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AN EXAMINATION OF THE EFFECTS OF SIZE AND ISOLATION ON THE WILDLIFE CONSERVATION VALUE OF WOODED SITES. II PLANTS

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Introduction

The general background to this paper has been set out in a previous paper (Helliwell 1973a), in which it was concluded that, in a sample of 60 woodland areas in south-east England, the isolation of a woodland area was not a major factor in determining the conservation value of its bird fauna. The concept examined previously was again used as the basis for this investigation, namely that, if areas of habitat are effectively isolated from other areas of the same type, an isolated area will contain fewer and less "valuable" species than a similar area which is not isolated.

A brief survey of hedgerows in part of west Shropshire (Helliwell 1973b) had indicated that hedges were unlikely to be a very significant factor in the dispersal of woodland plants, so the presence of hedgerows was not considered in this study.

Study area and sampling sites

The same area of countryside was selected as was used in the study of hedgerows, this being an area containing woodland areas of varying size and with relatively little recent afforestation or de-forestation. The study area covered two 10 x 10 km National Grid squares, reference SJ 30 and SJ 40. The survey covered woodland areas which were predominantly broadleaved and which were large enough to be marked on the one inch Ordnance Survey map. Access to several woods was refused by the owners and it was necessary to omit these from the survey.

Sampling procedure

A rapid survey of the woods in this area had been carried out in 1970, noting:-

% tree cover,
% shrub cover,
% bracken cover,

Apparent grazing intensity,
% canopy of native tree species,
% canopy of light-demanding species,
Distance to nearest stream or river,
Distance to nearest woodland,
Estimated age of oldest trees,

plus such information as could be obtained from the map on slope, altitude, aspect, area, length of perimeter, and amount of woodland within a one km. and two km. radius.

Excluding factors directly related to size, shape, and isolation, the woods were placed into groups by using a clustering procedure based on "nearest neighbours", i.e. sites which are most similar to each other in relation to a principal component analysis of the remaining variables. Of 10 groups produced in this way, 5 consisted mainly of woods of native species with little or no grazing by cattle or sheep, representing a total of 60 different woods, and these were taken as the sample for this study.

Before visiting these woods, all those which were larger than two hectares were divided into approximately rectangular areas of between one and two hectares on a 1:25,000 map of the area, and each of these areas was surveyed individually. Allowing for woods which had been felled or cleared since 1970, or which had been misclassified, or for which access was unobtainable, 106 areas were delineated and surveyed during the period June-September 1973.

In each of these areas the following information was collected:-

Soil:- pH
loss on ignition
depth (mean of 4 auger borings)

Trees, etc:- estimated age of oldest tree or stump
% tree cover
% shrub cover
% bracken cover
% canopy of native tree species
% canopy of "light-demanding" tree species*

*includes oak, birch, larch, and pine, but not sycamore, beech, spruce, etc.

Flora:- lists of vascular plant species in
1 sq. m.
4 sq. m.
200 sq. m.
5,000 sq. m.
and whole plot

Isolation:- distance to nearest other wood over 10 hectares.
% wooded area in surrounding 100 hectares.
% wooded area in surrounding 400 hectares.

Additional information was obtained from the first edition of the Ordnance Survey maps (surveyed 1816-17) and, for part of the area, an estate map of 1766, in order to assess the probable age of the woodlands. Only 27 of the 106 sample areas were not present in 1816.

Information was also taken from the current Ordnance survey map on

mean altitude,
altitudinal range,
and
length of perimeter,

and the Atlas of the British Flora (ed. Perring and Walters, 1962) was used as a basis for assessing the "value" of the vegetation at each quadrat size, following the procedure given in Hollivell 1973a and b.

Results

There was insufficient information to permit the assessment of the age of a woodland, beyond its presence or absence in 1816. Some areas of old oak coppice are obviously considerably older than this, and, together with other areas, may have been wooded for a very long time. However, the past management of a wood may be as important in determining its floristic composition as is its absolute age, and no attempt has been made to quantify this aspect. The general field of management history is an important one, but it was not possible to cover it adequately in this study, owing to shortage of time and readily-available information.

The percentage cover of trees, shrubs, and bracken was assessed visually.

