Session 4

Restoration and Creation of Field Margins

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HEDGE PLANTING: THE IMPLICATIONS OF USING ALIEN RATHER THAN NATIVE GENOTYPES

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ABSTRACT

Recent years have seen the widespread planting of hedges in Britain using alien (non-native) forms of hawthorn (*Crataegus monogyna*) and other species, especially from eastern Europe. There is evidence that alien forms may show poorer performance as hedging material than native ones probably because of poor adaptation to our climate. The planting of alien material does not follow the principles of the conservation of biodiversity. The implications of this need to be considered in terms of the genetic integrity of our native vegetation.

INTRODUCTION

Hedges are a quintessential feature of the British countryside, providing a network of woodland-edge type habitat for fauna and flora and delineating a landscape consisting of a pleasing patchwork of fields. It is well established that hedge-removal and decline has occurred on a large scale in post-war years. In areas where arable farming has increased, hedges have become redundant as a barrier and loss has mainly been through removal in order to increase field size for ease of soil cultivation with modern machinery. In pasture areas many hedges have become overgrown and eventually derelict with farmers having increasing reliance on fencing for stock proofing. Unfortunately hedge loss is still continuing with a sixth of our remaining hedges having disappeared between 1984 and 1990 (Barr *et al.*, 1990).

In recent years, there has been some replanting of hedges (Barr *et al.*, 1984) aided by grants from statutory bodies, e.g. Countryside Commission in England and the Countryside Council for Wales. Major planting of new hedges has also taken place along sections of newly engineered road and motorway (Dunball, 1982).

This paper addresses the problem of hedges being planted using material of non-native provenance and the consequences of this for both hedge establishment and the conservation of biodiversity in the British countryside. It also considers some guidelines for use in obtaining hedge planting material of native provenance.

PROVENANCES

There is substantial evidence to suggest that much of the material of a range of species that is planted in British hedges, both now (catalogues of the horticultural industry) and in the past two decades (Dunball, 1982) is of alien (non-native) provenance. Much of it appears to originate from eastern Europe where labour costs for the gathering of seed are low. For example, hawthorn (*Crataegus monogyna*) the most commonly planted species is often grown by British plant nurseries from imported Hungarian seed.

Implications of using non-native provenances

Though seed of alien material is often much cheaper, resulting in lower production costs for hedging plants, this advantage must be weighed up against the following implications.

Performance

The performance of newly planted hedges, encompassing their survival and persistence, growth, morphology, reproductive rate and disease resistance, may be poorer in alien than in native material. Jones and Evans (in press) found significant differences in growth rates, morphology and disease resistance between native-Welsh and Hungarian hawthorn, when planted together at an upland site in Dyfed, mid-Wales. Native material (Table 1) grew faster, had a more appropriate morphology, including greater bushiness and thorniness, and was less prone to hawthorn mildew, than the alien material.

Further work is needed to compare British hawthorn populations from other areas both with each other and with continental European hawthorn with respect to growth, morphology and disease resistance.

Continental material can often be identified, especially along new roads and motorways, by its early bud-burst which often occurs in February. It is also of note that newly planted hawthorn of continental provenance has been seen to develop extreme infestations of mildew in contrast to unaffected, native hawthorn nearby at low elevations in the West Midlands, England (pers. obs.) .

TABLE 1. A comparison of the growth, morphology and disease resistance of 2 year old native and Hungarian hawthorn (from Jones and Evans, in press).

	native (n = 129)		Hungarian (n = 63)	
	mean	s.d.	mean	s.d.
height (cm)	107.0	37.5	79.3	34.0
total stem (cm) length	235.0	134.7	129.0	84.0
branch number	3.1	1.7	1.8	1.4
thorns per plant	10.6	13.1	0.6	0.5
Mildew score	1.5	0.8	2.0	1.1

Mildew score: 1 = no disease and 4 = stems badly infected.
Anova, $P < 0.001$ for all variables.

Gene conservation

Virtually all species have some degree of variation within and between populations. It is important to conserve this variation and the most efficient way is *in situ* conservation, i.e. by planting material within its native range in those conditions where such variation evolved. It is desirable for hedge planting purposes that propagules of hedging species are collected from the nearest source populations to a planting site. This will increase the probability that genetic variation (including unique alleles and allele combinations) that may be related to adaptation to the local soils and climate is conserved.

