

Ancient Woodlands and Trees of Herefordshire

our heritage revealed



Native Woodland Restoration in Herefordshire

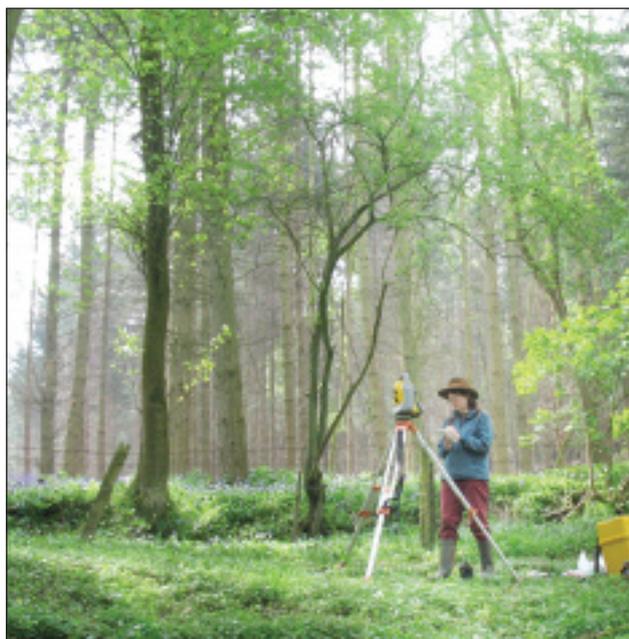
Project Summary Report
2006 - 2009

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1 The Project: concept and funding

Ancient woodlands are amongst the most enduring and biodiverse elements of the countryside and have protection under specific planning and forestry policies. Herefordshire contains a third of the documented ancient woodland in the West Midland region, although the county occupies only a sixth of the region. Nearly half of the county's known ancient woodland was subject to plantation forestry last century, one of the highest proportions in England. A county inventory for Herefordshire's ancient woodland sites of 2 hectares and larger was published in draft in 1984 but there has not been a systematic revision since then. In the intervening years there have been surveys of some individual woods and the recent Landscape Origins of the Wye Valley (LOWV) project carried out historical research into woodlands in the Wye valley between Fownhope and Ross-on-Wye.



Surveying a moated site in Fownhope Park Woods

The River Wye Preservation Trust (RWPT), as one of the partners in the LOWV project, realised from their landscape history work that the 'ancient' woodland resource was insufficiently researched and required more evaluation, protection and management. In 2005 the Trust conceived this project, the Native Woodland Restoration Project (NWRP), believing that woodland owners, managers, statutory bodies and many interested individuals would welcome an in-depth study of the county's ancient woodlands, which would produce an improved, comprehensive inventory to underpin conservation endeavours. In addition, RWPT proposed a modest practical, monitored programme of native woodland habitat restoration in selected plantations on ancient woodland sites.

When in late 2005 the then English Nature (now Natural England) invited project proposals under its Countdown 2010 Biodiversity Enhancement Programme, RWPT put forward their project as a proposal, with an estimated cost of £120,000. In order to benefit from the Countdown 2010 programme, RWPT had to show that they could cover 25% of this cost from private sector cash funds,

The SITA Trust, which dispenses environmental tax revenue from its landfill business, was approached to help fund the habitat restoration elements. RWPT succeeded in obtaining a grant of £24,000 from SITA's Enriching Nature programme, which supports projects which measurably increase habitat biodiversity. This grant allowed the project to qualify for Countdown 2010 funding of £61,100. The project started in April 2006, and was scheduled to finish its initial phase in December 2008. Supplementary sources of funds were obtained from Butterfly Conservation (£3000) to carry out moth surveys in selected under-recorded woods, from The Malvern Hills AONB (£4200 from its Sustainable Development Fund) to undertake a survey of veteran trees of the Herefordshire AONB parishes using trained volunteers, and from the Duchy of Cornwall (£2,000).

2. Aims and Objectives

- To inform future decision-makers on Herefordshire's ancient woodlands using a combination of historical information, new surveys and the outcomes of pilot restoration projects with respect to biodiversity.
- To provide consistent and reliable information about the history, location, current status and conservation values, present and potential, of Herefordshire's ancient woodlands.
- To survey the flora and fauna in a sample of key woodland sites, including those being restored from plantations, so that biodiversity changes could be measured, and lessons learnt for future woodland management.
- To co-fund the restoration of plantations on ancient woodland sites (PAWS) in the Woolhope Dome Biodiversity Enhancement Area.
- To record and map veteran trees and potential woodpasture sites in selected areas of the county.

3. Summary of project activities

The project has made a detailed study of the history of Herefordshire's woodlands from medieval to present times, increasing our understanding of their origin, management, economy and uses. A Geographic Information System (GIS) is used to analyse digitally-scanned historic maps to compare them with modern maps and aerial photography. This system is being used to update the Ancient Woodland Inventory based upon the Tithe maps circa 1840 and earlier estate maps.

The recently declassified and unpublished 1953 Forestry Commission census of Herefordshire has been digitised in its entirety and analysed for the first time. The census survey forms provide a detailed picture of the status, structure and species composition of the county's woodland resource just before the majority of private sector conversions to plantation forestry were carried out. For individual woods these are a valuable historical record and useful for planning the restoration of PAWS.

The project has reviewed known sources of ecological surveys of the county's woods and has studied the ecology of woods where data was poor or non-existent. Surveys of vegetation, moths, butterflies and beetles were carried out in 42 Herefordshire woods totalling some 600 hectares. Moths are good ecological indicators as many are reliant on managed woodland. 'Light-traps' were set up in 15 woods and some 806 species were recorded of which 56 are nationally or locally rare.

Medieval and Tudor records show that some Herefordshire woodland was formerly wood pasture or parkland. The project is providing information to help plan the restoration of some woodland areas to wood pasture which is now a rare habitat.

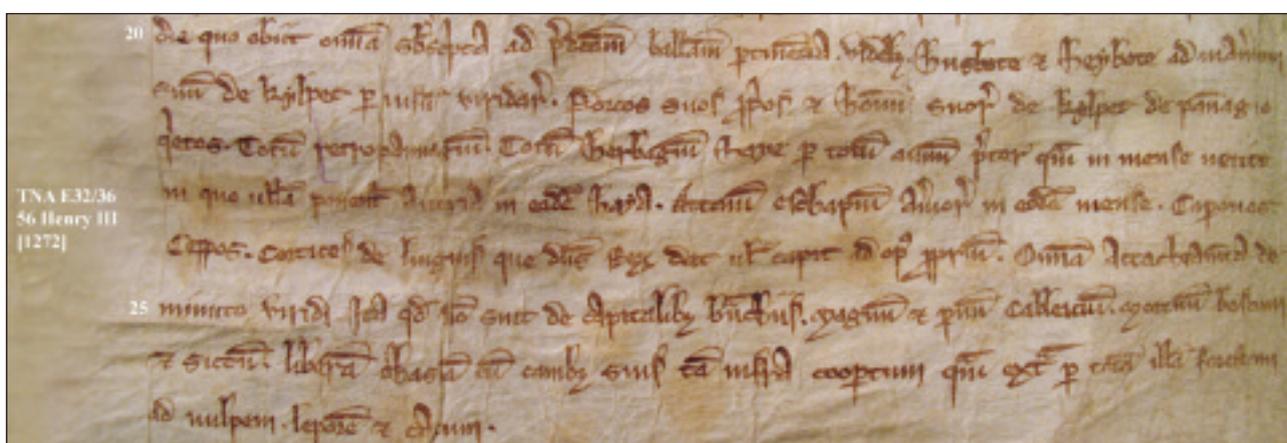
Parts of the county where there are concentrations of old trees have been surveyed by volunteers using a Global Positioning System (GPS) and digital cameras. Some such, in a pastoral setting, can be considered as small scale 'wood pasture' or potential 'wood pasture' sites. The project has now recorded over 1,600 such veteran trees.

4. Information gathering

4.1 Archives and maps

The project has taken over 25,000 digital images of original Herefordshire sources from medieval forest plea rolls to 20th century forestry surveys. Most of the medieval manuscripts have been made available and translated for the first time. Thirty-two original tithe maps and many 18th-century estate maps have also been photographed for use by the project's Geographic Information System. The 1953 Forestry Commission census survey forms for the Herefordshire woods involved taking almost 10,000 photographs.

The project has set up a Latin group under the tutelage of experts Janet Cooper and Sue Hubbard to translate medieval and Tudor manuscripts. The following image is from the 13th-century forest court rolls concerning the royal forest of Hays near Hereford.

