



Collating and disseminating England's wood-pasture and parkland inventory – data capture contract for the West Midlands Government Region

**Report to:
Natural England**

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March 2009



Acknowledgements

We are grateful to Suzanne Perry and Jeff Edwards of Natural England for their supervision of this work, and to members of the Steering Group for helpful advice and comment: Suzanne Perry, Jeff Edwards and Tim Dixon (Natural England); Chris Mayes (Herefordshire Council); David Lovelace (Herefordshire Native Wood Restoration Project); Justin Milward, Sian Atkinson and Jill Butler (Woodland Trust); Becky Lashley (Worcestershire Ancient Tree Project); and, Helen Woodman (Worcestershire Wildlife Trust).

Jim Mullholland from JUST ECOLOGY carried out the ground-truthing, as well as volunteers from the Worcestershire Ancient Tree Project, ably steered by Becky Lashley, and we express our gratitude to all.

A great many people contributed maps, data or other information for the inventory and we are indebted for their cooperation and enthusiasm for the project. These included: Chris Mayes (Herefordshire Council); Andrew George (Lichfield Record Office); Gordon Baker (National Trust); Brian Crumley and Rob Morris (Natural England); Liz Young (Shropshire Archives); Carmen Mayo and Shaun Burkey (Shropshire County Council); Robin Mager and Jan McKelvey (Shropshire Wildlife Trust); Craig Slawson (Staffordshire Ecological Record); Louise Flanagan (The GeoInformation Group); Jill Butler, Nick Collinson, Chris Hickman and Katherine Owen (The Woodland Trust); Dave Lowe *et al.* (Warwickshire County Council); Mike Shaw (Wolverhampton City Council); Becky Lashley and Simon Wood (Worcestershire Biological Records Centre); Emma Hancox (Worcestershire County Council); and, Ann Fells and Michael Liley (Worcestershire Wildlife Trust). Apologies to anyone inadvertently missed!

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1 Executive summary

- 1.1 Wood-pasture and parkland are a habitat resource of European level significance and the subject of a Biodiversity Habitat Action Plan agreed at the UK level. However, the true distribution and extent of the resource within Britain is currently unknown. Such information is key to the effective management of this habitat and to the delivery of many of the targets identified within the action plan.
- 1.2 This project sought, for the West Midlands Region only, to update and improve upon a crude national inventory of wood-pasture and parkland, whilst at the same time seeking to investigate the potential data sources and develop rules for the capture and analysis of data for wood-pasture and parkland.
- 1.3 A rules base for wood-pasture and parkland inventory work was developed, to guide this work and future updates of the inventory. Topics included cover: definition and recognition of the habitat; working methods for adding to the inventory; data capture rules; and dealing with key issues in mapping and discriminating wood-pasture and parkland from other habitats.
- 1.4 A provisional inventory for wood-pasture and parkland in the West Midlands Region is presented, based primarily on a collation of existing national, regional and local data sets, reference to old maps and aerial photography, supplemented by ground-truth information in selected pilot areas.
- 1.5 The results for this project alone suggest a total area of at least 28,688 ha of wood-pasture and parkland within the West Midlands region. Of the area studied, 0.38% was ground truthed. This can be compared with a previous UK best estimate of only 35,100 ha of wood-pasture and parkland (2002 estimate), and only 22,000 ha in England. Further wood pasture and parkland may occur in the West Midlands outside the study area but this is thought to be a smaller amount. Technical detail is provided for the inventory allowing readers to understand how the inventory was built and how the information was processed within it.
- 1.6 Ground-truthing of preliminary inventory polygons in two pilot study areas allowed some initial difficulties with the identification of wood-pasture from historic Ordnance Survey maps, and from aerial photographs, to be addressed. Analysis of a series of historic maps allowed apparent changes in wood-pasture and parkland area to be examined, although concerns over the accuracy of historic maps for this habitat cast doubt over the accuracy of the change estimates derived.
- 1.7 The usefulness of the various information sources for wood-pasture and

parkland inventory is discussed with a view to assisting future work. So too is the coverage achieved for the West Midlands Region inventory which, given gaps in the available information, should still be regarded as provisional.

- 1.8 Nevertheless, it is hoped that the updated wood-pasture and parkland inventory for the West Midlands Region will be useful in informing and enabling targeting of agri-environment schemes, in influencing planning decisions, and in helping to assess the success of policy instruments designed to assist the conservation of this important habitat.

2 Introduction

Wood-pasture and parkland habitat

- 2.1 Wood-pastures and parklands are areas that have been managed by a long-established tradition of grazing allowing, where the site is in good condition, the survival of multiple generations of trees, characteristically with at least some veteran trees or shrubs (UK Biodiversity Action Plan, 2008). The tree and shrub component may have been exploited in the past and can occur as scattered individuals, small groups, or as more or less complete canopy cover. Depending on the degree of canopy cover, other semi-natural habitats including grassland, heath, scrub *etc.* may occur in mosaic with woodland communities. While oak, beech, alder, birch, ash, hawthorn, hazel or pine are often dominant, a wide range of other tree and shrub species may occur as part of wood-pasture systems.
- 2.2 Wood-pastures and parkland are the products of historic land management systems, and represent a vegetation structure rather than being a particular plant community. Typically this structure consists of large, open-grown or high forest trees (often pollards) at various densities, in a matrix of grazed grassland, heathland and/or woodland floras.
- 2.3 In terms of the National Vegetation Classification (NVC) of plant communities lowland wood-pastures and parkland are most commonly associated with W10 *Quercus robur* - *Pteridium aquilinum* – *Rubus fruticosus* woodland, W14 *Fagus sylvatica* - *Rubus fruticosus* woodland, W15 *Fagus sylvatica* - *Deschampsia flexuosa* woodland and W16 *Quercus* spp. - *Betula* spp.- *Deschampsia flexuosa* woodland, although others may occur. Upland examples may show more resemblance to W11 and W17 woodland types. In addition the more open wood-pastures and parkland may include various scrub, heathland, improved and unimproved grassland NVC communities.

- 2.4 This habitat is most common in southern Britain, but scattered examples occur throughout the country for example Hamilton High Parks and Dalkeith Oakwood in Scotland, Glenarm in Northern Ireland and Glenamarra Park in the Lake District. Recently it has been recognised as also being widespread in the uplands. Outgrown wood-pasture and mature high forest remnants (virgin forests) occur in northern and central Europe, but the number and continuity of ancient (veteran) trees with their associated distinctive saproxylic fauna, saprotrophic and mycorrhizal fungi and epiphytic flora are believed to be more abundant in Britain than elsewhere.
- 2.5 Parklands and wood-pasture may also be of interest for bats and birds and may preserve indigenous tree genotypes. Wood-pasture and parkland sites are frequently of national historic, cultural and landscape importance, for example in the New Forest. Some areas are outstanding at a European level.

UK Wood-pasture and Parkland Habitat Action Plan

- 2.6 In 1998, the Habitat Action Plan (HAP) for Lowland Wood-pasture and Parkland was produced by the UK Biodiversity Group. It is one of a series of habitat and species action plans produced to implement the UK Biodiversity Action Plan (UKBAP).
- 2.7 The objectives and targets for Lowland Wood-pasture and Parkland habitat were:
- Maintain the current extent and distribution of the total resource of wood-pasture and parkland.
 - Maintain the current extent, distribution and condition of wood-pasture and parkland that is in favourable ecological condition.
 - Initiate in areas where examples of derelict wood-pasture and parkland occur a programme to restore 2,500 ha to favourable ecological condition by 2010.
 - By 2002 initiate the expansion of 500 ha of wood-pasture or parkland, in appropriate areas, to help reverse fragmentation and reduce the generation gap between veteran trees.
- 2.8 This HAP gave a best estimate of 10-20,000 ha of wood-pasture and parkland 'currently in a working condition' in the UK (although this condition can only be assessed through ground truthing). The most recent estimate from the Biodiversity Action Reporting System (www.ukbap-reporting.org.uk), made in 2002, is for 35,100 ha of lowland wood-pasture and parkland in the

UK, and 22,000 ha in England alone.

- 2.9 The recent UK BAP review (Biodiversity Reporting and Information Group, 2007) has extended the HAP to include upland sites as well as lowland ones. It also measures targets as numbers of sites rather than area. The total area of wood-pasture and parkland in England is currently unknown.

Habitat inventories

- 2.10 Knowing the area of a habitat and its distribution is important to all who seek to conserve and manage this important historical resource. Habitat inventories are important because they:

- Can inform and enable targeting of agri-environment schemes and maximise the contribution of these policies to the UKBAP and the England Biodiversity Strategy.
- Enable local and regional planning authorities to identify networks of semi-natural habitat and hence make a full contribution to the BAP process through the planning system.
- Provide a sampling framework for assessing and reporting on outcomes from a range of policy instruments – including agri-environment schemes.
- Make a useful contribution to the protection of priority habitats.

- 2.11 Given this, English Nature commissioned various studies of wood-pasture and parkland (Alexander & Lister, 2003; Harvey *et al.* 2004; Reid & Wilson, 1995; Webb & Bowler, 2001) whilst, in early 2008, Natural England commissioned a project that aimed to assess the state of knowledge on the status and location of wood-pasture and parkland sites across all counties of England (Lush *et al.* 2008).

- 2.12 This latter project covered the whole of England to create a rough inventory only, though more detailed investigations were made in Cumbria, Durham, Warwickshire and Suffolk. Wood-pasture and parkland polygons were mapped to historic boundaries or as grid references where such information did not exist, with attributes where they were available including those relating to BAP content, management, veteran trees, designations, historical details and saproxylic invertebrates. Even with this information all the important sites may not have been identified as other attributes, including fungi and lichen data, was not included.

- 2.13 In addition, the Woodland Trust Ancient Tree Hunt have made significant

progress in identifying the locations of individual ancient and veteran trees which has helped inform the development of the final dataset.

Project objectives

- 2.14 Defra and its partners in the UK BAP process have a well defined requirement for collating inventories of various habitats, although for wood-pasture and parkland the feasibility of this required some further clarification.
- 2.15 This project therefore sought to update the wood-pasture and parkland inventory for the West Midlands Region, and more specifically to:
1. Create a wood-pasture and parkland provisional inventory for the West Midlands Region, primarily from collating existing data sets, reference to old maps and aerial photography, and supplemented by ground-truth information.
 2. Develop a rules base for wood-pasture and parkland inventory development to guide this work and future updates.
 3. Ground-truth the rules base in two or three sample areas.
- 2.16 For the purposes of this project, the West Midlands Region was defined to include the counties of Warwickshire (including Coventry & Solihull), Staffordshire (including Stoke), Shropshire (including Telford & Wrekin), Herefordshire and the unitary authorities of Birmingham and the Black Country.
- 2.17 It is envisaged that the updated wood-pasture and parkland inventory for the West Midlands Region will be used to inform and target agri-environment schemes, influence planning decisions and assess the success of policy instruments.

Report structure and content

- 2.18 This report contains: the developed rules base (Chapter 3; Appendix 1); technical detail and results from the provisional inventory (Chapter 4; Appendices 2 and 3); and, results obtained from ground-truthing of the rules base and inventory (Chapter 5). To assist the reader, technical detail is largely presented within the appendices to the report, leaving the main body of the report to focus on results and discussion.
- 2.19 An overall discussion is presented in Chapter 6 of the report.

3 The wood-pasture and parkland rules base

- 3.1 A rules base was developed for the wood-pasture and parkland inventory, to guide the creation of the inventory, to assist with ground-truthing, and to allow future updates of the inventory to be undertaken in a consistent manner.
- 3.2 The rules base provides details of the wood-pasture and parkland habitat definition, as well as the habitat components that are included and not-included in the inventory (Appendix 1). A useful summary diagram is presented for helping to judge whether a site is/was a wood-pasture.
- 3.3 The rules base provides a general working method for the assessment and capture of data to the inventory, including a decision-making tree for site assessment (Appendix 1). Working methods are presented for the inclusion of previously available habitat polygons and for the capture of new habitat polygons, e.g. from paper data sources. It provides for key decisions to be recorded and contains guidance for the attribution of the polygons and the table structure used for the inventory.
- 3.4 The rules base explains what to do when two or more datasets provide contrasting results about the habitat make-up of a particular area, and also how to use aerial photography to support decisions taken for data capture. It also explains how sites that lie on the border of the project area have been treated.
- 3.5 The rules base provides details on the key issues with mapping and discriminating wood-pasture and parkland from other habitats. Data capture rules are provided as follows, together with the adopted boundary and digitising standards:
 1. A wood-pasture or parkland must contain a minimum of 3 trees (see Appendix 1), excluding boundary trees. Areas consisting entirely of young trees should not usually be mapped unless there is a known intention to manage them as wood-pasture or parkland.
 2. A tree is defined as an area of canopy not exceeding 15 m in diameter.
 3. Each tree within a wood-pasture or parkland must be no more than 250 m from another tree.
 4. The edge of the habitat is determined by mapping around the outside of the tree canopies. The edge should not span a distance of greater than 250 m between trees.
 5. Where trees are no more than 100 m from a boundary feature, the habitat is mapped to the boundary feature.
 6. The habitat boundary can be extended to include obvious large trees

within boundary features that are no more than 250 m from a wood-pasture or parkland tree.

7. The habitat boundary can also be extended to include standing dead trees, although these may well have a canopy of <15 m.
8. Trees following rivers and streams should be treated as falling within boundary features.
9. Habitat areas, or parts thereof, of only one tree width (i.e. less than 15 m) are not allowed.
10. Cemeteries and churchyards should not be included, even if they contain large trees, unless they are within an area otherwise identified as parkland. Gardens should also be excluded where they fail to include sufficient trees. Orchards, defunct or otherwise, as another priority habitat type should be excluded.
11. Defunct wood-pasture may have a closed canopy and resemble woodland. If there is evidence that it has been wood-pasture and still contains large trees it should be captured as defunct wood-pasture.
12. Areas that appear to be wood-pasture or parkland on aerial photographs should not be captured unless they are supported by other evidence, including historical maps. A process for assessing the confidence attached to these assessments is outlined in Appendix 1, with the levels of confidence for each area recorded in the inventory.
13. Clusters of trees in urban areas identified using aerial photographs that were once wood-pasture or parkland should be treated as low confidence, as the likelihood that they are now part of more modern landscaping is high.

- 3.6 It should be emphasised that the rules base is a working document and subject to update on account of experience with mapping from existing data sources and/or in the field. The rules base only allows for accurate mapping and quantification of wood-pasture and parkland habitat; habitat quality assessment requires ground-truthing to be undertaken. It is important to ensure that the latest draft of the rules base is obtained (contact Suzanne Perry at Natural England) before any future work on the inventory is undertaken.

4 The provisional wood-pasture and parkland inventory

Introduction

- 4.1 The key objective of this project was to create a provisional inventory for wood-pasture and parkland in the West Midlands Region, primarily from collating existing data sets, reference to old maps and aerial photography, and supplemented by ground-truth information (see Chapter 5). From this, a provisional estimate of the amount of wood-pasture and parkland habitat in this region can be derived.

Data sourcing

- 4.2 The data required for the inventory were sought from web sources and organisations and individuals thought likely to have access to useful information, by contacting them directly by telephone and email. A full list of organisations and individuals contacted is provided in Appendix 2.
- 4.3 A wide variety of information sources were investigated and assessed, some of which proved useful and some of which did not. As well as maps and aerial photographs, Information was sought on wood-pasture and parkland habitats and veteran trees. National, regional, county and local information sources were explored and utilised, as explained further in the following accounts.

Data from the previous project

- 4.4 The basis for this work was the inventory created by Lush *et al.* (2008), which had resulted in 3,342 wood-pasture and parkland polygons entered into a MapInfo GIS, with 735 sites known from grid references only. The national datasets this inventory drew upon mostly consisted of:
- English Heritage: Register of Parks and Gardens.
 - National Trust Habitat Database.
 - Woodland Trust Ancient Tree Hunt database.
 - Woodland Trust Provisional Wood Pasture and Parkland evaluation – England.
- 4.5 Although a useful start, it should be noted that this dataset had limitations Lush *et al.* (2008):
- Some data were known to be incomplete or inaccurate.
 - Very few polygons had been assessed such that the confidence of wood-pasture and parkland could be identified.

- Additional work was required in two main areas:
 - Elimination of non- wood-pasture and parkland sites.
 - Mapping of sites known only from grid references.
- 4.6 The polygons in the West Midlands Region were extracted from this dataset for checking and updating with additional data.

Ordnance Survey maps

- 4.7 Six sets of Ordnance Survey (OS) maps were obtained from which to locate wood-pasture and parkland and/or assess those boundaries identified in existing datasets.
- 4.8 First to fourth epoch OS County Series maps were made available by Natural England. The coverage of these maps for all parts of the region was variable (see Chapter 5), though epoch one and two maps were usually available. Nationally, these maps date from the following periods:
- Epoch 1: first edition published between 1843 and 1893.
 - Epoch 2: first revision published between 1891 and 1912.
 - Epoch 3: second revision published between 1904 and 1939.
 - Epoch 4: third revision published between 1919 and 1943.
- 4.9 The makers of these maps attempted to mark the location of every tree, rather than using the representative symbols of modern maps, and therefore provided a highly useful dataset for identifying parklands. While primarily used to assess the boundaries identified in existing datasets and add confidence to the identification process, those 1 km x 1 km tiles that were being displayed for assessment of these datasets were also fully checked for the presence of the habitat.
- 4.10 Current OS MasterMap was supplied by Natural England. This could not easily be used to identify parklands or wood-pastures, but was used for mapping the boundaries precisely.
- 4.11 OS Landranger 1:50,000 maps printed in 2005 were searched manually for areas mapped as parklands, which were shaded grey and thus easy to distinguish.

Dudley Stamp maps

- 4.12 Other map sources assessed included the Dudley Stamp compiled between 1931 and 1934 for a land use survey of the whole of Britain. The original field maps were hand-coloured by land parcel and land use, providing an incredibly detailed record, with much of the fieldwork undertaken by school children. These maps were summarised into larger-scale maps that showed less detail.
- 4.13 To explore the potential use of these maps, digital large-scale Dudley Stamp maps were obtained for Worcestershire. These maps were critically examined to determine any potential use for identifying wood-pasture and parkland. The smaller-scale field maps were not available to be assessed.
- 4.14 The large-scale maps do not show field boundaries or other details, so can only be used indicatively due to differences between the base map and modern mapping. The maps were found to show parkland, but only because parkland trees were marked on the underlying base map. Wood-pasture and parkland were otherwise undistinguished from other land uses. Woodlands were shown in green, though it was not clear whether this included scrub or what lower limit of tree density was used.
- 4.15 Because of the low resolution of the Dudley Stamp maps available and because they did not distinguish wood-pasture and parkland any better than the underlying base map, they were considered unlikely to provide significant additional information for this project. Should the original field maps become available in the future they would provide a much more useful resource.

Tithe and field name maps

- 4.16 Tithe maps were investigated for use in this project as an important first systematic mapping survey of most of the land in England and Wales prior to the OS Epoch 1 1:2500 maps from 1836 onwards. The maps are available separately for different parishes and provide information about land use through:
- Their illustration of tree cover.
 - Their cross referencing with the associated tithe apportionments that record the state of cultivation of each tithe area or a description of the premises.
 - Their cross referencing with the later compiled 'field name maps' that label each tithe area with the description as per the tithe apportionment document.
- 4.17 The usefulness of tithe maps and field name maps was investigated only in a limited way, as part of the ground-truth exercise for this project, and the results are provided within Chapter 5 below and discussed within Chapter 6.

Historic aerial photography

- 4.18 Wartime (1940s) aerial photography was evaluated for use in this project as they record a period of time in-between that of the historic OS maps and the UK perspectives aerial photography (see below).
- 4.19 Although county-level digital sources were potentially available for Herefordshire (David Lovelace, pers. comm.), no county level digital sources were identified for other parts of the region (e.g. Shropshire, Staffordshire or Worcestershire).
- 4.20 National digital sources were investigated, revealing the Cities Revealed Historical Aerial Photography dataset provided by The GeoInformation Group. However, significant gaps in coverage were apparent and, as with the tithe maps, it was decided to trial the use of this data source to just one area as part of the ground-truth exercise for this project. Results are provided within Chapter 5 below and discussed within Chapter 6.

UK Perspective Aerial photographs

- 4.21 First and second edition UK Perspective Aerial Photographs were supplied under licence by Natural England. The first edition photographs date from 1999 to 2004, with the second edition photographs, where available, taken subsequently. Again, while primarily used to assess the boundaries identified in existing datasets and add confidence to the identification process, those 1 km x 1 km tiles that were being displayed for these datasets were also fully checked for the presence of the habitat.

English Heritage: Register of Parks and Gardens

- 4.22 The Register of Parks and Gardens of special historic interest in England was downloaded from the English Heritage website, in case any updates had been made since the previous project (Lush *et al.* 2008). It is a spatial dataset in polygon format, covering all registered parks and gardens, and included the site name and grade for each site as follows:
- Grade II – includes the majority of sites, which are of sufficiently high level of interest so as to merit a national designation.
 - Grade II* - includes the 30% of sites that are considered to be of exceptional historic interest.
 - Grade I – includes the 10% of sites that are considered to be of international importance.
- 4.23 However, some of the sites included, especially gardens, did not match the UK BAP definition for parkland and were not historically parkland (e.g. churchyards, cemeteries and gardens and other areas without qualifying habitat). Therefore, all West Midland sites in the dataset were checked using the rules base and non-qualifying sites were excluded.

Woodland Trust Ancient Tree Hunt updates

4.24 The Woodland Trust provided an update (14th January 2009) of the verified records from the Ancient Tree Hunt database for the West Midlands. These data were provided in spreadsheet format and included the following, among other details:

- OS grid reference.
- Tree species.
- Veteran status (notable, veteran or ancient).
- Access information.
- Details about the physical form and condition of the tree.
- Site name, where known.
- Provider organisation (i.e. Ancient Tree Forum; Ancient Yew Group; Elm Map (Natural History Museum); National Trust; Shropshire Countryside Service; Shropshire Hills AONB; The Woodland Trust; Tree Register of the British Isles; Warwickshire Museum; Worcestershire Wildlife Trust).

Registered Common Land

4.25 The database of Registered Common Land was obtained from Natural England Access and Rights of Way. It is a spatial database, in polygon format that included, amongst other details, the name of the common.

Environmental Stewardship data

4.26 Fields listed as T03, i.e. Wood-pasture and parkland in Environmental Stewardship Farm Environmental Plan (FEP) data, were supplied by Natural England. This was supplied in spreadsheet format with grid references, as well as other data, for each field.

Worcestershire Ancient Tree Project

4.27 At the time of update, The Woodland Trust Ancient Tree Hunt had not incorporated veteran tree records from the Worcestershire Ancient Tree Project, so these were obtained from the Worcestershire Biological Records Centre. This was in spreadsheet format and included the following, among other details:

- Tree species.
- Tree measurements.
- Surrounding habitat.
- Information on the growth form and status of the tree.
- Site name.
- OS grid reference.

