Where the wild plants are:

Ecologists have just completed the largest ever survey of Britain's vegetation, paving the way for a radical new approach to plant conservation

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(from the Internet)

A Southern English woodland in spring. Among the clumps of bramble, a carpet of bluebells stretches into the distance and occasional fronds of bracken unfurl. Above them are shrubs and a canopy of trees coming into leaf: hazel and hawthorn, scattered holly, oak, birch and a few lime and beech. A special place by any account.

But just how unique is the vegetation in this woodland? What different species would we see if we walked into a woodland on similar soil in the cooler and wetter northwest of Britain? How would the different types of vegetation be affected if we replaced the canopy with conifers or admitted grazing sheep? And faced with a drastic threat to its future, what criteria could we use to assess the value of this kind of woodland for conservation or recreation?

It was to help answer such questions that we embarked on a comprehensive survey of Britain's vegetation in 1975 known as the National Vegetation Classification. Coordinated at the University of Lancaster and funded by the former Nature Conservancy Council, this mammoth project has now entered its final phase. Earlier this year we published the first of the survey's five volumes, which together will run to about a million words. The results are already used by Britain's new nature conservancy councils and the Department of the Environment. Ultimately they will provide the basis for, among other things, monitoring the effects of global climate change on Britain's vegetation.

The original aim of the project was ambitious: to provide plant ecologists with the first systematic account of the vegetation in all Britain's natural, semi-natural and major artificial habitats. The emphasis, however, was not so much on making an inventory of individual plant species, but on searching for communities of plants that were characteristic to an area and relating their compositions to variations in the local environment.

Gathering the data was a huge undertaking. It took a team of five surveyors four years to collect the necessary records of vegetation. Together, we covered over 300,000 kilometres, and, using the materials of previous surveys, accumulated samples from all parts of the country - from salt marshes at low tide up to wind-blasted moss heaths on the summits of mountains and from the centre of London to the furthest flung bog pool of the Outer Hebrides.

In between, we surveyed all terrestrial and freshwater habitats, and not simply for rare plants or communities rich in species. Of equal importance were the more mundane plant communities found on improved farmland, pathways and derelict ground, on run-down mires and around reservoirs. By the end of our survey we had put together Britain's largest ever plant database, comprising over 33,000 samples.

Sampling so many different kinds of vegetation was a simple but painstaking task, which involved recording the abundances of all the plant species present in each plot. That meant not just flowering plants, but mosses, liverworts and lichens; a tall order when 30 or more of these might be present in a single sample. With over half a million measurements of this kind, computers were the only way to make sense of the data. Using a battery of classification techniques, we sorted the samples into groups according to which species they contained. Ultimately we were able to draw up a list of 300 or so plant communities.

These groups could then be checked against environmental data. Were the samples from steep, rocky ground or gently sloping valley bottoms? From a spray-splashed sea cliff or a sunless mountain side? On soils derived from Old Red Sandstone, lime-rich bedrocks or gravels? Was the herbage grazed by cattle, or sheep, or rabbits? In this way, we were able to relate different plant communities to characteristic environments.

Fascinating patterns soon emerged. It became apparent that the compositions of our plant communities were related in diverse and subtle ways to a host of factors, from temperature and rainfall to soil acidity and, of course, the impact of humans. Sometimes the patterns were quite striking. For example, the composition of Britain's woodlands, grasslands and mires reflect gross contrasts in climate, so we could easily identify particular plant communities as hallmarks of either the lowland southeast or the cooler, wetter environment of the northwest uplands.

Other habitats seemed to be dominated by a single critical factor. On coastal salt marshes, for example, regular tidal inundation results in communities forming strikingly different zones, reflecting the varying abilities of the communities to withstand submersion, exposure and salinity. More often, though, a complex interaction of both natural and anthro-pogenic factors determines the character and distribution of vegetation types.

The Wiltshire Downs offer a prime example. Here there is a plant communitity of a highly distinctive turf with a wealth of lime-loving herbs such as wild thyme, rock rose and dropwort. Oddly, however, the community also contains herbs that have less liking for lime soils such as devil's-bit scabious, saw wort and betony. The reason lies partly in the climate. This region of Britain receives close to 1000 millimetres of rain annually, so its soils tend to be leached of calcium. In addition, the soils unusually contain extensive deposits of loess (fine, windblown silt laid down on the bare post-glacial landscape) which muffle the influence of the underlying chalk on the vegetation.