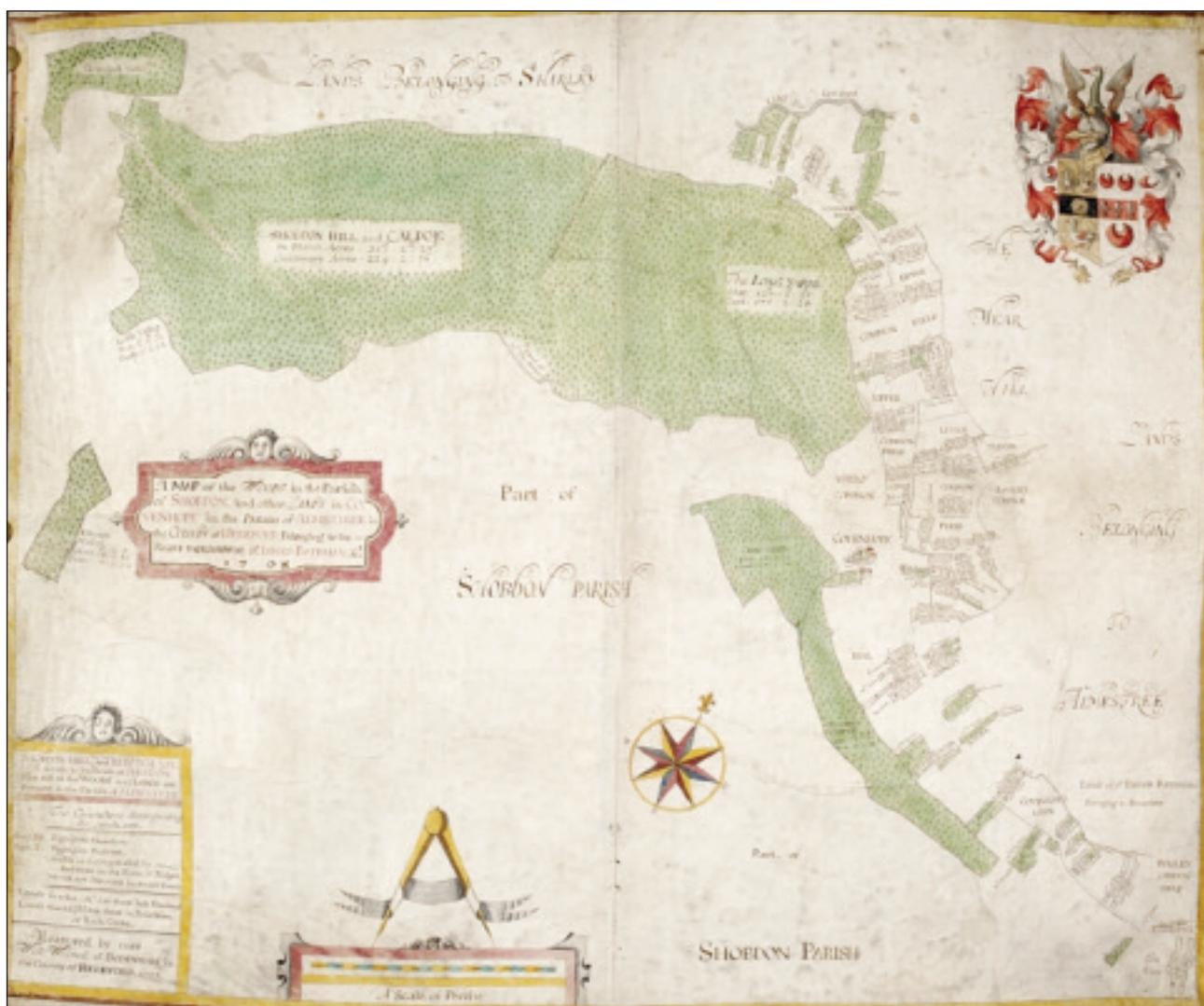


"[on the] day that he died, [he had] all the [rights] written below associated with that bailiwick, that is to say: housebote and haybote for the manor of Kilpeck by the view of the verderers, his own swine and his oxen of Kilpeck quit of pannage, all aftermath pannage, all herbage of Hays throughout the year, except in the forbidden month during which no livestock should be put out in the Hays, so avoiding the escape of livestock in that month. Branches, stumps and the bark of the timber, which the king takes for his own use, all the parts of scrub and bushes as long as they are not the main branches, big and small, of windblown dead timber. And [he has] the freedom to hunt with his dogs both within the forest canopy and outside [the canopy] throughout all that forest the fox, the hare and the cat."

This and many other documents from the Middle Ages that the project has translated are building up a picture of woodlands and forests in medieval Herefordshire as complex areas of multiple land use. This above passage describes a 'wood pasture' system with areas of the forest with a canopy and those which are open. It also includes the first known reference to wild cats (*Felis sylvestris*) in Herefordshire. Ancient customary rights of grazing and wood collection, coppice, fenced off areas for regeneration, pollarding, timber, hunting, cultivation and even drainage were all activities to be found in woods and forests. This structural complexity would have had a wide range of habitats and high biodiversity.

Following the decline of the feudal order during the Tudor period, much of the remaining areas of medieval 'boscus' in Herefordshire was enclosed for farmland or dedicated woodland or became open common land. In the late 16th century highly organised rotational coppice systems became dominant in woodlands driven by industrial scale demands for charcoal for iron, oak bark for tanning and wood for barrel making. Most timber trees were found outside woods.

The project has reviewed the large number of accounts detailing the productivity, economy and uses of coppice woodland from the 16th century to the Victorian period. Coupe sizes were large, creating a dynamic mosaic of different coppice age classes which would be colonized by flora and fauna associated in former centuries with the habitat mosaics of wood pasture systems. For example, in Haugh Wood annual fellings averaged 15 hectares (6% of the wood) in the late 18th century, and it continued as coppice until its 20th-century acquisition by the Forestry Commission. Haugh Wood seems to have been open heath and/or wood pasture in medieval times, and the subsequent four centuries of coppice regeneration has maintained a rich habitat continuity throughout recorded history, which accounts for its nationally important invertebrate assemblages and SSSI status. Other large ancient woodlands such as Queen's Wood Dymock, Mortimer Forest and Shobdon Hill woods had a similar history.



A map of 1708 of part of Lord Bateman's estate showing Shobdon Hill

The project has used the large-scale parish Tithe Maps (surveyed 1838 to 1842) as the baseline for revising the current Ancient Woodland Inventory. Their large scale, which varied between 14 and 26 inches to the mile, means that even very small land parcels are mapped and recorded. A useful adjunct to the tithe maps are the 2 inch to the mile Ordnance Survey Drawings (OSDs) of Herefordshire, which were made 1813-1816. These are the earliest county-wide maps which are available. Being much smaller scale than the tithe maps they tend to overlook smaller woods, but the boundaries of depicted woodland are clear. The OSDs also

show parkland as a distinct land use which is useful in determining the extent of parks at this time. The project obtained digital copies of the seven OSDs that cover Herefordshire.

The late Victorian 25" to the mile Ordnance Survey maps published c.1880 are used as the next earliest time horizon. They are some gaps in the coverage which were filled by the near contemporary 1st edition 6" to the mile. These are the first OS maps to show individual field and hedgerow trees, so are useful in studying the changes in the immediate surroundings of individual woods. The maps also distinguish between conifer and broadleaves and between coppice and high forest, which is useful in assessing the history of management for individual woods. Most of these maps were supplied in digital form by Natural England.

A key objective was to represent the mid-20th century Herefordshire woodland resource by using the original and unpublished Forestry Commission census survey of 1953. In addition the project has scanned a sample of the 1946 RAF aerial photographic survey to assess the state of woodlands as they were just after World War II.

Natural England made available to the project the 2006 datum Ordnance Survey MasterMap digital mapping of Herefordshire, the current digital Ancient Woodland Inventory on which to base revisions, and high-resolution digitally rectified colour aerial photographs for the county (1999-2003). These are stored as layers in a Geographical Information System (GIS) which is the reference database for all the gathered information.

4.2 Parish tithe surveys



Part of tithe map for Brampton Bryan 1839

Dating back more than a millennium, the tithe was a religious tax consisting of a tenth part of the produce of the land, and also a regular source of dispute. The 1836 Tithe Commutation Act attempted to make this church tax uniform, predictable and fair across the country by commuting the complex and varied customary payments to a standard annual charge levied on each parishioner according to the extent and productivity of their land. The Act therefore required a large scale and detailed mapping of each parish to determine an individual's tithe dues.

The resulting 'tithe maps' along with their 'apportionment' of land use, tenure and ownership remain a unique and detailed record of even the smallest parcels of land. As one historian has observed "The amount of detailed information they provide about land tenure, field systems, and land use is unequalled by any other series of documents. Their accuracy is sufficient to warrant their continued use as evidence in courts of law..". Tithe maps do however vary in quality, scale and detail from parish to parish so the project has used digitised copies of each Tithe map as transcribed to a standard scale by Geoff Gwatkin and which include each land parcel's number, land use and name. We have then digitally colour-coded each parcel according to its land use.

The 'apportionment' of each parish tithe map includes the 'state of cultivation' which is typically 'arable', 'pasture', 'meadow', 'orchard', or 'woodland'. Woodland categories include 'ash bed', 'coppice', 'plantation', 'orles' (alder trees), 'grove' and 'brake' (clump of bushes). Care has been taken when interpreting 'pasture' or 'rough pasture' as this may refer to a woodland open to

grazing, the grazing being the titheable activity and not any trees that may be present. One must not forget that the primary purpose of the tithe survey is determine a levy on each parcel rather than identify land use per se. If a parcel of tithe map is 'pasture' or 'rough pasture' but depicted as mature broadleaves 40 years later the chances are that it had at least some trees at the time of the tithe survey. This is especially so in upland areas where a matrix of wood, woodpasture, meadow, and dingle has co-existed for centuries. For example, a small area of 'rough grass' on the Newton St. Margaret tithe map of 1840 turns out from a field visit to be a woodland with a rich ground flora and the ancient woodland indicator small leaved lime (*Tilia cordata*) (See page 17). About a fifth of the county's tithe maps are of high quality showing individual trees. We have therefore digitised some of these original tithe maps for this extra information. As far as we are aware, this project is the first to have digitised and geo-referenced a significant proportion of any county's tithe maps as a layer within GIS.

4.3 The Forestry Commission 1953 census

This was the most detailed and comprehensive survey ever undertaken of the county's woodlands and has been digitised and analysed for the first time by this project. The census survey sheets include details of canopy type, age, standing volume and species composition, of both high forest and coppice, for each compartment, together with surveyors' notes. Digitising this survey, held at the National Archives, involved taking 9,670 digital images which included the maps showing the location of each compartment. The census was intended as a rolling programme of revision of the less detailed 1948 survey but it was abandoned without analysis after completing just 14 counties in England and Wales. Warwickshire is the only other West Midlands county surveyed. As ownership details appear on the census survey forms, they were inaccessible until 1995. The surveys were undertaken before the bulk of private sector conversions of native woodland to plantation forestry, so are a valuable record of the former character of those private woodlands which are now partly or mainly conifer plantations.

Below left is the map from the 1953 census identifying the stands of Athelstans wood in Little Birch, partly felled and converted to conifers in 1971. The front and back survey sheets which give the details of compartment 14 are reproduced below right. Red box: stand age classes.