Introgression within and between species

There is a high risk that introduced alien subspecies or ecotypes of a particular species will hybridise with conspecific natives, causing the formation of intraspecific but inter- subspecies or inter-ecotype hybrid swarms (Bonnemaison and Jones 1986). It is also possible that closely related species may be introduced with which hybridisation can take place. This can be seen as a form of genetic contamination of native populations.

Although hybrid material may be 'selected out' because of poor adaptation and consequently lower fitness, the time required for this to take place could be very great in the case of tree and shrub species. Selection pressures arising from plant competition may also not be great because of the disturbed and open nature of modern, intensively-managed agricultural environments.

Introduction of new species

There is the risk that seed obtained from the continent may be contaminated by alien species, especially by any which are closely related and morphologically similar to the target species.

Taxonomic confusion may increase the risk that alien species are inadvertently imported and planted. The taxonomy of *C. monogyna*, for example, has not been fully resolved. Tutin *et al.* (1969-1983) recognised six sub species of *C. monogyna* and 22 species within the *Crataegus* genus in Europe. At least four of these commonly hybridise with *C. monogyna* and are very similar in terms of their morphology. Recently, it has been suggested that some of the species are more likely to be hybrids (Holub, 1993).

In Czechoslovakia and Hungary where much seed is gathered, five very similar species and their hybrids are found. It would appear that there is a high risk of other *Crataegus* species being gathered along with *C. monogyna*. Such risks would not occur in collecting material from properly identified stands in Britain, where in many areas only *C. monogyna* is found.

Ethical arguments

Planting hedges of alien material, does not conserve local biodiversity and is it hardly in line with the treaty for maintaining biological diversity which Britain signed in Rio de Janeiro in 1992. Such habitats are of lower value in terms of their relevance to and association with other biota in the countryside and because of this they will be valued less in the future should they be identified as such and become threatened.

DISCUSSION

The British Isles has probably more exotic species planted for its area than anywhere else in the world and yet few of these species have 'escaped' from gardens and parks. Natural and semi-natural communities are still largely formed of native species and locally native populations of these species.

We should value the genetic integrity of our wild habitats and ensure that where trees or shrubs need to be replaced that we make use of propagules gathered from the most local populations or where possible rely on natural regeneration.

It may be impractical in every case of hedge-planting to obtain material of very local provenance, but at the very least it is conceivable that in Britain six hawthorn provenances could be made available by nurserymen for hedge-planting, representing an upland and lowland form in each of England, Scotland and Wales.

Guidelines for hedge and amenity plantings

Although the statutory organizations which provide hedging grants require that native material be planted for the provision of hedging grants, this needs to be more rigidly defined and enforced. The following guidelines should to be followed to ensure that native material is planted.

1. Managers of hedge planting programmes should specifically ask plant nurseries for native material and if possible material grown up from locally collected seed. Besides ensuring that the appropriate provenance is planted, this would ensure that sufficient demand for native material is created.

2. Conservation organisations should if possible establish shrub and tree nurseries using locally collected seed or cuttings.

3. Eventually, codes of conduct and even legislation for the genetic conservation of habitats should be formulated and introduced by the government funded conservation organisations. At the moment the only standards with regard to the provenance of material are those maintained by the horticultural industry.

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THE DEVELOPMENT AND TESTING OF HEGS, A METHODOLOGY FOR THE EVALUATION AND GRADING OF HEDGEROWS

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ABSTRACT

The development and testing of a system for the evaluation and grading of hedges (HEGS) is described. A flow–chart grading system was originally favoured over a simple additive system following a study of the literature, and desk–based experimentation. Field testing suggests that the flow–chart method does have advantages, but further testing is required before it is known whether ecologists agree sufficiently on hedgerow evaluation to make this method widely acceptable. A brief analysis of completed survey forms is provided, giving sample distributions of scores for 4 groups of hedgerow features. An alternative and less prescriptive approach to hedgerow evaluation is also discussed. Such an approach may be preferable if there is a significant element of disagreement on hedgerow evaluation amongst ecologists.

INTRODUCTION

A draft methodology for the evaluation and grading of hedges (Hedgerow Evaluation and Grading System (HEGS)) has been produced (Clements and Tofts, 1992). In the present paper we describe developments on this project and outline some areas which need future research.

