Managing the historic environment in woodland: the vital role of research

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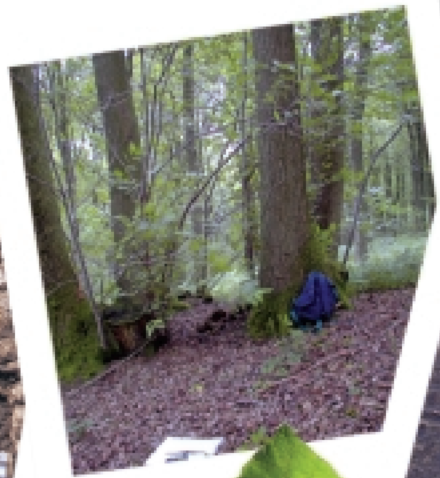
The historic environment is an important part of our heritage and contributes significantly to our understanding of the human past. This article provides a review of the management of the historic environment in woodlands, highlights important issues and reports on current and planned research.

Hawthorn roots growing across a roman floor

Ancient coppice stool



Excavation of a charcoal platform

Introduction

In woodland, as with other land uses, the conservation of the historic environment is highly important. This is reflected in a key Forestry Commission objective on sustainable forestry which includes the commitment that important historic environment features should be protected during woodland management and planning (Forestry Commission, 1998). There are many types of historic features in woodland and they provide a rich resource for study and research, including archaeological evidence, biocultural heritage such as veteran trees and historic landscapes such as wood pasture or ancient woodland. To maintain and enhance such features through informed management, we need improved understanding of how they interact with the surrounding environment and landscape. Such understanding is now being developed within a new research programme funded by the Forestry Commission.

The research programme began in 1999 by examining issues relating to the archaeological resource in British woodlands and these aspects are focused upon here. Archaeological evidence constitutes a major component of the historic environment and it is both finite and non-renewable. Within woodland environments, this evidence is often divided into two categories:

- Archaeology *in* woodland, where there is no relationship between the archaeological evidence and the woodland in which it occurs, for example, barrows.
- Archaeology *of* woodland, where the archaeological evidence is directly related to the history and management of the woodland, for example, saw pits, charcoal platforms and ancient woodland boundary banks. Here, the woodland itself is often an important part of, or setting for, the archaeological feature.

There are thousands of known archaeological sites in Great Britain (GB) ranging from extensive field systems and hillforts to single standing stones and sites of artefact finds. By their visual nature, earthworks are the most commonly known features, with sites of buried or less dramatic remains being harder to identify (Forestry Commission, 1995) while other archaeological evidence lies undiscovered. The total GB archaeological resource is therefore unquantifiable. Nevertheless, with over 2.7 million ha (27 000 km^2) of GB land currently under woodland management, it is inevitable that this will include many thousands of sites of archaeological interest.

Historically, forestry and archaeology have often been regarded as antagonistic. However, since the early 1980s, there has been an encouraging increased awareness of the historic environment reflected in government policy and an expanding dialogue between interested parties. This has led to a greater co-operation between foresters and archaeologists (Yarnell, 1999; Fojut, 2002).

A recent review of forestry and archaeological literature (Crow, 2004) has identified many ways in which tree presence or removal could be either benign or detrimental to archaeological evidence. The optimum management of a site is dependent upon many factors, all of which need to be considered when developing management plans, as described in Box 1. Indefinite preservation of archaeological evidence *in situ* is not possible, as it inevitably deteriorates with time. However, the rate of degradation can be greatly influenced by site management. Unfortunately, there is a limited understanding of the many complex interactions that influence the rates of change (Crow and Yarnell, 2002).

This article now looks at examples of three projects designed to help improve policy and management guidance. The first two examples concern new woodland establishment, while the third considers the management of sites already in a wooded environment. Other examples of research projects are listed in Box 2 (page 54).

Box 1

Examples of issues relating to historic environment features under woodland management.

