Assessing woodland history and management using vascular plant indicators

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Summary

This paper reports progress in studies to investigate current use of botanical indicators in historical research and to inform UK planning policies. As part of this process a comprehensive review of field survey techniques was undertaken and a hybrid system of survey is proposed. This includes a walkover transect with the ability to incorporate point monitoring in the form of standing quadrats. Because of the nature of this approach, a similarly novel approach to analysis is also discussed. One of the key issues raised from the review was a general lack of accounting for the internal variation of woodlands when obtaining or interpreting species lists. Many authors acknowledge the need to accommodate internal variation, but rarely propose any systematic method for dealing with this issue. This issue is considered here, with a primary aim to provide survey and analysis that can be applied by historians to interpret woodland history and evaluate woodlands subject to planning policy.

Key words: Woodland survey, ancient woodland, botanical indicators, woodland history

Introduction

Ancient woodland is an important wildlife habitat in all countries of the United Kingdom. This is recognised in national planning policies as well as in conservation targets and objectives set by government and statutory bodies. The assessment of woodlands as either ‘ancient’ or more recent has been the subject of considerable research since the 1970s. Ideally, woodland can be asserted as being ancient by consulting historic records and tracing it back to a period when it is unlikely that it would have been planted on land that was previously clear-felled. Most authors generally accept that woodland traced back to the period before 1600AD (Rackham, 2006) is most likely ancient in origin. This is because there is little documentary evidence suggesting new plantings before then. Where historic record is absent, it becomes more difficult to confirm woodlands as of ancient origin. Using historic documentation, in combination with botanical evidence, has led to the development of the concept that a range of plant species can be used as historic markers to predict that a given woodland has an ancient origin. Known as ‘Ancient Woodland Indicators’ (AWIs), these species are often used as surrogates for historic research in situations where it is impracticable to obtain historic records or where records are absent (Peterken, 1993, 2000; Rackham, 1990, 2006; Spenser, 1990).

For the species used as historic markers, the current research considers how they were derived in compiling the existing lists. It also seeks to develop refinements or improvements to ensure
that future lists are collected in a more rigorous fashion, and that the method of interpretation
provides a meaningful and robust estimation of the antiquity of woodland. Many of the current
AWI lists were derived from expert opinion within a defined spatial region of study. These are
often based on current, or former, county boundaries or on the key regions of organisations like
Natural England. Some of the more recent lists have been derived from both rigorous survey
sampling, as well as extensive historical research in order to validate the botanical data. The most
notable recent case was work done in Northern Ireland by the Woodland Trust. During the current
research, shortcomings of various surveys and survey techniques became apparent. This paper
presents some of the ideas involved in developing what is hoped may become a new and adaptable
approach to field survey. In addition to developing the field survey technique, the research also
investigated alternative methods of analysing and applying the data to inform decision-making
processes of both conservationists and planning authorities.

Materials & Methods

Many current woodland survey methods are based on a standard walk over survey, use of
one or more fixed areas, or the application of quadrats of varying sizes in order to characterise
and classify vegetation. The work done by Keith Kirby in his publication ‘A Woodland Survey
Handbook’ (Kirby, 1988) describes the different techniques and details the various shortcomings
that each has. One of the main problems of a walk over survey or transect is ensuring adequate
coverage of the entire area of the woodland. This type of survey generally does not differentiate
between any of the internal variations in habitat found within most woodlands. However, the
use of quadrats is often flawed by the choice of scale so that larger quadrats encompass internal
variations in vegetation and smaller quadrats require large numbers in order to characterise the
flora. As Kirby points out (p. 33; Kirby, 1988), rare species are often missed completely by
quadrat-based techniques.

Part of this research used a case study of Ecclesall Woods in Sheffield, where woodland ground
flora species had been mapped in detail by the local friends group. In attempting to repeat and
extend some of this work, it became apparent that it was extremely difficult to map accurate,
reliable boundaries for colonies of ground flora species. In addition, the boundary for one species
may be different from the boundary of another. The current survey attempted to map vegetation
without defining boundaries. This ‘open mapping’ system provides a visual impression of the
distribution of individual species, and groups of species, within woodland.