Initial experimentation and a survey of the literature (e.g. Margules, 1986) suggested that a simple additive scoring system did not possess the flexibility to enable evaluation of hedges in a way which satisfactorily reflected subjective judgement. From both published sources and discussion, the view was formed that surveyors evaluate different aspects of a habitat before arriving at an overall judgement (e.g. Ratcliffe, 1977). As a consequence, a different and more versatile method of scoring was developed, using a flow–chart. At one extreme, a flow–chart may produce identical results to an additive scheme, whilst at the other extreme it may invert some of the grades that would have been awarded by simple additive methods, depending on the design adopted. The flow–chart adopted in the test draft of HEGS was of this latter kind, and was based on the judgement of the authors. Due to the possible implementation of the Hedgerow Protection Bill around the time when the draft version of HEGS was produced, it was considered preferable to publish the document at the earliest opportunity, and then to continue testing the methodology at the same time as receiving comments from other ecologists.

In order to grade a hedge using HEGS, a field record card is completed. This allows the surveyor to record 12 hedgerow features (such as hedgerow height) in a categorical fashion, using up to five classes to which scores are attached according to their perceived wildlife value. Class limits were initially determined by pragmatic reasons (e.g. width classified in units of 1 metre), although an attempt was made to ensure that each of the classes would be encountered with moderate frequency in the field. The 12 hedgerow features are divided into four groups (structure, connectivity, diversity and associated features) and a total score for each group is derived.

At the time of writing, approximately 500 hedgerows have been surveyed using the HEGS methodology, with valuable data being supplied by surveyors from as far afield as Cornwall, Ireland and the Scottish Borders. A summary of these data is given below, following an analysis of the HEGS grading methodology.

ANALYSIS OF GRADING SYSTEM

Comparison of flow-chart and subjective grading system

During the ecological survey of a number of sites, we have collected information on hedgerow characteristics and have graded the hedgerows subjectively on a 12 point scale running from 1+ (highest value) to 4– (lowest value). Using the data obtained, it was also possible to grade the hedgerows using the HEGS methodology which likewise employs a 12 point scale. In total, 87 hedgerows were surveyed and then graded using the two techniques. A comparison of the results derived by the two grading methods is given in Figure 1.

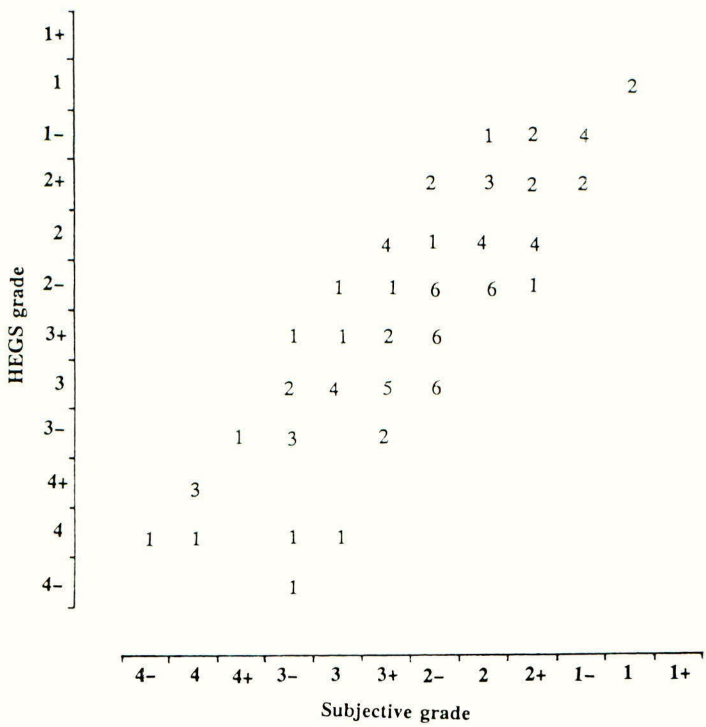

FIGURE 1. Comparison of HEGS grades and subjective grades. The numbers represent the number of observations of each kind.

Overall, the level of agreement is relatively good (using Spearman's rank correlation coefficient and allowing for tied values, r_s=0.83, P<0.005), although the number of 'mis-classifications' suggests that the present flow chart is not sufficiently sophisticated to assign grades reliably to a 12 point system. In the present example, 28 hedges were correctly classified, 24 were given higher grades than considered appropriate whilst the remaining 35 were under-graded. Analysis of these data using the sign test does not suggest that the flow-chart produces unduly biased grades in comparison with the estimated grades (P>0.10), however, and in all but two cases the hedges were graded to within two points of their subjective grade.

