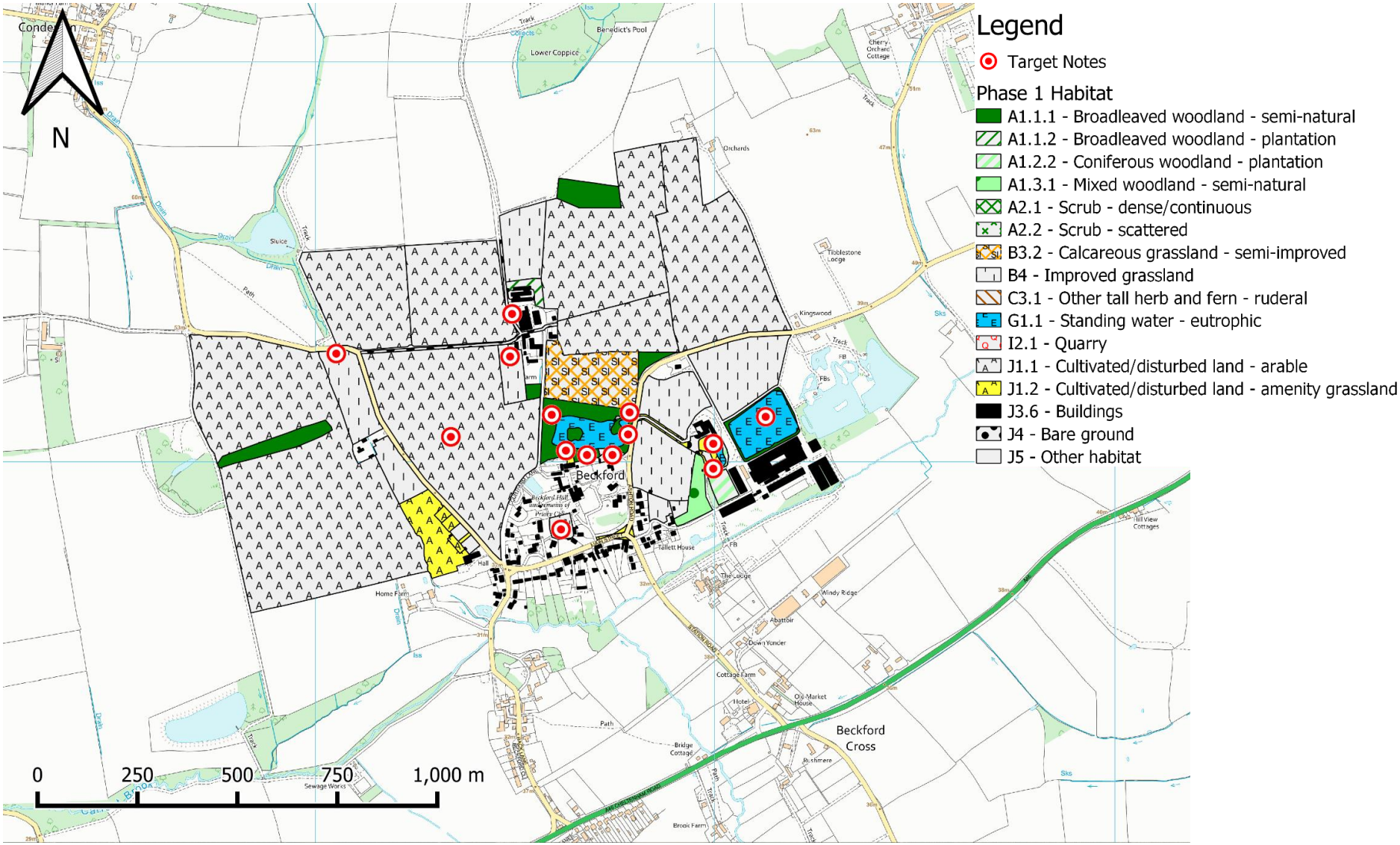

Figure S1: Map of Phase 1 habitat cover at Beckford Nature Reserve and immediate surrounding landscape. Scale: 1:10000 @ A3.