Compartment 14 was recently felled and restocked see page 27 below

The image displays a map of Little Birch woodlands on the left, with compartment 14 highlighted in green. To the right are two pages from the 1953 Forestry Commission census. The top page is the front sheet, which is a detailed table with handwritten entries. The bottom page is the back sheet, titled 'SUMMARY STATEMENT OF SPECIES', which contains a table of species and their percentages. A red box on the back sheet highlights the 'AGE CLASSES' section.

| SPECIES | | PER CENT (By Canopy)* | SPECIES | | PER CENT (By Canopy)* |
|----------|--|-----------------------|---------|--|-----------------------|
| Oak | | 70 | | | |
| S. Birch | | 15 | | | |
| Broad | | 10 | | | |
| Conifer | | 5 | | | |

| AGE CLASSES | | PER CENT |
|----------------|--|----------|
| Oak 31-60 | | 10% |
| Oak 41-60 | | 40% |
| S. Birch 31-60 | | 10% |
| 21-60 | | 30% |
| Broad 20-30 | | 10% |
| 30-60 | | |

Details of compartments as entered into the project database are tabulated below:

Table 1, Front survey sheet, compartment 14 highlighted in green

| Compartment | Acres | Type | Age | Volume cu feet | Main species | secondary species |
|-------------|-------|--------|--------|----------------|--------------|-------------------|
| 11 | 52 | Felled | | | | |
| 12 | 91 | BHF | Uneven | 109,200 | Oak | Sweet Chestnut |
| 14 | 33 | BHF | Uneven | 36,300 | Oak | Sweet Chestnut |

Table 2, Back survey sheet, compartment 14 highlighted in green

| Comp | Canopy percentage | Remarks |
|------|---|--|
| 11 | | Coppice regrowth: Hazel, Birch, Oak & Ash |
| 12 | Oak 50, S Chestnut 20, Birch 20, Ash 10 | 20% Stocked with standards originating from coppice, these average 2 shoots per stool. Another 10% of the area stocking with a coppice average 3 shoots per stool. |
| 14 | Oak 70, S. Chestnut 15, Birch 10, Ash Field Maple & Hazel 5 | Occasional Oak above 80 yrs, underwood Hazel Birch Ash & Field Maple. Red box: Age and volume of the stand by species see below |

Table 3. Age classes of compartment 14 by volume and species, see red box above

| Species | age | volume |
|----------------|---------------|--------|
| oak | 31 - 40 years | 10% |
| | 41 - 60 years | 40% |
| | 61 - 80 years | 10% |
| Sweet Chestnut | 31 - 40 years | 20% |
| | 41 - 60 years | |
| Birch | 20 - 30 years | 10% |
| | 30 - 40 years | |

4.4 Previous woodland surveys

A number of descriptions of Herefordshire woodland from an ecological and historical perspective were published during the late Victorian period, mainly in the Transactions of the Woolhope Naturalists' Field Club and also in a few books detailing the botany of the county. These tended to be either general in character or accounts of excursions through woodlands recording, for example, rare or notable plants or insects. The 1908 Victoria County History of Herefordshire includes detailed records of Lepidoptera but they are not site specific except for a few woods including Haugh Wood, Asperton Park and Stoke Edith. The first known comprehensive study of the vegetation of the county's ancient woodland was published in 1921 and the results are comparable with modern surveys. The study involved detailed botanical surveys of 23 woodlands between Ledbury and the Malvern Hills recording with their abundances, 63 species of trees and shrubs, including Juniper (*Juniperus communis*) now believed extinct in Herefordshire, and 225 species of ground flora. While these studies are a valuable scientific record of woodlands occupying calcareous strata, the published species lists are not site specific but aggregates of different woodlands sharing the same soil type.

Woodland Surveys 1968 to 2006

The first known site specific woodland surveys in Herefordshire were carried out between 1968 and 1970 by the NCC. The project has sought to locate all known woodland surveys since then which includes the 1982 survey of the Wye Valley AONB woods, the 1984 sample survey of ancient woodlands conducted by the Herefordshire Nature Trust (HNT), the 1988 Ancient

Woodland Inventory sample revision by the HNT, the 1990 ancient woodland management project by the HNT, the Marches Woodland Initiative (MWI) surveys 1995 - 1999 funded by the 'Objective 5b' EU Structural Funds programme and the Native Woodland Plan surveys 2000 to 2006. Both the latter two were a requirement of Forestry Commission Woodland Grants Schemes for woods deemed important.

The level of detail for individual woods varies considerably for these survey projects and for three projects the survey records have yet to be found. These apparently missing surveys are from the 1988 and 1990 HNT woodland projects and the MWI surveys. The ecological surveys of woods from 2000 - 2006 Native Woodland Plans are of high quality and cover a significant number and area of ancient woodland in Herefordshire. There are 101 of these surveys housed at the FC Ludlow Office, covering individual woods and aggregations of woods on whole estates and listed by the project. The FC kindly gave us permission to make digital copies, so the project has digitised a sample of 28 of these surveys. From 2001, Herefordshire Archaeology has undertaken archaeological surveys of selected woods entering forestry schemes.

Parkland Restoration Plans.

Since 2001, as part of the Countryside Stewardship Scheme and from 2004 the Higher Level Stewardship scheme, 80% funds have been available from MAFF, DEFRA and now Natural England for ecological surveys, historical research and management plans for a number of important areas of historical, archaeological and ecological interest throughout the county. These detailed reports of surveys together with management recommendations have been completed for the Croft Estate, Moccas Estate, Kentchurch Park, Whitfield Estate, Holme Lacy Park and other important locations comprising together significant areas of woodland, wood pasture, veteran trees, other semi-natural areas and archaeological features. These parkland restoration plans constitute an important addition to the county's environmental knowledge base but most are not currently available in the public domain.

While the project has identified the known surveys of woodlands, it remains an important objective that all the woodland and parkland survey records are located, collated, and placed into a searchable and publicly available database.



Microlite photograph of Croft Castle, park and the Fishpool valley

5. Mapping woods and trees with a Geographic Information System (GIS)

Time series through a 4km x 4km slice of countryside in the parish of Croft centred upon SO450660. The project uses a software package, Manifold GIS, to create multilayered and geo-referenced time sequences of maps and aerial photographs combined with vector representations of woodland boundaries and associated digital data. Digital scans or photographs of maps and aerial photos are imported into Manifold and geo-referenced using common reference points between imported image and the background vector map.



2003
Aerial
photos



1953
Forestry Commission
Woodland Census



1884 25" inch to mile
Ordnance Survey



1840s
colour-coded Tithe
maps (as transcribed by
Geoff Gwatkin)



1835
Bryant's Map of
Herefordshire



1816
2" to mile Ordnance
Survey Drawings

6. Ancient Woodland inventory: validation and extension

Background and methods

Land that has been continuously wooded since at least 1600 has been defined as 'ancient woodland' for policy and statutory purposes since 1985. Historically, woodlands were, in the main, restocked by natural regrowth, so that their ecological and genetic characteristics have been perpetuated through successive management cycles. Where they survive today such 'ancient semi-natural woodlands' (ASNW) are 'irreplaceable and should not lose their natural characteristics' in the words of the Forestry Commission's 1985 Broadleaves Policy. The restocking of such woodland with non-native species, usually conifers, between 1925 and 1985 transformed nearly half of all Herefordshire's known ancient woodland into 'plantations on ancient woodland sites' (PAWS).

Components of the original vegetation can survive such planting in varying degrees and many woodlands damaged by plantation forestry are now being actively restored. Today a significant proportion of ancient woodlands have stands that are transitional between PAWS and those composed of native species. Knowing to what extent such restored stands resemble the original ASNW communities depends upon records of the ecology of particular woodlands prior to their conversion to plantation forestry. Such records usually do not exist, which is why the details of trees and underwood recorded in the 1953 census are important in restoration planning. Because restored stands are unlikely to precisely resemble the original undamaged semi-natural woodland it may be necessary to create a new category of 'restored ASNW'.

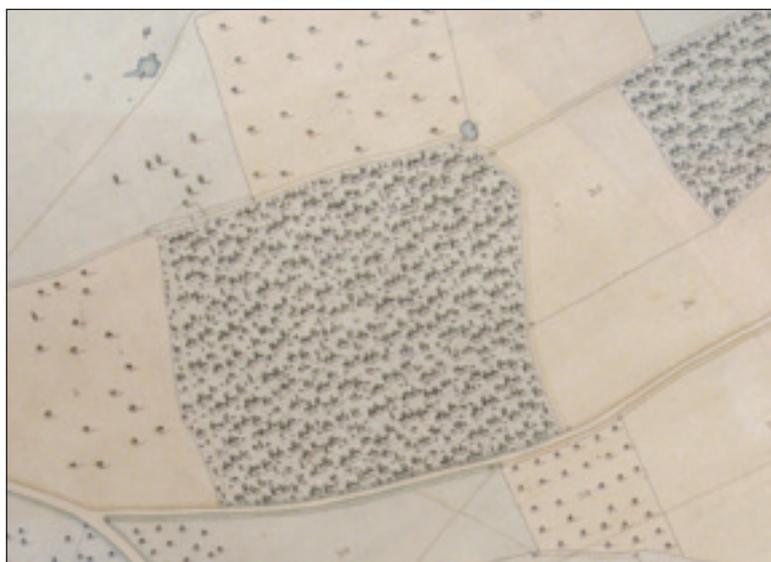
For only a few woodlands can their existence before 1600 be proved by documentation. Although pre-1600 archive sources give valuable insights into how the county's woods and trees were managed and used, details of the extent and boundaries of a particular wood can rarely be deduced. Only two Herefordshire maps of sufficient scale to show woodland boundaries are known earlier than 1700 and these cover just a small area. Large scale maps become much more numerous through the 18th century and were almost always privately commissioned for individual estates and farms. These are usually of high quality and sometimes with a schedule of land use but those that are accessible for research cover only a small proportion of the county. The first countywide maps of Herefordshire sufficiently detailed to show woodland boundaries appeared in the early 19th century. The historical status, extent and boundaries of a wood have to be derived from a combination of field work, maps, archives and knowledge of the history of the locality. While each woodland is unique, and would reward many years of study, a county inventory has to be based on a standard methodology applied to all woods.