Worcestershire Habitat Inventory

- 4.28 Polygons classified as 'Lowland wood-pasture and parkland' in the 'Management' field of the inventory were selected and supplied by Worcestershire Biological Records Centre. As well as this management field, the database also contained a comments field that gave some indication of site name and how the site was identified.

Worcestershire Wildlife Trust Special Wildlife Site Review

- 4.29 Worcestershire Wildlife Trust provided a list of possible wood-pasture and parkland sites from their Special Wildlife Sites Review. For each, the site name, district and centroid grid reference was provided.

Worcestershire registered and unregistered parks and gardens

- 4.30 The Historic Land Character assessment of Worcestershire is currently only in its pilot stage.
- 4.31 However, information on registered and unregistered parks and gardens was provided by Worcestershire Historic Environment and Archaeology Service. This included a spatial database, in polygon format, that detailed what features are present within each site, e.g. park, garden, deer park.

Shropshire parks and gardens

- 4.32 A spatial database, in polygon format, of all the sites characterised as "parks and gardens" by the Shropshire Historic Land Character (HLC) assessment was provided by Shropshire County Council. The database itself contained no other useful identifying information, and the Shropshire HLC does not contain a category that directly identifies wood-pasture.

Shropshire Wildlife Trust possible sites

- 4.33 Shropshire Wildlife Trust provided all the sites they believe are wood-pasture and parkland. This spatial database, in polygon format, also included the name of each site.

Shropshire County Council site locations

- 4.34 Shaun Burkey, a member of SCC's Conservation Team and Shropshire Lowland Wood Pasture, Parkland & Veteran Trees BAP lead partner, provided a list of names and grid references of parkland in the north of the county.

Herefordshire historic parks and gardens

- 4.35 Herefordshire County Council provided a spatial database, in polygon format, of historic parks and gardens. The database included name, status (confirmed or otherwise) and a comments field indicating the registered status of the site and other identifying information.

- 4.36 The Herefordshire HLC, like Shropshire, does not contain a category that directly identifies wood-pasture.

The Black Country HLC

- 4.37 Mike Shaw, The Black Country Archaeologist, supplied spatial databases, in polygon format, for all the categories from The Black Country HLC that could be used to identify wood-pasture and parkland sites. The categories were:

- Ancient unenclosed pasture.
- Paddocks and closes.
- Recreational.
- Woodland.

- 4.38 Each database included the following, among other details:

- Broad Type.
- HLC Type.
- Name.
- Summary – included details of how the site was identified.
- Confidence.
- Period.

- 4.39 Again, like Herefordshire and Shropshire, The Black Country HLC does not contain a category that directly identifies wood-pasture.

Staffordshire Habitat Layer

- 4.40 Staffordshire Ecological Record supplied the habitat layer for the county and additional data from English Nature Research Report 416 - *County surveys of parkland: The Staffordshire Experience 2001* (Webb & Bowler 2001).

- 4.41 The habitat layer consists of two spatial databases, one polygon and one line format. The database closely approximates the National Inventory data-structure, but with certain fields having specific uses in Staffordshire. The important fields are:

- S1HabClass - this holds the habitat system. All the parkland survey data is phase 1, as is the majority of the habitat layer.
- S1HabType - this holds the main habitat for the item.
- S2HabType - this hold any secondary habitat.

4.42 Three queries were used to select polygons that possibly contained wood-pasture and parkland:

1. Those that had the 2001 parkland survey as a source.
2. Those that contained parkland/scattered trees (Phase 1 codes A31-33) as their main habitat (S1HabType).
3. Those that contained parkland/scattered trees (Phase 1 codes A31-33) as their main habitat (S2HabType).

Warwickshire and Solihull HLC

4.43 A spatial database, in polygon format of all the sites characterised as “current parks and gardens” by the Warwickshire and Solihull HLCs was provided by Warwickshire County Council Ecology Unit. This also contained, among other information, name and confidence fields. Overlapping ecological sites were also supplied as supplementary spatial datasets, in polygon format.

4.44 The Warwickshire HLC does include the category 'Common Grazed Woodland' that would be a direct identifier of wood-pasture. However, it has only identified historic areas that are no longer present in the landscape and none that are currently present.

4.45 Coverage:

- The present day administrative county of Warwickshire
- The administrative area of the Metropolitan Borough of Solihull
- Rural fringe of Coventry and rural strip within Birmingham to the east of Sutton Coldfield, roughly between Curdworth and Watford gap. (Any full HLC coverage of Birmingham or Coventry remained unsourced)

Data capture and processing

4.46 Full technical details for the ways in which these various information sources were processed into the West Midlands Region inventory are presented in Appendix 3. The rules base procedures also applied – see Appendix 1. A discussion of the utility of the various data sources is presented in Chapter 6.

The resulting inventory

4.47 The resulting MapInfo spatial database allows for a detailed regional map of wood-pasture and parkland habitat to be produced for the very first time. This is shown in Figure 4.1, with more than a thousand polygons represented.

4.48 A few relatively large sites are evident from the map but most sites are relatively small and widely dispersed across the region.

- 4.49 The sites are distributed fairly evenly through the region, with some sparseness present towards the more upland areas of the Welsh borders and Peak District.
- 4.50 The inventory sites cumulate to provide a total resource of some 28,688ha, with 70% being identified as *definitely* the priority habitat. The remaining 30% were identified as either '*definitely present within polygon but not accurately mappable*' or '*probably the priority habitat but some uncertainty of interpretation*' (Table 4.1). The vast majority of the sites are parkland (941 from 1,013) with 72 being wood-pasture, 7 of which are believed to be defunct.

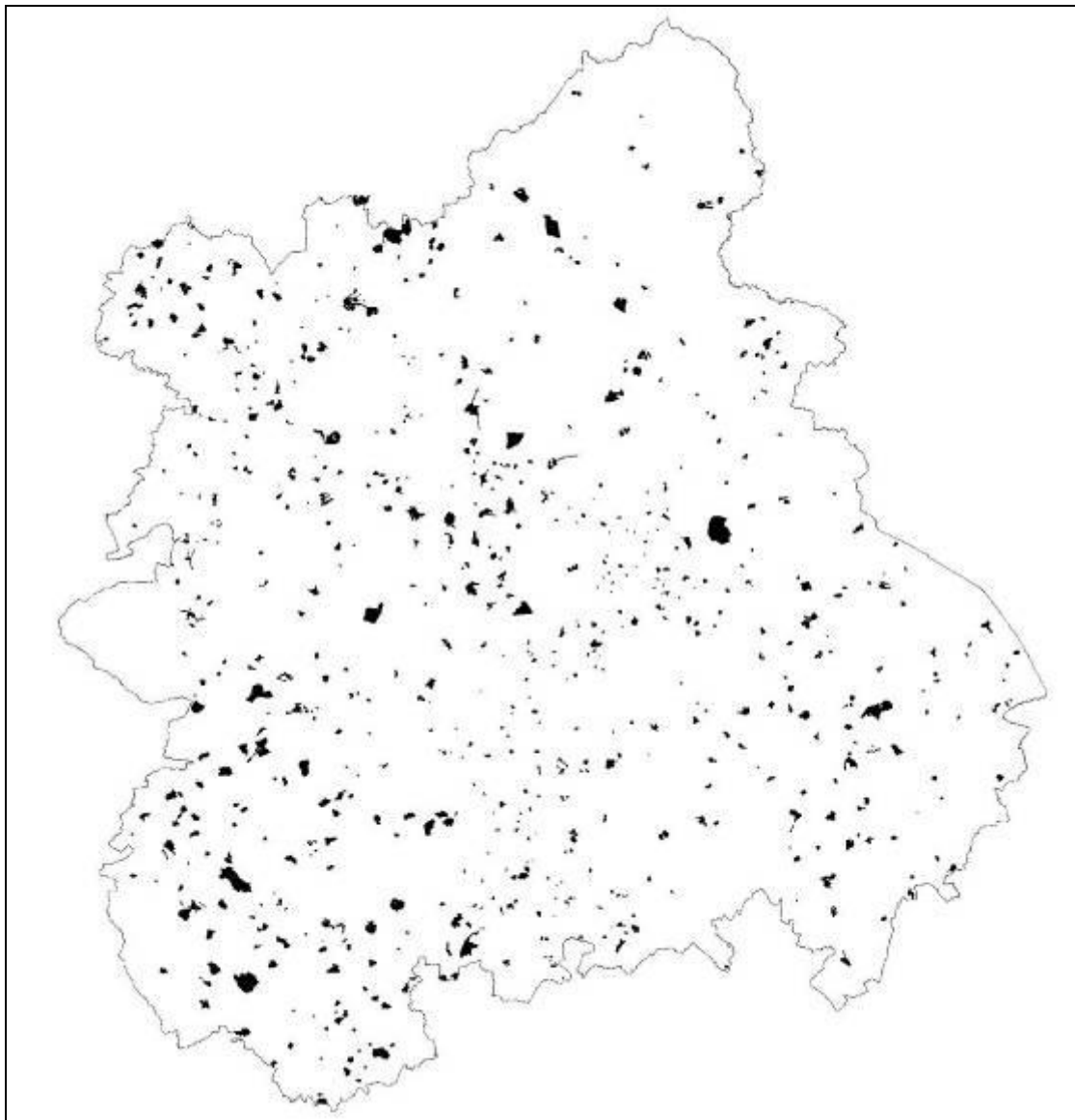


Figure 4.1: The distribution of wood-pasture and parkland in the West Midlands. © Crown copyright. All rights reserved Natural England 100046223 (2008).

Table 4.1: Summary table of wood-pasture parkland mapped in the West Midlands: Birmingham, Coventry, Solihull and the Black Country; Herefordshire; Shropshire; Staffordshire; Warwickshire and Worcestershire. Slight discrepancies between total for the West Midlands and the sums of the data from each county are due to rounding differences. Area checked refers to the area of historic OS maps and modern aerial photography checked, as well as, in the case of Staffordshire, the area of county habitat inventories interrogated as part of the capture methodology.

Coverage	Number of polygons	Total area of Wood-pasture and parkland (ha)	Number of parkland sites	Number of wood-pasture sites	Number of defunct wood-pasture sites	Confidence level (% of sites)			Area of county/region checked (sq km)	Total area of (sq km)	Proportion of county/region checked (%)
						Definitely is	Definitely present within polygon but not accurately mappable	Probably the Priority Habitat but some uncertainty of interpretation			
Birmingham, Coventry, Solihull and The Black Country	93	1,898	84	8	1	83	6	11	738	899	82
Herefordshire	155	8,906	148	3	4	33	64	3	615	2,173	28
Shropshire	283	9,118	260	23	0	65	33	1	726	3,476	21
Staffordshire	147	3,477	138	8	1	84	12	4	777	2,708	29
Warwickshire	132	3,444	132	0	0	74	26	0	389	1,972	20
Worcestershire	203	1,845	179	23	1	85	7	7	674	1,735	39
West Midlands	1,013	28,688	941	65	7	70	26	4	3,919	12,960	30

4.51 The coverage achieved, in terms of actual area of historic OS maps and modern aerial photographs referenced, through implementation of the methodology behind this inventory work is illustrated in Figure 4.2. The total coloured area in this figure equates to 30% of the entire West Midlands Region.

4.52 This figure should not be considered as bad, as wood-pasture and parkland is not expected to be present everywhere. However, it does not remove the possibility that further sites will be located in those areas than have not been referenced as a result of being highlighted by contributory datasets. As such the completeness of the inventory is very much related to the availability of these contributing datasets (i.e. the more data that is available, the more complete the inventory will be).

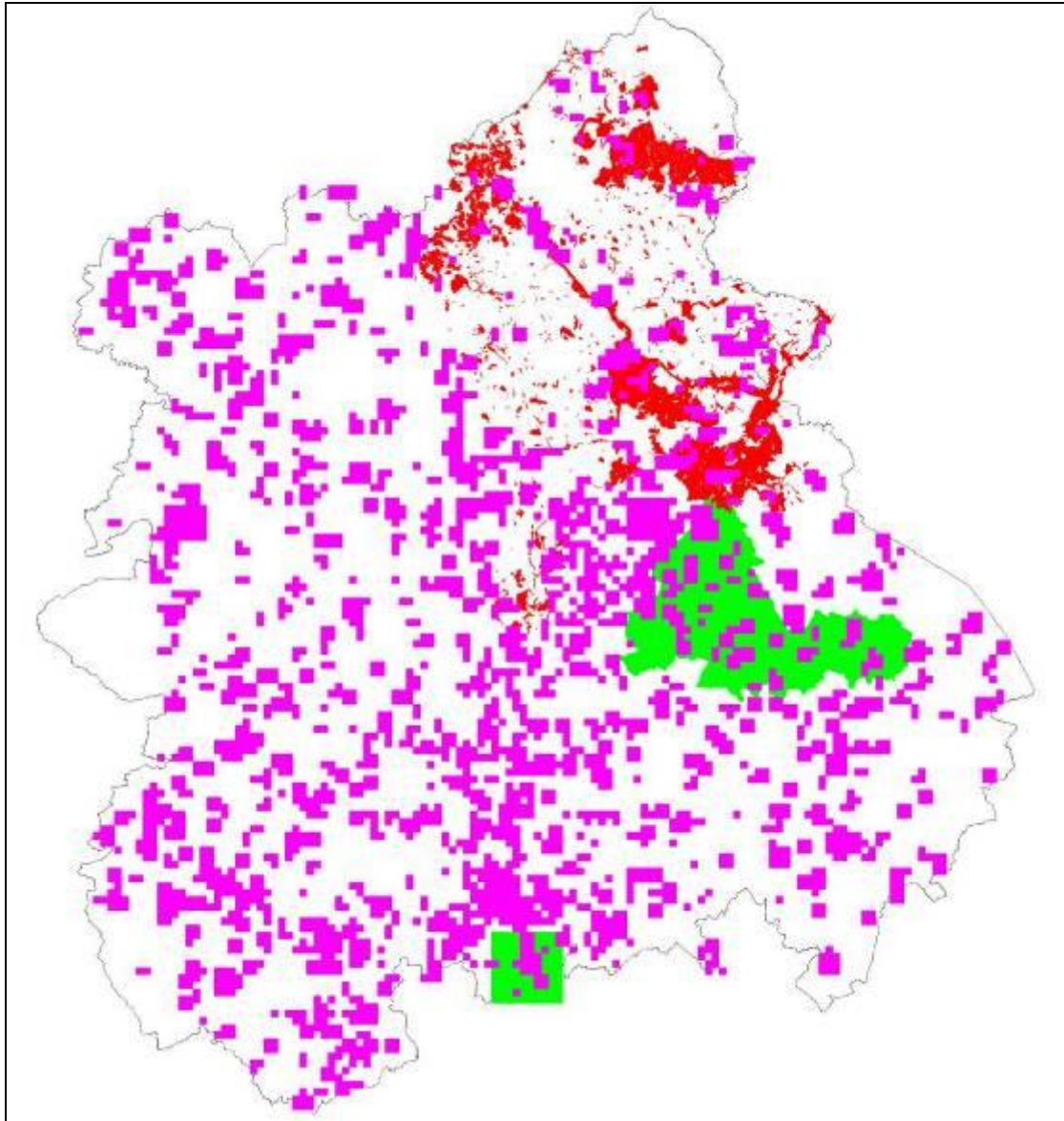


Figure 4.2: Map showing the area of the West Midlands covered by the methodology. Pink = checked on both historic OS map and modern aerial photography. Green = only checked on modern aerial photography. Red = areas of Staffordshire habitat Inventory interrogated and eliminated. © Crown copyright. All rights reserved Natural England 100046223 (2008).

5 Ground truthing

Introduction

- 5.1 The third and final objective of this study, and the focus of this Chapter, was to undertake a ground truthing exercise in order to: help inform the rules base (Chapter 3) for the development of the wood-pasture and parkland inventory (Chapter 4); and to ground truth the rules base on a small, selected area of the region, and contribute towards developing new methods for identifying sites not previously recorded.

- 5.2 Of key importance in this section of the work was to assess and improve the accuracy of remote sensing using historic Ordnance Survey (OS) 1:2500 maps and aerial photographs, and using ground truthing as an accurate assessment of wood-pasture and parkland in targeted areas. This would allow change in the resource over time to be assessed, for the selected areas.
- 5.3 Volunteers were used to ground-truth one of the selected pilot areas but these results are still to be assembled and are therefore not reported here.

Pilot area selection and ground truthing method

- 5.4 Three pilot areas were selected for the study as follows.
- 5.5 For pilot areas 1 and 2 (see Table 5.1), two 5x5 km squares were used as these were considered to be a suitable size for identifying a range of wood-pasture and parkland sites. These two pilot areas were selected subjectively to illustrate a combination of factors that might not be picked up if a random or even stratified sample was used. These factors were, respectively, an anticipated presence of primarily wood-pasture and parkland; upland and lowland positioning; and a rural versus urban/semi-urban setting.
- 5.6 Pilot areas 1 and 2 were ground truthed by an ecologist from JUST ECOLOGY using the Level 1 basic inventory methodology outlined in Natural England's Wood-pasture and Parkland Survey Methodology (Smith, 2007). As access permissions were not available, surveying took place from public rights of way (PROW) only, using binoculars to both identify areas not mapped during the desk mapping, and also check the accuracy of the attributes and boundaries for polygons mapped from desk work (see Figure 5.1 and Figure 5.).

Figure 5.2: Sites within pilot area 2 identified for ground truthing. (Pink dashed line = PROW, Yellow/green/pink/white lines = roads), © Crown copyright. All rights reserved Natural England 100046223 (2008).

- 5.7 In all cases, the habitat present was recorded as wood-pasture, parkland or another habitat, along with the confidence that the habitat was wood-pasture or parkland. Also, where possible from PROW, the number of veteran and standing dead trees was recorded. It should be noted that surveying only from PROW has some limitations, such as an uneven distribution of PROW throughout an area to be surveyed and the associated difficulties with recording from a distance.
- 5.8 Pilot area 3 is made up of three parishes that equal an area of approximately 25 km². These were targeted to coincide with the presence of Worcestershire Ancient Tree Project volunteers who were available to ground truth these areas. Parishes were used in this instance as volunteers, such as parish tree wardens, identify more readily with their local area.

Table 5.1: Pilot study areas.

Pilot area	Coverage	Reasons for selection	Ground truthing
1	Shropshire	Anticipated wood-pasture; rural; upland fringe	JUST ECOLOGY
2	Walsall	Urban/semi-urban; lowland	JUST ECOLOGY
3	Madresfield, Guarlford and Hanley Castle parishes, Worcestershire	Known wood-pasture and parkland; volunteers located in area.	Volunteers

Desk mapping in advance of fieldwork

- 5.9 Two main data sources were used (historic OS maps and aerial photographs) in order to produce maps of wood-pasture and parkland polygons that could be taken into the field.
- 5.10 The historic OS maps were supplied by Natural England as registered MapInfo files. They are split into four Epochs: Epoch 1 showing the initial survey and Epoch 2-4 showing subsequent revisions. The coverage and precise dates these maps were produced are shown in Table 5.2.
- 5.11 Whilst the coverage provided by Epochs 1 and 2 is good for our study areas, the coverage of Epochs 3 and, especially, 4 is much patchier. Complete coverage is necessary to make a valid assessment of wood-pasture and parkland on each Epoch. Unfortunately, complete coverage of the three pilot areas is not available as explained below.
- 5.12 The aerial photographs used were orthorectified for use in GIS, sourced from UK Perspectives, and dated between 1999 and 2000 (see Table 5.2 for more

accurate dates). The coverage of these aerial photographs in the pilot areas was complete.

- 5.13 For each pilot area, polygons were mapped into a MapInfo table where wood-pasture and parkland was identified on each source. These polygons were attributed indicating the type of habitat (wood-pasture or parkland) and the presence of the habitat on each source. Wood-pasture and parkland areas were split where part occurred in one or more sources and the other part did not. This allowed the presence of wood-pasture or parkland in each area to be recorded through time. The area of each polygon was extracted from this MapInfo table.

Table 5.2: The date range and coverage of Epochs 1-4 1:2500 Ordnance Survey maps and aerial photography in the three pilot areas. Coverage of aerial photography is complete. Coverage of Epoch 3 is incomplete in pilot area 1. Coverage of Epoch 4 is incomplete in pilot area 2 and 3, and entirely lacking in pilot area 1. Dates taken from Oliver (1994) and UK Perspectives metadata (NB Multiple passes contribute to aerial photography images. The date shown is that of the most recent pass).

Source	Date	Complete coverage?
Pilot area 1 (Shropshire)		
Epoch 1	1879-1884	Yes
Epoch 2	1899-1902	Yes
Epoch 3	1924-1926	No
Epoch 4	1937	No
Aerial photography	31/07/1999	Yes
Pilot area 2 (Walsall)		
Epoch 1	1875-1886	Yes
Epoch 2	1897-1902	Yes
Epoch 3	1912-1923	Yes
Epoch 4	1937-1938	No
Aerial photography	03/09/2000	Yes
Pilot area 3 (Worcestershire)		
Epoch 1	1881-1884	Yes
Epoch 2	1898-1900	Yes
Epoch 3	1913-1926	Yes
Epoch 4	1937-1938	No
Aerial photography	10/07/1999	Yes

Data analysis

- 5.14 The following ground truthing data were added to the MapInfo table for the pilot areas:
- Habitat
 - Number of veteran trees
 - Number of dead standing trees
 - Confidence
 - Notes

- 5.15 These data were exported for analysis, along with the polygon areas. Four combinations of the data were assessed:
- Where the ground truthing identified wood-pasture or parkland, i.e. the actual area of habitat present at the time of the survey.
 - Where the desk mapping accurately identified wood-pasture and parkland, as confirmed through ground truthing.
 - Where the desk mapping failed to map areas of wood-pasture and parkland that were recorded in during the ground truthing.
 - Where the desk mapping mistakenly identified wood-pasture and parkland that was shown to be another habitat during the ground truthing.
- 5.16 These combinations were assessed for wood-pasture and parkland separately, as well as both habitats combined, as this allowed trends to be seen in the different habitat types.
- 5.17 Three main analyses were conducted on the data to assess change through time. One assessed net change, in other words, change in overall area including apparent wood-pasture and parkland gains in areas that were previously another habitat, e.g. new planting on grassland or new management of woodland. The total area of wood-pasture and parkland on each source was calculated and plotted on a chart to show the change through time.
- 5.18 Another assessed wood-pasture and parkland loss only. This analysis required that the loss of individual wood-pasture and parkland blocks between two sources be accounted for. This meant that an area of wood-pasture and parkland could be lost between two dates, though comparison with a later source may show no loss at all if the habitat had recovered or if there had simply been mapping errors on the historic OS maps. This examines apparent wood-pasture and parkland loss within assessed periods.
- 5.19 The third method recorded and calculated the area of wood-pasture and parkland that was continuously present across all sources.
- 5.20 Together, these analyses provide an indication of the apparent changes to the cover of wood-pasture and parkland in the pilot areas through the periods assessed, although caution is necessary in any interpretation of the results (see further below).