The means and standard deviations of the measured variables are given below:-

	Mean	Standard deviation	Coefficient of variation
Age (years)	229	73.6	.321
Soil depth (cm)	32.3	14.8	.458
pH	4.70	.690	.147
% loss on ignition	13.3	10.4	.782
% trees	82.8	14.2	.171
% shrubs	29.2	18.9	.647
% bracken	12.4	17.5	1.41
% native trees	82.4	25.6	.311
% light-demanders	87.5	20.0	.229
Altitudinal range (feet)	70.0	58.5	.836
Mean altitude (feet)	588	191	.325
Distance nearest 10 ha wood (m)	763	982	1.29
% woods in 1 sq km	12.5	8.78	.702
% woods in 4 sq km	8.04	6.64	.826
No. of species in 1 sq m	6.29	2.45	.390
No. of species in 4 sq m	8.97	3.24	.361
No. of species in 200 sq m	18.5	7.57	.409
No. of species in 5000 sq m	35.6	13.3	.374
No. of species in 1 hectare	45.4	15.0	.330
No. of species in 2 hectares	56.4	16.1	.285
No. of species in 4 hectares	69.1	16.7	.242
"Value" of species in 1 sq m	28.8	35.6	1.24
"Value" of species in 4 sq m	43.4	44.8	1.03
"Value" of species in 200 sq m	90.4	75.3	.833
"Value" of species in 5000 sq m	176	130	.739
"Value" of species in 1 hectare	245	157	.641
"Value" of species in 2 hectares	362	259	.715
"Value" of species in 4 hectares	432	277	.641
Perimeter/area rating (sample plot size)	2.09	1.11	.531
Perimeter/area rating (2 hectares)	1.87	1.14	.610
Perimeter/area rating (4 hectares)	2.92	1.56	.534

All the 106 sample areas exceeded 5000 m^2 in size, 98 exceeded 1 hectare, and by aggregating contiguous sample areas it was possible to obtain 62 2 hectare samples and 24 4 hectare samples.

A total of 275 plant species were recorded, varying from very common plants such as Arrhenatherum elatius to less common plants such as Tilia cordata, Tilia platyphylla, Taxus baccata, Cichorium intybus, Genista tinctoria, Euphorbia amygdaloides, Campanula latifolia, and Apium graveolens.

Analysis

The numbers of plant species and their "conservation value" were treated as dependent variables in a series of multiple regressions; and correlations between these and all other variables were calculated.

The correlations of greatest interest are given in Table 1. As can be seen, there are no correlations which are consistently significant at all sample sizes, and the only correlation coefficient greater than 0.50 is the positive correlation of 0.68 between the "value" of the flora and the distance of 4 hectare woods from woodland areas of 10 hectares or more.

The amount of variation that can be explained in terms of the 15 independent variables is not very great, although it is statistically significant at the 0.05 probability level in most cases.

	Sample sites						
	1 m^2	4 m^2	200 m^2	5000 m^2	1 ha	2 ha	4 ha
No. of samples	106	106	106	106	98	62	24
Percentage of variation in spp. nos. explained	35	37	41	35	43	59	90
Percentage of variation in "values" explained	20	17	18	16	29	61	92
Percentage needed to reach significance at the 0.05 probability level	20	20	20	20	21	31	59

The floristic data were also analysed by Dr. M. Hill, using his "reciprocal averaging" method (Hill, 1973), to give an ordination and a dichotomous "association analysis". The association analysis divided the 106 sample areas

into a group of 80 areas with a fairly base-rich type of vegetation and a group of 26 areas of a more acidic type. Each of these two groups was then divided into areas with vegetation characteristic of woodland margins or hedgerows (e.g. Prunus spinosa, Tamus communis, Rosa spp., Ulex spp.) and areas without such vegetation. The subsequent divisions of these groupings were less easy to interpret.

The ordination of sample areas, on which this dichotomous grouping was based appeared to have the following characteristics:-

1st Co-ordinate	-	base-rich	:	acidic types
2nd Co-ordinate	-	species-rich	:	species-poor types
3rd Co-ordinate	-	undisturbed	:	disturbed types

These 3 co-ordinates accounted for 57.7% of the variability in the data.

The ordination of species had the following characteristics:-

1st Co-ordinate	-	base-rich	:	acidic species
2nd Co-ordinate	-			
3rd Co-ordinate	-	native	:	introduced species

The interpretation of the 2nd co-ordinate was not obvious.

