Ecological Flora of the Central Chilterns

Muscid fly *Echinomya fera* on Round-leaved Mint, Great Hampden

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Book I

Introduction:

The Chilterns - Habitat & Change

Chiltern gentian, Kit's Wood

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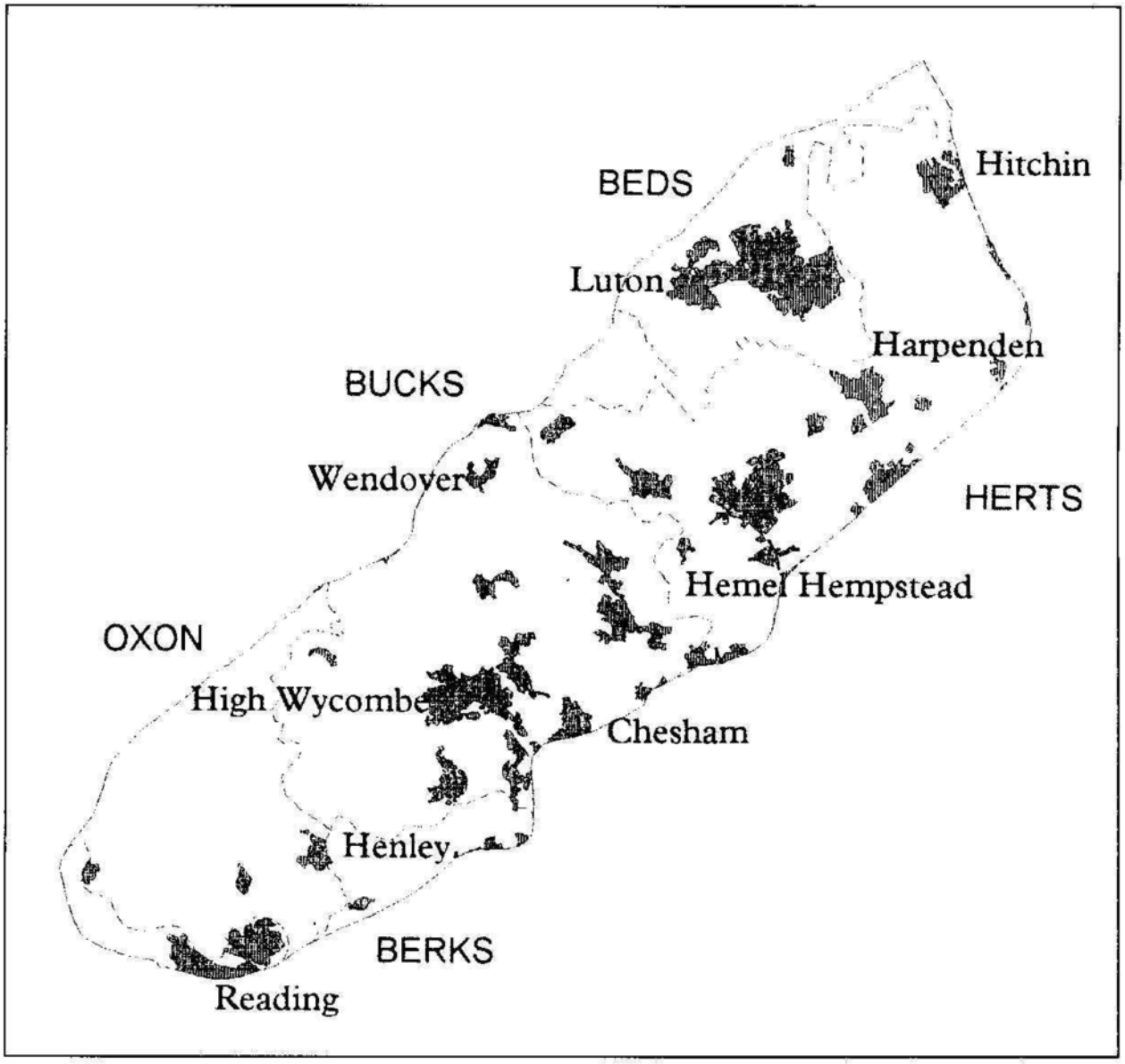
INTRODUCTION

The Chilterns

The Chilterns comprise a range of hills stretching diagonally across England from the south-west at Goring Gap where they are broken by the Thames Valley, north-east through Oxfordshire, Buckinghamshire, Bedfordshire and Hertfordshire, and even traceable in the line of intermittent chalk hills into Cambridgeshire. A steep north-west facing escarpment clearly delimits the main Chilterns on one side, but they slope gently south-eastwards with no clear topographical boundary, such that the area defined as Chilterns by the Chiltern Society, a voluntary body, stretches much further than the area defined in 1964 by the statutory Area of Outstanding Natural Beauty. The most ecologically significant definition is that used by English Nature in their Natural Area Profile of the Chilterns (1997), which is closer to the AONB but has some differences, in particular the inclusion of urban areas such as High Wycombe and Luton. This area, as in their map below, stretches from Goring and Reading in the SW to Hitchin in the NE, with the Thames Valley forming the southern boundary at the west end. (Note that "Chesham" is misplaced in their map.)