- The high density of historic environment features and the large area of GB under woodland, inevitably means that in some areas both must co-exist
- Current government policy is to promote the establishment of woodland and short rotation coppice (SRC), but no planting should occur at the expense of important historic environment features
- Whether or not tree cover should be retained/cleared/established on areas of importance will need to be considered in a strategic approach to the management of archaeological features under woodland and forests
- Damage to archaeological sites could potentially occur in many ways including: cultivation, desiccation, root damage (from trees and other vegetation), visitor erosion, burrowing animals or chemical changes to the surrounding environment
- The type, composition, size and depth (if buried) of archaeological evidence combined with surrounding environmental factors will influence preservation
- The aesthetic setting of historic environment features should also be considered to place the site in a suitable context; past land use may also be relevant
- Less is known about historic environment features in woodland than under other land uses due to limited surveys and research
- Awareness, identification and mapping of historic environment features in woodland and forests is essential to aid management and minimise the risk of accidental damage

Floodplain forestry and wetland archaeology

Known archaeological site information is routinely sought as part of the Woodland Grant Scheme (WGS) consultation procedures. When important remains are identified, the land on which they are located is typically excluded from the scheme or incorporated into planned open spaces. However, certain landscapes possess favourable preservation environments and were suitable locations for former settlement but have no recorded archaeological evidence. Such land is regarded as having a high archaeological *potential*. Evaluation of the possible risk of damage caused by a change in land use is therefore required, so that informed decisions can be made.

Waterlogged deposits have yielded many well-preserved archaeological remains and so the impact of woodland establishment on floodplains is of particular interest. Various geotechnical, geophysical and archaeological site assessments can be used to detect buried evidence, but these are expensive. A recent WGS proposal formed the basis of an evaluation of site investigation methodologies and this is outlined below.

Site background and evaluation

An application was made by a farm for a 67 ha mixed broadleaf community woodland on the Avon levels in South Gloucestershire. The water table of the floodplain deposits (<10 m above OD) is managed by a series of field drains which discharge into large ditches. The bedrock (Mercia Mudstone) below the alluvial deposit occurs at its shallowest depth (0.5 m below the surface) in the southeast of the farm and dips down as it extends northwest towards the Severn Estuary. However, towards the south of the farm it briefly rises again through the surrounding floodplain to form a small hill in one of the fields. The land use at the time of grant application was pasture, with three areas of existing woodland. During the installation of a gas pipeline across the site in 1997, Romano-British artefacts and deposits of peat (which may contain palaeoenvironmental evidence such as pollen grains) were identified.

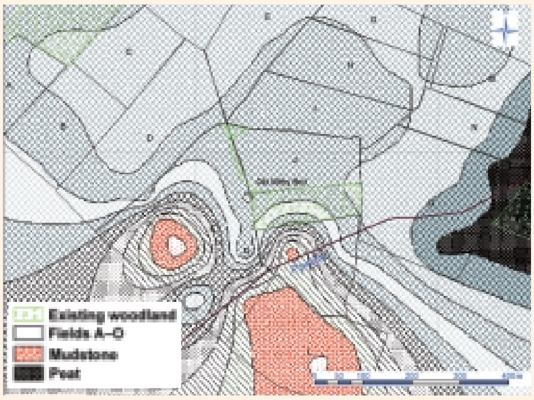
Before the last phases of alluvial inundation and historic land claim, the Mercia Mudstone forming the small hill and rising towards the southeast of the farm would have formed higher, dry ground at the edge of the floodplain. These areas were therefore considered as sites of earlier settlement and land use with a high archeological potential. For these reasons, collaborative research involving the Forestry Commission, South Gloucestershire County Council and English Heritage was planned and undertaken using the following surveys and excavations:

Auger survey (Forest Research)

This was to a depth of 1.7 m of the entire application area to map the extent of the shallow Mercia Mudstone and the peat deposits. Figure 1 shows the extent of the mudstone (red) and the peat (black) at a depth of 1.4 m.

Figure 1

Auger survey to assess extent of mudstone and peat.



Soil examination pits (Forest Research)

These were dug to assess the typical rooting depths of the trees in the existing woodlands. Figure 2 shows the shallow nature of the lateral root growth and the depth of the water table.

