A NATIONAL SURVEY OF NATIVE WOODLAND IN IRELAND: USING THE 2003 DATA TO EVALUATE THE CONSERVATION STATUS OF SITES

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Abstract

This study calculated that there are 87,298 ha of putative native woodland in the State in stands of 1 ha or more. A field survey of 312 sites in the south-east of Ireland found that the majority of sites were < 10 ha and pedunculate oak-ash-hazel woodland was the most frequently recorded native woodland type (24% of surveyed sites). The two most frequently occurring non-native species were sycamore and beech. An approach was put forward for separately evaluating the conservation status and the threat level of the surveyed woods. The conservation score was based on species richness, area, diversity of structure and habitats, nativeness, natural regeneration, dead wood and the presence of features and species of interest. The threat score was based on the abundance of exotic and invasive species, sub-optimal grazing regimes and damaging activities.

Introduction

The potential vegetation for much of Ireland is woodland (Cross, 1998). However, millennia of human activity and climate change have dramatically reduced native woodland cover and that which remains is limited in extent, scattered in distribution and much modified. Today, Ireland is one of the least wooded countries in Europe, with only about 9% of the State now covered with trees (Gallagher *et al.,* 2001). Woodland cover was estimated at less than 1% of the total land area at the start of the 20th century (Neeson, 1991), and the recent figure reflects an active State policy of afforestation since that time. The majority of Irish woodland today comprises commercial plantations of exotic species.

The need for a national inventory of native woodland has been recognised in the National Biodiversity Plan (Anon., 2002). The present study aims to make the important initial steps in this process, identifying all potentially native woodland sites in the country and beginning the field survey process. The dataset for the completed phases of the national survey of native woodland have been published (van der Sleesen & Poole, 2002; Higgins *et al*., 2004). This paper aims to set out the rationale for how the data can be used to evaluate the conservation status of sites and on which future management decisions and monitoring regimes can be based.

Ratcliffe (1977), in his nature conservation review, highlighted the factors that affect the conservation value of a site and these have been widely applied to habitat conservation (Cross, 1992; Spencer & Kirby, 1992; Kirby, 1988; Lockhart *et al*., 1993; Woodland Trust, 2002; Kirby *et al.,* 2002; Neville, 2002; van der Sleesen & Poole, 2002). Key native woodland attributes that affect the conservation value of a site include naturalness (e.g. species composition), woodland age, woodland size and the management regime for the site.

Some of Ireland's woodlands are closer to their potential natural state than others and usually these woodlands have a high conservation value. Naturalness is an important factor, and applies both to the species composition and structure of a wood. Woodland age is often highly valued with a large number of specialist species, particularly invertebrates and lichens, found exclusively in old woodlands (Woodland Trust, 2002). Old woodland sites also often contain features that have resulted from past management, for example large

coppice stools, banks and ditches, and these may add to the structural and species diversity of the site. Such historical features are also often of interest in their own right (Rackham, 1990).

Larger woodland sites usually have a higher conservation value than smaller sites as they contain a greater core area (Laurence, 1991) in which true woodland conditions prevail and also because they usually contain higher levels of biodiversity (Woodland Trust, 2002). Many woods are completely surrounded by intensively managed farmland. This can restrict the movement of species and gene flow between sites; it also restricts the potential of a woodland site to expand. Thus, the proximity of other semi-natural habitats, for example semi-natural grassland to woodland sites increases its conservation potential.

One third of the vascular plant species present in Ireland are naturalised introductions (Webb, 1983). Most of these species are relatively benign but a few are invasive and can out-compete native species, resulting in the degradation of semi-natural habitats. Of these species cherry laurel (*Prunus laurocerasus*[*]), rhododendron *(Rhododendron ponticum),* sycamore (*Acer pseudoplatanus)* and beech (*Fagus sylvatica)* are among the more widespread exotics and have achieved local dominance in many places. The negative effects of rhododendron in native acid oakwoods and on heath are well documented and many native woods, especially in areas with acidic soils, are badly affected (Neff, 1974; Cross, 1982; Hayes *et al*., 1991; Barron, 2000).

Grazing and browsing are a natural part of the woodland ecosystem (Putman, 1994; Vera, 2000). However, the continued expansion of introduced grazing species, particularly *Cervus nippon* Temminck (sika deer) and the intense grazing of woodlands by domestic stock, chiefly cattle and sheep, has severely reduced the field layer in many Irish woods and limited the success of natural regeneration (Hester *et al*., 1998; Higgins *et al*., 2001).