A basic problem with currently available lists of woodland indicators was identified in the
analysis. This is that there is nearly always no indication of species abundance and no account
is taken of where species are located in the wood. At a research level, the current work attempts
to refine woodland history interpretation by looking in detail at the species composition within
woodlands in ‘meso-habitats’ and ‘micro-habitats’. These internal features can range from
streams, springs, steeply sloping banks, and cliffs, to individual trees or stumps supporting small
colonies of epiphytes, etc. This lack of acknowledgement that woodlands are heterogeneous in
nature is addressed by the current approach. The present survey system is being developed and
produced as a ‘Woodland Survey System’ (WSS) protocol. The basic principle of this method
is that it will be an adaptable system designed to meet the needs of any project from an amateur
assessment, through to a detailed survey to record accurate detail to inform a planning authority or
conservation strategy. The basis of the system is to allow for survey at different levels of detail and
complexity using a single recording form that accommodates records from transects, quadrats and
individual point locations. A basic survey equates to a general walk over sufficient to characterise
the nature of the woodland flora and potentially prepare for a higher level survey at a later date.
The overall strategy for the methodology is to adopt a hybrid approach combining walk over
survey and using quadrats. The three elements are:
1. Transect: corresponding to sections of a walked route through the woodland. The number of transects and their direction and length can either be predetermined or vary depending on local conditions.

2. Standing quadrat: this is a rough area surrounding the observer that can comfortably be surveyed, ideally without moving from the observation point. (However, placing a marker or object at the observation point will allow the observer to move around within the defined quadrat area).

3. Point record: where localised conditions exist, a point record can be made of one or more species found at that location using a GPS reference, e.g. *Polypodium vulgare* growing epiphytically on a branch of a single tree, or a single spike of Bird’s-nest Orchid, *Neottia nidus-avis*.

For each of these elements the level of detail of the botanical recording and associated items can vary depending on the needs of the survey. For example, a transect or standing quadrat, could simply record the species surrounding the observer without any other information. With increasing levels of complexity, the abundance of each species may be estimated and information obtained on the nature and density of the woodland canopy as well as associated features. These include topography and other general characteristics of the meso-habitat. A transect survey would record the abundance of species overall along the length and locally if there were any discrete patches where the species was more abundant, or dominant. This uses the double DAFOR or DDAFOR system, used by the same authors when assessing hedgerows. The DDAFOR system records two abundance values for each species instead of the traditional DAFOR (Dominant, Abundant, Frequent, Occasional and Rare). The first value is an assessment of the overall abundance of species and the second value indicates whether the species is distinctly clumped or is significantly more abundant locally.

The recording form provides space for recording up to five standing quadrats per transect. Point records can also be made for individual species or very small patches. In this way, a walked transect can combine all three elements and produce data at all scales and levels of detail. The system is also additive, in that an initial survey can be extended to increase the number and density of transects and standing quadrats. Typically, an initial survey might begin by following footpaths and other easily accessible routes and completing transects, standing quadrats and point records as required. Subsequently, any gaps in coverage may be surveyed by returning to the woodland and visiting previously unrecorded areas using the same combination of recording elements. It is particularly important to be selective and survey areas that appear different or more species-rich. If these are relatively large, then a transect can be routed to cover the area or alternatively a number of standing quadrats can be located. The aim of this survey is not necessarily to provide any repeatable information such as required to classify woodlands according to the National Vegetation Classification system (NVC). Under the Woodland Survey System summarised in this paper, comparisons can be made between woodlands but not using rigid systems of fixed quadrats or search effort dictated by either a fixed survey time or a predetermined transect length.

Recording separates tree species between the canopy and the shrub layer beneath the canopy. At all levels, the survey technique relies on the recent development of high sensitivity global positioning system devices (GPS), although the survey can be done without such a device.

In the past, it has been difficult when surveying woodlands to identify specific locations owing to the frequent lack of physical features to be used as points of reference. It is also often difficult to navigate within woodland without covering the same ground more than once or missing areas because of the apparent homogeneity of the woodland habitat. The use of modern GPS devices can be advantageous in returning the observer reliably to a reasonably accurate position within the woodland. These devices are also used in the field to ensure adequate coverage of the woodland being surveyed. This relies on the observer taking out a field map on which is marked a 10 m grid with marginal indications of the coordinates. In the field, at any time, the observer can refer to their GPS device and using the second and third to last digits of both the Easting and Northing locate
themselves on the map. An example of this, extracted from a live field map, is given in Fig. 1. This shows the 10 m grid overlay with the numbered square boxes indicating the GPS waypoints for the standing quadrat. The linking lines indicate the transect route, with the arrowheads marking the direction of travel. In practical terms, even using a compass and attempting to cross the woodland in East-West bands, may be impossible because of impenetrable vegetation such as Holly *Ilex aquifolium* or Bramble *Rubus fruticosus agg*. This was the case in the examples below, which is why some transects deviate from the intended alignment.

Fig. 1 - a map section of Ecclesall Woods near Sheffield showing the method of field survey. The map is overlaid with a 10 m grid and the numbered cells indicate standing quadrats with the routes of transects indicated by the joining lines between standing quadrats.