<u>Comparison with additive scoring methods</u>

Although designed for use with the flow-chart grading system, completed HEGS forms may be used to obtain one overall additive score for each hedge by ignoring the four subdivisions of structure, connectivity, diversity and associated features, and simply producing a total score. This procedure was followed for the 87 hedges analysed above, giving a range of total scores from 11 to 35. These scores were partitioned in various ways, in an attempt to produce a 12 point grading system which had the highest positive correlation with the subjective grades (details not presented). The 'best fit' that could be obtained (r_s=0.79, at P<0.005) was found to have a slightly lower correlation with the subjective grades than did the HEGS grades. It is instructive to note that in this case the additive system is being fitted retrospectively, whilst the flow-chart system was being used in a predictive fashion. In this respect, the comparison is biased towards favouring the additive system, and it is therefore of interest that the flow-chart method appears to be slightly superior.

For any ecological grading system to gain widespread acceptance, it is vital that it should produce results which are regarded as reasonable by the majority of people likely to use it. Useful information on acceptability may be obtained by running experiments involving field testing, and also by methods such as sending out questionnaires requesting the views of users. The former method has the advantage of greater statistical rigour, but is only practical for a restricted sample size, since field meetings can be difficult to arrange and are only likely to attract volunteers from a relatively small area. The latter approach can involve a much larger sample, but the results may be more open to interpretation. Due to their different strengths and weaknesses, it was decided to adopt both approaches in the testing of HEGS. It is hoped to organise a formal experiment during 1994, and a questionnaire survey is currently underway.

Most of the feedback received so far is eith from questionnaire respondents, or others who have expressed their views in general conversation or letter. Most respondents have indicated that HEGS gives reasonable results, or would do so with slight modifications, although a full analysis awaits further questionnaire returns. A few respondents have, however, indicated that their judgement is substantially at variance with HEGS in at least some cases.

A study by a student at Southampton University (C. Walker, 1993) compared HEGS with a grading system of her own devising. On a sample of 20 hedges, the correlation between grades produced by the two systems was found to be positive but relatively weak (r_s=0.47, 0.025>P>0.01).

Discussion

The present evidence indicates that the flow-chart grading system does assign grades which we feel to be reasonable, based upon our knowledge of hedgerow ecology. The decision to adopt a flow-chart grading system rather than a simple additive system also appears to have been appropriate, given the results of the comparative study of the two methods. What is less certain, however, is the general applicability of HEGS, and further field testing by a range of ecologists is required. The comments we have received from other HEGS users have, however, been generally very encouraging, and further development of the system certainly seems worthwhile.

It remains possible, however, that there is insufficient agreement between ecologists to make HEGS (or any other method which produces grades along a single scale) widely acceptable. The implications of this are discussed in our concluding section.

ALTERNATIVE APPROACHES TO HEDGEROW GRADING

Figure 2 shows the sample distributions for 454 hedgerows (the number of fully completed forms received) with respect to scores for the four groups of hedgerow features.

The results obtained so far suggest that a flow-chart grading system does have a flexibility which is lacking in simple additive schemes, and it may be used to 'model' the subjective response of an individual, or perhaps a limited number of surveyors. What is not known is the extent to which practising ecologists agree or disagree about assigning values to hedges. A widespread lack of agreement would mean that approaches such as HEGS would lack general approval. We hope to investigate this problem through further field work, but are also researching alternative approaches to hedgerow grading. One of these is outlined below.

HEGS identifies certain hedgerow features (eg dense growth, high species diversity) as being generally of high wildlife value, and produces a score for each of four groups of features. There does appear to be general agreement that this approach is satisfactory. If, however, there is widespread disagreement about how a single overall grade is subsequently to be produced from these separate scores, a more modest method which simply places hedges into a context (e.g. national or county) may be preferable to one which attempts to model the response of ecologists.