Native woodland is also threatened by the underplanting of broadleaved stands with exotic species, mainly conifers. Although this was practiced widely in the past, it is no longer common, and at some sites conifers and broadleaved exotics are being removed to promote a more native habitat. In recent years there has been growing recognition of the need to preserve the genetic integrity of native species (Martin *et al.,* 1999) and projects such as the Native Woodland Scheme and the People's Millennium Forests have placed emphasis on using not only Irish seed, but on sourcing it as locally as possible.

When devising a protocol that evaluates the conservation status of sites, all the key attributes of semi-natural woodland sites discussed above must be considered. Importantly the data must then be recorded and scored using standard reproducible methodologies.

Mapping of native woodlands

Methods

One of the primary aims of this project was to identify and demarcate every block of putative native woodland in the country ≥ 1 ha and wider than 40 m (with the exception of riparian woodland where the width was reduced to 20 m). The Forest Inventory and Planning System (FIPS) was used as the primary data source for identifying and mapping native woodland. FIPS is a GIS platform produced by the Forest Service that uses a combination of 1993-1997 satellite imagery and 1995 panchromatic orthophotos to digitally map the majority of woodland in the State. The FIPS dataset was modified following the methods listed in Higgins *et al.* (2004) to produce a national map of putative native woodland.

Results

From the modified FIPS dataset it was calculated that there were 77,047 ha of putative native woodland in Ireland. A study of 2000 aerial photographs estimated that approximately 10,251 ha of native woodland were missing from FIPS, mostly due to the recent development of significant areas of scrub woodland. Therefore the total figure for native woodland in Ireland was corrected to 87,298 ha.

[*] Nomeclature for vascular plants follows Preston *et al*. (2002)

Field survey of native woodlands

Methods

325 sites in the counties of Carlow, Kilkenny, Laois, Wexford and Offaly were selected for field survey using the modified FIPS dataset. Only the western part of Co. Offaly was surveyed as eastern Offaly had been surveyed as a pilot study during 2001 (van der Sleesen & Poole, 2002). Field work was conducted between April 8th and 3rd October 2003. Of the 325 sites selected, 312 were visited, 214 were assigned a habitat type, 204 were selected for a full field survey and 248 relevés were recorded. To ensure that a broad range of woodland types was selected, criteria such as woodland size, woodland age, geographical position, conservation designation and ownership were considered. Certain geographical areas within the relevant counties were found to have a low density of woodland sites according to FIPS and so aerial photographs were used to identify any further possible areas of native woodland in these areas.

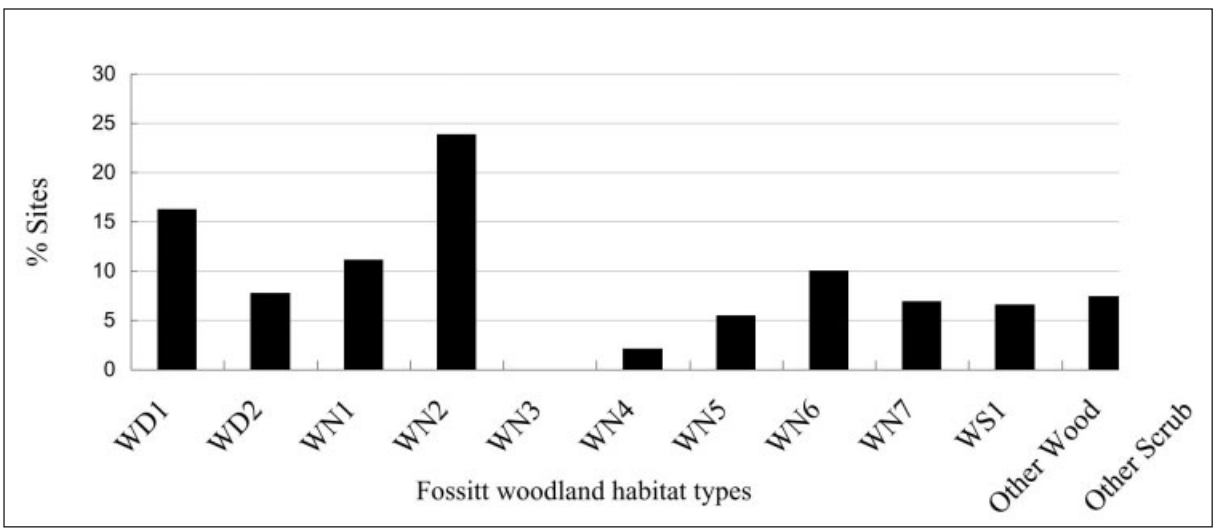
The field survey methods were divided into three sections. Firstly, the description and general survey of a site was undertaken, including features such as site area, topographical position, hydrological features and vegetation types using Fossitt (2000). Secondly, relevés were taken for each woodland vegetation community within a site. Within each 10 x 10 m relevé, plant species cover was recorded using the Domin scale. A soil sample was also collected and pH, loss on ignition and total phosphate were measured in the laboratory. Thirdly, to obtain structural data, the size, abundance and quality of the trees were measured. The plot size was increased until *c.* 40 trees had been recorded in order to ensure the assessment of large trees (dbh > 7cm) (Higgins *et al.,* 2004).