Figure 2

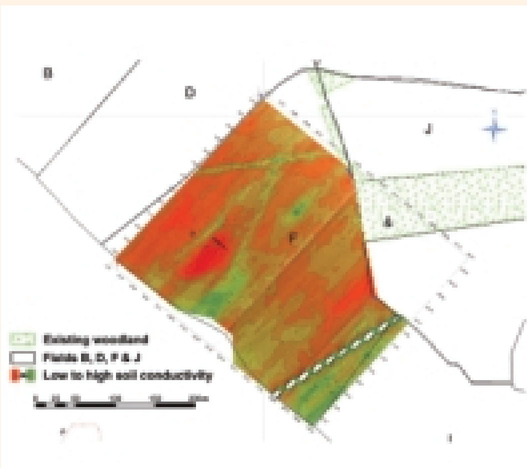
Soil examination pit revealing shallow lateral root growth.

Geophysical survey (Stratascan)

The field containing the small hill and location of Romano-British finds was surveyed, using various methods including electromagnetic (Figure 3), resistivity and magnetometry, tested for their ability to identify archaeological and geomorphological features. Survey costs ranged from £300 to £1000 per hectare.

Figure 3

Geophysical survey using electromagnetic methods.

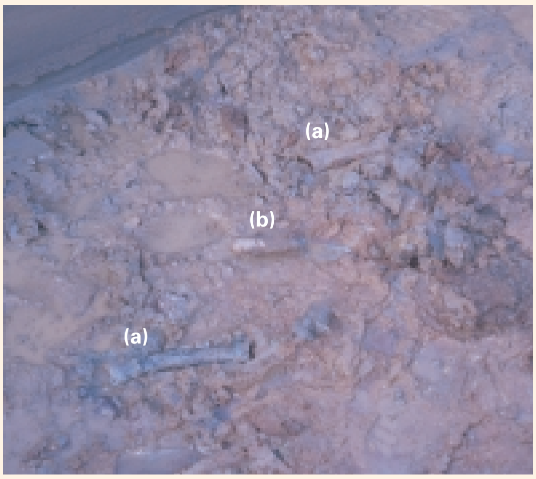


Trial excavations (Gwent Glamorgan Archaeological Trust)

These excavations were to examine features of interest identified by the geophysical survey and to re-examine the location of the previous Romano-British finds by expanding and developing the area exposed by the pipeline. Figure 4 shows the bones of domestic animals.

Figure 4

Trial excavations reveal bones of domestic animals (a); muddy trowel (b) added for scale.



Results

The excavations of areas of interest identified by the geophysical survey produced evidence of Romano-British occupation at the base of the alluvial deposits close to the surface of the Mercia Mudstone. These included bones of domestic animals, local pottery, charcoal and stone. This may have been the location of a simple Romano-British settlement, on low-lying but predominantly dry land on the margins of the floodplain. The full extent of the archaeological evidence at the site remains unknown but its topographical/marginal location is of importance in interpreting local Romano-British activity. The surrounding alluvial deposits, sampled during the excavations, were found to contain palaeoenvironmental information in the form of molluscs and some pollen grains. The peat deposits were not sampled, but it is probable that they contain a more complete pollen record. Palaeoenvironmental analysis of the peat was not in the remit of this study.

Woodland establishment and continued monitoring

The auger survey showed that most of the site was covered by at least 1.7 m of late or post-Roman alluvium and the threats of physical archaeological damage by tree roots was considered to be a very low risk. A revised planting scheme was therefore approved for the site. The areas that were considered to be the most archaeologically and palaeoenvironmentally sensitive were incorporated into open space to be maintained as grassland (Crow, 2003).

Observations during the above surveys showed that the water table occurred within 1.5 m of the soil surface. Throughout the site, the water table is managed by the field drainage system, but also influenced by climate and vegetation cover. As a precautionary measure, 12 months prior to the approval of tree planting, 24 dip wells were installed in three different areas, incorporating both open field and existing woodland. In all of the open fields containing the dip wells, trees have since been planted and the fortnightly monitoring of the water table is continuing. Results from this work will be published in a scientific journal once the trees have become fully established on the site.