Map copied from English Nature (1997)

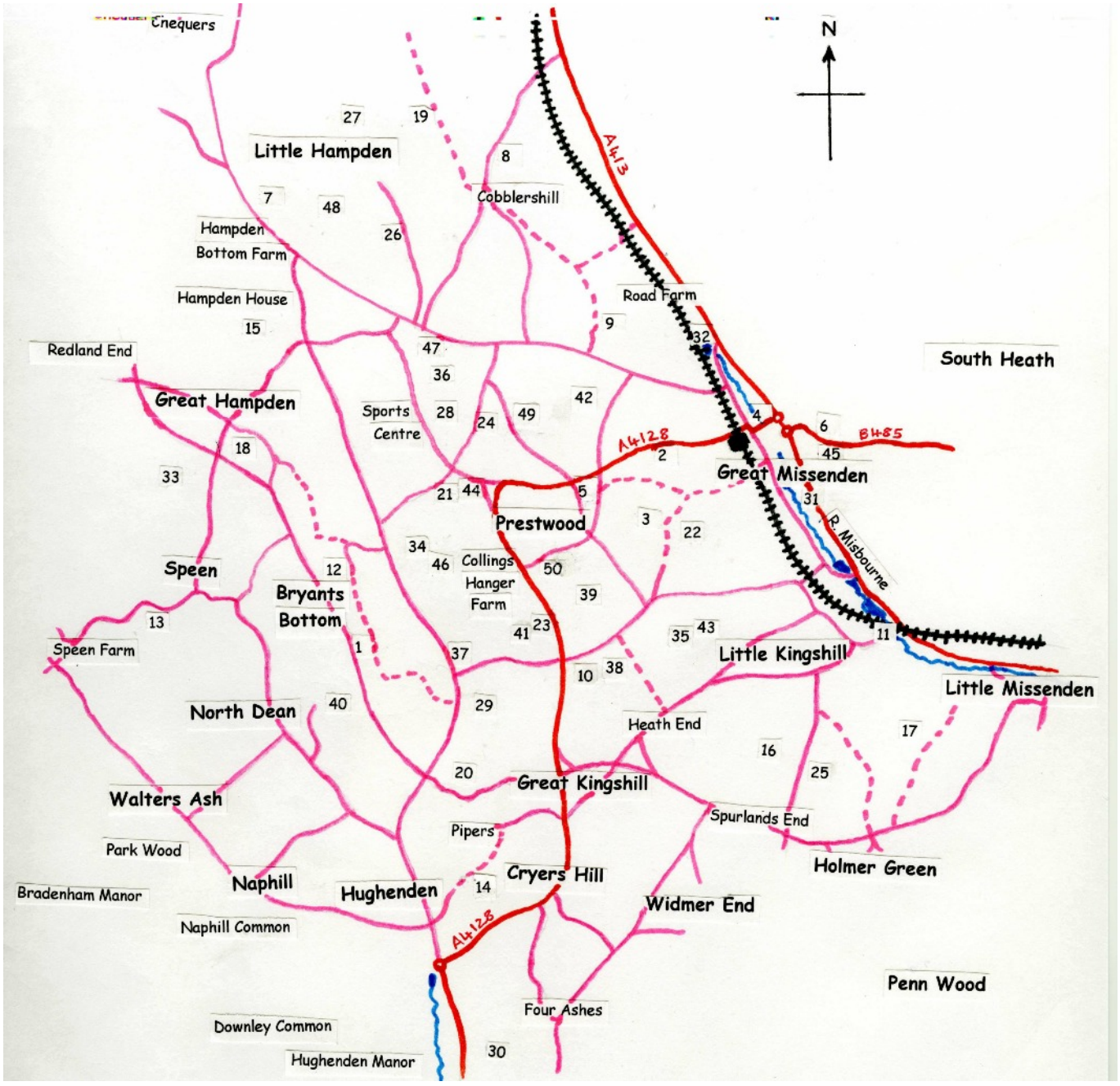
The escarpment is of Lower, Middle and Upper Chalk, and the rest of the area is underlain by the last two, although the hill-tops and plateaux are clay-covered. These clays are mainly Pleistocene clay-with-flints, derived from weathering of chalk hills, and sandy-clay-with-pebbles where the deposit was formed in riverine landscapes and the flints had been rounded by water action. The first tends to be neutral to slightly alkaline, while the second is more acid and once underlay extensive heathlands. Numerous dry valleys cut through the chalk in a south-easterly direction, creating an undulating landscape with steep slopes. The junction of the Middle and Upper Chalk is characterised by a narrow band of hard "chalk rock" (sufficiently strong to have been used for building purposes in the past). Where this comes near the surface, typically towards the tops of the dry valleys, the soils are thin and very calcareous, and these are often associated with special plant communities. Thin soils, stony ground, infertile clays and topography combined to set limits to farming, which was traditionally small-scale and marked by a tapestry of small arable and pasture fields separated by hedgerows, with woods particularly on the hilltops. Due to the lack of easily available water, which sinks through chalk, the main settlements by the Romans and Anglo-Saxons were along river valleys on the lower south-east edge of the hills, although the original Celtic inhabitants occupied and farmed the hills themselves. The river valleys have a rich alluvial soil particularly conducive to cultivation.