Results

Almost 80% of native woodland parcels identified from FIPS were less than 5 ha in extent. Due to their scarcity, larger woodlands were prioritised during the field survey. Nonetheless, sites less than 5 ha still comprised 40% of surveyed woods and only 3% of sites surveyed were > 50 ha.

Pedunculate oak-ash-hazel woodland, category WN2 (Fossitt 2000), was the most frequently recorded habitat type, and was identified at 24% of the surveyed sites (Fig. 1). Highly modified woodlands (WD1 and WD2) were abundant; they usually consisted of WN1 (sessile oak-holly-birch) or WN2 type vegetation that had high components of non-native species, particularly beech and sycamore, in the canopy. Yew woodland (WN3) was the only category of native woodland that was not recorded during the field survey. Wet woodland types were less frequent than woodland over drier soils, with wet pedunculate oak-ash woodland (WN4), recorded at only 2% of sites, being the rarest.

Fig. 1: *Occurrence of woodland habitat types (Fossitt 2000) in sites surveyed (n = 214).*



Definition of Fossitt (2000) categories used: WD1 (mixed) broadleaved woodland, WD2 mixed broadleaved/conifer woodland, WN1 oak-birch-holly woodland, WN2 oak-ash-hazel woodland, WN3 yew woodland, WN4 wet pedunculate oak-ash woodland, WN5 riparian woodland, WN6 wet willow-alder-ash woodland, WN7 bog woodland, WS1 scrub, other wood includes WD3 (mixed conifer woodland) and WD4 (conifer plantation), other scrub includes WS2 (immature woodland) and WS5 (recently-felled woodland).

All woodland included in this survey contained a higher number of native species than non-native. Nine sites (out of 204 where a relevé was recorded) were composed entirely of native species and in total 197 of these had a flora that was 80-100% native. No site contained fewer than 69% native species. Sycamore and beech were the two most frequently occurring non-native species recorded in the survey and were recorded at 162 and 154 sites respectively (Table 1).

Table 1. *The thirteen most abundant tree species in the survey area, represented by the number of stems and the basal area.*

Tree species	No. of stems	% of all stems	Basal area (m^2)	% of basal area
Fraxinus excelsior	2031	19.37	49.61	15.50
Betula pubescens	1591	15.18	28.59	8.93
Corylus avellana	1370	13.07	10.42	3.26
Quercus robur	992	9.46	80.36	25.10
Alnus glutinosa	843	8.04	22.18	6.93
Salix cinerea	780	7.44	11.12	3.48
Fagus sylvatica	576	5.49	31.15	9.73
Crataegus monogyna	490	4.67	5.27	1.65
Ilex aquifolium	385	3.67	3.82	1.19
Quercus petraea	338	3.22	25.78	8.05
Q. petraea x Q. robur	293	2.80	18.59	5.81
Acer pseudoplatanus	204	1.95	9.95	3.11
Sorbus aucuparia	182	1.74	2.86	0.89
Other	408	3.89	20.39	6.37
Total	**10,483**		**320.08**	

Ash (*Fraxinus excelsior*) was the most frequent species in terms of number of stems, comprising 19.4 % of all measured stems, but pedunculate oak (*Quercus robur*) contributed the highest proportion of total basal area at 25.1%. Table 1 also demonstrates how frequent *A. pseudoplatanus* and *F. sylvatica* were in the canopy.

Evaluating the Conservation Status of surveyed woods

Methods

To retain compatibility between the conservation scores calculated during this phase of the survey and those calculated during the pilot study (van der Sleesen & Poole, 2002) the actual scoring system used for each group of data was based on the pilot study wherever possible.

Of the data types collected during 2003, four of the most important indicators of the naturalness of a woodland were native species diversity (including the presence of notable or rare species), natural regeneration potential, heterogeneity of structure and the presence of dead wood (Ratcliffe, 1977; Neville, 2002). In addition other data were recorded that could be used to assess the conservation status of a site. The most important were area, woodland age, diversity of woodland and other semi-natural habitat types, the presence of hydrological and other

landscape features, features of interest such as the presence of old coppice stools, and the proximity of other semi-natural habitats.