When they were published in the mid 1980s, most county AWIs in England were based upon the readily available 1st edition 1" to the mile OS maps published c.1835, and these remain the basis for most AWIs today. These maps are insufficiently detailed especially for small woods and furthermore the hatching which denotes slopes in hilly areas can obscure woodland boundaries. Other countywide maps including Bryant's map of 1836, Price's of 1817 and the OS Drawings 1813-1816 show woodland boundaries more clearly. However none of these county maps are reliable for smaller woods many of which are missed completely. Furthermore the boundaries of larger woods are insufficiently accurate for a revision using modern maps and air photos. The project has therefore based the present inventory revision on the parish tithe maps and as far as we are aware only two other revisions of AWIs have used these: Mid Sussex and Ashford Borough.

In 1981 the then Nature Conservancy Council (NCC) set up the ancient woodland inventory project to record and map all surviving ancient woodland in English counties. The draft AWI for Herefordshire was published in 1984 with a subsequent partial revision in 1988. Since then there have been a few ad-hoc revisions of particular woods. Along with other counties, the woodland boundaries were digitised in 1999/2000 and this is the current working inventory.

To revise and amend the Herefordshire AWI the project has used digital images of the county's tithe and other maps which have been processed so that they are aligned with the modern map grid. When imported into the GIS these maps become a series of historical layers allowing the user to examine how the countryside, and in particular its woods and trees, has changed through time at any desired scale or location.

Using the current OS MasterMap digital mapping, digital colour aerial photographs and the current digital AWI woodland boundaries, these historical layers allow us to perform a times-series analysis for each woodland or compartment of woodland. Present day woodlands that

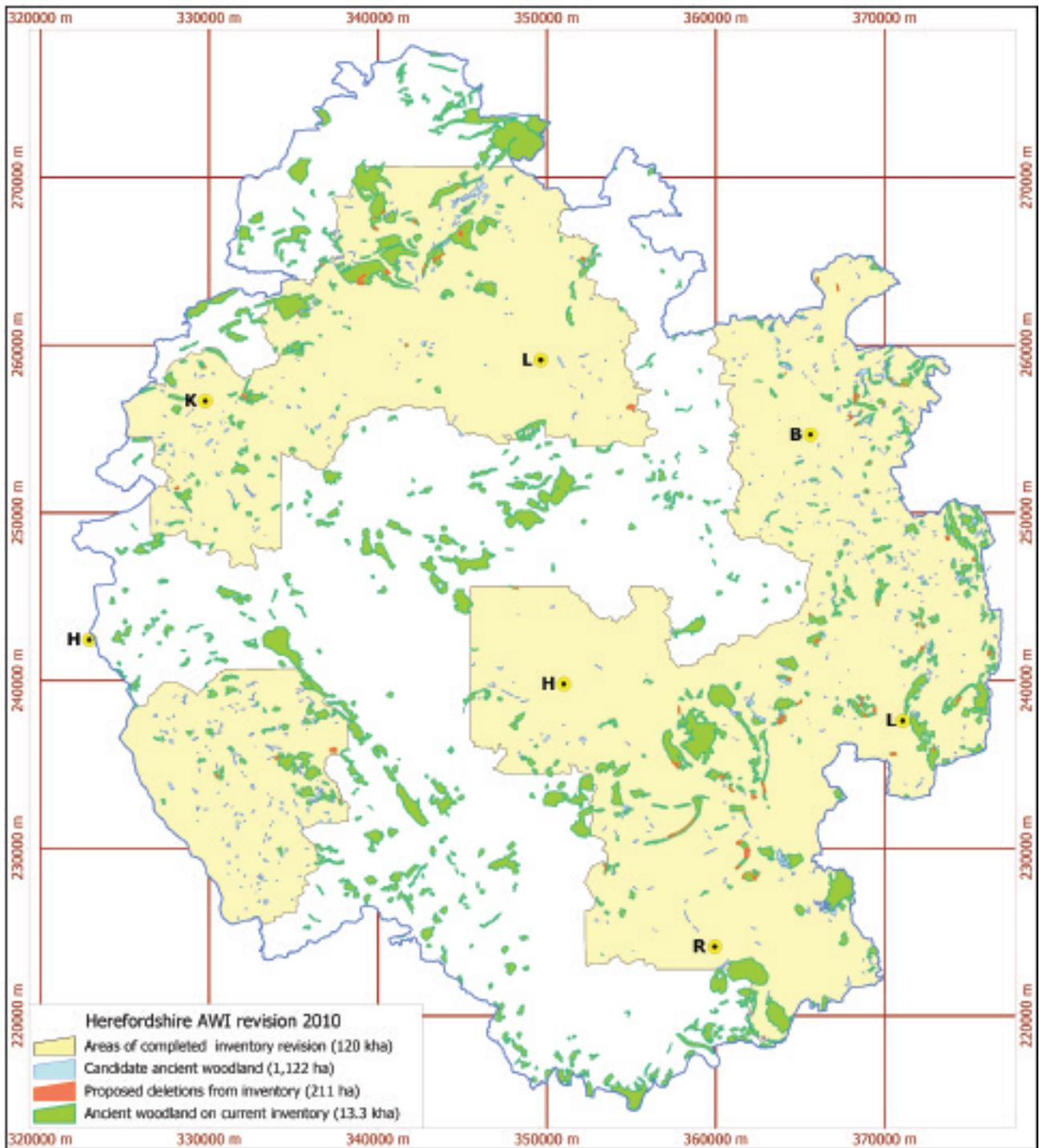


Woodlands shown on the Bartestree Tithe Map, 1840

have continuous tree cover stretching back to, and including, the Tithe map layer are put forward as candidate ancient woodland if they are not present on the current inventory. Conversely, woods or parts of woods which fail this 'continuity test' are put forward as proposed removals from the inventory. It should be noted that these deletions do not necessarily imply that the areas in question lack biodiversity or historical interest since the historic land use may be semi-natural permanent grassland or old orchard.

OS MasterMap digital woodland boundaries are edited where necessary to match the defining boundaries of the historical layers. Each revised area of woodland, whether a candidate addition or proposed deletion, is linked to a record in the GIS database. The attribute data for each area includes the name, land use and parcel number from the tithe map, symbols used to depict it on the c.1885 25 inch to the mile OS and its appearance on the recent aerial photograph. These attributes along with data intrinsic to the GIS, such as measured areas and grid references, allow a wide range of analyses to be carried out. The GIS data table comprising all the additions and deletions in the revised AWI can be exported in a variety of formats as required.

The GIS database so far developed by the project can incorporate field data, or be linked to, other data sets. For example, surveys using GPS and digital photographs can be uploaded and linked to individual woods or trees. Habitat components which are nearby, or are joined to, a woodland, such as hedgerows, orchards and veteran trees, can be mapped, characterised and entered onto the database.



Map of the county showing the areas where the AWI revision is complete

A revision using the above sources has been completed for 119,690 hectares, 55% of Herefordshire. The revision area was chosen to be representative of the variety of the countryside of the county and also to include the countryside around Hereford and the main market towns. The irregular boundaries of the revision area are those of completed parishes. The project has identified 1,122 hectares of new candidate ancient woodland and proposed the deletion of 211 hectares of inventory woodland identified as being of recent origin. This is a net addition of 925 hectares of woodland, which represents 13% of the woodland area on the current AWI within the revision area.

887 hectares (79%) of the 1,122 hectares of candidate ancient woodland is in the form of 597 separate woods, 484 of which are below 2 hectares. The number of these small separate candidate woods exceeds the number of woods on the current inventory (488) within the revision area. Further details of these small woods are given below. Most of the proposed deletions are parts of larger woodlands on the inventory, but include 10 separate woods amounting to 37 hectares, 18% of the proposed deletion area.

| Item | Hectares | % of current AWI |
|------------------------------------|----------|------------------|
| New candidate ancient woodland | 1,122 | 16.2 |
| Proposed deletion from inventory | 211 | 3.1 |
| Net candidate ancient woodland | 911 | 13.2 |
| Current AWI total in revision area | 6,906 | 100 |

Table 4. Area of candidate additions and proposed deletions in the revision area. The last column is those areas expressed as a % of current AWI woodland within the 55% revision area

| Item | Number parcels | Number of whole woods |
|--|----------------|-----------------------|
| New candidate ancient woodland | 692 | 597 |
| Proposed deletion from inventory | 82 | 10 |
| Net candidate ancient woodland | 610 | 587 |
| Current ancient woodland in sample areas | 684 | 488 |

Table 5. Number of candidate additions and proposed deletions in the revision area. Most candidate additions are whole woods and most proposed deletions from the inventory are parts of existing inventory woods. The number of candidate additions which are whole woods exceeds the number of whole woods on the current inventory