Discussion and conclusions

The variation in the age, soil pH, and percentage tree cover in the 106 sample areas was not very great, although there was a greater amount of variation in the amount of bracken, shrub cover, altitudinal range, and shape of the woodlands studied. The variation in woodland density within 4 km^2 and the distance to the nearest large woodland area, which were the matters under scrutiny, were also fairly large, which was satisfactory for the purposes of this study.

In spite of the fact that the "values" of the plant species in a sample area were significantly correlated with the numbers of species (see Table 1.) the "values" were much more variable than the numbers, and only 21-41% of the variation in "value" could be explained in terms of the numbers of species present.

The amount of variability in species numbers and "values" which can be explained in terms of the isolation of the sample area from other wooded areas is barely significant in most cases. The most significant trend appears to be that woodlands which lie some distance from larger woodlands (over 10 hectares) are likely to contain more "valuable" species. This runs counter to theoretical considerations of species migration and population viability, but may possibly

be explained in terms of the more intensive management of the larger woodland areas, for timber production. Thus, although in the long term an isolated area of woodland may be potentially less valuable than one which forms part of a larger woodland area, under the present circumstances, in the area studied, an isolated woodland area is likely to contain a more "valuable" flora for conservation purposes than a comparable area which is not isolated.

The fact that the ordination and association analyses did not have any major axes or divisions related to the size or isolation of the sample area lends support to the view that these are not major elements in determining the current woodland flora.

Summary

A total of 106 sample areas of mainly broadleaved ungrazed woodland was examined in a 200 sq km area of west Shropshire.

The amount of variation in numbers of plant species and their "conservation value", which can be explained in terms of the variables measured was only barely significant, and it would appear that factors such as the past history and current management of these woodlands are likely to be more important in determining their floristic composition than are factors relating to size and isolation.

Under present circumstances, in the area studied, an isolated woodland area is likely to contain a more "valuable" flora for conservation purposes than a comparable area which is part of a larger block of woodland.

Acknowledgements

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Reference.

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Table 1

Correlation coefficients

	Number of species in sample							"Value" of species in sample						
	1 sq.m.	4	200	5,000	1ha	2ha	4ha	1 sq.m.	4	200	5,000	1ha	2ha	4ha
Age	-.07	-.13	-.25	-.16	-.15	-.27	-.34	.16	.13	.04	.03	-.02	-.02	-.19
Soil depth	-.13	-.10	-.20	-.24	-.24	-.29	-.31	-.09	.03	-.11	-.09	-.20	-.24	-.18
pH	.27	.35	.32	.15	.10	.08	-.02	.01	.10	.15	.13	.06	.08	.40
LoI	-.15	-.16	-.11	-.05	-.02	.13	.39	-.16	-.19	-.15	-.02	.06	.03	-.04
% trees	-.09	-.12	-.27	-.35	-.44	-.41	-.18	-.16	-.11	-.07	-.12	-.24	-.13	-.11
% shrubs	.03	.17	.22	.15	.15	.21	-.11	-.13	-.04	-.06	-.01	.00	-.02	-.15
% bracken	.01	-.06	-.09	.00	-.01	.03	.25	.29	.19	.04	.04	-.05	-.05	.06
% native trees	.32	.36	.27	.10	.06	-.01	-.42	.18	.26	.22	.13	.17	.21	.03
% light demanders	.29	.34	.35	.23	.22	.11	-.05	.14	.22	.25	.21	.25	.24	.12
alt. range	-.16	-.21	-.26	-.30	-.31	-.26	-.31	.12	.03	-.05	-.06	-.13	-.11	-.21
mean alt.	-.18	-.25	-.37	-.22	-.21	-.18	-.13	.10	-.01	-.15	-.15	-.26	-.33	-.40
perim./ area	.20	.15	.23	.23	.33	.34	.03	.08	.05	.12	.21	.29	.31	.40
dist. wood 10ha+.	.28	.30	.30	.26	.23	.22	.27	-.03	.01	.17	.23	.30	.42	.68
% woods in 1 sq.km.	-.19	-.27	-.37	-.22	-.23	-.26	-.20	.06	-.02	-.13	-.13	-.23	-.27	-.31
% woods in 4 sq.km.	-.28	-.31	-.37	-.26	-.24	-.21	-.18	-.05	-.11	-.18	-.16	-.22	-.25	-.33

(Correlations significant at the 0.05 probability level are underlined.)

Correlations between numbers and "values" of species:-

1 sq.m.	4	200	5,000	1h.	2h.	4h.
.46	.50	.55	.63	.64	.52	.62