Results

5.21 Results are presented here in order to examine any issues with the accuracy of the desk mapping undertaken prior to ground truthing, and to examine the apparent change over time in wood-pasture and parkland habitat extent. Results are presented for pilot areas 1 and 2 only; results from the third pilot area are not yet available.

Accuracy of desk study

5.22 Table 5.3 shows the comparison of the desk study and ground truthing in pilot area 1. Approximately 28 ha of wood-pasture was identified during ground truthing, with no parkland present in pilot area 1 at all. Approximately 26 ha (c. 93%) of this wood-pasture was correctly identified through the desk study.

5.23 However, the techniques initially employed during the desk study also incorrectly identified 29 ha of wood-pasture, more than doubling the actual area. This was due to: initial misidentification of the symbols used on the historic maps; and difficulties in separating open habitats with scrub from open habitats with trees on aerial photography (explained further below; both issues corrected for the inventory presented in Chapter 4).

Table 5.3: Ground truthing results for pilot area 1. The identification of wood-pasture and parkland using aerial photographs and ground truthing is denoted as follows: API = identified by interpretation of the 1999 aerial photographs; GT = identified by ground truthing. Given in hectares.

		Wood-pasture	Parkland	Wood-pasture and parkland
GT True	API False	1.98	0	1.98
	API True	26.34	0	26.34
	Total	28.32	0	28.32
GT False	API True	29.43	0	29.43

5.24 Table 5.4 shows the comparison of the desk study and ground truthing in pilot area 2. Approximately 49 ha of parkland was identified during ground truthing, with no wood-pasture present in pilot area 2 at all. All of this parkland was correctly identified through the desk study.

5.25 The techniques employed during the desk study also incorrectly identified 15 ha of parkland. This occurred where parkland was clearly present on historic maps and trees were visible in these areas on aerial photographs. It was therefore assumed that the trees were former parkland trees, though in these cases the ground truthing identified that the trees were planted as part of more recent landscaping. These errors were corrected for the inventory presented in Chapter 4.

Table 5.4: Ground truthing results for pilot area 2. The identification of wood-pasture and parkland using aerial photographs and ground truthing is denoted as follows: API = identified by interpretation of the 2000 aerial photographs; GT = identified by ground truthing. Given in hectares.

		Wood-pasture	Parkland	Wood-pasture and parkland
GT True	API False	0	0	0
	API True	0	49.04	49.04
	Total	0	49.04	49.04
GT False	API True	0	14.82	14.82

Change analysis

Pilot area 1

5.26 The area of wood-pasture and parkland shown on different sources for pilot area 1 is shown in Figure 5.3. This shows that a substantial amount of wood-pasture was apparently lost or not mapped between OS map Epochs 1 and 2, with the area falling from 32 ha to 4 ha (c.13% of the area in Epoch 1). Some of this area of wood-pasture and parkland was apparently regained between the OS Epoch 2 maps and the 1999 UK Perspectives aerial photographs, when 26 ha (c. 82% of the area in Epoch 1) of wood-pasture and parkland habitat was identified. Only 3 ha of wood-pasture and parkland was continuously present in all sources; c. 9% of the area in Epoch 1.

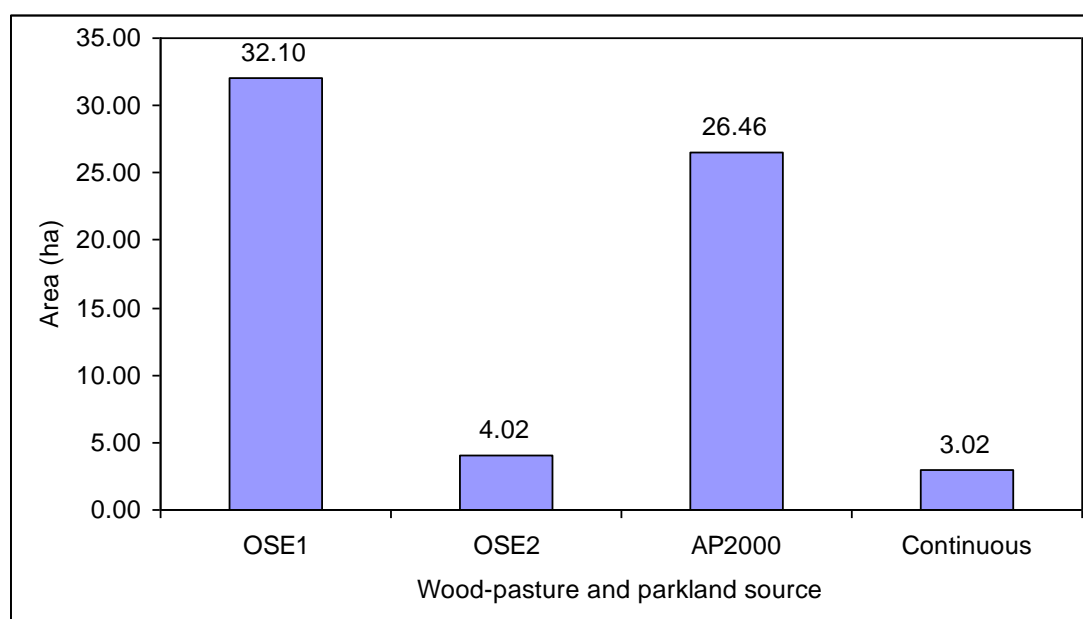


Figure 5.3: Area of wood-pasture and parkland in pilot area 1 shown on sources from various dates. The three sources used are: OSE1 = Epoch 1 Ordnance Survey 1:2500 maps (1879-1884); OSE2 = Epoch 2 Ordnance Survey 1:2500 maps (1899-1902); AP2000 = 1999 UK Perspectives aerial photography. Continuous shows the area of wood-pasture and parkland that was present in all sources.

- 5.27 The area of wood-pasture and parkland blocks apparently lost in pilot area 1 between the sources is shown in Table 5.5. This shows that 28 ha of the wood-pasture and parkland present in OS Epoch 1 maps had seemingly been lost by Epoch 2, with a relatively minor loss of 1ha lost between Epoch 2 and the 2000 UK Perspectives aerial photographs. Approximately 11 ha of the wood-pasture and parkland lost between OS Epochs 1 and 2 was apparently regained between Epoch 2 and the 2000 aerial photographs.

Table 5.5: Area of wood-pasture and parkland lost in pilot area 1 between sources from various dates. Each row directly compares the wood-pasture and parkland units present in two sources. The three data sources used are: OSE1 = Epoch 1 Ordnance Survey 1:2500 maps (1879-1884); OSE2 = Epoch 2 Ordnance Survey 1:2500 maps (1899-1902); AP2000 = 1999 UK Perspectives aerial photography.

	Area (ha)
Loss between OSE1 and OSE2	-28.08
Loss between OSE1 and AP2000	-17.47
Loss between OSE2 and AP2000	-1.00

- 5.28 The following series of three maps (Figures 5.4 - 5.6) shows the distribution of wood-pasture and parkland present in the British National Grid 5 km by 5 km square SO39NE on sources of different dates. The sources used were Epoch 1 and 2 Ordnance Survey 1:2500 maps and UK Perspectives aerial photography.
- 5.29 In Figure 5.7, an example of change is provided for a particular area of wood-pasture within pilot area 1.

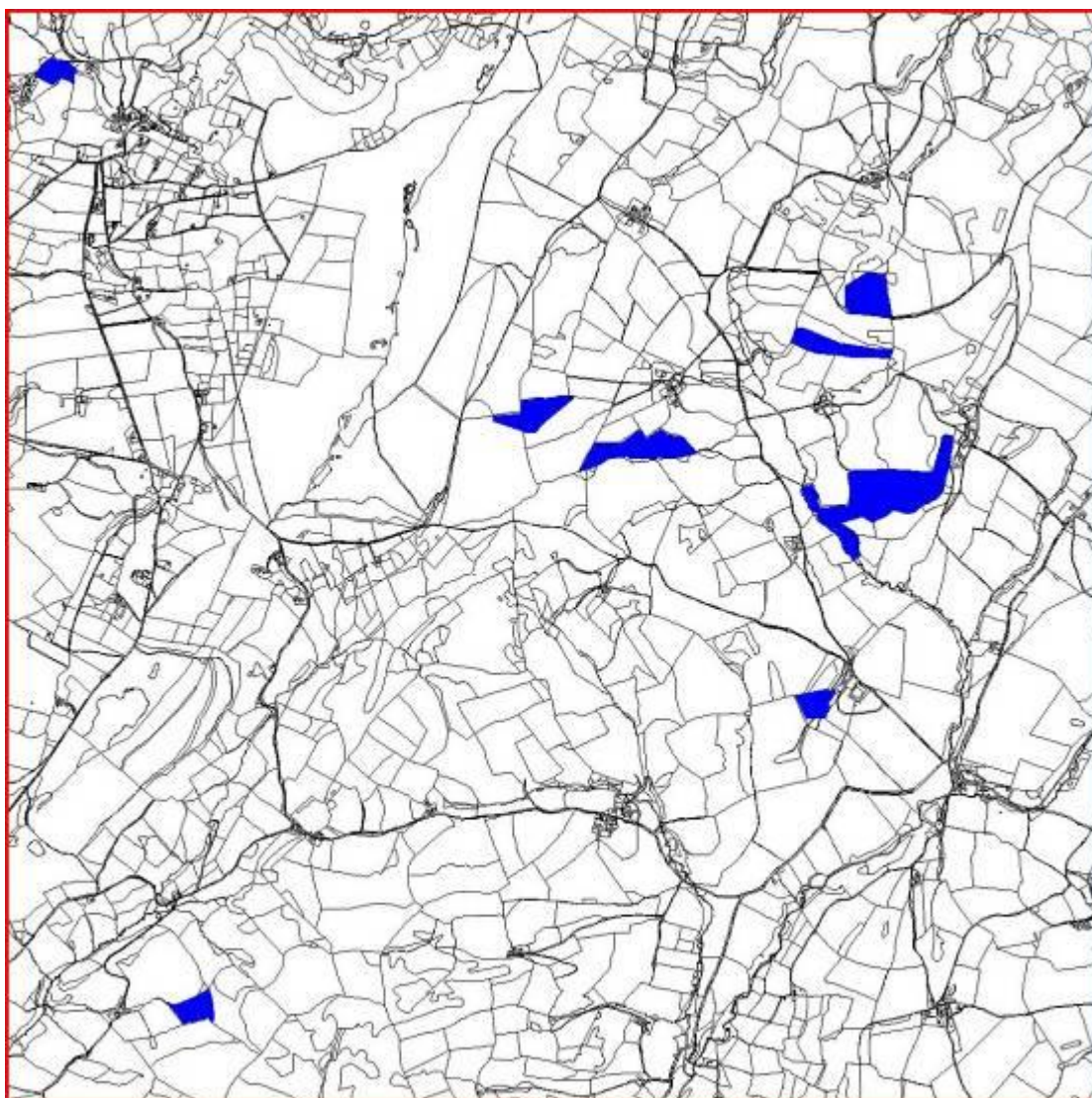


Figure 5.4: Wood-pasture and parkland present in pilot area 1 on Epoch 1 Ordnance Survey 1:2500 maps (1879-1884). © Crown copyright. All rights reserved Natural England 100046223 (2008).

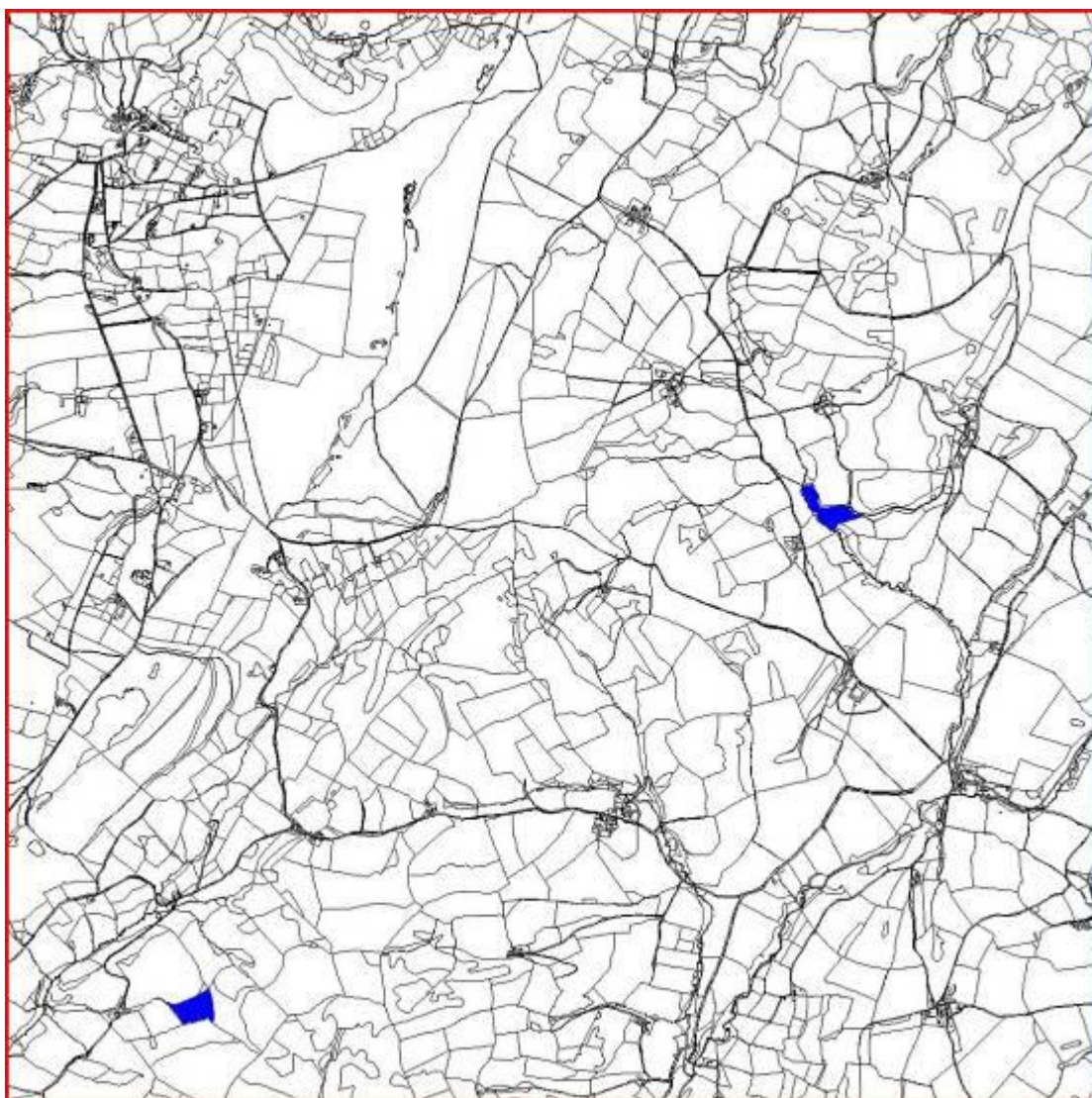


Figure 5.5: Wood-pasture and parkland present in pilot area 1 on Epoch 2 Ordnance Survey 1:2500 maps (1899-1902). © Crown copyright. All rights reserved Natural England 100046223 (2008).

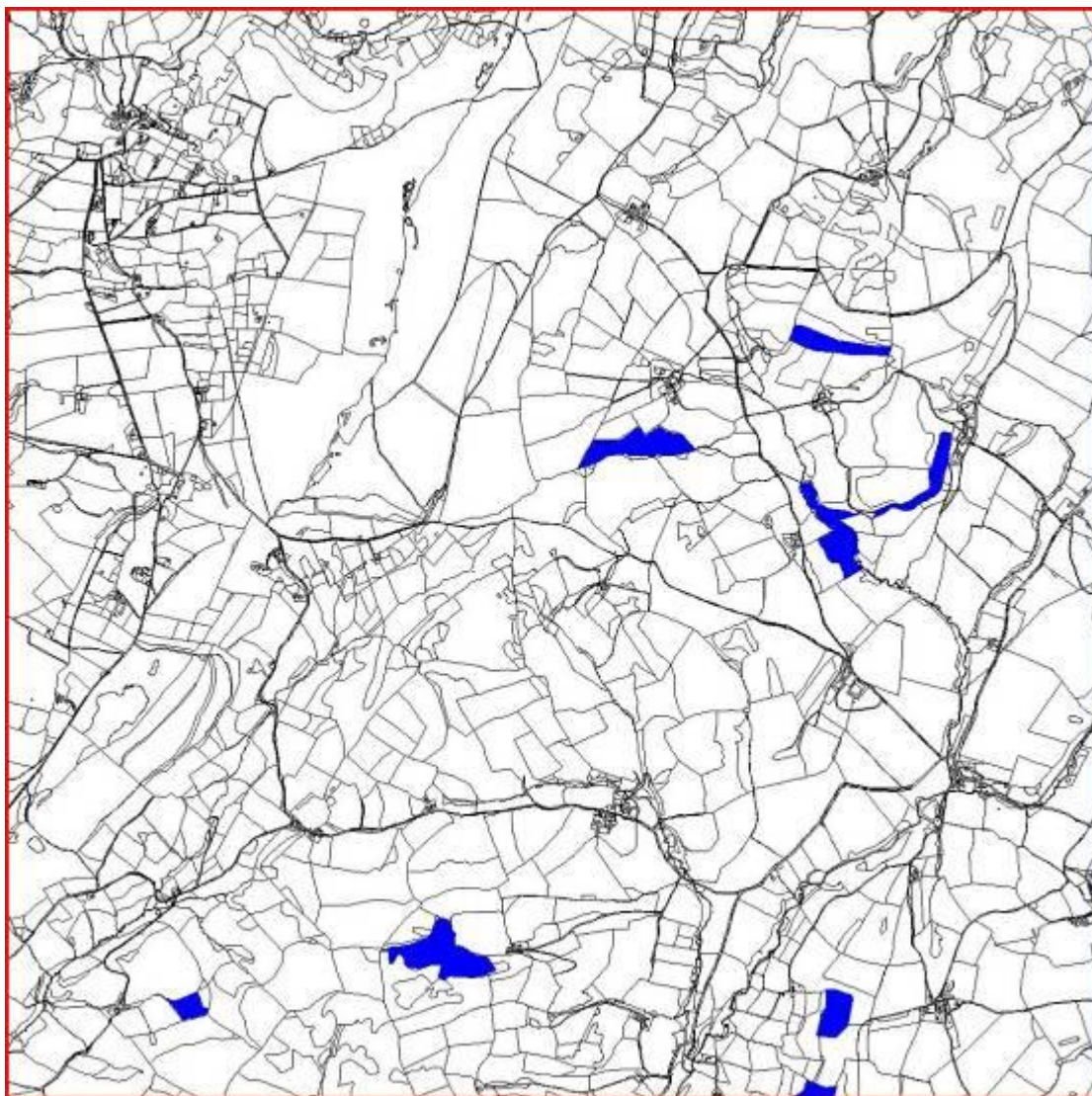


Figure 5.6: Wood-pasture and parkland present in pilot area 1 on 1999 UK Perspectives aerial photography. © Crown copyright. All rights reserved Natural England 100046223 (2008).

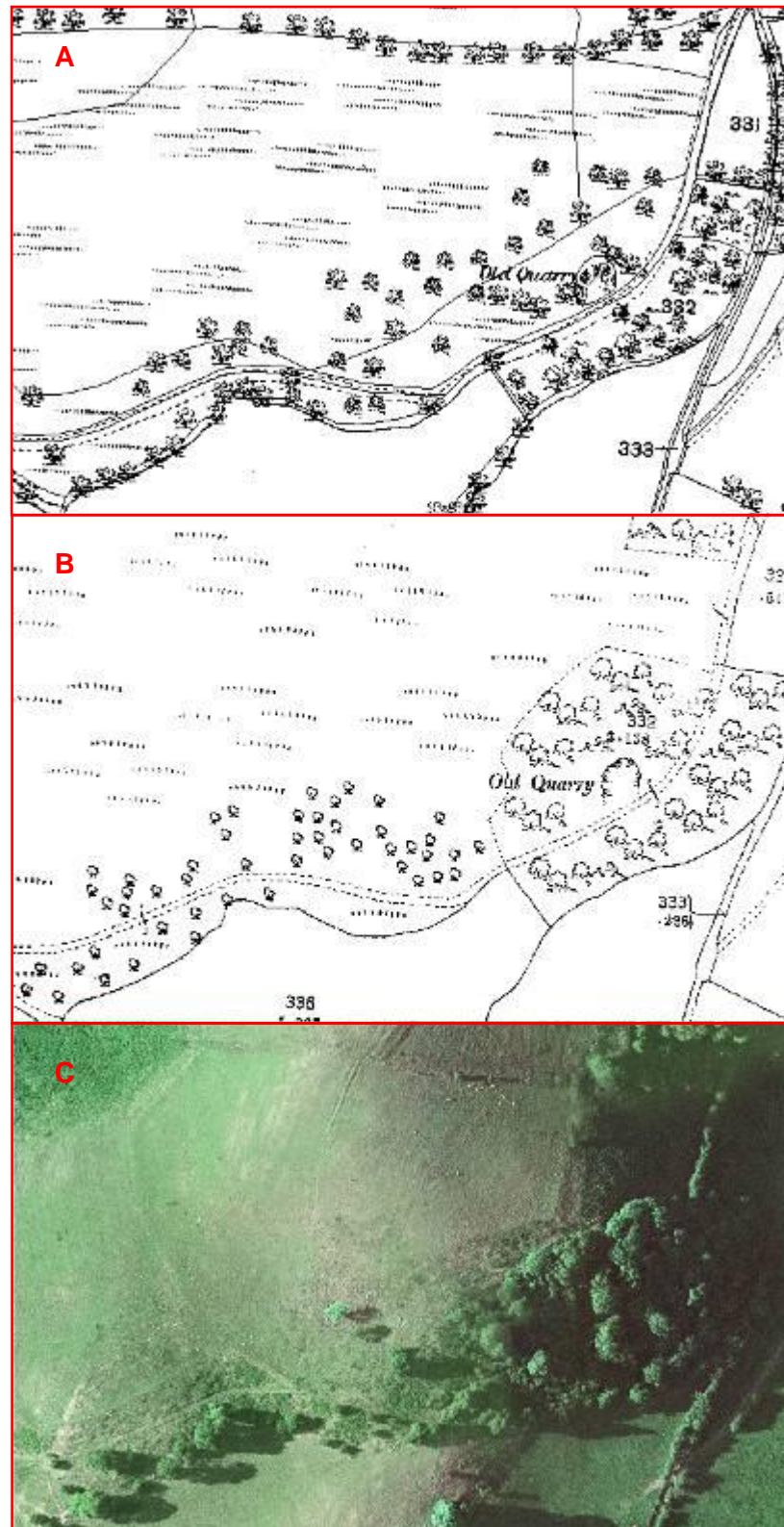


Figure 5.7: Wood-pasture in pilot area 1 on A) Epoch 1 B) Epoch 2 C) 1999 UK Perspectives aerial photography. The Epoch 1 extract shows the symbol combinations that indicate wood-pasture, while the Epoch 2 extract shows the site as a misinterpreted wood-pasture given the change in symbol used. © Crown copyright. All rights reserved Natural England 100046223 (2008).