These key elements of the woodland data were used to produce 15 categories of data (sub-scores) that contributed to an overall conservation score for each surveyed site (Table 2). While the overall conservation score of a site was useful for making comparisons between sites, examination of the values for the different categories provided a clearer insight into the particular issues that affected each site.

As criteria 1-6 in Table 2 directly represent naturalness, they were allocated some of the highest scores. Criteria 7-15 contain data that can enhance the naturalness or development of a wood. In order to ensure that these criteria would not contribute more to the final conservation score than the naturalness criteria 1-6, the weighting of each was generally expressed as 1 or 0. However, two sub-scores were more heavily weighted; area, with scores of 1-6, and the number of native habitats in a wood, with scores of 1-4. Area scores above 3 were reserved for the 12.5% of field sites that had an area greater than 20 ha. A score greater than two for the number of semi-natural habitats was reserved for the 14% of field sites that had more than two habitat types.

Table 2. *Data used to assess the conservation value of each site.*

Data	Calculation of score	Max
Naturalness/Development categories		
1. No. of native vascular plants	1=<40 species, 2=40-59 spp., 3=60-80 spp., 4=>80 spp.	4
2. No. of bryophyte species	1=<5 species, 2=5-10 species, 3=>10 species	3
3. No. notable lichen species	0=0 species, 1=1-3 species, 2=4-5 species, 3=>5 species	3
4. Regeneration of tree species[1]	0=0, 1=1-4 saplings, 2=5-10 saplings, 3=>10 saplings	3
5. Horizontal diversity[2]	1=σ of <10 cm, 2=σ of 10-20 cm, 3=σ >20 cm	3
6. Notable species[3]	0=0 species, 1=1 species, 2=2 species, 3=≥3 species	3
Contributing categories		
7. Area (ha)	1=<5, 2=5-9.9, 3=10-19.9, 4=20-49.9, 5=50-99.9,6=≥100	6
8. Native habitat types[4]	1= 1 habitat, 2=2 habitats, 3=3 habitats, 4=>4 habitats	4
9. Presence in the 1840s	0=woodland not mapped, 1=woodland mapped	1
10. Adjacent semi-natural habitats	0=no adjacent semi-natural habitats 1=≥1 adjacent semi-natural habitats	1
11. Natural hydrological features	0=none 1=≥1 of the hydrological features listed in the methods	1
12. Standing dead/damaged wood	0=none of the dead wood categories recorded at a level of frequent or higher 1=one of the dead wood categories recorded at a level of frequent or higher	1
13. Woody debris	0=none of the woody debris categories recorded at a level of frequent or higher 1=one of the woody debris categories recorded at a level of frequent or higher	1
14. Coppiced/pollard	0=none, 1=coppice or pollard recorded	1
15. Man made features	0=none 1=ditches, walls, ruins, exclosures, lazy-beds or other notable feature	1
Maximum Score		**36**

[1]Regeneration of tree species refers to the total number of saplings (> 2m) recorded in each relevé – when two or more relevés were recorded at a site the highest value was used. [2]Horizontal diversity as described above is the standard deviation (σ) of tree diameter (dbh) for each site; when two relevés or more were recorded the highest value was used. [3]Noteable vascular plant species are listed in Higgins et al. (2004). [4]All native habitats listed in Fossitt (2000) could contribute to the number of native habitats, as long as the area the habitat covered represented at least 5% of the woodland. The majority of recorded habitat types were woodland.

As stated above, a conservation score can be a useful tool when monitoring native woodland sites, but it can also be used to rank sites which have been surveyed in a similar manner. However, the ranking is based only on the conservation importance of the site as native woodland and does not take account of individual species, such as protected mammals or birds, for which a native woodland site may be an important habitat.

Certain factors can detract from the conservation status of a site and these must also be evaluated. The five factors that present the greatest threat to the natural status of a woodland site are the presence of invasive shrub species, sub-optimal grazing pressure, a high proportion of non-native species in the canopy, a high proportion of non-native species in the flora, and damaging activities such as dumping, felling of natives etc (Table 3). The lowest threat score for grazing was allotted to sites with a low to moderate level of grazing, as plant species diversity has been shown to be higher under these grazing levels (Kelly, 2000; Higgins *et al*., 2004).