This study has provided a valuable benchmark for future woodland proposals on alluvial floodplains. If woodland is to be considered on floodplains believed to have a significant archaeological potential, it gives an indication of the types and costs of the survey techniques that may need to be considered. Finally, it emphasises the need for good and early consultation and collaboration between foresters, surveyors and archaeologists.

Bioenergy and the expansion of short rotation coppice

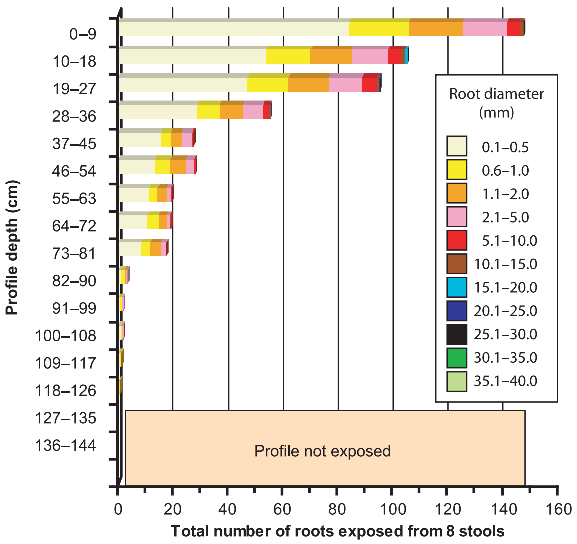
With a government commitment to reduce dependence on fossil fuels, some former agricultural land has been proposed for the establishment of short rotation coppice (SRC) as a biofuel crop. Despite regular agricultural ploughing, buried archaeological evidence may still survive below many fields and some SRC proposals have led to concerns over 'deeper rooting' tree species, often regarded as more intrusive and destructive than the former agricultural crop. The Forestry Commission has a responsibility to evaluate environmental risks from tree establishment, including SRC, and initiated the following study into rooting depth of this crop type.

Root evaluation method

To examine the typical rooting habit of biomass tree species, trenches were dug in a variety of established willow (*Salix* sp.) and poplar (*Populus* sp.) SRC plantations on a range of soils to assess the roots in profile. The diameter and location of each root exposed within the soil profile was recorded. This was repeated for eight stools within each trench. In total, 33 trenches were dug, 264 coppice stools assessed and over 18 000 roots were measured (Crow and Houston, in press). Figure 5 shows the mean root distribution data obtained for willow, plotted against a typical excavated trench profile.

Figure 5

Plot of mean root distribution for willow SRC.



The rooting habits were found to be influenced by many variables and too complex to predict accurately but the following conclusions could be made:

- Regardless of soil type, typically 75–95 % of willow and poplar SRC roots occurred within the topsoil (0–20/30 cm).
- SRC roots were found to a depth of over 1.3 m in some soils, but were few in number. (When grown in uncompacted soils many agricultural crops will produce roots to a depth of 1–1.5 m: Weaver, 1926.)
- Typically, at least two-thirds of the SRC roots were less than 1 mm diameter. Root diameters decreased with increasing depth.
- SRC poplars had larger stem and maximum root diameters than willows of the same age and management.
- A significant relationship was found between maximum root diameter and maximum stem diameter for poplars ($p<0.005$) and willows ($p<0.001$).
- SRC subject to greater exposure or less competition (e.g. at the plot edge) developed significantly larger root diameters ($p<0.001$).
- Poplars on well-drained soils had more and deeper roots than on other soil types. Wetter soils supported shallower root systems.

The depth of SRC root systems measured was very similar to common agricultural crops. Some SRC roots are clearly thicker than those of other crops, but regular harvesting of the coppice stems was found to inhibit large root development. The implications for any buried archaeological evidence will be site specific. However, where important archaeological evidence is known to exist just below the agricultural topsoil, SRC establishment would rarely be encouraged as the recommended cultivation usually involves deeper subsoiling to aid root growth and break any compacted soils (Ledin and Willebrand, 1996; Tubby and Armstrong, 2002).