Pilot area 2

5.30 The area of wood-pasture and parkland shown on different sources for pilot area 2 is shown in Figure 5.8. This shows a more gradual decline in the area of wood-pasture and parkland OS map Epochs 1 and 3, with the area apparently falling overall from 96 ha to 38 ha (c. 40% of the area in Epoch 1). Slightly over 1 ha of wood-pasture and parkland was apparently gained between Epoch 3 and the 2000 UK Perspectives aerial photographs. Approximately 12 ha of wood-pasture and parkland was apparently continuously present in all sources; c. 13% of the area in Epoch 1.

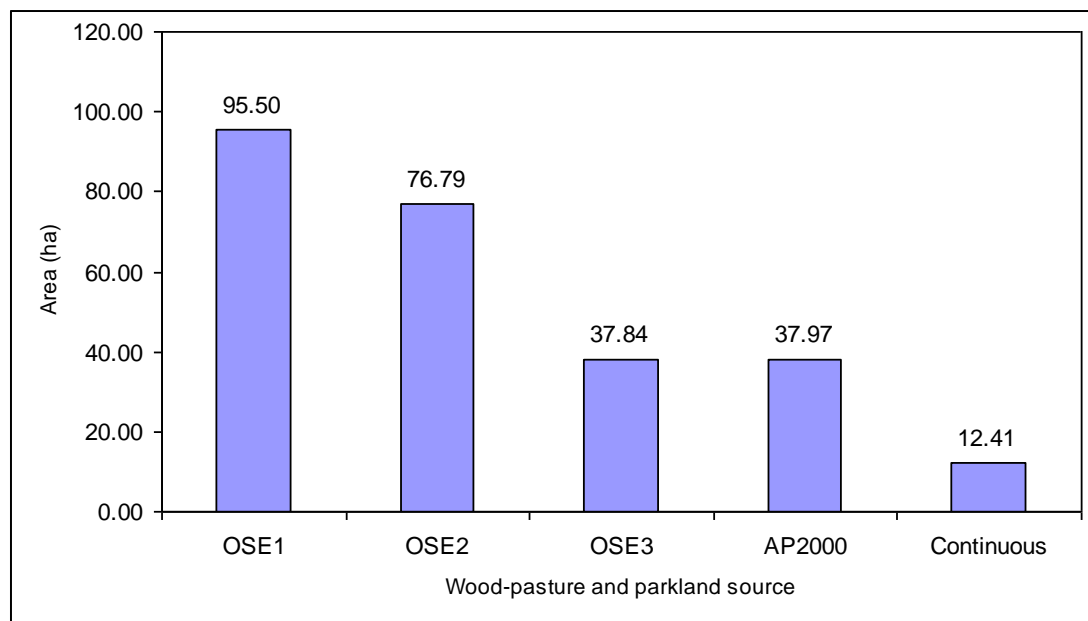


Figure 5.8: Area of wood-pasture and parkland in pilot area 2 shown on sources from various dates. The four sources used are: OSE1 = Epoch 1 Ordnance Survey 1:2500 maps (1875-1886); OSE2 = Epoch 2 Ordnance Survey 1:2500 maps (1897-1902); OSE3 = Epoch 3 Ordnance Survey 1:2500 maps (1912-1923); AP2000 = 2000 UK Perspectives aerial photography. Continuous shows the area of wood-pasture and parkland that was present in all sources.

5.31 The area of wood-pasture and parkland blocks apparently lost in pilot area 2 between the sources is shown in Table 5.6. This shows that loss of wood-pasture and parkland habitat between the periods Epochs 1-2 and Epochs 2-3 was seemingly approximately 40 ha. Approximately 12 ha of wood-pasture and parkland present on the Epoch 3 maps was not present on the 2000 UK Perspectives aerial photographs.

Table 5.6: Area of wood-pasture and parkland lost in pilot area 2 between sources from various dates. Each row directly compares the wood-pasture and parkland units present in two sources. The four sources used are: OSE1 = Epoch 1 Ordnance Survey 1:2500 maps (1875-1886); OSE2 = Epoch 2 Ordnance Survey 1:2500 maps (1897-1902); OSE3 = Epoch 3 Ordnance Survey 1:2500 maps (1912-1923); AP2000 = 2000 UK Perspectives aerial photography.

	Area (ha)
Loss between OSE1 and OSE2	-41.91
Loss between OSE1 and OSE3	-80.40
Loss between OSE1 and AP2000	-83.01
Loss between OSE2 and OSE3	-38.95
Loss between OSE2 and AP2000	-50.52
Loss between OSE3 and AP2000	-11.65

- 5.32 The following series of four maps (Figure 5.9 – 5.12) shows the distribution of wood-pasture and parkland present in the British National Grid 5 km by 5 km square SP09NW (pilot area 2) on sources of different dates. The sources used were Epoch 1, 2 and 3 Ordnance Survey 1:2500 maps and UK Perspectives aerial photography.
- 5.33 In Figure 5.13, an example of change is provided for a particular area of parkland within pilot area 2.

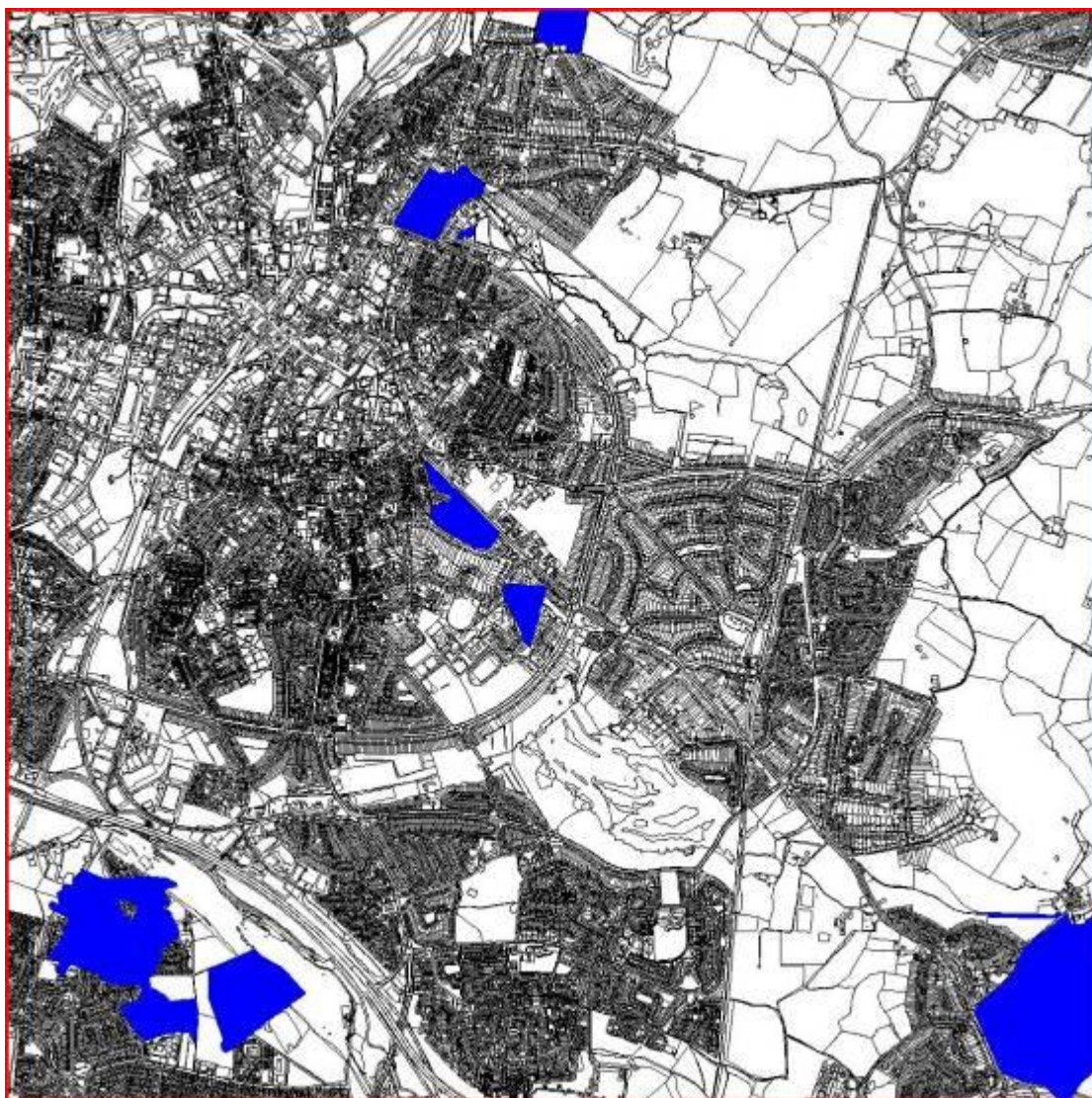


Figure 5.9: Wood-pasture and parkland present in pilot area 2 on Epoch 1 Ordnance Survey 1:2500 maps (c.1843-1893). © Crown copyright. All rights reserved Natural England 100046223 (2008).

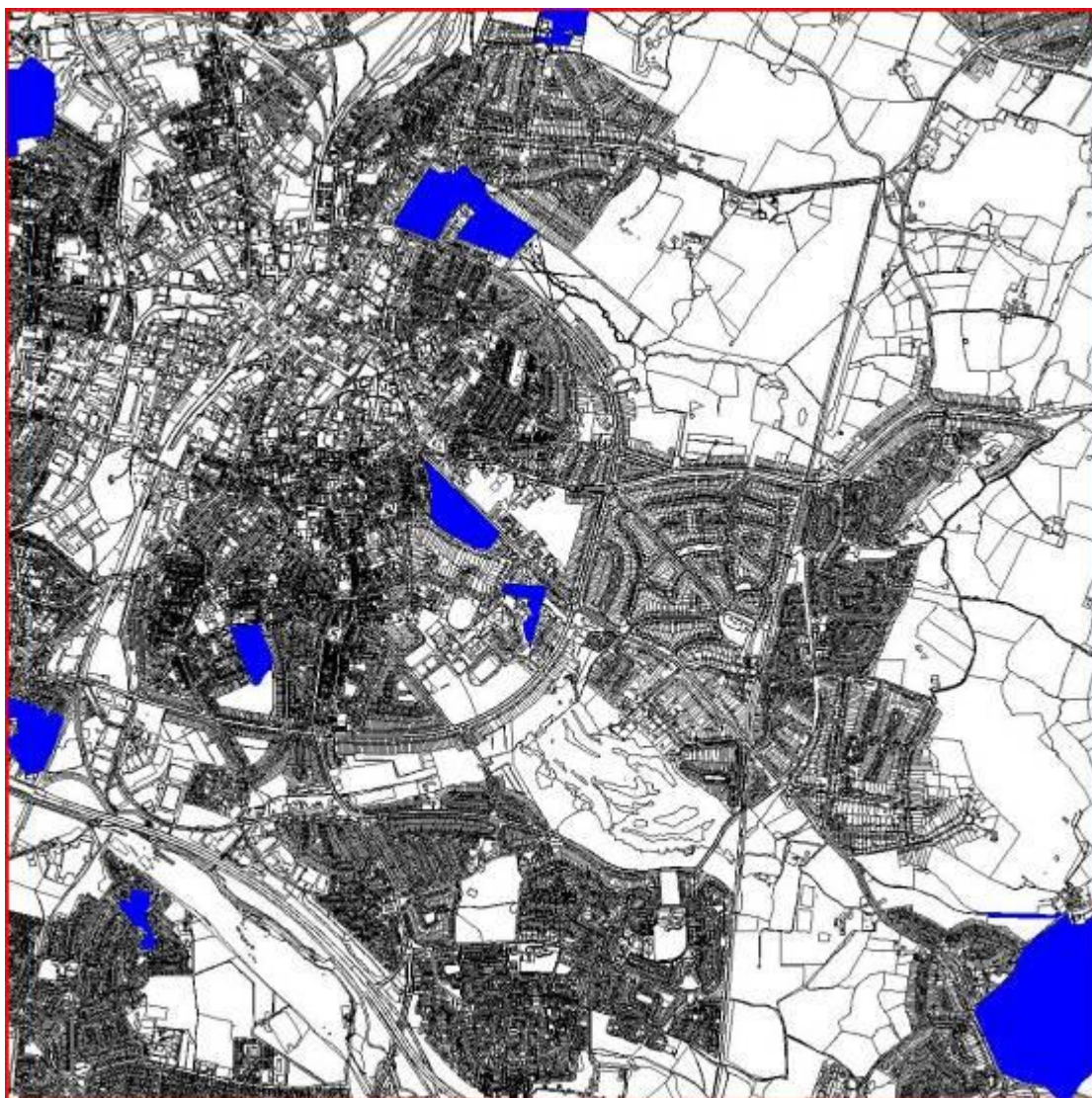


Figure 5.10: Wood-pasture and parkland present in pilot area 2 on Epoch 2 Ordnance Survey 1:2500 maps (c.1891-1912). © Crown copyright. All rights reserved Natural England 100046223 (2008).

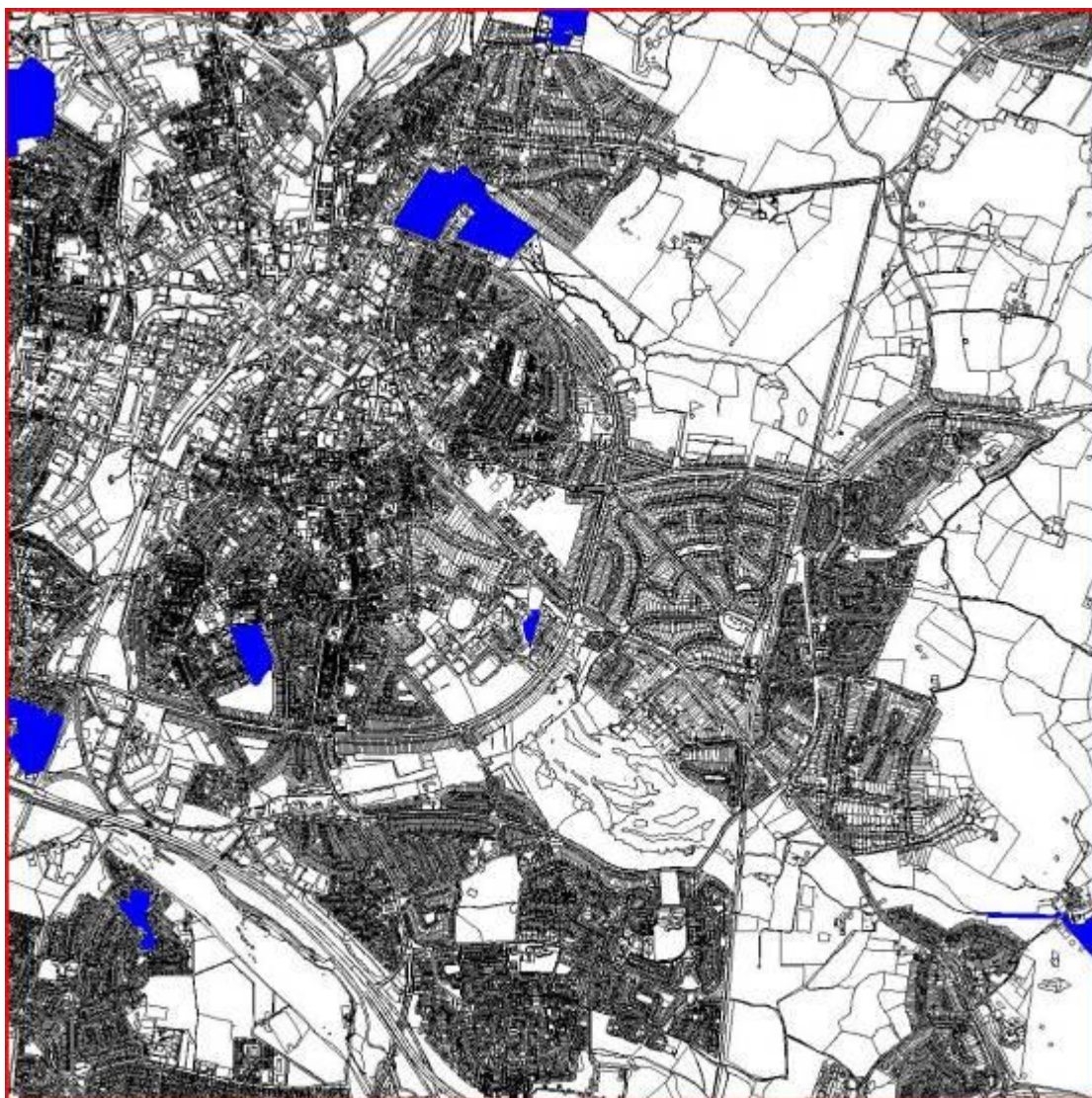


Figure 5.5: Wood-pasture and parkland present in pilot area 2 on Epoch 3 Ordnance Survey 1:2500 maps (c.1904-1939). © Crown copyright. All rights reserved Natural England 100046223 (2008).

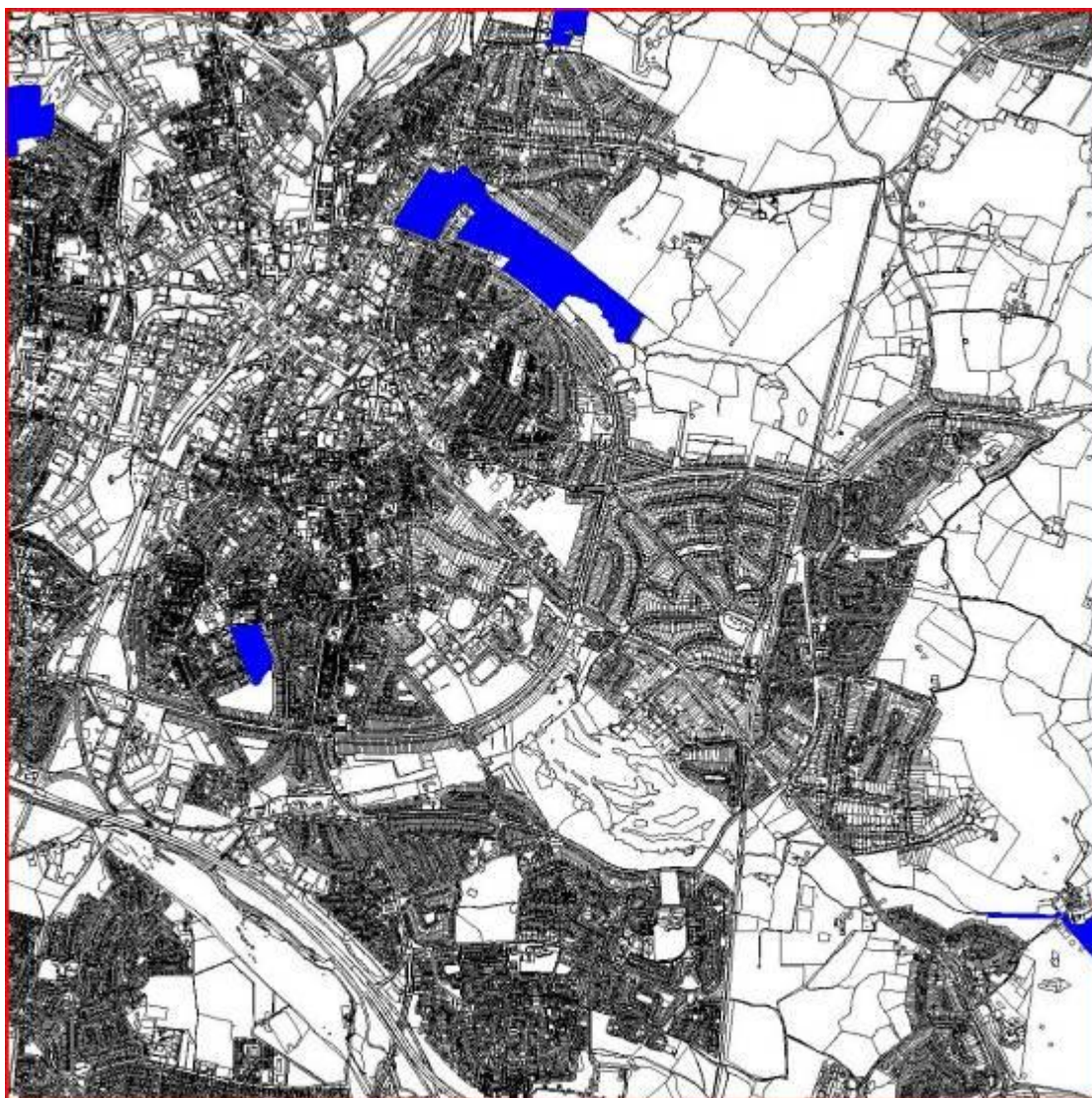


Figure 5.12: Wood-pasture and parkland present in pilot area 2 on UK Perspectives aerial photography. © Crown copyright. All rights reserved Natural England 100046223 (2008).



Figure 5.13: Parkland in pilot area 2 on A) Epoch 1 B) Epoch 2 C) Epoch 3 D) 2000 UK Perspectives aerial photography. The extracts from Epoch 1-3 indicate the presence of parkland and there are trees present on the 2000 aerial photography, which were in this case part of more recent landscaping. © Crown copyright. All rights reserved Natural England 100046223 (2008).

Discussion

Accuracy of desk results

- 5.34 The ground truthing exercise, though limited in scale, proved useful, the results from pilot areas 1 and 2 allowing some mapping issues to be resolved before production of the final inventory dataset. The study also allowed for the apparent changes in wood-pasture and parkland habitat extent to be presented but, due to uncertainties over the accuracy of the historic OS maps from Epochs 1-4, such changes should be interpreted with caution, as discussed further below.
- 5.35 The accuracy of the identification of wood-pasture and parkland using historic OS maps and 1999-2000 aerial photographs was variable. Much of this was due to the difficulty of accurately identifying wood-pasture sites, as demonstrated by the relative inaccuracy of the desk study in the wood-pasture rich pilot area 1 when compared with the parkland rich pilot area 2. A number of causes were identified for the initial misidentification of wood-pasture, as follows.
- 5.36 The Epoch 1-4 OS 1:2500 maps are a highly detailed source of information on wood-pasture and parkland sites. What this study has demonstrated is that it is imperative that there is a clear understanding of the symbols used to represent various habitats on the historic maps. Many of the errors in the desk study were based partially upon a misidentification of wood-pasture on the historic maps. This has also allowed us to identify the symbols used on the maps that usually indicate wood-pasture and those that indicate woodland, as follows:

Indicators of wood-pasture

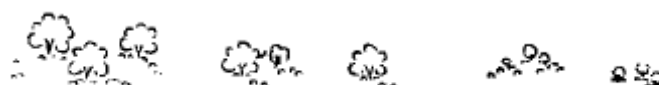


Trees, either scattered or denser.