Climatically the Chilterns are part of the drier and warmer south-east of the country, but the hills experience more rain and snow than the rest of the south-east, so that the flora lacks some of the warmth-loving chalk flora of Kent and Sussex, while being too dry for typical western Atlantic species, the limited variety of ferns being particularly noticeable. Aquatics and plants of acid soils are under-represented because of the paucity of wetlands and heaths, made more severe by water extraction which has considerably reduced river flows in recent times and by modern human settlement concentrated on the unproductive plateau clays and former heathy common-land.

Like the rest of England the flora is tremendously affected by man's activities, and all the main habitats are essentially human artefacts – hedgerows, fields, managed woods and plantations, parklands, orchards, wasteland, artificial ponds. Even rivers are more or less managed and altered, even though some of the original rare chalk-stream ecology survives in places. The effect has been particularly marked in the last 50 years by intensive agriculture using chemical fertilisers and weed-/insect-killers and by the growth of human settlement and the consequent wealth of new garden escapes. Excessive nutrients entering soils from air pollution (industry, cars) and agricultural run-off are still modifying the flora, reducing botanical diversity by encouraging the expansion of populations of nitrogen-guzzling ground-smothering plants like nettle, cow parsley and docks. Efforts at conservation have stemmed the tide at a few places, but the pace of change is likely to make even such amelioration temporary unless more concerted resources are invested into country-wide environmental improvement.

Main area of study 0.3

This account of the flora is based on detailed personal knowledge of one area and its natural history, and on accumulated records over many years by a great many people. This area of the central Buckinghamshire Chilterns has as its focus what was until the 1960s a tiny hill-top agricultural village called Prestwood, famed for its cherry orchards. It is now a major modern settlement covering what was once Prestwood Common, although that large area of heathy grassland had already been largely lost to the Enclosures in 1860. The area (see map below) extends over some 100 square kilometres, from Great and Little Missenden in the east to (but not including) Naphill Common in the west, and from the Great and Little Hampdens and Cobblershill in the north to the edge of the High Wycombe conurbation at Hughenden, Cryers Hill and Holmer Green in the south. This area covers parts of three civil parishes – Great Missenden, Hughenden and Great Hampden. It includes the whole of the ecclesiastical parish of Prestwood.



Key to major sites numbered on the above map

1 Acrehill Wood
2 Angling Spring Wood
3 Atkins Wood
5 Brickpits Pond
6 Chalkdell Wood
7 Coach Hedgerow
8 Cockshoots Wood
9 Coneybank Wood
10 Crooks Wood
11 Deep Mill Pond
12 Dennerhill Pond
13 Flowers Bottom (Speen Access Land)
14 Gomms Wood
15 Great Hampden Churchyard
16 Grubbins Plantation
17 Haleacre Wood
18 Hampden Common
19 Hampdenleaf Wood
20 Hatches Wood and Bank
21 Haypole
22 Hobbshill Wood
23 Holy Trinity Churchyard
24 Kiln Common Orchard; Greenlands Lane Allotments; Prestwood Nature Wildlife Garden
25 Langley's Wood
26 Little Hampden Churchyard
27 Little Hampden Common
28 Lodge Wood
29 Longfield Wood
30 Millfield Wood
31 Missenden Abbey Park
33 Monkton Wood
34 Nanfan Wood
35 Old Orchard
36 Pepperpots Wood (formerly part of Lodge Wood)
37 Perks Lane Picnic Site (Prestwood Nature Reserve)
38 Peterley Manor Farm and Pond
39 Peterley Wood
40 Piggotts Wood
41 Prestwood Park
42 Rignall Wood
43 Sandwich Wood
44 Sheepwash
45 St Peter & St Paul Churchyard
46 Stonygreen Bank
47 The Glade
48 Warren Wood
49 Wibner Pond
50 Widmere Field

The area has a concentration of biological records in recent times because of the formation in 2002 of Prestwood Nature, a local conservation group and registered charity. Although the main purposes of the group are to involve the community in active conservation measures, such a group of people with a strong interest in natural history naturally note what they see around them and constitute a considerable resource for biological recording. The author has therefore taken an active role in collating such observations, adding to the ecological surveys he and others have carried out in the locality. To these have been added historic records from various sources and all data relating to the area from the Buckinghamshire and Milton Keynes Environmental Records Centre (BMERC).

The focus area as described (referred to in the text as "our area" or "the area") is typical of most of the Chilterns, although excluding the escarpment with its concentration of high profile nature reserves of the Berkshire, Buckinghamshire and Oxfordshire Wildlife Trust (BBOWT), and the National Nature Reserve of Aston Rowant. The Prestwood plateau is slightly cooler and wetter than the Chilterns generally, and first dates of flowering, for instance, tend to be slightly later. Farmland still accounts for three-quarters of the landscape. The proportion of arable to pasture has varied considerably over time, but currently about two-thirds of farmland is pasture, which therefore occupies half of the district. Another 15% is occupied by woodlands, and 10% by human settlements.