This work has provided valuable information as the basis for guidance for landowners and archaeologists considering land for SRC establishment (Crow and Houston, in press).

Managing the vegetation cover of earthworks

In established forests and woodlands, tree retention may be acceptable on some types of archaeological site. However, what is usually poorly understood is the full extent of buried archaeological evidence on such a site, and how tree root growth may affect it.

While tree cover is managed to prevent windthrow, the long life of structural tree roots may provide a stabilising lattice to support the form of an earthwork such as a bank. Where appropriate and possible, coppice silviculture may offer long-term soil stability with reduced risk of windthrow compared with high forest management (Harmer and Howe, 2003). Knowledge of the rooting habits, water requirements and the environmental chemistry under different tree species can also be used to reduce risks of some potential impacts (Crow, 2004).

To maintain an archaeological site in open grassland, vegetation management will usually be required and possibly some measures to avoid erosion or to control burrowing animals. Nevertheless, the opening of areas through purposeful deforestation in the interests of both the archaeological evidence and their landscape setting has been successful in many places. However, preventing the re-establishment of scrub, bracken or other unwanted plant species on a site will always require some degree of active management.

Vegetation monitoring methods

To aid the development of effective scheduled ancient monument management plans within the Forestry Commission estate, vegetation monitoring is under way on a sample of earthworks in southern England at three surveying/monitoring levels. These are briefly outlined opposite, with an illustration of the data collected for each (Figures 6, 7 and 8).

During the past three years, some of the sample study sites have seen considerable changes in vegetation. For example, one enclosure with sycamore regeneration of up to 3 m, seen during the survey of 2001 (Figure 9a), was successfully cleared from the earthworks, as shown in Figure 9b. Annual mowing is now in place to maintain the site. These photographs clearly illustrate the need for continual vegetation management to maintain an earthwork, with the actual amount of work required being site-specific.

Where trees remain on a monument, such monitoring also provides a method of recording disease or damage. On another settlement site in Hampshire, this led to an assessment of wind firmness and general health of the trees, resulting in a selective thinning to prevent any damage to the earthworks through windthrow. On some monuments there are different floral communities associated with the banks and ditches. For example, below the canopy of the thinned monument, the initial spring survey showed parts of the bank to be dominated by bluebell (*Hyacinthoides non-scriptus*), while dog's mercury (*Mercurialis perennis*) was more abundant in the ditch. However, this pattern was not found across the whole monument and may simply reflect the natural occurrence of a different soil type. Whether or not such changes were due to bank/ditch induced environmental conditions (such as soil moisture) and could thus be used to map the location of any eroded features will require further study.

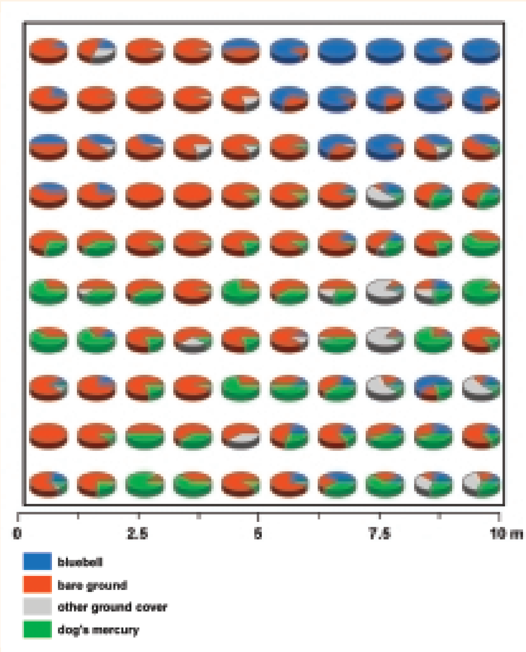
All archaeological earthworks will need an active management plan to prevent the establishment/proliferation of unwanted vegetation types and reduce the risk of site damage or enhance the monument setting. Vegetation monitoring (even in its simplest form) should be considered as it provides a method of assessing the effectiveness of such plans. And, when combined with GIS, it also allows longer term changes in both the condition of the monument and its environment to be examined.