Rough pasture and two symbols for furze scattered amongst tree symbols. 'Furze' probably includes heather and bracken, as there is no separate symbol for heathland.

Indicators of woodland (ignoring conifer symbols)



Trees with understorey or brushwood (probably an indicator of recent coppice in obvious woodlands).



Orchard, bush (presumably indicating scrub rather than trees) or osiers.

- 5.37 The other reason for the misidentification of wood-pasture was due to the occasional difficulty of interpreting the 1999 UK Perspectives aerial photography. The ground truthing demonstrated that in a number of cases open habitats containing scrub were misidentified as wood-pasture. In all cases this was initially supported by a misinterpretation of the historic maps (see Figure 5.). It therefore became apparent that the correct symboling on historic maps was essential for mapping wood-pasture using aerial photographs and that such areas should not be identified using aerial photography unless other supporting information is available.
- 5.38 The mis-identification of parkland from aerial photograph interpretation in pilot area 2 was moderate in comparison. This occurred where parkland was present on historic maps, and trees were present on the 2000 aerial photography. Without ground truthing, there could be no way of knowing whether the trees present in 2000 were some of the original parkland trees or planted as part of more recent landscaping – in the erroneous cases they were the latter (see Figure 5.). This is evidently one of the instances where supporting information would be most useful in assessing the confidence of the identification and in cases where small fragments apparently remain from historically larger parkland the confidence should default as low.

Change analysis

- 5.39 The most surprising result from the change analysis is the apparent 87% loss of wood-pasture in pilot area 1 in the c.19 years between the Epoch 1 (1879-1884) and Epoch 2 (1899-1902) maps. During this time, wood-pasture was apparently almost completely removed from the area, with only 4 ha remaining. Over 10 ha of the wood-pasture removed had apparently regenerated by the 1999 aerial photographs.
- 5.40 In contrast, the decline in wood-pasture and parkland in pilot area 2 was apparently much more gradual. Much of the decline in area happened in the period between the Epoch 1 (1875-1886) and 3 (1912-1923) maps, with a slight increase occurring between then and the 2000 aerial photographs. Approximately 13% of the wood-pasture and parkland present in the Epoch 1 maps was still present on the 2000 aerial photographs, which is higher level of continuity, both in terms of area and the proportion of habitat present in the Epoch 1 maps, than for pilot area 1.
- 5.41 Excluding the continuous wood-pasture and parkland in pilot area 2, much of

that present in the 2000 aerial photographs had evidently been created as public green space, as they were typical urban landscaped parklands rather than the traditional parklands found in less urban areas. A similar pattern was also noticeable in the period between the Epoch 1 (1875-1886) and 3 (1912-1923) maps, though parklands were created to a lesser extent during this time than subsequently. Urban parklands appear to have been much more ephemeral features in the landscape, being lost to development, whilst the demand for such areas has caused their creation elsewhere.

- 5.42 Interpreting the reasons for these changes in wood-pasture and parkland area is difficult. Losses in wood-pasture may be genuine and due to factors such as changes in the demand for timber or agricultural land. However, they might equally be due to inaccuracies in the Epoch 1-4 maps, for example if map makers failed to mark-up all areas diligently or use the appropriate symbols, so we remain uncertain about which of the changes are genuine.
- 5.43 To explore the changes in wood-pasture and parkland area further and to investigate the accuracy of historic OS maps, other potential sources of information were explored, including the use of war-time (1940s) aerial photography and tithe maps, as explained in the following sections.

Validation using war-time aerial photography

- 5.44 The 'Cities Revealed Historical Aerial Photography' dataset, provided by The Geo Information Group, was assessed, although coverage was limited for pilot area 1 but scanned, rectified and mosaiced (joined-together) historic imagery at 1m pixel resolution could be supplied for pilot areas 2 and 3, *i.e.* those in and around urban areas. Of these, it was decided to use the imagery from pilot area 3, to complement the full spectrum of interpretation being carried out there. It should be noted that the pilot area 3 data has been ground truthed, but the information was not available to incorporate into this report
- 5.45 Figure 5.3 shows the area of wood-pasture and parkland identified on each source (note that Epoch 4 data are excluded since there was incomplete coverage from this source for pilot area 3). A gradual overall decline is observed.
- 5.46 Between Epoch 3 and the 1947-8 aerial photography there is a net loss of 3 ha. This is the result of 53 ha of apparent loss, combined with re-identification of a different 50 ha of wood-pasture and parkland on the 1947-8 aerial photography. These sites were previously thought to have disappeared before Epoch 2 (1898-1900) and do indeed disappear by the 1999 aerial photography. See Figure 5.4 for those sites present in Epoch 1, apparently not present by Epoch 2, re-identified on the 1947-48 aerial photography and not present on the 1999 aerial photography.

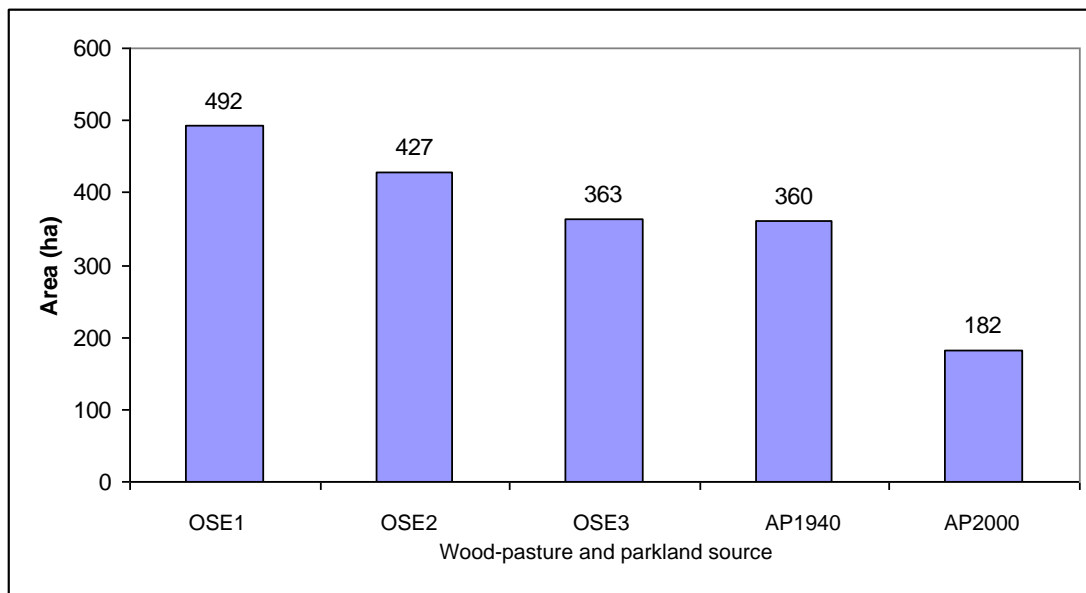
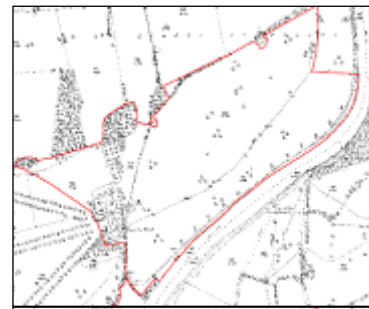


Figure 5.3: Area of wood-pasture and parkland in pilot area 3 shown on sources from various dates. The four sources used are: OSE1 = Epoch 1 Ordnance Survey 1:2500 maps (1881-1884); OSE2 = Epoch 2 Ordnance Survey 1:2500 maps (1898-1900); OSE3 = Epoch 3 Ordnance Survey 1:2500 maps (1913-1926); AP1940 = 1947-1948 historic aerial photography; AP2000 = 1999 UK Perspectives aerial photography.

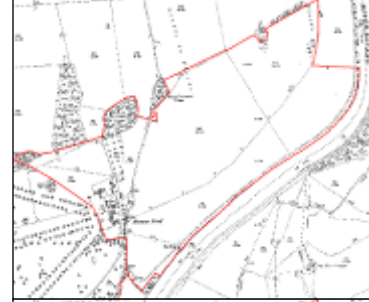
5.47 This analysis of war-time aerial photography has revealed how there may be mapping inaccuracies in the historical OS mapping post Epoch 1, given that areas of wood-pasture and parkland thought to have disappeared before Epoch 2 can be identified on 1947-8 aerial photography. However, while providing a better historical context to those sites identified on other sources in the pilot area, in this instance it did not locate any additional sites.



Epoch 1: 1881-1884



Epoch 2: 1898-1900



Epoch 3: 1913-1926



Epoch 4: 1937-1938



1947-8



10/07/1999



Figure 5.4: Two sites in pilot area 3 where wood-pasture and parkland, believed to have disappeared by Epoch 2, was identified on the 1947-8 historic aerial photography. ©

- 5.48 Tithe maps, compiled prior to the OS Epoch 1 maps, were considered as an additional information source for pilot areas 1 and 2. There appears to be no standard symbology used or any reference to what the symbols actually mean. Therefore the presence of tree symbols can only infer the presence of trees and nothing about their coverage, i.e. woodland or scattered trees.
- 5.49 For pilot area 1, however, coverage by tithe maps was incomplete and restricted to just the south and north-west of the area (see Figure 5.5). Tithe maps and field name maps were acquired for the parishes of More (1841), Norbury (1846) and Worthen (1848), supplied as print-outs from microfiche/microfilm at a scale where field numbers and tree cover could be identified (field name maps were available online at www.secretshropshire.org.uk).

Figure 5.5: Map showing the tithe and field map coverage in pilot area 1 and the text labels (if present) from the associated tithe area on the field name map. © Crown copyright. All rights reserved Natural England 100046223 (2008)

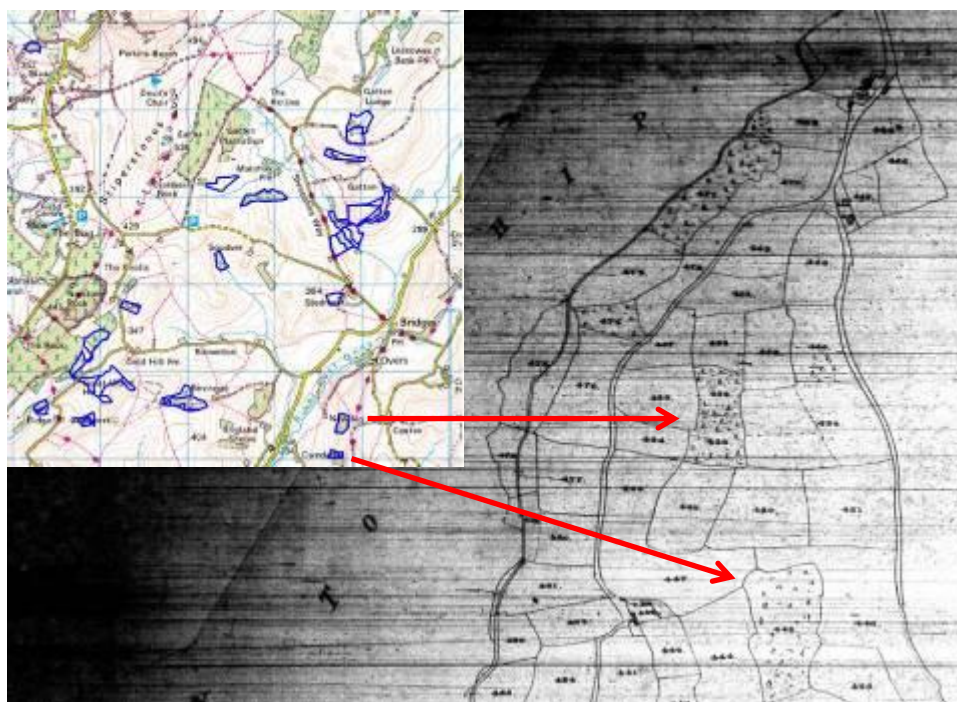


Figure 5.6: An example of two tithe areas shown to contain trees on the Wentnor tithe map that had been later identified as possible wood-pasture and parkland in the previous desk study. © Crown copyright. All rights reserved Natural England 100046223 (2008).

- 5.50 Where the tithe maps were available, no wood-pasture and parkland sites were identified that had not already been identified on the later historical OS maps during the previous desk study. All the wood-pasture and parkland that had been identified on later mapping, was represented on the tithe map by areas illustrated with trees and in two cases labelled as wood on the field name map (See Figures 5.5 and 5.6). The remaining areas either had no label or were labelled with text that did not reveal any conclusive detail about their associated land use, e.g. “Sideland Piece” or “Lower Douke Rough” (see Figure 5.5).
- 5.51 For pilot area 2, there was better coverage by tithe maps and the original maps were photographed at the Lichfield Record Office. The photographic segments were stitched (see Figure 5.7) and geo-referenced to allow overlay in GIS. No field name maps have been produced for these parishes, so the tithe apportionment documents were referenced where appropriate.

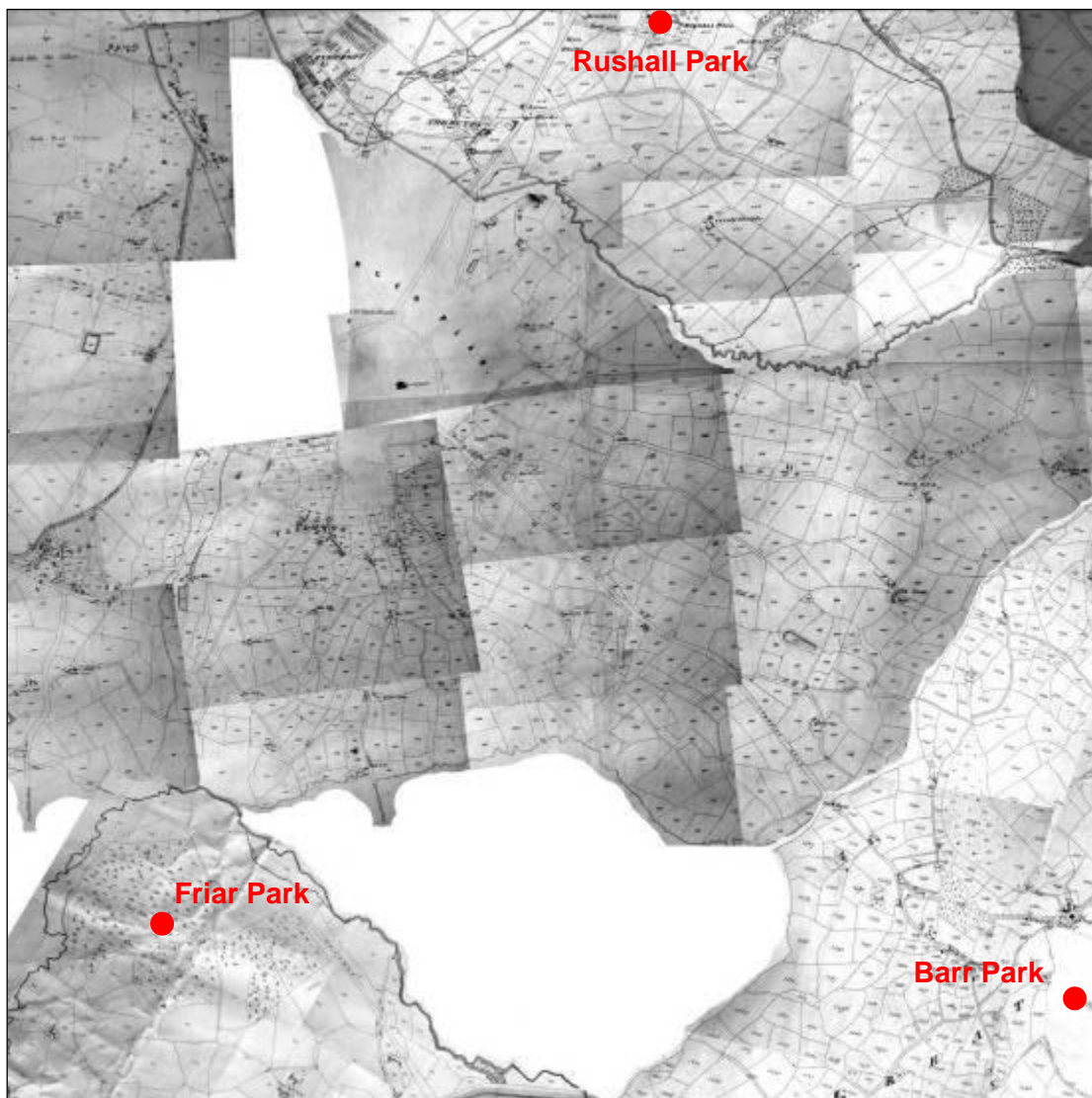


Figure 5.7: Stitched photographic segments of those tithe maps intersecting with pilot area 2. Names and location of wood-pasture and parkland that could be identified from illustrated trees given. Blank areas show tithe maps that we omitted as they did not illustrate trees and no wood-pasture or parkland had been identified in them in the previous desk study.

- 5.52 Only the tithe maps for the parishes of Rushall (1842), Aldridge (1841) and Wednesbury (1843) illustrated trees, the latter doing so in a different way to the others. The Walsall tithe map (1845) did not. The areas that had been previously identified as wood-pasture and parkland later in history during the previous desk study that are found these tithe maps are shown in Figure 5.8.
- 5.53 Rushall Park: The apportionment indicates it as being used as a garden of Rushall Hall, and in this instance given the apparent number of trees present (Figure 5.8) it is reasonable to assume with a high degree of confidence that that this is wood-pasture and parkland.

- 5.54 Barr Park: Of those areas shown to contain trees, the apportionment indicates land use as an avenue (a feature of parkland) or plantation woodland. The largest tithe area 1399 (see Figure 5.8) does not contain trees but is described as being “part of park” with it being utilised as pasture. Without the presence of trees it is not possible to say with any confidence that this is wood-pasture and parkland even though the apportionment indicates the correct land use.
- 5.55 Friar Park: Consists of three areas containing trees illustrated in a different fashion to the previous two examples. They contain different degrees of small foliage symbols, and a symbol similar to that found on the historical OS maps indication rough pasture, amongst the tree symbols. The apportionments indicate that two of the areas are wood and the other is rough pasture (see Figure 5.8). The symbols alone here could be enough to identify these areas as wood-pasture and parkland, but the highest confidence would have to go to that area that is identified in the apportionment as rough pasture. The other two areas were believed to be wood-pasture by the Epoch 1 OS maps, but perhaps at this time they were still being managed as woodland.
- 5.56 No other areas shown to contain trees with land use described as anything other than “wood” were identified within the area covered by these tithe maps.
- 5.57 Frair Park represents an area where wood-pasture could be identified due the presence of tree cover and its identification in the apportionment as rough pasture, showing that it is possible to determine this subtype from this resource.

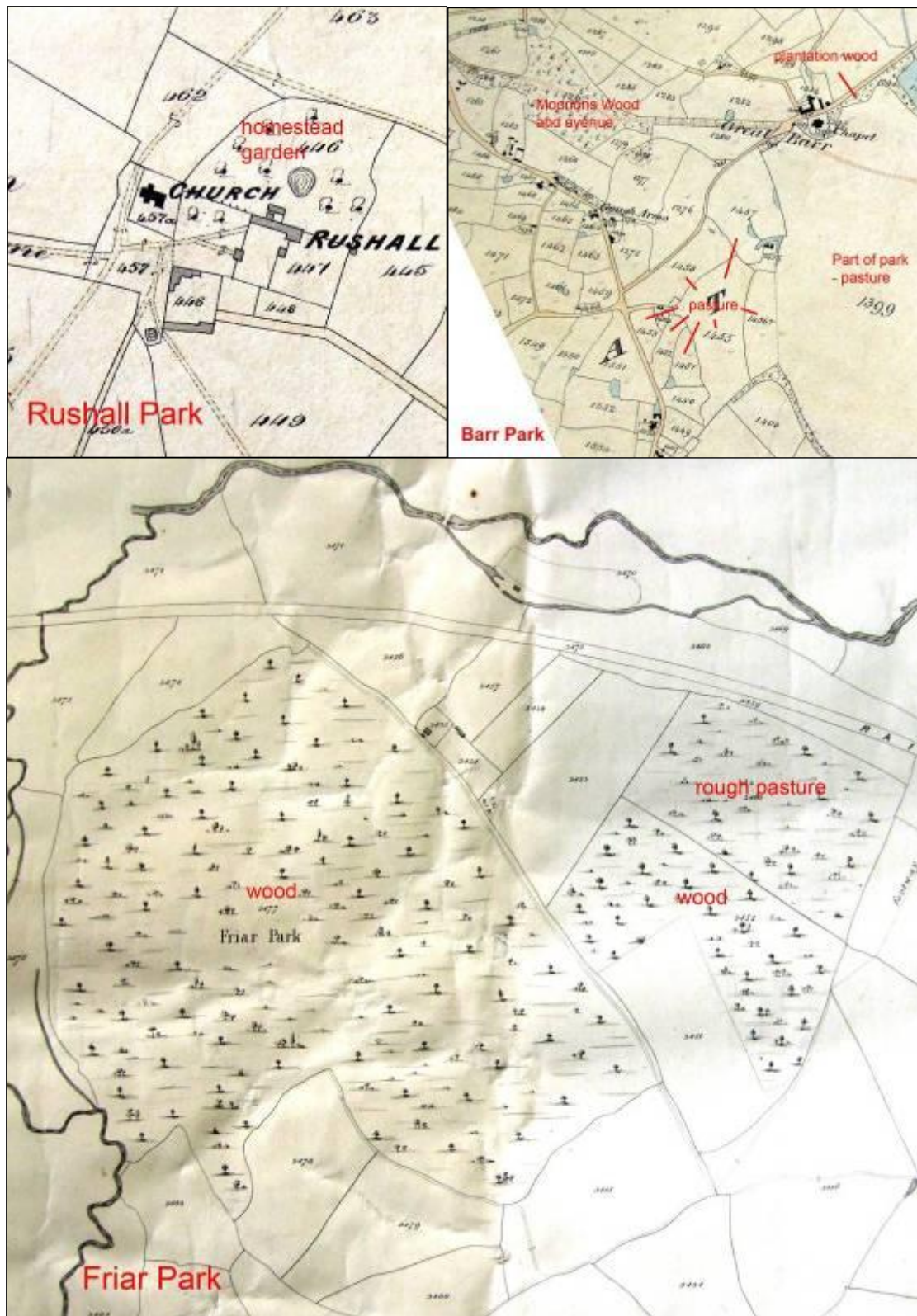


Figure 5.8: Detailed view of those previously identified areas of wood-pasture and parkland that could be identified on the tithe maps that illustrated trees. Associated tithe apportionment text is given in red.