The influence of human activities on the downs is striking, too. Being light and deficient in certain trace elements, the soils were cultivated only sporadically in former times. Farmers quickly discovered that cereal crops were dismal and, in any case, the newly ploughed soil simply blew away. Instead the land has long been used for grazing, particularly (and unusually for this region) cattle. Producing more dung than sheep, these animals have enriched the ground considerably, allowing a distinct and rich variety of plants to flourish. Such intricate stories probably lie behind most of our plant communities.
How can we use this new knowledge of what makes each plant community distinctive? First, we now have a single scheme for describing and mapping our vegetation resources, whether in a small and vulnerable nature reserve or across huge tracts of more commonplace land. Plant communities can be recognised in the field, their boundaries drawn and their areas measured. Organisations like the new nature conservancy councils can now calculate the extent and distribution of different kinds of vegetation much more accurately.

Already, many sites of special scientific interest have been surveyed by the new approach: mires in Cumbria, woodlands in Lochaber and Surrey, wet grasslands in Radnor and the New Forest, sea cliffs in Cornwall and Orkney. For some parts of our uplands and sand dunes, the nature conservancy councils are well on the way to a strategic overview of the vegetation resources to help establish conservation and research priorities.

Secondly, because the scope of the scheme is national, it offers a powerful tool for assessing the value of a site within its region. Is the vegetation there representative or peculiar? And how does one site compare with another? Better answers to questions like these give us a stronger basis for making choices about conservation and alternative land uses - and for striking sensitive bargains.

Suppose we have alternative routes for a motorway or several possible locations for a third London airport. Our survey should help those conducting the environmental impact assessments to cost the vegetation resources of these sites much more accurately. Already the scheme is being used by both sides in public inquiries - for example, into a proposed housing development on rich grasslands in Essex.

The survey should also enable Britain to make a more informed response to European Community legislation on environmental protection. Although there has been nothing quite like the National Vegetation Classification elsewhere in Europe, many plant ecologists in France, Germany, the Netherlands, Scandinavia and in the East, have long used a similar approach to define their vegetation resources. Our classification had to be compatible: so we related every plant community to its nearest European equivalent, using terminology adopted by the European Community's Environment Directorate.

On Europe's northwest fringe

Looking at Europe's plant communities as a whole, we see that the bluebell woods we often take for granted in Britain are in fact confined to a rather small region along the northwest seaboard of the European mainland. This gives this kind of vegetation an added value. And what emerged from the survey is not just new sites for types of vegetation already well known on the Continent. In many cases the inclusion of British examples alters our view of European vegetation trends. For instance, we have defined a series of plant communities in western Britain which give us a quite different perspective on heaths. An abundance of oceanic shrubs and herbs in this mild and humid part of Europe makes the heaths of the Continent look rather impoverished.

We can also use the survey for monitoring change in vegetation as a result of atmospheric pollution and global warming. So far this has been a sporadic and uncoordinated affair in Britain. Our survey should help in several ways. First, it provides a 'snapshot' of all Britain's vegetation which can be used as a marker for assessing the results of future, small-scale surveys. Secondly, it should help to save time and money by providing an economic way of selecting representative plots of vegetation or relating any peculiarities of species composition in a given plot to environmental variables. Finally, the survey's broad descriptive base should allow results from particular sampling stations to be applied to the country as a whole.

The survey is already being put through its paces in two studies for the Department of the Environment: the Critical Pollution Loads and Climate Change programmes. We have begun to locate monitoring plots in representive stands of 14 different types of grassland on lime-rich bedrocks throughout Britain (see Box 2 for further details). Being on sharply draining, nutrient-poor soils, these grasslands will be among the first to register the impact of a drier climate. Even though the soils are generally well buffered against the effects of acid rain by the underlying lime-rich rocks, we have identified some borderline swards where surface acidification is likely to have an early effect.

What contribution can our classification scheme make to the management of Britain's vegetation resources? Human activity has influenced most plant communities in this country. Grazing or mowing grass; the cutting or burning of heaths; coppicing and extraction of timber; reclamation for farming or forestry; draining and the management of rivers, lakes and reservoirs; trampling, or just plain neglect - all have left their mark on our plant communities and their distributions. Our survey should help assess the likely impact of such activities on different types of vegetation, making it easier to know when to intervene or leave well alone.

For example, on Shakespeare Cliff near the exit of the Channel Tunnel workings, maritime grasslands have been mapped by a team of difficult-terrain surveyors from the former Nature Conservancy Council. We know from our survey that the intricate patterns of different plant communities here can be related to the salt from sea spray. How will these be affected by the wide

berm of tunnelling waste being deposited along the foot of the cliff? Judging by the earlier effects of a smaller berm nearby, the waste will be more than sufficient to push the wave-break zone too far from the cliffs for sea-spray to control the vegetation pattern. The diverse zones of plant communities on Shakespeare Cliff are likely to be lost.