Typical farmed landscape of improved pasture interspersed with woodland and hedgerows (Stony Green 2013)

The bulk of the pastureland is "improved" in agricultural terms, i.e. has been fertilised to encourage the growth of grasses nutritious to stock, and has a limited number of species of flowering plants (largely dandelions and buttercups). Little is cut for hay, which has largely been replaced by silage, where the grass is cut while still green and flowers have not set seed, which reduces the diversity of species. A significant proportion of pasture has recently been replaced by horse paddocks, for which there is considerable demand from a growing equestrian leisure industry. Such paddocks are generally very low in biodiversity.

Horse paddock and arable field, Atkins Farm, 2013

Most woodland in the area is formally "semi-ancient", but much altered by the timber industry over centuries and recently neglected because of the slump in demand for timber and other woodland products. Some woodlands are used for rearing game-birds for shooting syndicates and these are particularly low in plant diversity. There is a private arboretum at Little Kingshill, Priestfield Arboretum, which has a wide-ranging collection of conifers (see Chapter 9, p.20), covering all genera able to grow in Britain.

Overgrown woodland (Lawrence Grove 2006)

Areas of human settlement are not devoid of environmental value. A large part (about a half) is occupied by gardens, which vary considerably in their biodiversity according to how they are used and managed. Allotments, which are usually close to housing, have a role in supporting native arable annual plants displaced from intensively managed farmland. There are often interstitial green spaces between houses that are particularly valuable in relieving the monotony of the built environment and can support ecological communities, although these are considerably affected by the intensity of human use. Buildings themselves are of value for a few species of wildlife – such as swallows, house martins and swifts that build their nests under eaves, and barn owls and bats that may find roosting and nesting sites in the roofs of old buildings. Other "invaders" of our living space, such as fat dormice and grey squirrels, are usually less welcome but nevertheless persistent.

Particularly bio-diverse small garden, Orchard Lane, Prestwood, 2013

Natural Habitats

The following habitats were once characteristic of the area but are now endangered because of changes in land-use:

(1) Common land (acid grassland and heath with gorse scrub) – virtually extinct with no good surviving examples but a few with diminished remnants (Holy Trinity churchyard, Widmere Field, Priestfield Arboretum). The only members of the grass-heath community that are still common are creeping-soft grass *Holcus mollis* and common bent *Agrostis capillaris*. Heath violet *Viola canina* is long-extinct, though once common, while heath-grass *Danthonia decumbens*, sheep's sorrel *Rumex acetosella* and heather *Calluna vulgaris* are now extremely rare. Silver birch *Betula pendula* and foxglove *Digitalis purpurea* are common on more acid soils.

(2) Chalk streams – two such streams arise in the area (Hughenden and Misbourne); both suffer from low flows resulting from a lowered water-table from reduced precipitation and over-extraction for human consumption. Both these upper sections of the streams were always winterbournes, liable to dry up over summer, but now no longer flow at all most years, except for the Misbourne below Deep Mill. Water-cress *Nasturtium spp* and water forgetmenot

Myosotis scorpioides still occur, the first having once supported a water-cress farm between Deep Mill and Little Missenden. Amphibious bistort *Persicaria amphibia* still grows at one site. The best section of the Misbourne is Doctor's Meadow, accessed by the footpath on the west side of Little Missenden church. Here stream water-crowfoot *Ranunculus penicillatus ssp pseudofluitans*, brooklime *Veronica beccabunga*, blue and pink water-speedwells *Veronica anagallis-aquatica* and *V. catenata* (along with their sterile hybrid) all grow.

River Misbourne, Boug's Meadow, Great Missenden, 2013, which has been continuously dry since 2014

River Misbourne, Doctor's Meadow, Little Missenden

(3) Chalk grassland – a few moderately good examples (eg Prestwood Picnic Site, see Marshall 2013), but many in serious decline and reversion to scrub. Common plants in these remnants are yellow oat-grass *Trisetum flavescens*, quaking-grass *Briza media*, glaucous sedge *Carex flacca*, salad burnet *Poterium sanguisorba*, hoary plantain *Plantago media*, rough hawkbit *Leontodon hispidus*, burnet-saxifrage *Pimpinella saxifraga*, hairy violet *Viola hirta*, common spotted-orchid *Dactylorhiza fuchsii* and pyramidal orchid *Anacamptis pyramidalis*. Rock-rose *Helianthemum nummularium* is rare, but there are good communities of Chiltern gentian *Gentianella germanica*.