Intensive survey

This examines a monument section (typically bank and ditch section) using a 10 m^2 survey grid divided into 100 quadrats. Each plant species is recorded as a percentage of the ground cover within each quadrat. Over successive surveys, this technique will allow very small vegetation changes to be resolved and is particularly well suited to smaller monuments such as barrows.

Figure 6

Intensive survey: suitable for smaller monuments.



Walk-over survey

The main plant communities are recorded as areas drawn onto a map of the earthworks. This is unlikely to show gradual or minor changes but will enable differences to be mapped following active management or rapid vegetation succession. This method is more appropriate to larger monuments.

Figure 7

Walkover survey: suitable for larger monuments.

Photographic record

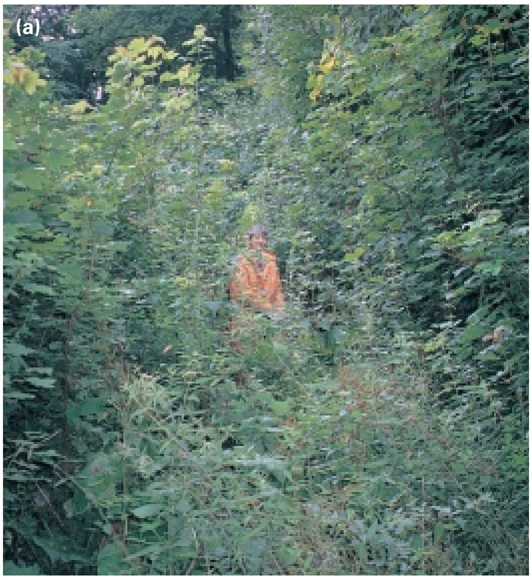
This is the simplest method and involves taking photographs of the monument from a selection of viewpoints. Subsequent photographs of the same views allow changes in vegetation to be monitored.

Figure 8

Monitoring by photographic record.

Figure 9

Vegetation cover on a Hampshire settlement enclosure (a) before and (b) after clearing.



The way ahead

Many current and proposed types of land use and management issues could potentially have implications for the preservation of the historic environment. Examples include:

- The increasing public awareness and interest in the historic environment.
- The government commitment to sustainable forest management and increased use of biofuels such as SRC.
- The Forestry Commission's commitment to increase the non-timber value of the estate by improving visitor access and social benefits, enhancing biodiversity and implementing conservation or restoration projects.

The research under this programme is essential in order to address these and other issues outlined in Box 1, through sustainable forestry. The varied nature of these issues and historic environment features is reflected by the range of research projects carried out under this programme. In addition to the three projects outlined above, Box 2 lists other examples of current and planned research projects.

Box 2

Ongoing and planned research projects.

- Continued research collaboration and communication with other organisations to increase awareness and understanding of the subject area
- Fundamental study of archaeological features in woodland environments to ascertain rooting impacts
- Hydrological monitoring of the Gloucestershire floodplain forestry case study site
- Monitoring of the Forestry Commission's management guidance and practice of both archaeological and biocultural features
- Evaluation of the preservation of the archaeological resource in woodland soils
- Development of GIS as a tool for the management and research of historic environment features
- Examination of the potential and practical applications of remote sensing as a tool for surveying woodland environments
- Development of a decision support guide to assist in the management of the historic environment
- Provision of advice through research on the management of existing and future veteran trees
- Study of the pollen production of different tree species under coppice silviculture and assessment of implications for palynology and palaeoenvironmental interpretation

This work will significantly improve our understanding of how woodland management influences the survival of historic environment and subsequently more informed decisions will be possible.

Considering the diverse variety of historic environment features and their different surroundings, more site-specific guidance is required. This will be taken forward in the forthcoming revision of *Forests and archaeology guidelines*, to be retitled *Forests and historic environment guidelines*, to reflect the wider heritage values and underpin *The UK forestry standard*. At a time when there are increasing demands on land use, sensitive woodland management can offer a setting in which archaeological evidence can be conserved, enhancing both the landscape and its value as well as the wider historic environment.

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