The results of the National Vegetation Classification should help us restore derelict ground and identify sites which had other uses and might now be valuable for conservation. We should be better able to restore plant communities, too. The Forestry Commission, for example, can now select sites with the best combinations of climate and soil for particular kinds of broadleaf afforestation.

Specifically, the commission can target a fen or heath site which already has vegetation elements of the semi-natural woodland that would be most appropriate for the site, an approach that could speed the development of a suitable field layer. The survey could also be used as a guide to the proportions of the particular trees and shrubs in the plantation.

The goal of sensitive conservation of the landscape and its resources is elusive and costly. And our research does not provide the last word on the definition of British plant communities. There are types of vegetation for which our coverage is rather sketchy, and the detailed distribution and extent of the communities we have classified remains to be catalogued in many parts of the country. Some of our comments about the environmental relationships of the vegetation types are also of necessity educated guesswork. Despite this, the classification is, we feel, a reliable tool for describing and studying plant comunities. We hope the work will help us all look with new interest at Britain's vegetation, which, for its own sake, deserves understanding and care.

1: On the trail of a rare black bog rush

Conserving rare plants depends on understanding both their habitat requirements and the plant communities in which they occur. The National Vegetation Classification shows that many rarities occur not just in one but in many types of vegetation, with their plant community 'context' shifting according to environment.

The bog rush Schoenus nigricans is now a decidedly local plant through much of the English lowlands, having declined greatly with the draining and eutrophication of wetlands - it prefers wet and nutrient-poor habitats.

In this part of Britain, it is exclusively associated with calcareous mires and related meadows on fen peat and lime-rich mineral gleys. In western Ireland, by sharp contrast, the plant is abundant on the highly acidic peats of blanket bogs. What lies behind this difference in behaviour? The favoured explanationis the vulnerability of S. nigricans to aluminium. In more base-poor mires in the drier east of Britain, accumulation of aluminium ions excludes the bog rush. But in the very wet 'oceanic' climate of western Ireland, aluminium ions are leached from the soil, allowing the plant to grow in spite of the soil's acidity.

Thanks to our survey we are now able to define a series of plant communities containing bog rush that lie between these two extremes of continental and oceanic habitats. In the wetter north of England and central Scotland, for example, the plant still predominates in communities that thrive on alkaline soils, though the soils are not always so markedly lime-rich as in the southeast.

In the more oceanic west of Britain, however, the shift towards the bog habitat becomes obvious. In the southwest of England, S. nigricans can be occasionally found among bog plants in the acid peats of valley mires, but only when these are flushed with somewhat less acidic waters.

In the very wet western Highlands of Scotland, however, S. nigricans commonly occurs in this kind of plant community, marking out gentle water tracks in the thinner fringes of blanket peats. And by

the time we reach Islay, looking out across the water to Ireland, the plant begins to make an appearance on the bog plane itself.

Having classified this spectrum of vegetation types, we are now much better placed to identify sites that may be capable of supporting a greater abundance of S. nigricans for a given level of aluminium. And that brings us a step closer to understanding how we might conserve the plant throughout its habitat range.

2: Looking for the first signs of climate change

Among the grasslands likely to be most affected by climate change in southern Britain is a community dominated by rich mixtures of small basiphilous tussock grasses, dicotyledonous herbs and mosses. The community occurs on sharply draining rendzina soils on a wide variety of limestones.

If the climate of southern Britain becomes warmer and drier, as predictions suggest, this kind of grassland will change. It is likely to become more like a related community that is at present largely restricted to the chalk of East Anglia, where the climate is already quite continental.

So we will be looking for an opening up of the sward at our monitoring locations, with the loss of less drought-tolerant perennial plants; a spread of xerophytic mat plants able to capitalise on increased light, and an abundance of ephemeral plants germinating on patches of bare ground in the autumn, which are able to complete their life cycle before the soils become parched again in the summer. We will concentrate our observations on plots located close to the boundary between the two grassland communities, where we might expect responses to occur first.

Being naturally poor in nutrients, the rendzina soils that support these swards are especially prone to enrichment by nitro-gen deposited in various forms from the atmosphere. Comparison with similar grasslands on rather more fertile calcareous earths suggests that we might see a spread of bulky mesophytic herbs through the basiphilous swards. Com-bined with a more drought-prone climate, though, an increased deposition of nitrogen might encourage the spread of rank nutrient-demanding weeds through many grasslands on limestone in southern Britain.

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