Chalk grassland slope and scrub, Prestwood Picnic Site 2008

(4) Hay meadows – largely replaced by cutting for silage, these flowery meadows supported communities of butterflies, bees and other insects, and early-flowering orchids now rare or (green-winged orchid *Anacamptis morio*, early purple orchid *Orchis mascula*) extinct locally. Betony *Betonica officinalis* and devil's-bit scabious *Succisa pratensis* are now uncommon, although unfertilised neutral grasslands still hold a good assemblage of common flowering plants

like field scabious *Knautia arvensis*, oxeye daisy *Leucanthemum vulgare*, meadow buttercup *Ranunculus acris*, common sorrel *Rumex acetosa*, cat's-ear *Hypochaeris radicata* and cowslip *Primula veris*. The only two recently surviving meadows containing a good suite of meadow plants, Haypole and a field by the Old Rectory, have both been lost in the last few years through conversion into horse pasture.

Degenerate former hay meadow, Idaho Farm, Prestwood, neglected and with low diversity, dominated by Yorkshire fog grass *Holcus lanatus*

(5) Arable land – once supported a range of annual native plants, but many of these are now rare and endangered, or even extinct in the wild, because of modern chemicals; a few communities with the likes of narrow-fruited cornsalad *Valerianella dentata* and Venus's looking-glass *Legousia hybrida* only survive on unsprayed cultivated field margins on one farm, while a few others live vicariously in allotments. A good number of arable annuals are still commonly found, however, including scentless mayweed *Tripleurospermum inodorum*, common fumitory *Fumaria officinalis*, parsley-piert *Aphanes arvensis*, scarlet pimpernel *Anagallis arvensis*, common poppy *Papaver rhoeas*, petty spurge *Euphorbia peplus* and fool's parsley *Aethusa cynapium*. Dwarf spurge *Euphorbia exigua* and field madder *Sherardia arvensis* are still locally common.

Arable field edge with sharp-leaved fluellen, dwarf spurge and creeping buttercup

(6) Orchards & parklands – a few orchards survive along with fragments of many others. Only one is in active conservation (Collings Hanger) but there are plans to restore others; by far the largest is the Old Orchard, Little Kingshill. All orchard remnants in the area (virtually all on private land) were surveyed by Prestwood Nature in 2010 in association with the national orchard survey run by PTES for Natural England. The hard winter of 2009-10 saw major muntjac damage of orchard trees, as other forage became difficult to find. Old decaying fruit trees provide invaluable habitat for invertebrates, but the ground flora of is usually of little interest. Parklands (eg Abbey Park, Great Missenden; Hampden House; Prestwood Park - see Marshall 1999) may also have important old trees (see below), but their ground flora similarly lacks diversity.

Old Orchard, Little Kingshill

(7) Ponds – most in poor condition. About 100 ponds still exist in the area, no more than a tenth in good order. Only two water-plants can qualify as common in our area - common duckweed *Lemna minor* and floating sweet-grass *Glyceria fluitans*, although contiguous marshes, if these survive, usually hold soft rush *Juncus effusus*, yellow iris *Iris pseudacorus*, and great willowherb *Epilobium hirsutum*. Reed *Phragmites australis*, however, is surprisingly rare.

Sheepwash Pond, Prestwood, April 2011 (restored by Prestwood Nature in 2009)

Larger lake-like ponds can be found along the River Misbourne where it has been impounded for scenic purposes in the past. Those from Deep Mill south are more or less permanent, but the largest ones in Abbey Park, Warren Water and Banks Pond, are dependent on river flow and therefore absent in most years, preventing them sustaining perennial aquatic vegetation.

Warren Water, with Missenden Abbey in background (April 2014)

(8) Ancient trees – veteran trees can each support a unique ecological community of their own but there are few trees in the area over 300 years in age. Only one measured to date exceeds 6m, a fast-growing tulip tree *Liriodendron tulipifera* at Missenden Abbey, probably planted in the C18th. Fourteen trees measure 5m or more, including three pedunculate oak *Quercus robur*, two sycamores *Acer pseudoplatanus* and an ash *Fraxinus excelsior*, which being slower in growth are probably 400 years old; they are joined by 5 sweet chestnut *Castanea sativa*, a cedar of Lebanon *Cedrus libani*, a London plane *Platanus x hispanica*, and a Wellingtonia *Sequoiadendron giganteum*, which are not so old despite their size - indeed the last-named is known to have been planted in the C20th. Trees between 4 and 5m are dominated by pedunculate oak (35 specimens), a tree that was often left as a landmark tree after the decimation of oakwoods for ships' timber in the C17th, while other timber trees like beech *Fagus sylvatica* and ash were largely cropped, especially for furniture-making, and seldom allowed to achieve such an age (only three beech trees measure over 4m and four ash). Sycamores, which were largely used as parkland trees or for majestic avenues, were much more likely to survive to this sort of age (11 specimens). Veteran trees most likely to be threatened are those near residential areas or obstructing new-build.

Ancient ash, Missenden Abbey Park 2007

(9) Semi-ancient woodland – due to a mixture of clear-felling in the past and recent neglect, hardly any of our woodlands, despite being extensive and of long-standing, contain really good examples of ancient woodland flora and fauna communities, and most are in decline. The beechwoods, often seen as a quintessential Chiltern feature, are basically a human artefact of the late 18th century; as these monocultures decline it will be better to encourage a mixture of species that would have been typical of the area in previous centuries. Grey squirrels, muntjac and roe deer (all introduced species, as native roe were hunted out centuries ago) have become major pests and are having an increasingly deleterious effect on the regeneration of woodlands, although the deer do browse brambles and limit their dominance of the forest floor.