6 Discussion

Information sources

Historic OS maps: Epochs 1-4

- 6.1 The ground truthing study highlighted several issues with using this resource to identify where wood-pasture and parkland historically existed at several points in time.
- 6.2 Overarching them all is the fact that there is no way of knowing whether the decline in wood-pasture and parkland observed was due to actual loss of habitat or just differences in the mapping process during different epochs.
- 6.3 The subjective nature of having different surveyors and/or cartographers is one possible explanation. For pilot area 1, where there was no apparent land use change, much of the changes in decision over the presence of wood-pasture and parkland between epochs was due to change in symbol depicting the vegetation present. While in pilot area 2, the change of decision was due to more defined change in land use, i.e. construction on sites/urbanisation causing loss, and new urban parks being created from pasture/meadow. The latter is less likely to be subjectively interpreted by the surveyor/cartographer and subsequently by the individual looking for wood-pasture and parkland.
- 6.4 The maps produced during Epoch 2-4 were revisions of the initial survey map produced during Epoch 1. It is possible that these maps are only recording changes that have occurred since the previous epoch, with the unchanged areas from the previous epoch being inconsistently replicated on them. This could explain the lack of coverage, especially of Epoch 3 and 4 maps, and also the apparently blank fields observed where there is map coverage available.
- 6.5 Evidence for the fact that Epoch 2-4 maps do record changes comes from the identification on Epoch 2, 3, and even 4, maps of:
 - New wood-pasture and parkland sites not present on the Epoch 1 map.
 - Addition/removal of area to/from wood-pasture and parkland sites identified on the Epoch 1 map.
- 6.6 As a result of the work done in pilot area 2 and the inventory work in rest of the West Midlands, new wood-pasture and parkland identified post-Epoch 1 was particularly associated with the creation of public parks and green spaces in urban areas. Therefore, using solely maps from this period to identify historic wood-pasture and parkland would mean that some sites could be

missed.

- 6.7 Interpretation error cannot be ruled out, but the same rules for identifying wood-pasture and parkland were consistently re-applied across all epochs after lessons from the process had been learnt.
- 6.8 For the source as a whole, there is no way of knowing for sure that the maps accurately depict what the landscape looked like at the time, even for the Epoch 1 maps that represent the initial survey carried out in the series. The evidence that the many of the features identified on these maps are still present, in the same position, on modern aerial photographs, gives weight to the argument that they do.
- 6.9 Given what we have found, the Epoch 1 maps still represent the single most accessible and complete source of historic mapping of England currently available. Like all maps they are never going to be perfect, as they are interpretations of what was present at the time they were created. They therefore offer the next best thing to aerial photographic evidence, which is not available until the 1940s.
- 6.10 Therefore for identification of wood-pasture and parkland, Epoch 1 maps represent the most logical primary historic resource, utilising Epoch 2 maps onwards within urban areas.

Tithe and field name maps

- 6.11 Tithe maps are a significant source of information and pre-date the Epoch 1 maps. However, the use of tithe maps for two of the areas used for ground-truthing has revealed that, even though tithe maps and their associated documents are potentially useful in identifying wood-pasture and parkland with high levels of confidence, there are many features of the tithe map resource that indicate it is not as useful as one would assume.
- 6.12 Tithe maps are not available digitised and geo-referenced under one resource like the historical OS 1:2500 maps. They are available in different formats at both national and county repositories, either digitally (e.g. Worcestershire), on microfiche/microfilm (e.g. Shropshire), or as original documents (e.g. Staffordshire). The effort required to source and georeference the maps, to allow interpretation, increases through these examples.
- 6.13 If a tithe map does not have an associated field name map, e.g. the situation in Staffordshire, the tithe apportionment documents would have to be referenced to get detail about land use, a labour intensive exercise in itself. Also, there were instances where the information that was available on field name maps did not offer any conclusive indication of the land use.

- 6.14 If no trees are indicated on a tithe map it is impossible to draw any conclusion about the presence of wood-pasture and parkland even though land-use information is available, as there is no indication of tree cover to complement it. Even when trees are mapped they do not offer information on the exact position and therefore coverage of trees akin to the historic OS maps, but are more for representative purposes like modern OS maps.
- 6.15 Where tithe maps which do indicate trees are part of a readily available resource, and land use information of sufficient detail is also readily available, then tithe maps could offer a valuable source for identifying wood-pasture and parkland, although the experience in this project suggests otherwise.

Dudley Stamp maps

- 6.16 As discussed in Chapter 4, the use of the Dudley Stamp land-use survey maps from the 1930s was explored for this project. However, due to the low resolution of the available maps and because they did not distinguish wood-pasture and parkland any better than the underlying base map, they were considered unlikely to provide significant additional information for this project. Should the original field maps become available in the future they would provide a much more useful resource.

War-time (1940s) aerial photographs

- 6.17 With availability and coverage at its present state, the use of war-time (1940s) aerial photography was restricted to our investigation of wood-pasture and parkland in pilot area 3. However, this source was found to be useful in providing historical context, although in that particular area did not result in the identification of any new sites.

UK Perspectives aerial photographs

- 6.18 The UK Perspectives aerial photographs are the most recent complete source of information available to remotely identify wood-pasture and parkland using the habitat assessment criteria.
- 6.19 The only problem with the resource, particularly identified in pilot area 2, is that it is very difficult to tell the age of the trees present on the photographs. Perceived continuity of tree cover between historical and modern sources may not actually be correct. It is impossible to tell otherwise without ground-truthing, as was the case in pilot area 2, which may mean sites lacking in ecological continuity are incorporated into the inventory. The only way this can be addressed is by lowering the confidence in assessment for any site where there is uncertainty about age of trees present, certainly if there is no actual historical evidence of them.
- 6.20 This becomes a particular problem when wood-pasture and parkland has become coniferised, making it difficult to distinguish different types of tree

canopies from one another.

Historic Landscape Characterisation (HLC) and similar datasets

- 6.21 HLC compartmentalises the historic landscape into a finite number of categories, often primarily based on Epoch 1 OS maps. All of the West Midlands' counties for which this was sought had completed or were undertaking HLC. All had HLC (or equivalent) data available as spatial databases, in polygon format. However, differences in methodology meant they were of varying use.
- 6.22 All had a 'Major Type' category that identified 'Parks and gardens' but only Warwickshire had the category 'Common Grazed Woodland' that was believed to be the direct equivalent of wood-pasture. Of the categories supplied from The Black Country (*i.e.* those that were felt to be most useful by the Black Country Archaeologist), as well as 'Parks and gardens' (under the 'Broad Type' of 'Recreational'), 'Ancient unenclosed pasture' also identified a small number of sites.
- 6.23 The Worcestershire HLC was still in its pilot stage, but a spatial database, in polygon format, of registered and unregistered parks and gardens, created in a similar way to the HLC was provided.
- 6.24 While these datasets are very useful in identifying the location of possible wood-pasture and parkland sites (and particularly parkland), the boundaries are created based on historical sources. This meant that for those sites that did not fully meet the habitat definition the boundaries had to be remapped or, because of time constraints, kept and the determination decision recorded. Some sites identified by these datasets were not included at all as they were no longer considered present in accordance with the habitat definition and were gardens.

County level habitat inventories

- 6.25 Two very different county level inventories were obtained from Worcestershire and Staffordshire. The latter contained the previous wood-pasture and parkland survey and mapping work that had been carried out there in 1999-2000.
- 6.26 The 'Lowland wood-pasture and parkland' identified in the Worcestershire Habitat Inventory only made up 12% of the overall habitat identified in the county, with the majority of sites being identified by the parks and gardens dataset.
- 6.27 The Staffordshire Habitat Layer, by contrast, classified habitat primarily by Phase 1, with some by National Vegetation Classification (NVC), as opposed to the BAP categorisation in Worcestershire. This meant that not all the

polygons that listed the previous wood-pasture and parkland survey as their source were actually wood-pasture and parkland according to the rules based definition.

6.28 Also additional sites were identified from:

- Analysis of other Phase 1 data within the layer.
- More recent versions of national datasets, e.g. English Heritage: Register of Parks and Gardens was used to identify sites in the original work.
- Chance identification on historic OS maps and UK Perspectives aerial photography.

6.29 The Staffordshire experience shows that previous survey work should be treated with caution as methods by which wood-pasture and parkland is recorded can be different from those used for this work. Habitat inventories are generally by no means definitive and are continually being developed to make them more comprehensive.

Registered Common Land

6.30 As Registered Common Land (RCL) does not directly identify wood-pasture and parkland, not every site in this dataset was checked for the presence of the habitat. Instead the RCL data was used alongside other datasets, either where they overlapped directly, or with historic OS map/aerial photography tiles onto which they were overlaid, to provide information on enclosure. This is essential for confidently identifying the habitat, particularly wood-pasture. The Biological Survey of Common Land was not referred to during this project.

Other organisational datasets

6.31 Knowledge of the management of a site is essential for the identification of the habitat, particularly wood-pasture. While symbols on historic maps and visible identifiers on aerial photography can offer some clues, no confidence can be assumed without knowledge of site management.

6.32 Such information will come from land managers themselves or more centrally from organisations responsible for land, e.g. County Wildlife Trusts, Environmental Stewardship data sets, and from ground truthing.

Veteran tree datasets

6.33 Veteran tree datasets are extremely useful as they can potentially provide current spatial information about the trees that may be present within wood-pasture and parkland sites. Without such information the accuracy of the historic OS maps in locating trees has to be relied on, and even when trees

are identified as present within the modern landscape, they may not be those individuals that were identified historically as being part of wood-pasture and parkland.

- 6.34 The cluster analysis performed on the Worcester Ancient Tree Project data identified areas where there are many field boundaries that contained more than three veteran trees, but the surrounding landscape does not contain any trees within the fields themselves. In all these cases, by looking at their context on the historic OS maps the trees were deemed not to be associated with wood-pasture and parkland. However, field boundaries are not included in the habitat definition, so those that are historically associated with wood-pasture and parkland will not be captured. These sites could be better for restoration of the habitat over sites that have lost all of their wood-pasture and parkland features, so excluding them from the habitat definition may need to be reviewed.

Ground truthing and volunteers

- 6.35 Ground truthing represents the only method by which the current status of wood-pasture and parkland habitats in the landscape can be confidently recorded, and is especially important when there is less than full confidence in remote sensing interpretation. Ground truthing proved extremely useful to the process of inventory creation reported here. An extension to the work could be the development of a rules base specifically for the ground-truthing of this habitat. This should cover location and mapping details as well as a system for assessing the quality of each habitat parcel, and should allow ground-truthing to be carried out consistently into the future. It will also be valuable to develop a system whereby land which has been ground truthed can be flagged up.
- 6.36 While no assessment of the information local volunteers could provide could be made (as no data was received from ground truthing by volunteers in pilot area 3), the exercise did provide some important lessons. There is no denying that local knowledge and support is valuable for the free collection of detailed information on this habitat, but it does come at another price in terms of the time required to locate, organise, and finally receive useful data.
- 6.37 Locating volunteers can be straightforward as networks already exist across the county, e.g. Ancient Tree Hunt, parish tree wardens and local nature groups. However, for the data they are to provide to be useful, it needs to be of consistent quality and as such any volunteers will require training. Not all will possess the skills to identify features of wood-pasture and parkland, if Level 2 wood-pasture site survey (Smith, 2007) is to be achieved, as this survey technique requires the identification of features both biological and archaeological.

- 6.38 Only a small proportion of our study area was ground truthed because the exercise was primarily designed to help put the rule base into practice. However ground truthing is likely to play a more important role in further work when it comes to addressing those sites that have been assessed as having anything less than high confidence as definitely being the priority habitat as a result of remote sensing. This is likely to cover more sites/larger areas than those covered as part of our pilot. The extent of ground truthing that needs to take place will depend on the confidence that can be given remotely to sites based on the information sources considered in other areas, which is determined during the evidence gathering exercise.

The Inventory

Worcestershire

- 6.39 Worcestershire was the county with the most complete set of data available, both biological and archaeological, including data on veteran trees. As a result it represents the county (outside of Birmingham and The Black County, discussed below) with the largest area referenced on historic OS maps and modern aerial photography (39% of the county), identifying wood-pasture and parkland with the highest degree of confidence (85% of sites were captured as definitely the priority habitat).

Shropshire

- 6.40 Inventory information for Shropshire is predominantly based on the Shropshire HLC, with approximately two thirds of sites captured as definitely the priority habitat. This is a result of time constraints that meant un-modified HLC boundaries were captured without the removal of areas that did not meet the habitat definition. This also probably explains the comparatively high area of habitat identified in this county.

Herefordshire

- 6.41 Like Shropshire, the provisional inventory for Herefordshire is predominantly based on its counties historic parks and gardens dataset. However, here only approximately one third of sites were captured as definitely the priority habitat. As before, this is a result of time constraints that meant un-modified boundaries were captured without the removal of areas that did not meet the habitat definition, which also probably explains the comparatively high area of habitat identified in this county.
- 6.42 The lower percentage of boundaries that definitely identified the priority habitat could indicate one of two things. That the definitions used for the Herefordshire historic parks and gardens dataset were further removed from those proposed in this methodology than those used for the Shropshire HLC parks and gardens. Or, if they were established using similar definitions, then

it could indicate that there has been a greater loss in extent of sites in Herefordshire compared to Shropshire. Further work is required to confirm this.

Birmingham, Coventry, Solihull and the Black Country

- 6.43 Data coverage in these areas was somewhat lacking with coverage primarily arising from The Black County HLC and to a lesser extent the Solihull HLC (identifying 71% of sites). In order to compensate for this fact, modern aerial photograph interpretation was undertaken for Birmingham, Coventry and Solihull, resulting in a much high coverage than achieved through data sourcing and identification of the remaining 29% of sites within the area.
- 6.44 However, the resulting inventory in these areas identifies wood-pasture and parkland with a high degree of confidence (83% of sites were captured as definitely the priory habitat).

Staffordshire

- 6.45 The inventory in Staffordshire was primarily based on the work that resulted from ENRR 416 (*County surveys of parkland: The Staffordshire Experience 2001*), as well as an additional county habitat layer that was obtained in sourcing the results from this project, and national datasets.
- 6.46 The project mainly identified sites through modern OS map interpretation. Combining this with the fact that the identified sites were mapped to Phase 1 habitat definitions, meant that not all the polygons in the dataset related to actual wood-pasture and parkland according to the definition of the habitat.
- 6.47 Extra coverage in this county was achieved through interrogation of the habitat layer for the whole county resulting in a figure more in line with the other counties in the West Midlands.
- 6.48 This process, along with the utilisation of more recent national datasets and chance historic OS map/modern aerial photography interpretation, revealed the incompleteness of the outputs from the original project. Table 6.1 shows the breakdown of the sources that were the primary habitat identification sources within Staffordshire. Seventeen additional sites were identified within the Staffordshire habitat layer that were not identified as a result of the survey work for the previous project.
- 6.49 Therefore previous wood-pasture and parkland inventory projects should be treated with caution, especially if the methodology and definitions used to construct them are unclear and not the same as the rules base that has been developed by this project.

Table 6.1: The primary wood-pasture and parkland habitat identification sources within Staffordshire

Primary Habitat Identification Source	Identified sites
English Heritage Register of Parks and Gardens	13
National Trust Habitats Database	2
Staffordshire Ecological Record Habitat Layer	111
UK Perspectives Aerial Photography	19
Woodland Trust Provisional Wood Pasture and Parkland evaluation England v.2	2

* Note that some of the sites included have been identified from more than one data-source, which has been recorded within the further sources field of the inventory.

6.50 Polygons defined by Phase 1 definitions and snapped to OS MasterMap did allow those areas that were definitely the priority habitat to be easily and accurately captured. This resulted in an inventory that identifies wood-pasture and parkland with a high degree of confidence (84% of sites were captured as definitely the priority habitat).

Warwickshire

6.51 The inventory for this county was based on the work in the county from a previous JUST ECOLOGY project (Lush *et al.* 2008). The sites mapped during this project were revisited and aligned with the habitat definition and removed or altered when they did not agree, resulting in identification of sites that are definitely the priority habitat. Alteration was mainly as a result of historical wood-pasture and parkland area that had been mapped.

6.52 Using Warwickshire HLC and the data for current parks and gardens resulted in the identification of the remaining 26% of sites in Warwickshire. All of these contained the priority habitat but were not re-mapped in accordance with the habitat definition used for the inventory. These sites were recorded as definitely containing the priority habitat but not mappable.

Conclusion and Recommendations

6.53 The methods employed during this work drew upon existing datasets in order to focus the identification of extant wood-pasture and parkland on the most widely available historic (i.e. the historic OS maps) and modern (i.e. the most recent and complete UK Perspectives aerial photography edition) data sources. Considering the historic sources assessed during this project, it is logical to conclude that Epoch 1 maps should represent the primary historic reference resource, utilising Epoch 2 maps onwards within urban areas. Ancient/veteran tree data (where available) can be used alongside these to increase the confidence of assessment and help to remove any doubt surrounding the way in which the historic OS maps were compiled.

- 6.54 While the methodology used would appear to be more cost-effective than systematically searching the entirety of these sources, it cannot 100% guarantee that all the habitat is identified. This is due to the availability/completeness of contributing datasets and differences in the methodology/definitions they utilise. It also relies heavily on the co-operation of data providers.
- 6.55 However the methods used for this project do provide a very good baseline to facilitate the continual development of the inventory. The resulting inventory identifies 68% of sites as definitely the priority habitat with high confidence. The remaining 32% of sites have lower confidence attached to their assessment or are sites they definitely contain the priority habitat but not to the extent of the mapped boundary. It is these latter sites that have scope to be considered for a stage of ground truthing to improve the confidence or correct the assessment that has resulted from remote sensing.
- 6.56 Whilst the current inventory documents the location and extent of wood-pasture and parkland in this region, habitat quality is not assessed, this being another area where ground-truthing could contribute valuable information.
- 6.57 The following are some key recommendations for how further work in this area should be undertaken:
- Utilisation of Epoch 1 historic OS mapping as the primary historic reference resource for the remote mapping and confidence assessment of current wood-pasture and parkland. These should be supported by Epoch 2 mapping and ancient/veteran tree data where appropriate.
 - While it is considered unlikely that a significant number of sites will have been missed through the application of methodology used in this project, it does not rule the possibility out. To confirm this either way, the areas where the presence of the habitat was not inferred/identified could be interrogated for the habitat. This could take the form of consultation with local experts or searching those areas on the most appropriate historic/modern mapping sources.
 - The incorporation of the previous inventory work in Staffordshire has revealed its potential incompleteness. While some additional data was utilised, it is recommended that the inventory in this county is further updated.
 - After any remote sensing stage has been undertaken, as was the case in this project, a ground truthing stage will be important in addressing those sites that have been assessed as having anything less than high confidence as definitely being the priority habitat.

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8 Appendix 1: WAPIS data capture rule base

General description of Wood-pasture and Parkland

- 8.1 Wood-pastures are areas that have been managed by a long-established tradition of grazing allowing, where the site is in good condition, the survival of multiple generations of trees, characteristically with at least some veteran trees or shrubs (UK Biodiversity Action Plan, 2008). The tree and shrub component may have been exploited in the past and can occur as scattered individuals, small groups, or as more or less complete canopy cover. Depending on the degree of canopy cover other semi-natural habitats, including grassland, heath, scrub *etc.* may occur in mosaic with woodland communities. While oak, beech, alder, birch, ash, hawthorn, hazel or pine are often dominant, a wide range of other tree and shrub species may occur as part of wood-pasture systems.
- 8.2 Wood-pastures and parkland are the products of age and historic land management systems, and represent a vegetation structure rather than being a particular plant community. Typically this structure consists of large, open-grown or high forest trees (often pollards) at various densities, in a matrix of grazed grassland, heathland and/or woodland floras.
- 8.3 In terms of the National Vegetation Classification (NVC) of plant communities lowland wood-pastures and parkland are most commonly associated with W10 *Quercus robur* - *Pteridium aquilinum* – *Rubus fruticosus* woodland, W14 *Fagus sylvatica* - *Rubus fruticosus* woodland, W15 *Fagus sylvatica* - *Deschampsia flexuosa* woodland and W16 *Quercus* spp. - *Betula* spp.- *Deschampsia flexuosa* woodland, although others may occur. Upland examples may show more resemblance to W11 and W17 woodland types. In addition the more open wood-pastures and parkland may include various scrub, heathland, improved and unimproved grassland NVC communities.
- 8.4 There are no reliable statistics on the extent of the overall resource, nor on historical and current rates of loss or degradation of this type of habitat. UK and England estimates of 35,100 ha and 22,000 ha, respectively, are the current best estimates (www.ukbap-reporting.org.uk). This habitat is most common in southern Britain, but scattered examples occur throughout the country for example Hamilton High Parks and Dalkeith Oakwood in Scotland and Glenamarra Park in the Lake District. Recently it has been recognised as also being widespread formerly in the uplands. Outgrown wood-pasture and mature high forest remnants (virgin forests) occur in northern and central Europe, but the number and continuity of ancient (veteran) trees with their associated distinctive saproxylic fauna and epiphytic flora are more abundant in Britain than elsewhere. Parklands and wood-pasture may also be of interest for bats and birds and may preserve indigenous tree genotypes. They

are also frequently of national historic, cultural and landscape importance, for example in the New Forest. These areas are outstanding at a European level.