Testing of the system was done in Ecclesall Woods, Sheffield. The Friends of Ecclesall Woods in their earlier coverage of ground flora surveys omitted part of this woodland. Hard-surfaced bridleways and footpaths that are broad and well maintained surround this area and these are well used by the public. The area within this ring of footpaths is a designated Bird Sanctuary where public access is discouraged. Towards the northern part, two streams converge before leaving the Bird Sanctuary. Within the study area, there are extensive archaeological remains in the form of charcoal hearths, ‘Q-pits’, early industrial features, various earthworks and evidence of a Romano-British field system. The area was initially surveyed by following the perimeter footpath and then exploring the stream; finally ensuring adequate coverage by routing transects across the main body of the woodland to encompass any variation within the area. This survey adopted all
the described techniques: transect, standing quadrats and point records. Abundance values using the DDAFOR system were also taken, along with parameters such as slope, aspect and records of the degree of shading in the canopy. Photographs and video footage aided interpretation.

**Results**

The basic output of the survey (e.g. Fig. 2) was the production of maps indicating the distribution and abundance of AWIs. The maps can be used, either singly or in combination, to identify areas that the Woodland Trust calls ‘hot spots’. These are areas where there are significant concentrations of AWIs that can become the focus of further study. These are represented visually by indicating presence and abundance as follows:

- **Transects**: indicated with the thickness of the transect line representing the overall abundance of the species (or groups of species) and the depth of colour of the line indicating the degree of local abundance where a darker colour indicates distinct clumping of the species.
- **Standing quadrats**: represented as circles where a larger diameter indicates a greater abundance of the species.
- **Point records**: indicated in a similar fashion to a standing quadrat if there is an abundance value assigned, otherwise they can be indicated by using a different symbol to signify that they are either rare or a single specimen.

Fig. 2. A map showing the results for a survey in part of Ecclesall Woods near Sheffield. This shows the records for a single species – Bluebell – derived from transects and standing quadrats. The thicker the centre line and the larger diameter of the circles correspond with increasing abundance. Numbered squares without encompassing circles indicate absence from the quadrat. An absence of a centre line would also indicate absence from the transect.

An example from Ecclesall Woods is shown in Fig. 2 with the results for a single species assessment, Bluebell *Hyacinthoides non-scripta*. The broad, pale lines indicate the route taken for the transect and the variable width centreline indicates the relative abundance of Bluebell between nodes (where a node is a GPS waypoint location). Nodes are indicated by small numbered squares that also correspond with standing quadrats. Where the node is encircled this indicates that Bluebell was present and the diameter of the circle represents the abundance of that species at
that location. Where there is no circle around the standing quadrat, this indicates that the species was absent. Similarly, where there is no centreline to the transect route indicates that the species was absent along the entire length of that transect section.

A similar map can be drawn to indicate the number of AWIs (or a derived index as discussed below) along transects and within standing quadrats. It is not possible to present the detailed results from the survey here, but selected results are presented and discussed in terms of issues and possible solutions.

The survey results corroborated visual assessment that the majority of this part of Ecclesall Woods was relatively species-poor and devoid of AWIs. The exceptions were the predicted ‘hot spots’ of the stream sides towards the north of the study area, and the valley of the Limb Brook to the south. Both of these areas supported a good range of typical AWIs, including Wood Anemone *Anemone nemorosa*, Wood Sedge *Carex sylvatica*, Opposite-leaved Golden-saxifrage *Chrysosplenium oppositifolium* and Wood Sorrel *Oxalis acetosella*. The main component ground floor species of most of this area of woodland was Bluebell with some Creeping Soft-grass *Holcus mollis*. However, in parts of this section the canopy was dominated by Beech *Fagus sylvatica*, that suppressed, and at times eliminated, the ground-flora component. This is illustrated in Fig. 2 by the number of standing quadrats where Bluebell is absent.

Detailed analysis of the results requires consideration of a number of elements to assist in the interpretation of the data with regard to the historical context of the woodland. The primary consideration is the identification of meso-habitats that form the basis of analysis. Very few woods are completely homogeneous throughout their entire extent. Most sites have small pockets with differences in topography, moisture, pH etc that give rise to either major or minor variations in the vegetation components. This diversity can be the result of natural processes or the intervention of people and the predicted range of species in each meso-habitat differs.