In the present case, one might argue that for any particular group of features, a hedge which is better than 'average' has some conservation merit, and a hedge which is better than average in several respects is generally more worthy of conservation than one which is better in one respect alone. Using the data shown in Figure 2, it is possible to assign (provisional) median values for each of the 4 categories of features currently recognised by HEGS. It is therefore possible to assign grade A, for example, to a hedge which is better than average in all 4 groups of features, and to continue the grading down to grade E hedges which are not better than average in any features (this approach can be made more sophisticated to reflect greater and lesser departures from the median value). Each grade would then have a clearly defined meaning, and would act as a general indicator of value to inform the judgement of the evaluator. Detailed value judgements may then be made on a less 'mechanistic' basis, by considering data for other hedges in the vicinity (if such data are available). A better than

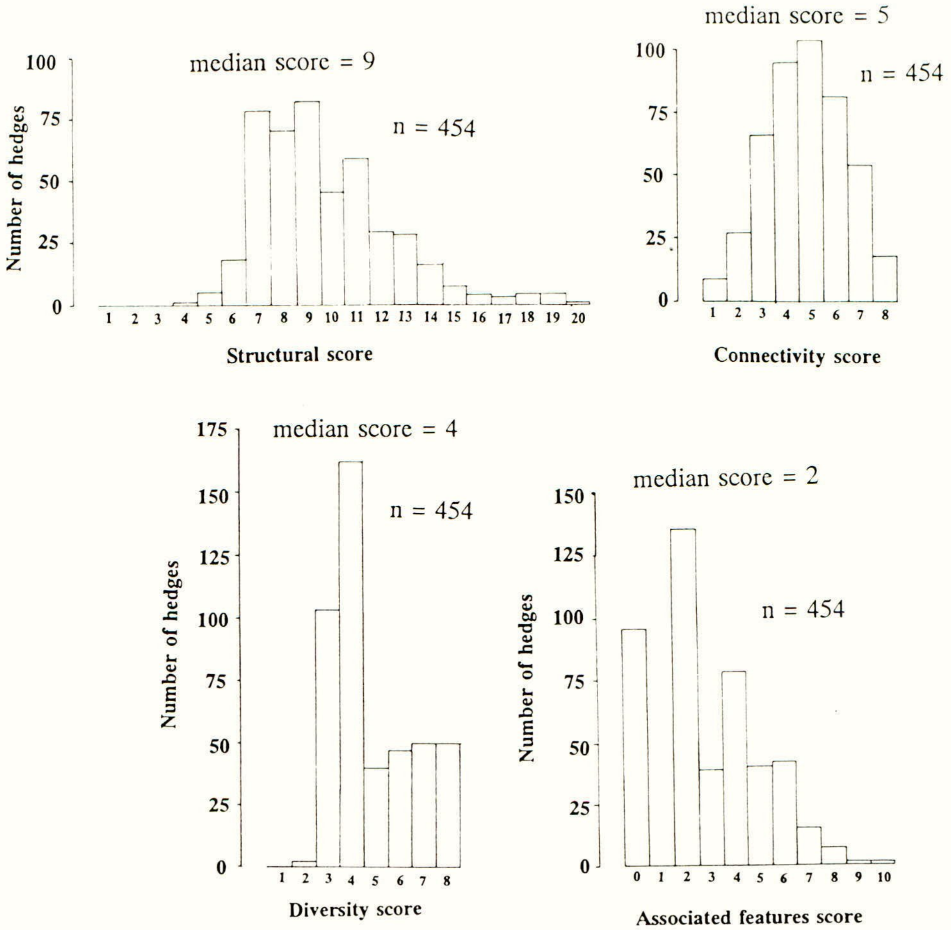

FIGURE 2. Distributions of structural, connectivity, diversity and associated features scores.

average diversity (in whatever way it is defined) may, for example, be valued more highly than a better than average structure, if species diversity in hedgerows is generally poor in the vicinity and structure is not. This type of comparison is extremely difficult to build into a simple grading system, but is certainly a factor which can influence the judgement of hedgerow ecologists. A record card of the HEGS type would aid comparisons of this kind, by providing scores for individual groups of features.

CONCLUSION

At its present stage of development, the grading system adopted by HEGS does appear to have some advantages over a simple additive grading system, but it is not yet known whether there is sufficient agreement between ecologists undertaking evaluation to make a simple 'modelling' approach widely acceptable. If experienced ecologists do not agree sufficiently about the values to be assigned to particular hedges, a system which provides one or more indicators of value but allows flexibility on the part of the evaluator may be a more satisfactory approach.

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