Natural Environment Research Council

Institute of Terrestrial Ecology

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CAPTIONS FOR COVER'S PLATES

The cover shows from the top: White admiral adult butterfly, photo: E. Pollard; *Mycena galopus* fungus fruiting on oak leaf litter with signs of white rot caused by this fungus, photo: J. K. Adamson; the ant, *Tapinoma erraticum*, photo: A. Abbot; head of female sparrow hawk, photo: I. Newton; the moss, *Sphagnum fallax*, photo: R. Daniels; the pseudoscorpion, *Dendrochernes cyrneus* (L. Koch), the largest and rarest British species, on decaying oakwood, photo: J.L. Mason, Nature Conservancy Council.

Centre: grouse moor, photo: G. Wilson.
Right: an artificial wear machine being demonstrated by Alan Frost. The studded rotors used in the field experiment have been replaced by rubber covered ones in this photograph, photo: A.J.P. Gore.

ACKNOWLEDGEMENT

The Institute wishes to thank Miss Sally Knight for drawing the figures in this Report. The work was carried out as part of her year's sandwich course at our Monks Wood Experimental Station, Huntingdon. Sally is a cartography student at the Luton College of Higher Education, Bedfordshire.

The Institute of Terrestrial Ecology (*ITE*) was established in 1973, from the former Nature Conservancy's research stations and staff, joined later by the Institute of Tree Biology and the Culture Centre of Algae and Protozoa. ITE contributes to and draws upon the collective knowledge of the fourteen sister institutes which make up the *Natural Environment Research Council*, spanning all the environmental sciences.

The Institute studies the factors determining the structure, composition and processes of land and freshwater systems, and of individual plant and animal species. It is developing a sounder scientific basis for predicting and modelling environmental trends arising from natural or man-made change. The results of this research are available to those responsible for the protection, management and wise use of our natural resources.

Nearly half of ITE's work is research commissioned by customers, such as the Nature Conservancy Council who require information for wildlife conservation, the Forestry Commission and the Department of the Environment. The remainder is fundamental research supported by NERC.

ITE's expertise is widely used by international organisations in overseas projects and programmes of research.

Contents

Table 2 Fluoride budget for the grassland ecosystem at the end of 1976

	Fluoride in the system $[gF^{-}m^{-2}$ to a depth of 11 cm.]
live plants	0.34
dead plants and litter	0.58
soil [water soluble]	2.70
[bound]	15.04
	Fluoride accumulated since 1970 $[gF^{-}m^{-2}$ to a depth of 11 cm]
in plants [live and dead biomass]	0.90
in soil [less that in roots]	12.02
total accumulated	12.92
	Fluoride in transfer $[g\ F^{-}m^{-2}yr^{-1}]$
Through primary producers & de composers	0.68
Mean deposition rate over the 6 year period	2.15

F^{-} ($0 \cdot 68$ g F^{-} m^{-2} yr^{-1}) passes through 2177 g m^{-2} of living and dead plants containing $0 \cdot 90$ g F^{-} m^{-2}. Since 1970, it is estimated that total F^{-} in soil has increased by $12 \cdot 0$ g m^{-2} giving, with amounts in above- and below-ground biomass, a total of $12 \cdot 92$ g m^{-2}. This calculation suggests an average rate of deposition of $2 \cdot 2$ g m^{-2} yr^{-1} for the 6-year period since emissions commenced. Because the dead fraction contains 84 per cent of the F^{-} in the above-ground biomass, the decomposer system at this contaminated site is subject to the influences of large concentrations of pollutant F^{-}. As yet, the nature of these influences on the decomposingactivities of microbes and soil fauna is little understood. However, it is known that the augmented F^{-} concentrations affect plant growth, decreasing tillering and dry matter production.

D. F. Perkins, V. Jones and P. Neep

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Plant Community Ecology

ECOLOGICAL SURVEY OF BRITAIN

This survey has evolved from the application of numerical methods to the analyses of complex arrays of floristic and environmental data. It depends upon a close relation between environmental attributes read from maps and other records, and environmental observations made in the field. As these 2 sets of observations are strongly correlated, and as vegetation reflects habitat characteristics, it has become possible to predict the vegetation types of differing localities from environmental attributes read from maps.

Early studies in Grizedale Forest and the Lake District National Park (Bunce *et al.* 1975) led to the ecological survey of Cumbria (Bunce and Smith 1978). In this survey, data from physical, geological and human artefacts recorded on maps were analysed to produce 16 groups of km squares, termed land classes. These land classes have subsequently been characterised by field surveys of vegetation, soils, landscape and woodlands. The correlations between the classification derived solely from maps and the field surveys proved sufficiently high to enable valid predictions of observed characters to be made for regions where map information alone was available. Independent tests of the predictions proved that the method provided sufficiently accurate results for general trends to be established.