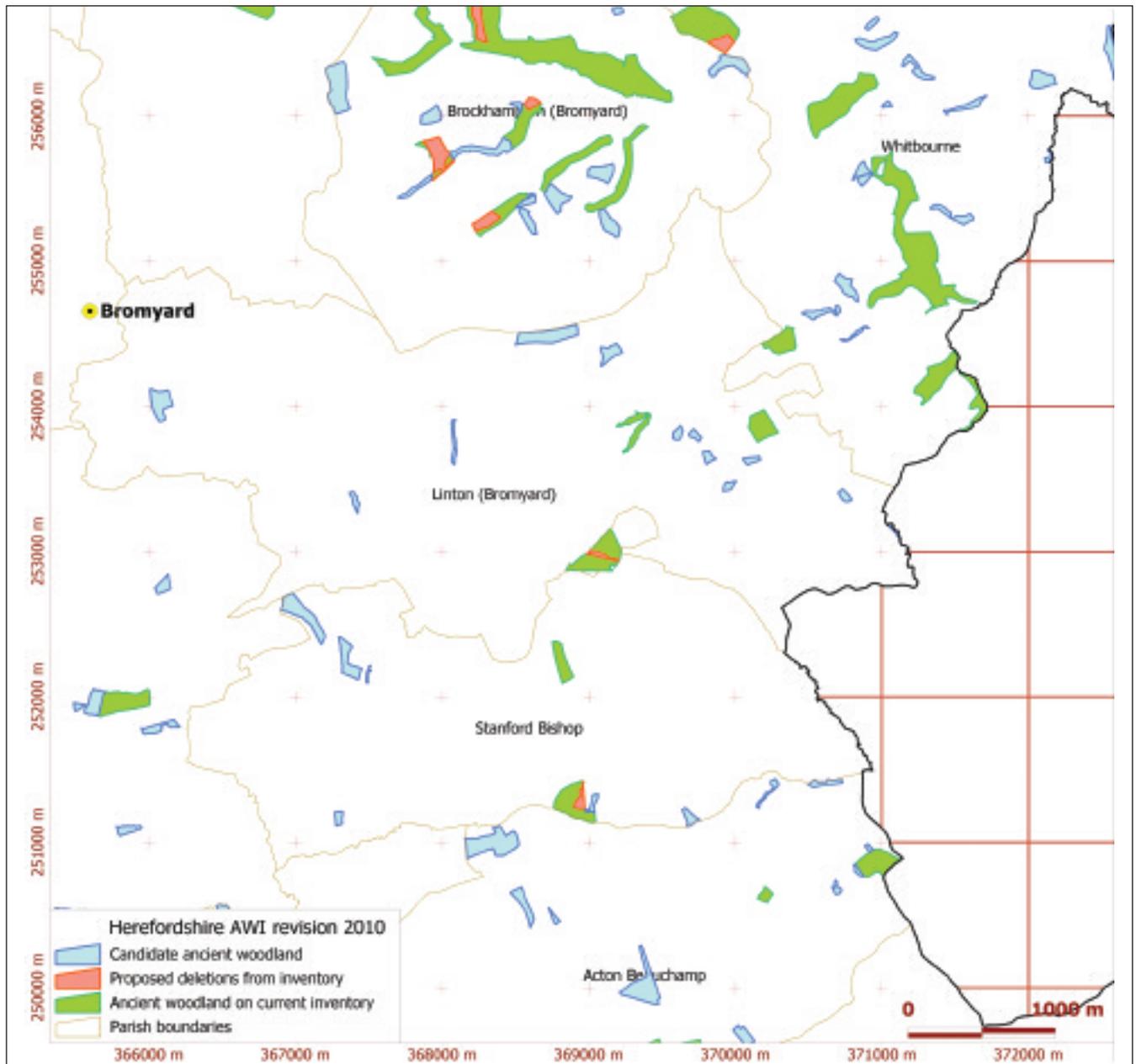
If the remaining 45% of the county were to be comparable to the 55% of the county already completed, the above figures can be extrapolated to give estimates for the whole county. For example, the total net increase in candidate ancient woodland can be estimated to be 1,650 hectares, and total net number of additional candidate whole woodlands would number 1080. This exceeds the number of woodland sites on the current AWI (887) by about 20%.



Wood Anemones in a small candidate ancient wood at Mount Boon, Little Dewchurch

Small candidate ancient woods

Although not large in cumulative area, the great many small native woods of Herefordshire are a characteristic feature of many parts of the county. They often abut other semi-natural features such as hedgerows, wooded dingles or old orchards and can have a rich flora and fauna. Such woods have sometimes been regarded as too small to be ecologically significant while the task of recording and classifying them all is seen as an expensive operation with low returns. All AWIs, except two recent revisions in Sussex and Kent, have excluded woods of less than 2 hectares because of resource constraints. However, the results of this inventory revision demonstrate that current technology makes the mapping and classification of small woods both practical and desirable. Furthermore, the techniques employed are readily applicable to many other English counties.



Having geo-referenced tithe maps, colour-coded for land use, as a layer within GIS makes the task of assessing historic woodland continuity easier and quicker than in previous years. The historical status of small woods that appear on the tithe maps may not be as robust as larger woods, but as the Newton St Margaret site demonstrates, small woodlands can have a high

nature conservation value. At the time of the tithe survey small woods were typically part of a close-grained mosaic of hedgerows, orchards, pasture and streams, a pattern which may well have been stable for many centuries. This idea is reinforced by the comment in 1791 of the surveyor-general to a Parliamentary report that "Herefordshire is much enclosed and has been for ages past". Although this mosaic has been much reduced in recent decades, existing small woods which were present on the tithe maps may still have a rich wildlife and a long history.

Small woods have usually not attracted the attention of commercial forestry and where they have survived agricultural clearance they are likely to have remained semi-natural, proportionately more so than larger woods. A majority of small woods would be described as 'farm woods' and are now an eligible component within Higher Level Stewardship as well as Woodland Grant Schemes. Where small woods have become isolated, due to field boundary removal for example, the digital tithe map and associated GIS based data can inform plans to restore previously linked habitats and landscape features in a way that respects the local distinctiveness and historical continuity of the locality.

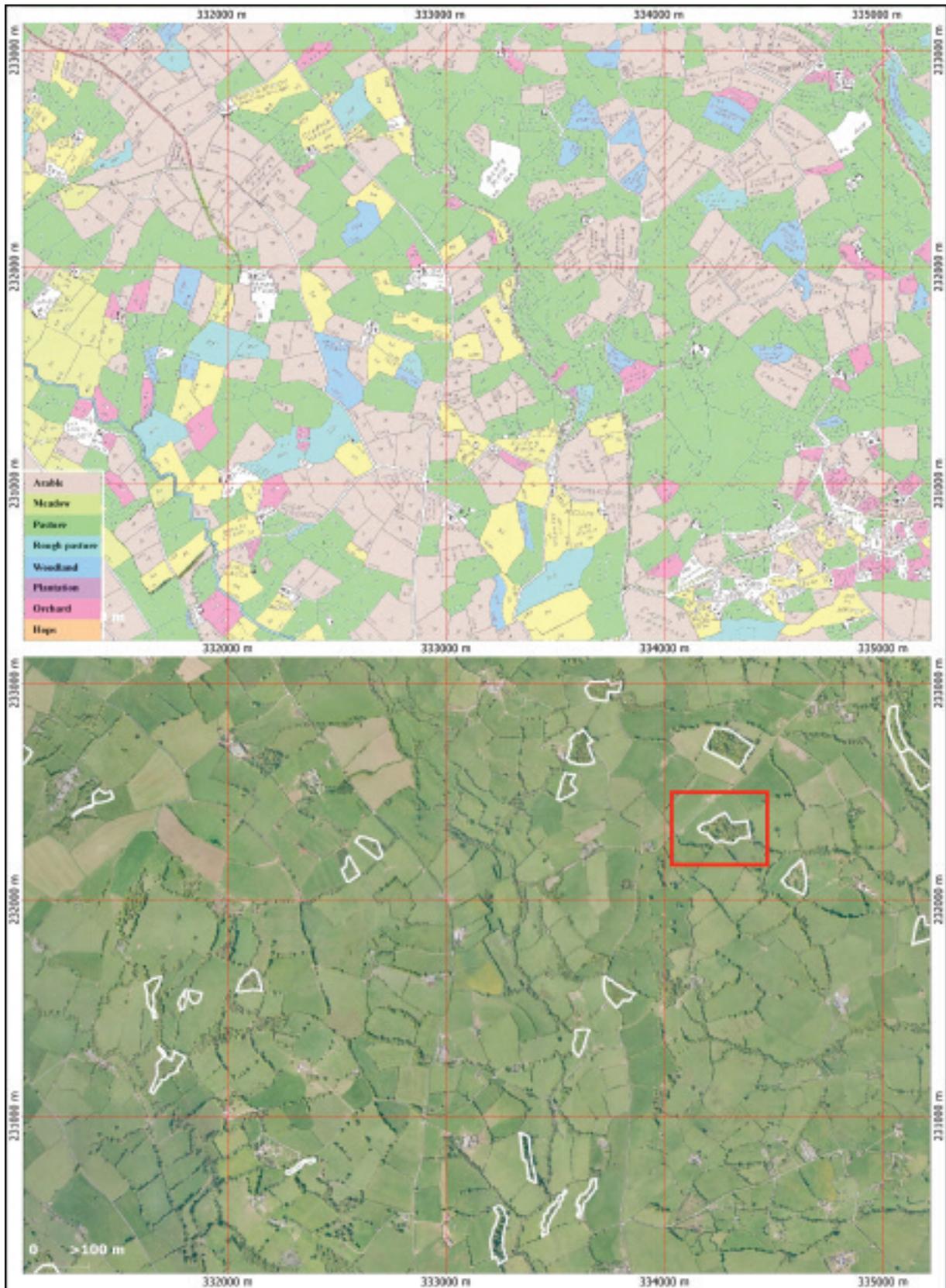
The size and area distribution of the 597 individual new candidate ancient woods that have been identified in the AWI revision areas are shown below.

| Candidate whole ancient woods | Number of woods | Area of woods, ha |
|---|-----------------|-------------------|
| 1 hectare or less | 312 | 173 |
| Over 1 hectare but less than 2 hectares | 172 | 235 |
| Between 2 and 6 hectares | 98 | 316 |
| Over 6 hectares | 15 | 164 |
| Total | 597 | 887 |

Table 6. Area and number of small candidate ancient woodlands identified from the tithe maps within the revision area.