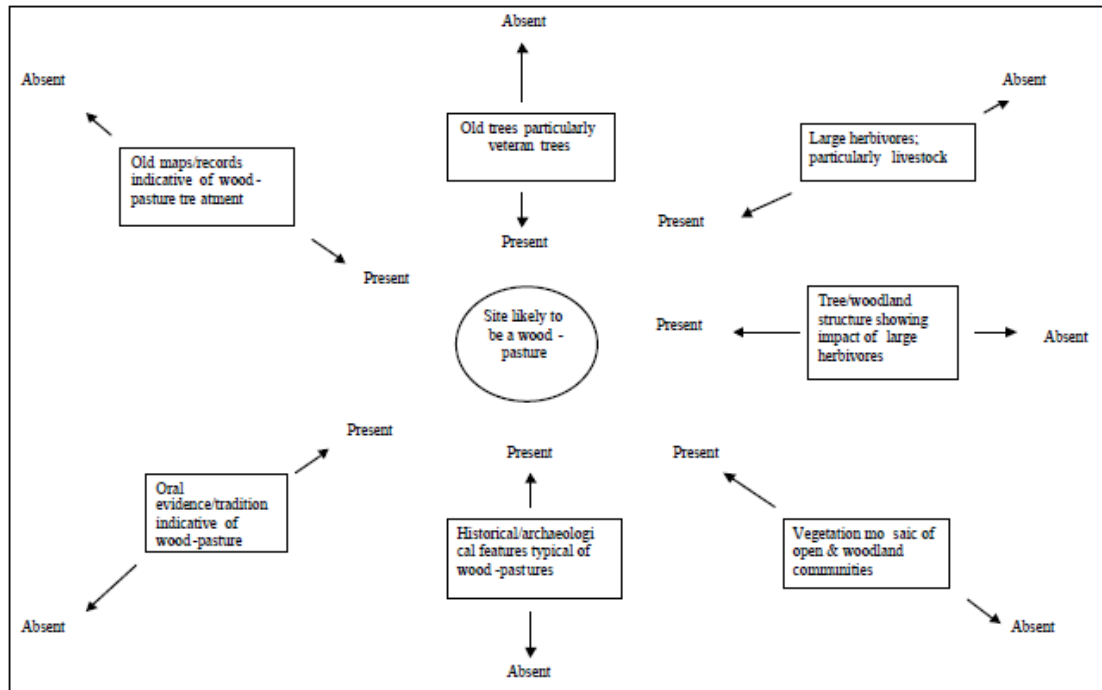
8.5 Included in this plan are:

- Wood-pastures and parklands derived from medieval forests and emparkments, wooded commons, parks and pastures with trees in them. Some have subsequently had a designed landscape superimposed in the 16th to 19th centuries. A range of native species usually predominates amongst the old trees but there may be non-native species which have been planted or regenerated naturally.
- Parklands with their origins in the 19th century or later where they contain much older trees derived from an earlier landscape.
- Under-managed and unmanaged wood-pastures with veteran trees, in a matrix of secondary woodland or scrub that has developed by regeneration and/or planting.
- Parkland or wood-pasture that has been converted to other land uses such as arable fields, forestry and amenity land, but where surviving veteran trees are of nature conservation interest. Some of the characteristic wood-pasture and parkland species may have survived this change in state.

8.6 Not normally included in this plan are:

- Upland sheep-grazed closed-canopy oak woodland, derived from coppice, or Caledonian pine forest (see the respective plans for these habitats), although in some cases grazing may be part of the desirable management approaches for these woods.
- Parklands with 19th century origins or later with none of the above characteristics.

8.7 The diagram below from Neil Sanderson's work in 2000 may help judge whether a site is/was a wood-pasture. Wood-pastures in good condition are likely to have most factors scoring towards the central circle. Sites with a wood-pasture history (relic wood-pastures) that have not been managed as such recently may be lacking some of the characteristic features. Land use is fluid and just as relic wood-pastures are evolving into different woodland types, other woodlands, or formerly open ground, may be evolving towards wood-pastures with increases in grazing pressure or tree/shrub invasion respectively. Again these will not score as closely to the centre of the diagram.



8.8 Notes (clockwise from top left):

1. Old maps, these are variable across the country, but many do indicate unclosed grazed woodland as different from enclosed woodland, as is seen if one compares known wood-pastures with known enclosed woods. A very useful source, especially in the uplands, is the 1st series 6 inch OS maps dating from 1860s and 1870s. At this time most coppices will still be shown as enclosed, any wood shown as unenclosed, with dense stands irregular in shape and with areas of open scattered trees is likely to be an ancient pasture woodland. Enclosed relic stands will, however often have been enclosed in the lowlands by this time.
2. The term veteran tree includes both ancient (massive limb loss and large visible hollows) and post mature trees (or shrubs) (thinning of crown and hollowing starting but not very visible yet). Old trees are a strictly a consequence of wood-pasture management and not part of the definition, but they do indicate sites likely to be of great biodiversity interest. The more the better but any are significant.
3. Significant numbers of herbivores must be present in working pasture woodland but these may have been long gone in relic sites. Presence in past can be significant in relic sites, if significant numbers of trees originated under grazing pressure survive.
4. and 5. Structure is a complex factor and can be very different between woods and between regions, but characteristic features are irregular boundaries, very uneven stocking, frequent glades and areas with scattered trees. In healthy and expanding wood-pastures, scrub and thickets of infilling young trees are also to be expected but are normally patchy in working pasture woodlands, only where all enveloping due to

the cessation of grazing are these negative features. Closed canopy stands are also typical in many wood-pastures but these will be in mosaics with more open stands, uniform even aged closed canopies are a negative feature, but not closed canopies per se. Non-boundary pollards nearly always indicate grazing but not all pasture woodlands have pollards. Alder pollards are highly indicative of summer grazed upland wood-pasture but unprotected Alder coppice on wet soils is characteristic of lowland pasture woodlands. Open grown trees and shrubs are typical but this does not mean just fully open grown individuals but also includes tall partially open grown ones with irregular growth forms in low density grazed high forest. No fixed boundaries with open vegetation.

6. Archaeological features will vary regionally and can include the total absence of features, as in many New Forest pasture woodlands, in particular an absence of boundary banks is a positive feature. Charcoal can be made from pollards or unenclosed Alder coppice, so a few charcoal heaths does not indicate enclosed coppice but a high density may.
 7. Useful for 20th century, not usually before this.
- 8.9 Some wood-pastures have very clearly defined boundaries; in others it may be difficult to set limits and many may simply be part of a much larger range landscape. In the same way that a mire will be only part of a larger moorland ecology with the heath and grassland on drier ground wood-pasture is often intimately linked to non treed land. While it may be pragmatic to distinguish the area that represents the tree component of the wood-pasture from the broader grazing unit, this should not lead to the treed area being regarded as uniquely separate from the rest of the ecological unit.
- 8.10 This is intended as a guide to the identification of high quality relic and evolving wood-pasture. Identification does not mean that all areas identified as such should be managed as wood-pasture but it is vital that its existence is appreciated and the possibility of maintaining or enhancing wood-pasture features considered. The positive features of grazing in woodland and the role of wood-pasture in planning ecological restoration needs recognition.

General working method

Manual assessment and data capture

Assessment of site data

- 8.11 Appendix 1.1 provides a decision making key for the assessment of site data, as well as a process for judging the confidence that the site matches the adopted habitat definition. Any exceptions to this key should be recorded. This key is currently quite basic and will not cover every eventuality, so it may be necessary to make modifications as new situations are encountered.

- 8.12 The most important factor in making an accurate decision is to include all available data sources in the assessment, including all available historic maps and aerial photographs. Experience has taught that using just one or two data sources to make an identification of wood-pasture or parkland, especially using remote sensing, can be highly misleading. This significantly adds to the time required for inventory creation, but avoids identifying non- wood-pasture and parkland areas.

Existing polygons

- 8.13 Any datasets that are already available in GIS format may be used to populate or update WAPIS. Attributes from these existing datasets may be used, though only where they conform to the standard of WAPIS. Their boundaries may also require some level of improvement, though the cost-benefit of doing so should be considered. Overlap queries can be used to assess the scale of overlap and hence the proportion of update to population required.
- 8.14 Polygons of the existing WAPIS database should be modified if they are found to be significantly erroneous or if additional data are included. Polygons may require altering if:
- >0.25 ha of another priority habitat is present and mappable with no allowable overlap with wood-pasture and parkland;
 - >0.25 ha of mappable non-priority habitat is present;
 - New wood-pasture and parkland, creating a polygon of at least 0.25 ha, is discovered outside of an existing polygon.
- 8.15 Where polygons of the existing WAPIS database are found not to contain any wood-pasture or parkland priority habitat, either through the assessment of data sources or where aerial photographs show <0.25 ha of wood-pasture or parkland to be present, they should be removed from the database.

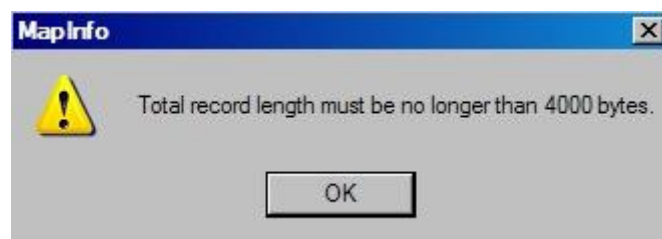
Newly digitised polygons

- 8.16 Where new polygons are digitised (particularly from paper data sources) they **must** be drawn to the standards described in Appendix 1.3. These include:
- Snapping to OS MasterMap where possible;
 - No application of maximum polygon size limits;
 - A minimum mappable unit of 0.25 ha or 500 m in length for linear habitat areas, such as road verges. However, where smaller fragments occur these may be mapped if they are part of a larger contiguous area, separated only by a linear feature such as a metalled road;

- Polygons will not extend across any road or river with an OS polygon, though may cross smaller linear features;
- Polygons will be closed, with no dangling nodes, and will not have overlap with other polygons within the same inventory.

Attribution of the WAPIS inventory

- 8.17 The standard priority habitat inventory format has been made consistent across all priority habitat inventories. However, none of the other habitats rely so extensively on historical and biological evidence, such as saproxylic species present and number of veteran trees. The standard habitat inventory format has not been designed to allow for this sort of information to be easily captured.
- 8.18 We have considered a number of potential solutions to this. The simplest is to fit this data into the standard format. Much of the historical map information could be included within the source fields. However, there are no fields suitable for containing information on the subtype (parkland or wood-pasture), species, veteran tree number and Registered Parks and Gardens grade. These important data would have to be included in the comments field and could not then be separately analysed.
- 8.19 We have also considered whether it would be possible to add appropriate fields to the standard priority habitat inventory format. However, the priority habitat inventory format is already near to the maximum table length and the addition of more fields is limited by the available space. Adding only the fields relevant to subtype, species, veteran tree number and Registered Parks and Gardens grade is impossible, as attempts lead to the following error:



- 8.20 The option of adding this data to a supplementary database, cross-referenced with the unique ID of each polygon, has also been discussed. However, it is felt that if such an inventory was created the links between the two databases would quickly be lost, as the wood-pasture and parkland inventory would be the only priority habitat inventory to have an associated database. Once this happens, any changes to polygons would lose their links to the supplementary database and the important information it contains.

- 8.21 For these reasons, it has been agreed that WAPIS will not conform to the priority habitat inventory standard table structure. This will allow much more flexibility in the data that can be captured within WAPIS, but will nevertheless aim to include the core fields from the standard table structure.
- 8.22 The precise table structure will be developed during this contract, based upon the existing digital WAPIS data and standard priority habitat inventory format. A provisional table structure is provided in Appendix 1.2.
- 8.23 One of the key fields from the standard priority habitat inventory format is the Priority Determination field (Pridet); this allows the user to define the level of certainty of a polygon meeting the relevant habitat definition. A priority determination comment field is also provided (Pridetcom). Users should make full use of this field to describe how the determination decision has been made, using the table in Appendix 1.1 as a guide.

What to do when datasets do not agree

- 8.24 When two datasets disagree an assessment should be made of the most reliable, taking into account:
- Date of the data – recent information is more likely to depict the current condition of the site;
 - The evidence provided for wood-pasture and parkland habitat;
 - Resolution of the data – detailed maps are an indication that more time was spent conducting the survey and thus it is likely to be more accurate;
 - Detail and therefore likely quality of the data – detailed surveys are more likely to be carried out by experienced assessors than by amateurs.
- 8.25 Inevitably, this sort of decision making requires a subjective decision and is greatly influenced by personal experience of wood-pasture and parkland habitats. If in any doubt the opinion of experts in this habitat should be sought.

Use of aerial photography to support decisions

- 8.26 Aerial photograph interpretation is an incredibly useful tool available to the habitat ecologist, but has its limitations. Whilst it will be possible in most cases to identify parkland habitats, it will not always be possible to identify closed-canopy wood-pastures from aerial photographs. In this situation data identifying wood-pasture becomes of key importance, with aerial photographs used to help determine the boundary. In such cases, aerial photography should be added as a data source in the data capture tool.
- 8.27 In addition, where the aerial photograph clearly shows wood-pasture and parkland to be lacking and is more recent than the survey data the aerial photograph should be given the highest priority. This includes areas that have

obviously been entirely cleared.

- 8.28 Aerial photographs may also be used to determine the associated habitat. This may be grassland, heathland or some other land use, including priority habitats where there is an acceptable overlap.

Treatment of sites on the border of the project area

- 8.29 Sites on the border of the project area should be kept intact where there is a contiguous area of wood-pasture or parkland. This may mean capturing data for areas outside of the West Midlands government region. Any subsequent overlaps with adjacent datasets will be dealt with at a later date.
- 8.30 Where there is an existing site boundary in the WAPIS database that crosses the border these should be treated as though they occur entirely within the West Midlands government region. This includes capturing data for areas of wood-pasture entirely outside the West Midlands but within the existing site boundary.

Automated data processing

- 8.31 It is possible that some of the electronic datasets can be processed automatically. By necessity this process will be tailored for each dataset, but will ensure that the MapInfo tables created meet the standards and format of the WAPIS database. Any overlaps between polygons created for these data and other WAPIS polygons will be dealt with subsequently.

Final processing

- 8.32 The completed dataset will be cleaned and checked. Identically attributed polygons can be merged to simplify and complete the dataset.
- 8.33 We will produce metadata describing the WAPIS database using MetaGenie. Each polygon within WAPIS must also be linked to further metadata describing the original data sources from which the polygon was attributed.

Key issues with mapping and discriminating from other habitats

- Please refer to the description of wood-pasture and parkland above.
- The minimum mappable unit (MMU) for this habitat is 0.25 ha, and the minimum width is 15 m (i.e. the width of one large tree canopy).
- Overlaps between wood-pasture and parkland and many other inland priority habitats, especially woodland¹, grassland and heathland, are

¹ This has been determined by the following statement, which is included in the woodland priority habitat definitions: 'Except for lowland wood pasture and parkland, woodland priority habitats are mutually exclusive of each other and there should be no overlap between polygons belonging different woodland priority habitats.'

allowable.

Applicability of aerial photos and other remote sensing technologies

- 8.34 Dependant on factors such as the time of year the photographs were taken, their scale, and the experience of the interpreter, it is possible to distinguish most parklands from other habitats with scattered trees. However, this should be supported by the use of historical maps and other data sources that identify parkland boundaries.
- 8.35 The identification of wood-pasture can be more difficult, depending upon tree density and the current and historical management. Whilst open grown trees in currently managed wood-pastures will be identified in the same way as parklands, the identification of essentially defunct wood-pastures with closed canopies, or nearly so, will rely much more on historic data sources and local knowledge.

Altitudinal limits

- 8.36 No specific upper or lower altitudinal limits.

Habitat classification

- 8.37 The categories in these classifications are not totally synonymous and the comparisons below attempt to be the best approximation.

Table 8.1: Wood-pasture and parkland habitat classifications

CLASSIFICATION and version date	CODE	DESCRIPTION	RELATIONSHIP *	COMMENTS
BAP priority habitat (2007)		Wood-pasture and parkland Grassland priority habitats Heathland priority habitats Woodland priority habitats	= # # #	Overlaps with woodland priority habitats are most likely to occur with wood-pasture. Overlaps with other priority habitats are less likely, but may occur.
BAP priority habitat (1995)		Lowland wood-pasture and parkland Grassland priority habitats Heathland priority habitats Woodland priority habitats	< # # #	Definition extended to include upland wood-pasture and parkland. See also above.
BAP broad habitat (1998)		Broadleaved, mixed and yew woodland	>	

CLASSIFICATION and version date	CODE	DESCRIPTION	RELATIONSHIP *	COMMENTS
Phase 1 (1990)	A111 A112 A131 A132 A31 A33	Broadleaved semi-natural woodland Broadleaved plantation woodland Mixed semi-natural woodland Mixed plantation woodland Scattered broadleaved trees Mixed parkland/scattered trees	# # # # # #	Overlaps occur with other Phase 1 communities in a mosaic with scattered trees.
NVC (1991)	W10 W11 W14 W15 W16 W17	<i>Quercus robur</i> - <i>Pteridium aquilinum</i> – <i>Rubus fruticosus</i> woodland <i>Quercus petraea</i> - <i>Betula pubescens</i> - <i>Oxalis acetosella</i> woodland <i>Fagus sylvatica</i> - <i>Rubus fruticosus</i> woodland <i>Fagus sylvatica</i> - <i>Deschampsia flexuosa</i> woodland <i>Quercus</i> spp. - <i>Betula</i> spp.- <i>Deschampsia flexuosa</i> woodland <i>Quercus petraea</i> – <i>Betula pubescens</i> – <i>Dicranum majus</i> woodland	# # # # # #	There are overlaps with other woodland communities, though these are the most likely to occur. Overlaps will occur with some non-woodland NVC communities, especially grassland and heathland communities.
Forestry Commission guide types (1994)	1 3	Lowland acid beech and oak woods Lowland mixed deciduous woods		Woodpasture treatment is a management option within several of the guides; but is likely to be most appropriate to stands managed under Guide 1, Lowland acid beech and oak woods (forestry Authority 1991a) and Guide 3, Lowland mixed deciduous woods (Forestry Authority 1994c)
Peterken stand types	6C 8A 8B 8D	Lowland birch-oakwoods Sessile oak-beech woods Acid pedunculate oak-beech woods Acid pedunculate oak-ash-beech woods		
EUNIS	X10 E7	Mosaic landscapes with a woodland element Sparsely wooded grasslands		Bocage landscape

CLASSIFICATION and version date	CODE	DESCRIPTION	RELATIONSHIP *	COMMENTS
Annex 1 type (1999 Interpretation manual)	9120	Atlantic acidophilous beech forests with <i>Ilex</i> and sometimes also <i>Taxus</i> in the shrublayer (<i>Quercion robori-petraeae</i> or <i>Ilici-Fagenion</i>)	#	Overlaps will occur with some non-woodland Annex 1 habitat types, especially grassland and heathland communities.
	9130	<i>Asperulo-Fagetum</i> beech forests	#	
	9160	Sub-Atlantic and medio-European oak or oak-hornbeam forests of the	#	
	9180	<i>Carpinion betuli</i>	#	
	9190	<i>Tilio-Acerion</i> forests of slopes, screes and ravines	#	
	91A0	Old acidophilous oak woods with <i>Quercus robur</i> on sandy plains	#	
		Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> in the British Isles		

* Relationship of classification type to priority habitat:

= equal, < narrower, > wider, # overlap

Species composition

8.38 There are no specific guidelines for species composition for wood-pasture and parkland, as the habitat is defined mostly by its physical structure. See the General description above.

Geographical restrictions

8.39 Wood-pasture and parkland is found throughout the UK in all climates where trees can grow.

Geology and soils

8.40 Wood-pasture and parkland is not associated with any particular soil types or geology.

Hydrology

8.41 Wood-pasture and parkland is generally associated with moderate to freely drained sites.

Table 8.2: Relationship with other habitats

	Wood-pasture and parkland
Ancient and/or species rich hedgerows	Allowable overlap. Hedges will be mapped as linear features and should not artificially sub-divide contiguous areas of wood-pasture and parkland.

Lowland beech and yew woodland	Allowable overlap.
Lowland calcareous grassland	Allowable overlap.
Lowland dry acid grassland	Allowable overlap.
Lowland heathland	Allowable overlap.
Lowland meadows	Allowable overlap. Grassland under meadow management is unlikely to overlap with wood-pasture and parkland, though otherwise managed neutral grasslands within wood-pasture and parkland boundaries may fall within the definition of lowland meadows.
Lowland mixed deciduous woodland	Allowable overlap.
Traditional orchards	Separate by tree species.
Upland birchwoods	Allowable overlap. Most likely to occur with upland wood-pasture. Overlaps with parkland are to be determined.
Upland calcareous grassland	Allowable overlap. Will only occur in upland wood-pasture and parkland.
Upland heathland	Allowable overlap. Will only occur in upland wood-pasture and parkland.
Upland mixed ashwoods	Allowable overlap – wood-pasture only.
Upland oakwood	Allowable overlap.

Management

8.42 Wood-pasture and parkland often has a historical management of pollarding, though this will vary locally. Landscaped parklands are more likely to be tidier in appearance resulting from clearance of deadwood, etc. However, many wood-pasture and parkland landscapes have been neglected in recent years, leading to reductions in extent, aging tree populations, scrub invasion and development to woodland. There is always evidence of grazing animals having an influence on the habitat in the past or present.

Size of mappable units

- Minimum mappable unit (MMU): 0.25 ha
- Minimum width: 15 m

Data capture rules

- 8.43 Wood-pasture and parkland will be identified using a range of data sources, including historic maps and aerial photographs, other inventories, species information, veteran tree information and local knowledge. However, much of the mapping will be based upon modern aerial photographs (i.e. less than ten years old), as this will allow the extent of wood-pasture and parkland to be accurately mapped.
- 8.44 Rules are needed to standardise how the determination of wood-pasture and parkland boundaries is made. Appropriate rules were developed for the inventory with the help of experts in wood-pasture and parkland habitats, including the Steering Group. The rules adopted are as follows:
1. A wood-pasture or parkland must contain a minimum of 3 trees, excluding boundary trees. Areas consisting entirely of young trees should not usually be mapped unless there is a known intention to manage them as wood-pasture or parkland.
 2. A tree is defined as an area of canopy not exceeding 15 m in diameter.
 3. Each tree within a wood-pasture or parkland must be no more than 250 m from another tree.
 4. The edge of the habitat is determined by mapping around the outside of the tree canopies. The edge should not span a distance of greater than 250 m between trees.
 5. Where trees are no more than 100 m from a boundary feature, the habitat is mapped to the boundary feature.
 6. The habitat boundary can be extended to include obvious large trees within boundary features that are no more than 250 m from a wood-pasture or parkland tree.
 7. The habitat boundary can also be extended to include standing dead trees.
 8. Trees following rivers and streams should be treated as falling within boundary features.
 9. Habitat areas, or parts thereof, of only one tree width (i.e. less than 15 m) are not allowed.
 10. Cemeteries and churchyards should not be included, even if they contain large trees, unless they are within an area otherwise identified as parkland. Gardens may also be excluded if they fail to include sufficient trees. Orchards, defunct or otherwise, as another priority habitat type should be excluded.
 11. Defunct wood-pasture may have a closed canopy and resemble woodland. If there is evidence that it has been wood-pasture and still contains large trees it should be captured as defunct wood-pasture.

12. Areas that appear to be wood-pasture or parkland on aerial photographs should not be captured unless they are supported by other evidence, including historical maps. A process for assessing the confidence attached to these assessments is outlined in Appendix 1.1, with the levels of confidence for each area recorded in the inventory.
13. Clusters of trees in urban areas identified using aerial photographs that were once wood-pasture or parkland should be treated as low confidence, as the likelihood that they are part of more modern landscaping is high.