Although there is almost continuous variation, the land classes in Cumbria have recognisable characteristics and are readily identifiable in the field. Thus classes 7 and 8 are coastal and are predominantly mud or sand. Classes 6, 5 and 1 are lowland, with arable land predominating, and with many hedgerows and small copses. Class 4 is distinguished as being a lowland class but with a geology more usually associated with the uplands. Classes 2 and 3 are still lowland but are at higher altitudes than the previous classes, and hence tend to have more pasture and more open scenery. The remaining classes are upland in character, although classes 9–12 still have some relatively fertile land. Classes 13 and 14 are similar to those of 15 and 16, but, whereas the former are associated with the rounded slopes of the Pennines with much deep peat, the latter are present on the steep rocky slopes of the central Lake District and have mainly mineral soils.

The results of the Cumbria Survey have contributed to the structure plan drawn up by the County Council and have also been used in a variety of other projects, such as the comparison of valley systems for reservoirs, and an estimation of the county's potential for producing energy derived from plant material. Following the success of this exercise, the same principles are being applied to a survey of the UK. As for Cumbria, 'map' data are being assembled using a 1 km grid with 6,000 squares being characterised and used to establish 32 land classes—in contrast to the 16 classes which were found to be adequate for Cumbria. When this preliminary stage has been completed, 8 replicate squares of each of the land classes will be surveyed in greater detail, including vegetation assessments and descriptions of soil profiles. In due course, the ability to predict land characteristics will be tested objectively in anticipation of the requirements of an increasing number of agencies concerned with land classification, and the rational use of natural resources.

R.G.H. Bunce

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PLANT SPECIES LISTS IN WOODLANDS

(This work was commissioned by the Nature Conservancy Council as part of its programme of research into nature conservation)

Many methods are commonly used to compile lists of plants growing in specified woodlands, ranging from informal wanderings to the formalised recording of species occurring in quadrats of a chosen size and distributed in a pre-determined manner. The characteristics of species lists compiled in these different ways, and the costs involved in their compilation, are being analysed as part of a wider investigation of woodland survey methods. Hales Wood, Essex, a mixed oak-ash-hornbeam woodland of 8 ha is one of the smallest in a series of woodlands being investigated. Five different types of survey, the most intensive being a series of 33 quadrats of 200 m^2 spaced at 50 m intervals throughout the wood, gave a total of 100 vascular plants, of which only 49 were recorded using all 5 methods. Numbers of species discovered by different methods ranged from 61 to 82 in the quadrat survey, with a mean of 71; similar differences occurred when the range of methods was applied to larger areas of woodland. Although the quadrat survey is the most expensive, this disadvantage is offset, at least in part, by the provision of a better base-line, including spatial distribution, against which temporal changes may be judged.

J.M. Sykes and A.D. Horrill

THE CHANGING GROUND FLORA IN UPLAND FOREST PLANTATIONS

(This work was commissioned by the Nature Conservancy Council as part of its programme of research into nature conservation)

To assess the alterations in upland Britain following extensive afforestation, vegetation in plantations in south-west Scotland, in north and south Wales and in north Yorkshire has been recorded over a 3-year period (1975–77) using a stratified-random programme of sampling. Observations were made of newly-planted areas, and on crops of different species and at different stages of development, attempt also being made to relate floristic differences with soil type. Additionally, it was possible to resurvey a forest in south Wales which had been recorded in 1944, shortly after planting, by an Oxford University team led by Mr. E. W. Jones (see Hill and Jones 1978).

Afforestation has an immediate impact on the abundance of ground flora species, with populations of *Calluna vulgaris* and *Vaccinium myrtillus* (dwarf shrubs) and *Molinia caerulea* and *Deschampsia flexuosa* (tall grasses) increasing at the expense of *Nardus stricta* and *Juncus squarrosus* and of *Trichophorum cespitosum* and *Narthecium ossifragum* in bog sites. Although these changes seem largely attributable to the cessation of grazing, other factors such as improved drainage and the application of fertilizers and herbicides must play a part. While bryophytes such as *Campylopus introflexus* and *Ceratodon purpureus* begin colonizing bare ground shortly after enclosure, their numbers and diversity increase greatly at canopy closure 15–20 years after planting, with *Lophocolea cuspidata* (growing mainly on dead wood) and *Plagiothecium undulatum* (on all substrata) being particularly abundant. Apparently, in western Britain, *P. curvifolium* owes its occurrence to afforestation, previously being virtually confined to deciduous woodlands in the east of the country.

As forest canopies become increasingly dense, with light intensities being minimal after 30–35 years, even bryophytes may be excluded, the effects of pine, larch and Douglas fir, which cast less shade, being less drastic than that of spruce and western hemlock. However, the complete suppression of ground species has been observed in thicket stage (15–20 years) larch.

Leaf litter, like shade, seems to restrict the growth of ground species, its effects sometimes contrasting with the luxuriant growth of bryophytes and ferns, sometimes found on litter-free tree stumps.

From a 'low' when plantations are 30–35 years old, the diversity of ground flora increases as forest crops approach maturity (say 50 years) (figure 42). The fern *Dryopteris dilatata* seems particularly well-adapted to this stage in forest rotations, while other species invade the spaces created by losses attributed to wind damage and other hazards.

Clear-felling, when "lop and top" is commonly left covering much of the ground, can severely disrupt the 'natural' development of ground flora. At this time, it seems that soil-borne spores and seeds play an import-