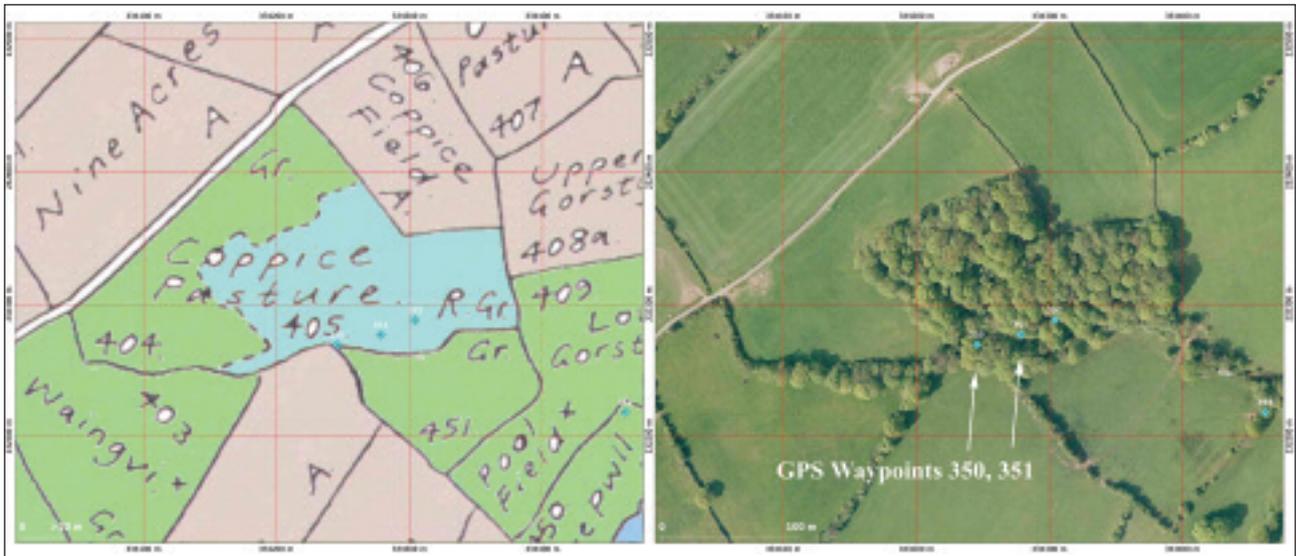


Landscape of small woodlands: the Woolhope Dome



Above is a 4x3 km sample of the Golden Valley area (SO33) in 1840 and 2002 generated by GIS. The map shows the colour coded land use parcels from the tithe apportionment including the woodlands (blue) and rough pasture (turquoise). The intersection between the digitised boundaries of these areas and those woods which are still present are shown as white outlines on the aerial photograph below bottom. These should be considered as candidate ancient woodlands. No woodlands in this particular sample are included in the current inventory.

The woodland highlighted in the red box on page 16 is a good example of the way historic mapping and field work are combined to characterise a wood, which in this case is too small to be considered by the 1984 AWI. The Newton St. Margaret tithe map classifies it as 'rough grass' and the original tithe map does not have tree symbols. However, since this is a pastoral farming area derived originally from the medieval Forest of Ewyas, such sites may be woods which happen to be paying tithes for pasture at the time of the tithe survey in 1840.



The GPS points (blue above) record old trees in the wood including the ancient woodland indicator small leaved Lime (bottom right), an old ash pollard boundary tree (bottom left)



Example of a large scale map times series from the GIS

The following is a 600-meter square sample of countryside in the parish of Castle Frome showing the layers of geo-rectified maps and aerial photography used to validate candidate ancient woodlands for the revised Ancient Woodland Inventory.



Top left: part of the original tithe map for Castle Frome parish (1840).

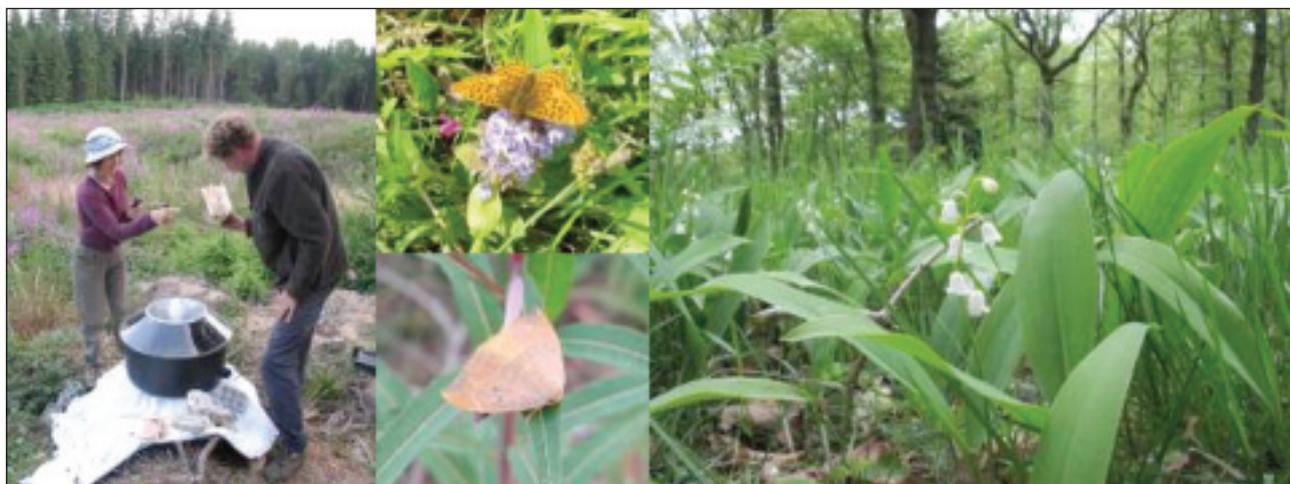
Top right: the same tithe map as transcribed by Geoff Gwatkin and digitally colour-coded by the project. Colours are chosen so as to be as distinct as possible for the eight common land-use types. See page 16.

Bottom left: the 25" to the mile Ordnance Survey map c.1880 showing the two candidate ancient woods as well as the distribution of individual trees in the vicinity.

Bottom right: Recent (2002) aerial photograph showing little change in the woods and their immediate countryside. The southern tip of Cheyney Court Wood which is on the current AWI is outlined in blue teeth and the current Ordnance Survey Master Map polygons of the two 'new' ancient woods in purple.

7. Field surveys and results

The project has identified a number of woodlands where there have been few, if any, vegetation or invertebrate surveys. Surveys were carried out on a sample basis in 42 woods which cover some 600 hectares.



Left: Examining the catch from a moth trap in a conifer clearfell area in Haugh Wood
 Middle top: Pearl Bordered Fritillary, Haugh Wood, Middle bottom: Oak hook-tip Sned Wood.
 Right; wild Lily of the Valley, Barnet Wood

7.1 Woodland Lepidoptera

From 2006 to 2009 the project recorded 806 species of moth and butterfly, including 56 species which are either Biodiversity Action Plan (BAP) priority species, Red Data Book rarities or are nationally notable. Seven of the woods had no previous moth records at all.

| Category and number of species | No | BAP species: Moths | BAP species: Butterflies |
|-------------------------------------|-----|---------------------|---------------------------|
| UK Biodiversity Action Plan species | 8 | The False Mocha | Pearl Bordered Fritillary |
| Red Data Book species | 6 | Drab Looper | Wood White |
| Nationally Notable species | 42 | Barred Tooth Stripe | White Admiral |
| Total species | 806 | | Grizzled Skipper |



Wood White, Park Wood, St. Margarets



Barred Tooth-striped, Queens Wood Dymock

Red Data Book species recorded:

Eupithecia egenaria (the Pauper Pug), *Yponomeuta orreella* (Willow Ermine), *Oecophora bractella*, *Endothenia ustulana*, *Ancylis upupana* and *Alebriopsis albicilla* (a pyralid moth). The latter five species are micro-moths.



Oecophora bractella (Left) and *Alebriopsis albicilla* (right) both from Queens Wood

The project's Lepidoptera surveys were co-funded by Butterfly Conservation, who commissioned the project to report on the status of moths and butterflies in 10 of 15 woodland sites and to make management recommendations. The results are published by Butterfly Conservation in the report 'Sites Dossier of ten Ancient Woodland sites in Herefordshire 2007', Butterfly Conservation Report No. S07- 43. The woodlands in the dossier are Haugh Wood, Lords Wood, Shobdon Hill Wood, Sned Wood, Mabberley Wood, Seige Wood, Queens Country Park, Timberline Wood and Woodside. The other 5 woods that project commissioned Lepidoptera surveys were Aconbury Wood, Ast Wood, West Wood, Westhide Wood and Mowley Wood.

The results of this report were used by the Forestry Commission to secure funds from the SITA Trust for a project to improve the habitat for Wood White butterflies in Forestry Commission woods in Herefordshire. This project runs until 2011.

7.2 Vegetation monitoring

A method of rapidly sampling woodland structure & vegetation, which can be used by volunteers, was developed using GPS and digital camera. Results from 15 plots in 6 semi-natural woods are stored for subsequent revisits. In addition, 10 plots have been established in the compartments in 5 PAWS woods which have undergone or are about to undergo conifer removal. These plots can be relocated by GPS and will be used to monitor semi-natural vegetation re-establishment. The woodland sample plots were chosen to be representative of the stands being sampled.

The survey method

A GPS way point was marked at the centre point of each sample, and a digital photograph taken of the stand. We used the Garmin 60cx which is typically accurate to within 6m in woodland situations. The camera's time is synchronised to that of the GPS so that image files can later be uniquely linked to each GPS point in GIS. Ground flora species are recorded within a 10m square, and the canopy with the underwood is recorded using the same square over 30m x 30m.