Table 3. *The five factors used to assess the threat level to native woodland. The maximum score is 13 and the minimum is 0.*

Threat Category	Calculation of Sub-score	Max.
Invasive shrub species	0=none recorded, 1=low level invasiveness, 2=high level invasiveness	2
Grazing	0=low/moderate grazing, 1=no grazing, 2=high grazing, 3=severe grazing	3
Non-native canopy	0= low cover value for non-native species recorded in the canopy 1=a non-native species recorded in the canopy as abundant or dominant	1
Damaging activities	0=no damaging activities, 1=1 damaging activity, 2=2 damaging activities, 3=≥3 damaging activities	3
% of non-native species	0=0%, 1=1-5%, 2=6-10%, 3=11-20%, 4=≥20%	4
Maximum Score		13

Results

The three sites from this survey that had the highest conservation value using the evaluation system described above are listed in Table 4.

Table 4. *The three sites from the 2003 study with the highest conservation scores*. The maximum possible score is 36.*

County	Site Name	Score	Rank
Carlow	Borris	27	1
Wexford	Killoughrum Forest	26	2
Offaly	Cushcallow	24	3

**It should be noted that two of the most important native woodland sites in the survey area, Abbeyleix and Charleville were not assessed in this survey because both woodlands have been studied extensively in recent times (Kelly & Fuller 1988; van der Sleesen & Poole 2002).*

When the conservation score is viewed in the context of the threat score, more informative comparisons can be made. For example the top ranking site in terms of conservation score is Borris in Co. Carlow, but this site also had the second highest threat score of 9 due to the high level of invasive shrub species, the high percentage of non-native vascular plants and the high number of damaging activities.

Discussion

Mapping

The figure of 87,298 ha of native woodland, calculated from the modified FIPS dataset, only includes sites $\geq$ 1 ha so there is a difficulty in making comparisons with previous estimates for native woodland cover in Ireland. However, the figure agrees well with a recent estimate by O'Sullivan (1999) of no more than 100,000 ha of broadleaved woodland (which will include exotic broadleaved species) and is close to the figure of 84,000 ha given by Cross (1987). Until a more complete field survey of the country has been carried out it will be difficult to provide an accurate figure for the area of native woodland in Ireland.

Field Survey

As this field survey was restricted to one geographical region of the country, most conclusions are only pertinent to woodland in this region and only limited statements can be made regarding the national native woodland resource. Nonetheless, important information about the woodland of this region has been gathered.

In the survey area, as was the case nationally, the majority of sites were small (< 10 ha) and very few sites exceeded 100 ha. The most significant woodland type encountered, both in terms of frequency and abundance, was oak-ash-hazel woodland (WN2): this result is not surprising given the predominantly calcareous bedrock and brown earth soils in the region. It differs from the perceived notion, however that acid oak woodland (WN1) is the most abundant native woodland type that remains in Ireland (Neff, 1974; Poole *et al.,* 2003). As the native woodland survey is extended, a more accurate assessment of the extent and distribution of the different woodland types will evolve.

The high number of sites assigned to mixed broadleaved woodland (WD1) is a direct result of the widespread abundance of the two exotic species beech and sycamore in the canopies of the woodlands surveyed. The impact of these species has been noted by previous authors (Dierschke, 1982; Quinn, 1994) and Higgins *et al*., (2004) demonstrated that they have a negative impact on the native flora.

This survey has attempted to identify the main factors pertinent to native woodland conservation and to summarise these by way of a scoring system that can be used to assess and monitor the status of a site. However, such a system comes with provisos; sites must be judged on their overall merit, and the application of a single number to a site could prove to be misleading if used inappropriately. To avoid this, the sub-scores for each of the factors that were considered to be of merit were retained. This means that the overall status of a site can be easily assessed but, more importantly, the factors that contribute to that status are also clearly understood. When assessing a woodland site, the criteria indicating how valuable, in conservation terms, a site is have been separated from those that reduce this value and it is important that they are examined in the context of each other.

Conclusion

This first phase of the National Native Woodland Survey has brought together a range of datasets, both GIS and non-GIS based, that provide information on the many native woodland sites throughout the country.

The field survey of woodland in the south-east of Ireland has resulted in a network of 204 surveyed sites that have helped to define and increase the understanding of the woodland resource in this previously little studied region. In addition to supplying baseline data, the survey has highlighted management issues, in particular that of invasive species. The impact of non-native canopy species, most importantly beech and sycamore, will require careful consideration when planning the future conservation management of native Irish woodland.

An assessment and monitoring scheme has been proposed that should be adopted for the remainder of the native woodland project. On completion of the survey a network of studied sites representing the heterogeneity of native woodland types in the country will be available as a conservation and research resource.

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