There are still many common woodland plants in the area. Common canopy trees are beech *Fagus sylvatica*, pedunculate oak *Quercus robur*, sycamore *Acer pseudoplatanus*, hornbeam *Carpinus betulus*, and ash *Fraxinus excelsior*. Undershrubs are often predominantly holly *Ilex aquifolium* and less dominant yew *Taxus baccata*, but particularly at the edges whitebeam *Sorbus aria*, wayfaring-tree *Viburnum lantana*, hazel *Corylus avellana* and many other trees occur. Common ground-plants include three-nerved sandwort *Moehringia trinervia*, common figwort *Scrophularia nodosa*, woodruff *Galium odoratum*, sanicle *Sanicula europaea*, wood-sorrel *Oxalis acetosella*, yellow archangel *Lamiastrum galeobdolon*, wood spurge *Euphorbia amygdaloides*, wood speedwell *Veronica montana*,the violets *Viola reichenbachiana* and *V. riviniana*, wood millet *Milium effusum*, wood melick *Melica uniflora*, wood-sedge *Carex sylvatica*, and male fern *Dryopteris filix-mas*. Many of the woods are still noted for their splendid displays of bluebell *Hyacinthoides non-scripta* on the upper clays, although these colonies generally lack other species (occasionally coralroot *Cardamine bulbifera* may accompany them, as in Gomms Wood.

Angling Spring Wood 2003 with regenerating beech

(10) Churchyards – non-intensive management has left many as rare oases for wildlife with several uncommon species, especially where longer grass areas are left, as at Great Hampden churchyard, where bistort *Bistorta officinalis*, meadow cranesbill *Geranium pratense*, devil's-bit scabious *Succis pratensis*, and cuckooflower *Cardamine pratensis* may flourish. Holy Trinity churchyard, Prestwood, includes a rare survival of original heathland (Marshall 2017a) in dwarf form because of intensive mowing (and removal of aftermath), including heather *Calluna vulgaris*, tormentil *Potentilla erecta*, heath bedstraw *Galium saxatile* and heath grass *Danthonia decumbens*. The short turf and high incidence of moss and lichen support an internationally important community of waxcaps (23 species so far recorded). Most churchyards, however, fail to achieve such richness due to poor cutting regimes and leaving cuttings *in situ*.

Great Hampden churchyard 2006

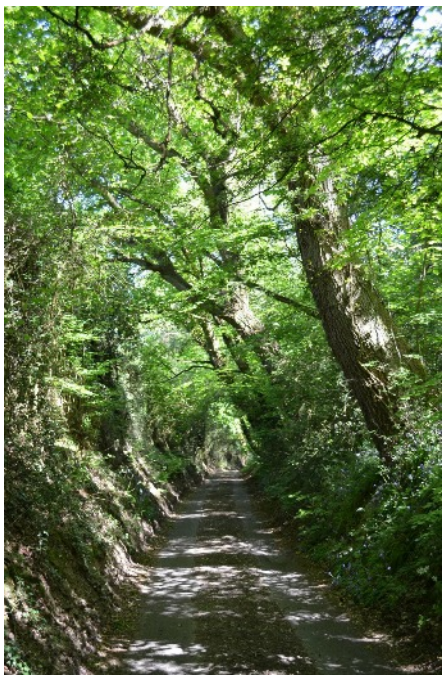
(11) Pasturelands - despite their frequency are almost wholly species-poor because of fertilisation. Some, which have been left unfertilised for several years are recovering some of their original variety, especially where they occur on chalk - prime examples being Meadsgarden Field and Hockey Field, both on the (organic) Wren Davis farm. The former has many cowslips *Primula verum*, much wild marjoram *Origanum vulgare*, extensive patches of large wild thyme *Thymus pulegioides*, many common broomrape *Orobanche minor* parasitic on the clovers, tor grass *Brachypodium pinnatum* and occasionally greater butterfly orchid *Platanthera chlorantha*. The latter, at an earlier stage of re-development, is still dominated by bulbous buttercup *Ranunculus bulbosus* and hoary plantain *Plantago media*. A special suite of pastures close to Collings Hanger Farm has the only county population of corky-fruited water-dropwort *Oenanthe pimpinelloides*, which is here abundant and spreading.

In addition to the above, the following provide interstitial wildlife habitats that provide connections between wildlife areas. They often contain the only survivals of ecological communities that were once more extensive:

(12) Hedgerows Some local hedgerows date back to medieval or even Anglo-Saxon times. Hawthorn *Crataegus monogyna*, blackthorn *Prunus spinosa*, and hazel *Corylus avellana* tend to dominate, but there is also much spindle *Euonymus europaeus* and a range of fruit trees *Prunus* and *Malus*, while many woodland ground-species find their shade congenial, most notably moschatel *Adoxa moschatellina*, but also cow parsley *Anthriscus sylvestris*, lesser celandine *Ficaria verna*, greater stitchwort *Stellaria holostea*, bluebell *Hyacinthoides non-scripta*, goldilocks buttercup *Ranunculus auricomus*, wild strawberry *Fragaria vesca*, and several violets. Modern labour-saving hedge-maintenance unfortunately damages many of our hedges.