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Appendices

Appendix 1

Appendix 1.1: Key for site-by-site assessment

Key

1.	Phase 1 data	Go to 2
	Peterken woodland classification	Go to 3
	NVC and similar classifications	Go to 4
	Includes reference to presence of areas of wood-pasture or parkland within site	Go to 5
	None of the above apply	See confidence assessment
2.	Clearly distinguishes wood-pasture and parkland	Go to 5
	Scattered trees indistinguishable from parkland and wood-pasture not recorded	See confidence assessment
3.	Clearly distinguishes wood-pasture	Go to 5
	Does not distinguish wood-pasture	See confidence assessment
4.	Clearly distinguishes wood-pasture and parkland	Go to 5
	Does not distinguish wood-pasture and parkland	See confidence assessment
5.	Some either map or grid reference available	Go to 6
	No map or grid reference available, only a vague location known	Do not capture, but list in spreadsheet
6.	Historic information only	Go to 7
	Modern information (with or without historical information)	Go to 8
7.	Extant wood-pasture or parkland exists in the location	Go to 8
	No extant wood-pasture or parkland in the location	Do not capture
8.	Map available	Go to 9
	Only grid reference available	Go to 10

9.	Map clearly delimits wood-pasture and parkland boundaries	Map as definitely wood-pasture and parkland
	Map for overall site boundary only	Go to 10
10.	Possible to map wood-pasture or parkland extent from aerial photographs from the last ten years.	Map as definitely wood-pasture and parkland
	Not possible to map wood-pasture or parkland extent from aerial photographs from the last ten years.	Map as definitely present but not mappable

Confidence assessment

Historical evidence (e.g. maps, documentation) available	No historical evidence available	Parkland boundary clearly visible	Designated as wood-pasture or parkland	Over 10 veteran trees per hectare	Saproxyllic/lichen/fungi importance documented (e.g. from IEC assessments)	On an existing inventory	On modern aerial photographs	Confidence
						No	Yes	Do not capture
Yes						*	Yes	High
	Yes					*	Yes	Medium
	Yes	Yes				*	Yes	High
		Yes				*	Yes	Low
		Yes		Yes		*	Yes	High
		Yes			Yes	*	Yes	High
			Yes			*	Yes	Medium
			Yes	Yes		*	Yes	High
			Yes		Yes	*	Yes	High
				Yes		*	Yes	Medium
				Yes	Yes	*	Yes	High
					Yes	*	Yes	Low

* The presence of sites on existing inventories should be taken into consideration, though the quality of each inventory data source should be individually assessed and used to inform the confidence assessment.

Appendix 1.2: Provisional WAPIS table structure

The WAPIS table structure will use fields from the standard priority habitat inventory format and those from the existing WAPIS database. Provisionally, these will include the following:

- From the standard priority habitat inventory format:
 - Incid Char (17)
 - Prihabtxt Char (254)
 - Pridet Char (100)
 - Interpqual Char (10)
 - Pridetcom Char (254)
 - Phabfeanot Char (254)
 - Source1 Decimal (6, 0)
 - Source1txt Char (100)
 - S1captdate Date
 - S1boundary Char (10)
 - S1habid Char (10)
 - Source2 Decimal (6, 0)
 - Source2txt Char (100)
 - S2captdate Date
 - S2boundary Char (10)
 - S2habid Char (10)
 - Source3 Decimal (6, 0)
 - Source3txt Char (100)
 - S3captdate Date
 - S3boundary Char (10)
 - S3habid Char (10)
 - Bsmapscale Char (50)
 - Digquality Char (10)
 - Fileref Char (100)
 - Siteref Char (100)
 - Createdate Date
 - Createdby Char (50)
 - Boundary Char (50)
- From the existing WAPIS database (Lush *et al.*, 2008):
 - PWP_name Char (50) – The name of the parkland or wood-pasture, where known.
 - PWP_subtype Char (20) – ‘Wood-pasture’, ‘Parkland’ or ‘Defunct wood-pasture’.
 - Ownership Char (50) –The name of the current owner of the site, where known. Where the parkland is owned by a private individual, as far as can be judged, this field should be attributed with ‘Private’.
 - ManagingBody Char (50) –The name of the current manager of the site, where known, as this may differ from the owner.

- Access Char (10) – ‘Open’, ‘Restricted’, ‘PROW only’ (public right of way only) or ‘None’, depending upon the type of access on the site, where known.
- Designations Char (50) – Any conservation designations applicable to all or part of the site, supplemented by the following three fields.
- SSSI_area Float – Area of the site designated as a Site of Special Scientific Interest (SSSI) in hectares.
- SSSI_prop Float – Percentage (proportion) of the site designated as a SSSI.
- EH_RPG_Grade Char (3) – English Heritage Register of Parks and Gardens code, where appropriate.
- VetTreeNo Integer – The number of veteran and ancient trees known to occur on the site. Where two or more datasets provide such information for a single site the highest value should be used, to avoid counting trees more than once.
- VetTreeSource Char (100) – The source dataset for the veteran tree information used.
- SpSapBeetleNo Integer – The number of saproxylic beetle species qualifying for SQI or IEC assessments recorded on the site. A site requires at least 40 species to produce a valid SQI score.
- SpSQI Float – The SQI for the site, including sites where the number of beetle species recorded is not high enough to produce a valid score.
- SpBeetleRIEC Float – The revised beetle IEC for the site.
- SpLichenNo Integer – The number of lichen species qualifying for any measurement of IEC recorded on the site.
- SpLichenRIEC Float – The revised lichen IEC for the site.
- SpLichenNIEC Float – The new lichen IEC for the site.
- SpBeechFungi595 Integer – The number of fungi listed in Ainsworth (2004) recorded on the site.
- SpSource1 Char (100) – The primary source dataset for species data.
- SpSource2 Char (100) – The secondary source dataset for species data.
- SpSource3 Char (100) – The tertiary source dataset for species data.

Appendix 1.3: Boundary and digitising standards

The following are Natural England's digitising standards, which are to be followed during capture of wood-pasture and parkland data:

- Digitise by snapping to existing OS MasterMap features wherever possible. Where there is no corresponding MasterMap feature then interpretation must be done at a scale appropriate to the resolution of the base map. As a general guiding principle, information and precision should not be lost from the base map to the MasterMap-based inventory dataset. The scale displayed on-screen during heads-up digitising must be sufficient to CLEARLY distinguish and digitise to closely mapped and detailed lines on OS MasterMap. This may involve work at, for example, 1:1000 or less, around complex features such as parallel-running streams, paths and fence-lines; at other times a smaller scale will be appropriate to accurately capture the desired lines. Care must be taken at all times, to ensure the cursor snaps to the correct vertex on the correct feature – this is why a small scale is recommended most of the time.
- All data within habitat inventories should be mapped as polygons unless otherwise stated in the habitat inventory development plan (IDP). Where lines and/or points are specified as allowable features within the habitat IDP, feature types should not be mixed within GIS datasets. Maintain separate GIS datasets for points, lines and polygon features.
- There is no maximum polygon size. Digitise large polygons as large polygons. The size of the polygon (or length of a linear feature) is determined by the extent of the contiguous habitat patch to which a single habitat code and associated attribution can be applied. There should be no artificial limiting of polygon size to match an existing GIS dataset, such as site boundaries.
- Generic minimum mappable units (MMU) are defined in the habitat definition for each habitat, generally 0.25 ha can be used as a guide. Many priority habitats are to be found in small fragmented parcels and to omit these from inventories on the basis of an arbitrary minimum would devalue the overall project and its aims. Therefore, the MMU in the habitat definition is based on knowledge of habitat fragmentation and the perceived significance of smaller parcels in defining the overall resource. In some cases minimum parcel sizes should be determined by the contributory data sources in use. This information should be stored in the metadata on the contributing datasets. No polygons of priority habitats are to be mapped that fall below the defined MMU for that habitat, unless they are part of a larger contiguous area of BAP habitat divided by a linear feature such as a metalled road and would not meet the MMU if counted as a single polygon.
- Where local record centres (LRCs) are undertaking work they should liaise

with their neighbours to ensure boundaries between LRCs are well defined and understood and that the amalgamated activity of all LRCs should yield 100% coverage of the project in the region with little or no overlap in activity. In general LRCs should digitise only up to the boundary of their geographic area of coverage, even if the land parcel continues into the adjacent area. These should be validated and rectified against neighbouring LRC data at a later stage when data are amalgamated.

- All polygons must be ‘closed’. No polygon boundary or line feature should be self-intersecting. Adjacent polygons should share a common boundary and have no slivers or overlaps between them.
- Polygons with holes should have ‘voids’ containing no data. There should be no dangling nodes outside the polygon area.
- Some land parcels may be included in more than one inventory. For example lowland meadows that are part of coastal grazing marshes should be mapped as both (i.e. a copy of the polygon should be included in each inventory dataset and attributed accordingly for each inventory). Each habitat definition defines allowable overlaps with other priority habitats.
- In the cases of habitat “mosaics” where possible the mosaic should be separated into polygons meeting individual habitat definitions, subject to the MMU for that habitat. Where it is impossible to separate closely associated habitats, then the land parcel may be included in both inventories but mapped as “definitely present within polygon but not mappable” under the priority determination attribute.
- Polygons may not extend across roads (as defined with metaling on the OS MasterMap data) or used railways. Polygons may not extend across any rivers that are mapped as polygons. Hedgerows (including the BAP Priority Habitat, ancient and/or species rich hedgerows) should not normally subdivide an otherwise continuous area of priority habitat. If subdividing an otherwise contiguous area of priority habitat with a road causes a polygon to fall below the designated MMU for that habitat then it may be included within the inventory even if below the ascribed MMU.
- As soon as a feature has been captured to GIS its mandatory attributes should normally be added before further features are captured. This must be done using the Data Capture Tool developed specifically for this purpose.

9 Appendix 2: Organisations and individuals contacted

9.1 A list of organisations and individuals contacted during this project. Note that some of the organisations listed had information available via websites, *etc.* and were not contacted, but indirectly provided useful information.

- Worcestershire Wildlife Trust: Michael Liley and Ann Fells (Special Wildlife Sites Officer – Woodlands)
- Worcestershire County Council: Jess Allen (Conservation and Landscape Officer), Emma Hancox (HER Officer), Alex Kinnersley, Becky Lashley (Ancient Tree Project Officer), Rose Parker and Jane Patton (Conservation and Landscape Officer)
- Worcestershire Biological Records Centre: Simon Wood
- Worcestershire Naturalists' Club: Michael Pettigrew
- Herefordshire Nature Trust: Francesca Griffith
- David Lovelace
- Herefordshire Council: Neil Rimmington (Countryside Advisor - Archaeology), Chris Mayes (Senior Landscape Officer) and Juliet Wheatley
- Herefordshire Biodiversity Partnership: Nicky Davies (BAP Co-ordinator)
- Herefordshire Biological Records Centre: Steve Roe
- Wye Valley AONB: Andrew Nixon
- Malvern Hills AONB: David Armitage
- Shropshire County Council: Shaun Burkey (Conservation & Ranger Team), Carmen Mayo (Environmental Data Technician), Helen Moriarty, (Landscape Officer) and Dan Wrench
- Shropshire Wildlife Trust: Robin Mager (Planning & Data Systems Officer) and Jan McKelvey
- Shropshire Hills AONB: Ian Dormor
- Shropshire Archives: Liz Young (Senior Archives assistant)
- Birmingham and Black Country Wildlife Trust
- EcoRecord (Ecological Database for the Black Country and Birmingham)
- Wolverhampton City Council: Mike Shaw (The Black Country Archaeologist)
- Sutton Coldfield Natural History Society
- Walsall Record Office
- Staffordshire County Council: Andy Goode and Ali Glaisher (Principal Ecologist)
- Staffordshire Ecological Record: Craig Slawson (Ecological Records Co-ordinator)

- Cannock Chase AONB: Ruth Hytch
- Peak District National Park: Karen Shelley
- South Staffordshire Naturalists' Society
- Lichfield Record Office: Andrew George (Area Archivist)

- Warwickshire County Council: Dave Lowe (Principal Ecologist) and Ben Wallace (Archaeologist)
- Rugby Natural History Society: Peter Reeve
- Warwick Natural History Society: Barbara Cuttell
- Warwickshire Museum: Steven Falk and Anna Stocks

- Natural England: Jez Bretherton, Paul Dutton, Frances McCullagh and Rob Morris (Open Access GI & Web Systems Officer)
- Woodland Trust: Jill Butler and Katherine Owen
- English Heritage
- National Trust: Gordon Barker
- Gateway Gardens Trust
- Parks and Gardens UK
- National Association for Areas of Outstanding Natural Beauty
- Heritage Britain
- Farming and Wildlife Advisory Group: Nigel Baskerville
- Bill Butcher

10 Appendix 3: Capture and processing data to the inventory

Existing inventory

- 10.1 The existing inventory was modified to match the table structure described in the data attribution section below. During this process all relevant original attributes were retained, occasionally being moved to different fields were fields were lost or converted into the correct format.
- 10.2 All polygons from the existing inventory were also checked on UK Perspective aerial photographs and historic OS maps, to apply the correct priority habitat determination and remove areas that were no longer considered wood-pasture or parkland. Initially this also involved modifying the boundaries to ensure that non wood-pasture and parkland habitat was excluded from the polygon, though this proved too time-consuming in the long term. Where appropriate this decision was recorded in the determination fields of the inventory.

Tabular datasets

- 10.3 Tabular datasets with grid references were imported directly into MapInfo and mapped as polygons based upon the resolution of the grid reference, for example:
- SJ518042 (Pitchford Hall, Shropshire) is at 100 m resolution and so was converted into a 100 m x 100 m square with the south-west corner at 351800 east and 304200 north.
 - SO9841 (Elmley Castle Park, Worcestershire) is at 1 km resolution and was converted to a 1 km x 1 km square with the south-west corner at 398000 east and 241000 north.
- 10.4 Similarly, 1 m resolution grid references would be converted to 1 m x 1 m squares and tetrad resolution grid references would be converted to 2 km x 2 km squares, each extending north-eastwards from the point of the grid reference.
- 10.5 The reason for mapping the grid references in this way was that points do not adequately represent the true location of the grid reference, which might refer to a location anywhere within the square. This was important, as interception queries were undertaken to identify where the same parklands were identified by different datasets. Grid references mapped as points, especially the lower resolution grid references, might be located outside and to the south-west of the parkland boundary, whereas if they are mapped as squares, and the grid reference is correct, there should always be an overlap.

- 10.6 Grid reference-based datasets mapped in this way were checked on UK Perspective aerial photographs and historic OS maps, so that as accurate a decision as possible, on the wood-pasture and parkland boundary, could be made. Each new wood-pasture and parkland site or extension of an existing site located in this way was mapped in MapInfo using OS MasterMap boundary data. Extensions of existing sites were mapped separately, allowing the difference in boundary source to be recorded.

Spatial datasets

- 10.7 Spatial data in polygon format representing the boundaries of wood-pastures and parklands were incorporated directly into MapInfo, checked against UK Perspective aerial photographs/historic OS maps and assessed against the habitat definition.
- 10.8 Such datasets were often imperfectly mapped and not snapped to OS MasterMap boundary data, or contained areas that did not meet the definition of wood-pasture and parkland. Due to time constraints, the polygons in these datasets were not always modified, with the decision recorded appropriately in the determination fields.

Worcestershire Ancient Tree Project

- 10.9 The Worcestershire Ancient Tree Project data was used in two ways to update the inventory. Firstly, a cluster analysis was performed, followed by an update of the inventory with the number of veteran trees intersecting with each wood-pasture or parkland.
- 10.10 The cluster analysis was carried out on polygonised tree records, all of which were at 10 m resolution. Trees were clustered where the polygonised records were no more than 250 m from each other. Only those clusters containing three or more trees were considered. These clusters were then used, along with UK Perspectives aerial photography, to identify new areas of wood-pasture and parkland. This resulted in the addition of 15 potential wood-pasture and parkland polygons in the county.
- 10.11 Due to time constraints and availability of data, only the latter process was performed with the veteran tree data from The Woodland Trust's Ancient Tree Hunt.

Data combination

- 10.12 The datasets where wood-pasture and parkland boundaries had been mapped were merged and attributes of any overlapping sites from different sources were combined. All boundaries within source datasets were duplicated in the combined dataset, so that individual sites could be made up of a number of polygons each referring to a different combination of source datasets.

Data attribution

10.13 All polygons were attributed with the information within the original datasets. To ensure consistency with the data produced during the previous project and to try to incorporate some of the standard habitat inventory fields, as described above, these data were rationalised into the following fields:

- Incid (Character field of length 17) – During the previous contract unique identifiers were given to each polygons to be consistent with the coding in Alexander & Lister (2003). For this contract this was replaced with the standard habitat inventory field Incid. This was a unique reference number consisting of a 3 digit site reference, a 1 digit workstation/PC reference together with a polygon counter.
- Prihabtxt (Character field of length 254) – This was the priority habitat text field from the standard habitat inventory format.
- PWP_subtype (Character field of length 20) – This field was attributed with either 'Wood-pasture', 'Parkland' or 'Defunct wood-pasture'. The latter was used mainly to highlight areas of former wood-pasture that had been left to develop into woodland. Such defunct wood-pastures were included because they were still likely to have much of the original wood-pasture structure left.
- Pridet (Character field of length 100) – This was the priority qualifier field from the standard habitat inventory format. Four options were possible, but only the following three were relevant:
 - Definitely is – Where there was a high degree of confidence that the entire polygon was wood-pasture or parkland and the parcel boundaries were mapped with a high degree of accuracy.
 - Definitely present within polygon but not accurately mappable – Where there was good confidence that wood-pasture or parkland was present somewhere within the polygon boundary but there was insufficient information to map the boundaries of the priority habitat parcel within acceptable limits of accuracy.
 - Probably the Priority Habitat but some uncertainty of interpretation – Where the data sources suggested that the parcel was wood-pasture or parkland but there is less confidence than polygons attributed as 'Definitely is'.
- Interqual (Character field of length 10) – This recorded the reliability of the habitat interpretation. Three options were available: High, Medium and Low. The criteria for choosing these were provided in the Rule Base.
- Pridetcom (Character field of length 254) – This was completed for all priority habitat determinations (Pridet) except "Definitely Is". It was a description of the reasons for the less than accurate determination.

- Phabfeanot (Character field of length 254) – This was used, where appropriate, to list other key habitat features that were of relevance to the habitat. This was particularly useful for noting other priority habitats that were associated with the polygon.
- PWP_name (Character field of length 50) – The name of the parkland or wood-pasture, where known. Where the name was not known the field was left blank.
- OnOS_E1 (Character field of length 1) – This, and the following three fields, was attributed as either true ('T') or false ('F'), depending upon whether or not the parkland was shown on Epoch 1 OS maps. A character field was used rather than a logical one to distinguish sites where the OS Landranger maps were not checked (ie the field left blank), from those that were checked and were not marked on the maps (ie 'F').
- OnOS_E2 (Character field of length 1) – As above, but depending upon whether or not the parkland or wood-pasture was shown on Epoch 2 OS maps.
- OnOS_E3 (Character field of length 1) – As above, but depending upon whether or not the parkland or wood-pasture was shown on Epoch 3 OS maps.
- OnOS_E4 (Character field of length 1) – As above, but depending upon whether or not the parkland or wood-pasture was shown on Epoch 4 OS maps.
- Source1 (Decimal field 6, 0) – This was the numeric code of the first source used, to allow cross referencing with the associated MetaGenie metadatabase.
- Source1txt (Character field of length 100) - This was the title of the first source used.
- S1captdate (Date field) – This was the original date of source 1.
- S1boundary (Character field of length 10) – in the previous contract the BoundarySource field was used. This was replaced with the standard habitat inventory fields. The field was used to determine whether the source was the 'Primary' or 'Secondary' boundary data source, or whether it was of no value for determining the boundary ('None').
- S1habid (Character field of length 10) - used to determine whether the source was the 'Primary' or 'Secondary' habitat data source, or whether it was of no value for determining the habitat ('None'). Identical fields were used for sources 2 and 3. Source 1 was usually the most significant source used for determining the habitat, with less significant sources following in sources 2 and 3.

- Ownership (Character field of length 50) – This field was attributed with the name of the current owner of the site, where known. Where the parkland was owned by a private individual, as far as could be judged, this field was attributed with 'Private'.
- ManagingBody (Character field of length 50) – This field was attributed with the name of the current manager of the site, where known, as this may differ from the owner.
- CurrentLandUse (Character field of length 254) - This was a free text field for any information relating to the current land use of the site. Land use was kept separate from habitat, which is discussed below.
- Access (Character field of length 10) – This was attributed with 'Open', 'Restricted', 'PROW only' (public right of way only) or 'None', depending upon the type of access on the site, where known.
- Designations (Character field of length 50) – This field contained any conservation designations applicable to all or part of the site, supplemented by the following four fields.
- SSSI_area (Float) – Attributed with the area of the site designated as a Site of Special Scientific Interest (SSSI) in hectares.
- SSSI_prop (Float) – Attributed with the percentage (proportion) of the site designated as a SSSI.
- EH_RPG_grade (Character field of length 3) – This field was attributed with the English Heritage Register of Parks and Gardens code, where appropriate.
- VetTreeNo (Integer) – This field was attributed with the number of veteran and ancient trees known to occur on the site. Where two or more datasets provided such information for a single site the highest value was used, to avoid counting trees more than once.
- VetTreeSource (Character field of length 100)
- SpSapBeetleNo (Integer) – Attributed with the number of saproxylic beetle species qualifying for SQI or IEC assessments recorded on the site. A site required at least 40 species to produce a valid SQI score.
- SpSQI (Float) – Attributed with the SQI for the site. This included sites where the number of beetle species recorded was not high enough to produce a valid score.
- SpBeetleRIEC (Float) – Attributed with the revised beetle IEC for the site.
- SpLichenNo (Integer) – Attributed with the number of lichen species qualifying for any measurement of IEC recorded on the site.
- SpLichenRIEC (Float) – Attributed with the revised lichen IEC for the site.
- SpLichenNIEC (Float) – Attributed with the new lichen IEC for the site.

- SpBeechFungi595 (Integer) – Attributed with the number of fungi listed in Ainsworth (2004) recorded on the site.
- SpSource1 (Character field of length 100) - The title of the first source used for species information. Identical fields were used for species sources 2 and 3.
- Bsmapscale (Character field of length 50) – The scale of the base map used to map the polygon, using the set scales in the habitat data capture tool.
- Fileref (Character field of length 100) – A file reference number associated with the source data, as appropriate.
- Siteref (Character field of length 100) - A site reference number associated with the source data, as appropriate.
- Createdate (Date field) – The date the polygon was created
- Createby (Character field of length 50) – The name of the person who created the polygon.
- Boundary (Character field of length 50) – Taken from the standard habitat inventory format, this field allows the quality of the boundary mapping to be recorded. The options were:
 - A - Snapped to OS Land-Line
 - B - Snapped to OS MasterMap feature
 - C - Interpreted from Aps
 - D - Freehand
 - E - Other