The following is an example of the tabulated result of one sample:

| Stand sample: 2, Brockhall Wood GPS waypoint no: 68, 10/5/2007 14:47 | | | |
|---|------|-------|--|
| Canopy | | | |
| Species | Type | Cover | Comments |
| Ash | Tx | 50 % | Singled ash and oak from coppice dating from the early 20th century. Alder about 50 years. |
| Oak | Tc | 15 % | |
| Alder | Ct | 15 % | |
| Underwood | | | |
| Hazel | Cx | 15 % | Underwood rather suppressed by canopy, sparse in places |
| Wych Elm | St | 30 % | |
| Hawthorn | Sx | 20 % | |
| Dogwood | Sx | <1 % | |
| Holly | Jp | <1 % | |
| Honeysuckle | Sc | <1 % | |
| Ivy | Sc | <1 % | |
| Wild Rose | Sx | <1 % | |
| Ground Flora | | | |
| Wild Garlic (D), Bramble (F), Bluebell (O), Wood Anemone (O), Dog Violet (O), Ash seedlings (O), Wood Speedwell (O), Wood Avens (O), Yellow Archangel (O), Pendulous Sedge (O), Field Maple seedling (R), Red Campion (O), Sweet Woodruff (R), Enchanter's Night Shade (R), Lords and Ladies (R). | | | |
| Other features/species | | | |
| Stand abuts stream within gently undulating terrain on the north side of the wood. | | | |
| Abbreviations | | | |
| <p>Tree type abbreviations: Tp=Planted tree, Ts Standard in c-w-s, Tc=Stool grown tree, Tn=Self sown tree, Tx=Any other tree, Cx=Coppice, Ct=Stool re-growth, Px=Pollard(>2.5m) , Pc=Pollard(1-2.5m) Sx=Shrub, Sc=Climber, St=Young tree, Jp=Sapling, Js=Seedling, Jv=Sucker.</p> <p>DAFOR ground flora abundance scale: D=Dominant, A=Abundant, F=Frequent, O=Occasional, R=Rare.</p> | | | |

Photograph of above stand sample:



Stand sample 2
Brockhall Wood, Colwall

Image file reading:
Exposure: 1/60s
Aperture: f2.8
Time stamp: 10.05.2007 14:41

The GPS reading:
Way point no: 68
Grid Ref:SO7587644054
Date: 10/5/2007 14:47
Altitude: 158 meters

Specially-commissioned aerial photography

High resolution geo-rectified aerial photography is becoming ever more available, for example Google Earth and Microsoft Virtual Earth, but at present such photography is only carried out in every 5 years or so outside cities. Recent changes in woodland management and canopy structure, including PAWS restoration initiated by this project, do not appear on some 'modern' aerial photographs some of which can date back several years. In any case, such photography will not necessarily take place at the optimum time of year for visualizing species discrimination in woodland canopies. This occurs at leaf emergence in late April or early May and as leaves turn in autumn in late September or early October. It is sometimes useful to have images of both seasons.



Barnet Wood and Knowle Wood, Wigmore



Annotated photo showing location of Wood Whites in Merehill and Sned Woods, Aymestrey

In 2008, as a feasibility exercise, the project took its own aerial photographs of selected woods in spring and autumn using a hand-held, consumer-grade digital camera from a microlite which flew from Shobdon airfield. These photos provide a fair level of detail and discriminate well between different stand structures and canopy species. Such photographs can be used as a monitoring tool and are cost-effective method of remote sensing of woodland.

7.3 Veteran tree survey and mapping

Areas of the county where there are concentrations of veteran trees were surveyed on an opportunistic basis, mostly by volunteers trained to use appropriate survey forms and supplied with GPS and digital camera. Some of these tree clusters are in a pastoral setting and could be considered as small scale 'wood pasture' or potential 'wood pasture' sites. In all, 1,184 veteran trees have been recorded and mapped by the project and its volunteers.

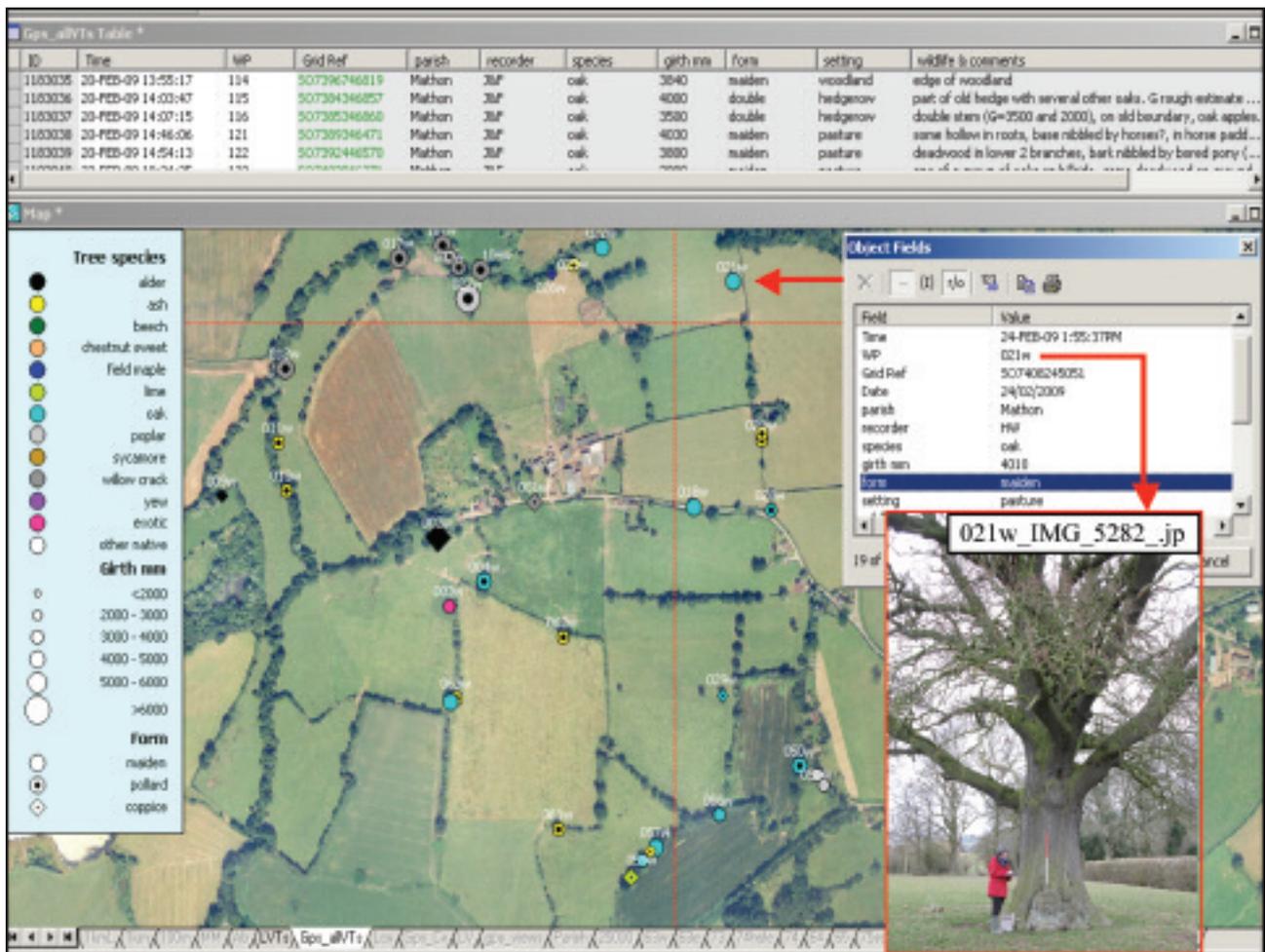
In winter and spring of 2008/9 the project trained 5 volunteers to record, measure and photograph 453 trees of historic and wildlife interest in the parishes of Cradley, Mathon, Colwall (and part of Coddington) within the Malvern Hills Area of Outstanding Natural Beauty (AONB), covering an area of 3,440 hectares. 19 tree species were recorded and 37 trees with girths of 6 meters or over were recorded. The trees were located by GPS, photographed using digital cameras, synchronised for time as described in 7.2, mapped in a Geographic Information System (GIS) and their survey details entered onto a database linked to the GIS.

Historic maps of the area were digitised and geo-referenced as 'time layers' within the GIS to provide the historic context for the tree population. This veteran tree project demonstrates the flexibility of the GIS system developed by the project. Volunteers were supported by being supplied with detailed modern and historic maps as well as airphotos of each 1km x 1km square in 'their patch'. These are automatically generated by the GIS system. The results of the surveyors work was periodically downloaded to a laptop with the GIS so the tree locations, photos and tree characteristics are quickly produced, resulting in confidence building feedback for the survey team. This results of this work, co-funded by the Malvern Hills AONB sustainable development fund, are detailed in the report 'A Veteran Tree Survey of the Malvern Hills Area of Outstanding Natural Beauty' April 2009.



Left: A cluster of veteran oaks in pasture at Lower Eggleton. Right: recording a double pollard in Mathon

The results of the project's veteran tree surveys will be incorporated into the growing tree database of the Herefordshire Biological Record Centre, and the Woodland Trust's national Ancient Tree Hunt project.