Formerly laid ancient hedgerow by Crooks Wood

(13) Road verges and green lanes. Ancient lanes that have avoided the desecration of motorised traffic are often rich in plants, particularly the shade-loving members of woodland and hedgerow communities. Rare plants here may include toothwort *Lathraea squamata*, green hellebore *Helleborus viridis*, leopard's-bane *Doronicum pardalianches*, orpine *Sedum telephium* and dark mullein *Verbascum nigrum*. Most road verges are unfortunately badly managed from a conservation point of view, limiting what would otherwise be an important botanical resource.



Greenlands Lane, Prestwood 2011

Lastly, there are ecological communities, often very changeable and temporary, that arise, and depend, on

(14) Disturbed ground, usually in association with human settlement or industrial sites, including allotments. Allotments are often the last refuge of such arable annuals as corn spurrey *Spergula arvensis*, while night-flowering catchfly *Silene noctiflora* has recently appeared in one Prestwood garden, where it has flourished now for several years. A surprisingly large number of species, both native and garden escapes, flourish alongside the paved, asphalted and concreted areas of the main Prestwood settlement, from red dead-nettle *Lamium purpureum* to purple toadflax *Linaria purpurea,* wall barley *Hordeum murinum*, love-in-a-mist *Nigella damascena*, Canadian fleabane *Erigeron canadensis*, to more recent invaders such as water bent *Polypogon viridis* and whitlow-grass *Erophila verna*. Appropriately managed gardens, too, can be havens for wildlife and many plant species (see Marshall 2009).

Nairdwood Lane allotments, Prestwood 2007

Near the allotments off Greenlands Lane on the edge of Prestwood, Prestwood Nature has established a small wildlife garden as an example of how common colourful flowers can attract lots of pollinators - bees, flies and beetles. In 2018 an experiment was started here to establish a "mini-cornfield", removing turf to establish bare soil where rare cornfield annuals have been sown among rows of wheat, in the hope that populations of these annuals can be self-sustaining with annual cultivation and sowing of wheat in the autumn. Nearly 30 commoner annuals appeared in the first year from long-buried seed, while of 20 rare species that were deliberately sown 15 germinated, including thorow-wax *Bupleurum rotundifolium*, corn cleavers *Galium tricornutum* and field cow-wheat *Melampyrum arvense* (see Appendix II for further details). This experiment owes much to the support and guidance of the volunteers at College Lake BBOWT reserve, who continue to maintain a much larger cornfield of the same kind that has been remarkably successful.

Plan of this book

I have attempted to describe all plant taxa that exist or have existed in our area, including their distribution, frequency, habitat, key sites or examples, ecological associations with other plants and creatures, and human significance. This covers most of the plants to be seen anywhere in the Chilterns, native and introduced. I have therefore added brief notes on other established Chiltern plants that would otherwise not have been included, without, however, any attempt to cover all temporary escapes and planted species recorded in this wider area. I have used not only public records and my personal experience of the immediate area in question, but also a general knowledge of the Chilterns as a whole, gathered over 30 years living there.

I originally intended to feature for each species its status in the National Vegetation Classification (NVC) (Rodwell 1991), as this is a standard reference for contemporary ecological site assessments. In practice, however, I find that the NVC adds little to our understanding of the ecological role of each species, such an attempt to categorise ecosystems faltering in the face of the high degree of inherent variability that has evolved and is still evolving in nature. My reasons for making few references to the NVC are included in Appendix I on Woodland Typologies, describing my attempt to replicate the NVC with local data.

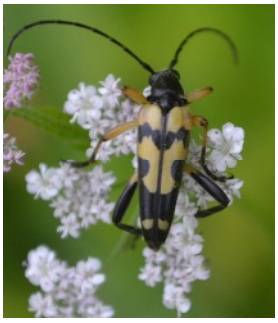
I have departed slightly from the usual practice in Floras of listing plants in their scientific order (which in any case is currently in flux because of ongoing genetic analyses), as I felt it was most helpful to start with the trees, major definers of botanical communities, even though they do not comprise a coherent group in the scientific sense. Volume I therefore covers the trees and larger shrubs. Subsequent volumes, however, are based on the accepted order of families (as per Stace 2019) within each section: Volume II spore-bearing plants, Volume III flowering plants: monocotyledons, Volume IV flowering plants: dicotyledons, Volume V rushes, sedges and grasses. It is important to keep families together wherever possible, as it enables users obtain an idea of these crucial aggregates that give a proper understanding of our flora. Within families I take genera (and, within these, species) in order of descending frequency of occurrence, so that readers will each time be introduced to the plants most likely to be encountered in the area before coming on to the rarer ones. The scientific names for plants have been updated in accord with Stace 2019, which I have also followed, with few exceptions, for their vernacular names, although mentioning other common names and, where relevant, traditional local names compiled by Trevor Hussey.