**Discussion**

Part of the process of analysis is the identification of which species can be classified as Ancient Woodland Indicators rather than merely indicators of woodland conditions. Most lists of Ancient Woodland Indicator species contain those that are either shade-evaders (species which complete their season’s growth cycle early and died back soon after the canopy expands), or shade-tolerant species. These lists tend to disregard species that are light demanding. Some lists include light demanding species since these can occur within the survey limits of woodland being studied. This is a valid approach in that woodland, in its broadest sense, will include both the modern perception of closed-canopy high forest and the more open woodland type (proposed by Frans Vera, 2000), more closely resembling wood-pasture. At this open canopy end of the spectrum, the woodland will be expected to contain light demanding species. The presence of either group of species in contemporary woodland can be used to indicate continuity of conditions, both shade and open glade. However, the more classically regarded ancient woodland indicators are shade-evaders and shade-tolerators. The role played by light demanding species in interpretation is part of ongoing research. This paper, only discusses the species found in the shaded component of woodland.

Within the group of typical woodland ground-flora plants there are species that are either exclusively found in, or are preferential to, specific meso-habitats. For instance, Opposite-leaved Golden-saxifrage has a distinct preference for wet and relatively acidic situations. Hence, it is most likely to be located along the internal stream sides or associated with springs within the woodland and is very unlikely to occur on the relatively free-draining soils throughout the wider woodland. Therefore, if the woodland lacks this meso-habitat it will also lack this as an indicator species. This will reduce the number of candidate AWIs for this woodland. Work done by Pieter Bremer (Bremer, 2007) as part of his Ph.D. thesis took account of the presence of meso-habitats within the woodlands he studied. He noted that the distribution of Lady Fern *Athyrium filix-femina* was more frequent along stream sides.
In terms of applying lists to inform planning decisions, the general practice is to set thresholds for the number of AWIs that need to be present in order to assert that the woodland is ancient in origin. This is inherently flawed, since it ignores the internal variations that can significantly elevate or depress the overall species counts. One wood may contain a wide range of meso-habitats and consequently have a high count of species compared with another site with fewer meso-habitats and a lower species count. Both may be of the same age, but one would be designated an ancient woodland based on indicator species, and the other may fall short of some arbitrary threshold. This is the penalty of attempting to arrive at a single figure as the answer. The analysis of data from the WSS uses the same general principle as the same authors use for analysing data from hedgerows. This is referred to as SLAG (Species, Location, Abundance, Grouping) analysis. This approach looks at four elements in order to interpret the significance of the botanical content of woodlands. These are:

- **Species**: what can the species themselves tell us about the historic origins of the woodland and about the overall history of the wooded landscape?
- **Location**: where are individual species located within the wood?
- **Abundance**: how abundant are species within the woodland?
- **Grouping**: how are species dispersed and associated with each other in the wood, or in different parts of the wood?

Where woodland is heterogeneous, each meso-habitat should be evaluated before an overall assessment is done for the entire woodland block. This process should begin by identifying any candidate list of AWIs for the locality. Currently this can be by using the published regional lists or by adapting them to take consideration of the geographical distribution of woodland species based on the *New Atlas of the British & Irish Flora* (Preston et al., 2002). Using candidate species lists is similar to the approach adopted by Coppins & Coppins (2002) with an index generated based on the candidate list of species, rather than an absolute numerical threshold. Thus, if their survey data recorded fifty species out of the candidate list of 100, the index would be fifty percent. In addition, 25 species out of a candidate of 50 species would also have the same index of fifty percent. Generating candidate lists for the woodland as a whole is one of the objectives of the current study. In addition, attempting to generate candidate lists for meso-habitats is also proposed. The eventual aim of the outputs of WSS is to identify and quantify the heterogeneity of the woodland and to use botanical indicators to evaluate each component in terms of the overall historical context of the woodland block.

Accounting for very localised and rare species can also pose problems for interpreting their significance within woodland. Both Francis Rose (1999) and Coppins & Coppins (2002) advocated using such species to augment the species list recorded from the main body of the woodland. Some such species may be so rare that they would trigger immediate elevation of the woodland to being of high conservation status, e.g. species like Lady’s Slipper Orchid *Cypripedium calceolus*. Fundamental to this approach, is being able to provide a robust method of evaluation to compare woodlands of different character but of similar ages. This should provide confident predictions applied to planning issues, and used by surveyors and organisations to prioritise actions and identify ‘hot spots’.

In terms of SLAG analysis, it is important to consider the significance of the AWIs recorded, where they were located, and how abundant they are in those locations. The presence of groups of AWIs in hot spots provides vital information to identify critical areas. It is hoped that this paper stimulates discussion and directs research to enable vascular plant species lists to be applied to situations requiring a robust evaluation of the historic status of woodlands.

**Acknowledgements**

The authors thank the Friends of Ecclesall Woods for their contributions, in particular Monica Rorison and Linda Evans. We are grateful for financial and general support of ADAS UK Ltd.
References