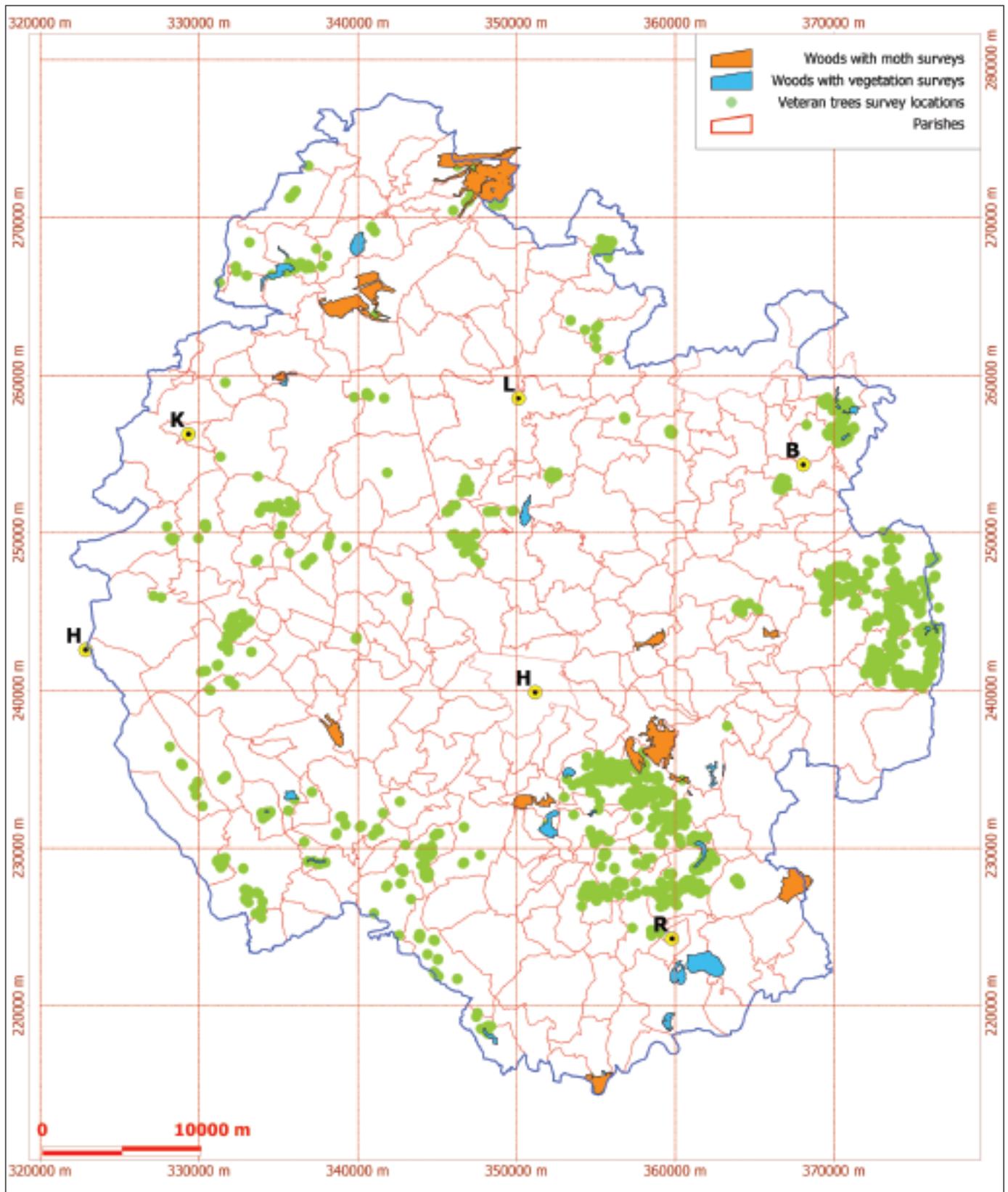


The project GIS showing the database of veteran trees, and how the tree record relates to a stored photo and location against a backdrop of the aerial photograph

Analysis from GIS showing type of land use where the recorded trees are growing in the Malvern Hills AONB:

| Land use setting of tree | No. | % |
|---------------------------|-----|------|
| arable | 15 | 3.3 |
| churtyard | 3 | 0.7 |
| common | 3 | 0.7 |
| garden | 17 | 3.8 |
| hedgerow | 103 | 22.7 |
| orchard | 4 | 0.9 |
| other | 10 | 2.2 |
| parkland | 30 | 6.6 |
| pasture | 180 | 39.7 |
| recreation | 2 | 0.4 |
| streamsideside or wetland | 11 | 2.4 |
| woodland/wood edge | 75 | 16.6 |
| Total | 453 | 100 |





Locations of woodland and veteran tree surveys undertaken by the project

8. Practical restoration of ancient woodland sites

The project has helped fund the ongoing restoration of 28 hectares of PAWS in the Woolhope Dome area. Restoring native woodland damaged by plantation forestry involves more than simply felling and harvesting the conifer stand. Years of accumulated conifer needles and twigs will have affected the soil pH, structure and soil microflora. This will often restrict plant and animal colonisation from adjacent semi-natural stands, and compromise the viability of any seedbank. After felling and harvesting there will be large volumes of brash, sometimes a few metres thick, to be disposed of. If left, this layer further inhibits natural regeneration, while the by-products of rotting conifer wood enrich the soil encouraging weeds such as nettles and thistles. Project funds at a rate of £450 per hectare have paid for brash treatment of various kinds including 'rowing up' and burning on non-sensitive areas. This still leaves some material behind but is better than leaving the brash as a continuous layer. In Siege Wood all conifer brash was meticulously removed from the ground after felling, showing a good response of native plant species within two years on mildly calcareous shale soil. Survey plots have been established on these restoration sites so that subsequent vegetation growth can be monitored if resources were available.

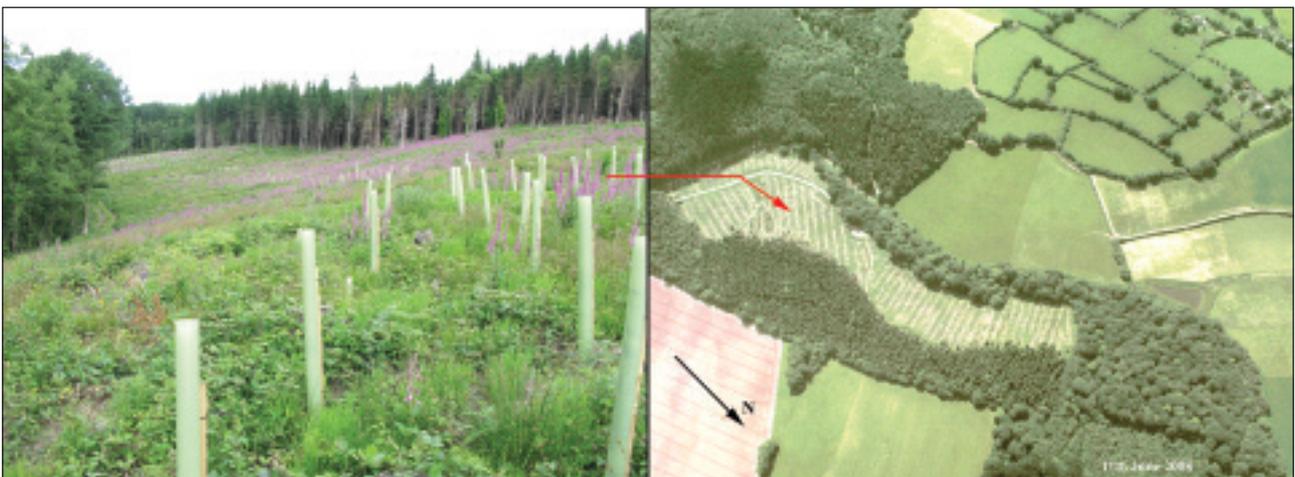


Above left shows compartments in green of Haugh Wood and Fownhope Park Wood where the 1953 census recorded the ancient woodland indicator Lime as present in the stand. All these stands have been converted to conifers since that survey but Lime survives in all of them.

Bottom right shows a Lime coppice survivor in a Norway Spruce stand in Fownhope Park wood which has now started to be restored (below) . Note the survey pole recording the GPS location of the lime stools for future monitoring.



1: Harvesting a young Corsican Pine plantation in Haugh Wood near 'butterfly corner'
 2: Eight months after felling the Norway Spruce stand (1953 stand 28 above) in Fownhope Park Wood
 3: Clear area between brush rows after 'rowing up' following felling Western Red Cedar, Haugh Wood
 4: Siege Wood. Inspecting re-colonisation of Wood White butterfly two years after intense conifer brush removal has enabled recovery of species-rich ground flora.



Left: Felled conifer stands in Athelstans Wood which occupied stands 14 and 12 in the 1953 census example (see page 6) are being partly restocked with native broadleaves.
 Right: Microlite air photo of the same felled area.

9. Conclusions and next steps

This 3-year project has broken much new ground, using innovative and painstaking methods, and involved a wide range of organisations and contributors in a creative way. It has highlighted the rich and multi-faceted potential of one of the county's treasures - its ancient woodlands and historic 'treescapes.' This potential links the pursuit of knowledge - through further research and survey, with social gains - with voluntary and community engagement, and with economic activity grounded in sustainable land management and utilisation of its products and services. Ancient woodland restoration and upkeep will both strengthen the rural economy and foster local character and culture, whilst caring for our oldest biodiversity strongholds.

The project's findings of the wealth of moth species from specific woods suggests other important discoveries await, and illustrates the exciting scope for wildlife recording across the county's ancient woodland heritage. It underlines the case for strategic investment in recording and in site management for targeted wildlife interests. Other project fieldwork has boosted the accumulating information on veteran tree occurrence; contributed to native woodland habitat restoration in the Woolhope Dome - a regionally important Biodiversity Enhancement Area - and shown how aftercare of coupes released from conifer plantations can secure the best nature conservation outcome.

The accessing, interpretation and integration of historic and contemporary records, in tandem with the spatial analysis of a Geographical Information System, has built a powerful body of evidence for understanding and better-conserving individual ancient woods, including verifying the antiquity of many small woods for the first time. A comprehensive ancient woodland inventory for half the county is a major achievement from modest resources. The completion and extension of this work requires additional resources, and new project partners. Attention will also focus on early practical applications such as a future strategic programme for PAWS restoration; design of grant schemes and applications and prioritised locations for improving ecological connectivity between woods. The next phase of the project will be explored by participants in the project conference in April 2010 and through a proposed Herefordshire Trees and Woodland Task Group.

Ultimately, the worth of this major investment in information should be demonstrated through a strengthened, secure place for ancient woods in today's and tomorrow's countryside. This will further the county's vision for 'an outstanding natural environment', as expressed in the 2010 Community Strategy.

January 2010

Project Partners: River Wye Preservation Trust, Natural England, SITA Trust, Duchy of Cornwall, Forestry Commission, Herefordshire Biological Record Centre, Woodland Trust, Royal Forestry Society.

Project Funding

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Janet Cooper and Sue Hubbard (transcription and translation of Latin manuscripts).

Fenny Smith (Archive research and photography)

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