An important aspect of this Flora are the ecological associations of plants, most of which are my personal records. I firmly believe that one can only really understand our plants in the context of the local eco-system as a whole, not forgetting man, a very influential part of it. These associations drive both longer-term evolution and shorter-term change - they affect both the nature of our plants themselves and their distributions and survival. A vital on-line resource for plant associations is www.bioinfo.org.uk.

Volucella inanis hoverfly

6-spot burnet caterpillar

Tree bumble-bee



Rutpela maculata Longhorn

The Nature of Our Plants

Why do we have the plants we do? Why are some more common than others? Is there anything special about the Chilterns flora?

To answer such questions I have analysed a range of characters of our local flora, as supplied by PLANTATT (Plant Attributes), Hill et al. (2004). These data apply to all the native and established aliens in Britain (i.e. omitting temporary garden escapes), covering 1,885 species. 852 of these species have been recorded in our area at some time (45%). An additional 134 have been recorded at some time in the rest of the two 10-kilometre squares (SU89 and SP80) that include most of our area (from Preston at al. 2002).

The plants studied have been classified as follows:

Never present - Recorded in SU89/SP80 but not recorded in our area (134)
Extinct - Recorded in our area at some time but no longer present (99)
Rare - Present in our area at only one or two sites (166)
Uncommon - Present in our area at fewer than 10 sites (194)
Occasional - Present in our area at 10-20 sites (150)
Common - Present in our area at over 20 sites (243).

In addition, within the last category, I have also looked at the 40 most ubiquitous plants in our area that dominate the vegetation (see list of *Dominants* in Table VII at end of this chapter).

Status

Of the British plants 72% are classed as "native", having been in this country before the advent of man. Natives account for two-thirds of our local flora, a slightly lower proportion than for the national flora. Categories that are over-represented locally are "archaeophytes" (species introduced before 1500: annuals of arable land mostly fall here) - 105, or 70% of all British archaeophytes; "neophytes" (species introduced after 1500) - 147, or 57% of all British neophytes; and "alien casuals" (escaped crop-species, mostly grasses) - 6, or half of all the British ones. This shows a greater influence of man on the flora in this part of the country than elsewhere, largely through farming. Altogether, "aliens" (including neophytes) make up 23% of the national flora but 30% of our local plants.

Although "archeophytes" are regarded strictly as "aliens", they have all been around for over 500 years and some of them for millennia, so they should really be regarded as honorary natives. They include many of our most established and appreciated flowers, such as the poppies. If one includes them with the true natives, then 79% of our local flora are members of the long-established British flora, which is almost exactly the same as the national figure (80%). The distinction is more academic than useful, as it is extremely difficult to be sure when and how many of our plants arrived on these shores after the last Ice Age, and decisions on status are made on the basis of balance of evidence rather than certainties. (Applying the same argument, one would have to say that no person could claim to be native British unless they could prove their descent from the first Neolithic settlers.) Most "neophytes" and other aliens have never become a significant part of our flora, as can be seen in the fact that 92% of our common plants are members of the established flora (natives and archaeophytes). This includes all but one of the 40 dominant plants in our area. The exception is Sycamore *Acer pseudoplatanus*, currently classified as a neophyte, although there is evidence that it was here in Roman times and some consider it may even have been native.

Britain has very few endemics (plants that grow in this country and nowhere else) and only two have been reported locally (Plot's Elm *Ulmus plotii*, possibly in error and in any case since destroyed; and Chalk Eyebright *Euphrasia pseudokerneri*, which is rare).

The most up-to-date information on the status (rarity) of our plants is the English Red Data List of BSBI (2014). This has been used in conjunction with the Buckinghamshire Rare Plant Group provisional list of county "rare" and "scarce" species. The full list of these "notable" plants, as recorded in our area, is given in Table VIII at the end of this chapter.

One of our species is recorded as "extinct in the wild", Interrupted Brome *Bromus interruptus*. This has also been long extinct in our area except for a few plants in cultivation in a garden in Hughenden Valley. Another extinct local plant, Corncockle *Agrostemma githago*, was formerly given "extinct in the wild" status, but has now been placed on BSBI's "Waiting list", leaving its status undecided. This species is often included in packets of "wildflower" seed (presumably from European stock) and is often seen where people have scattered these mixtures, which complicates the picture, although they usually appear for just one year and vanish the next. It continues to be cultivated in the arable plot at BBOWT's College Lake nature reserve. Both these extinct plants were annuals of arable ground, the brome especially with crops of sainfoin, which is no longer grown as such today.

There are nine species described as "Critically endangered", the most serious category of threat in the list (based on European Community criteria). Six of these are in our "Never present" group and the other three are all now locally extinct - Pennyroyal *Mentha pulegium* (also extinct in Bucks), Starfruit *Damasonium alisma* (rare in Bucks and virtually extinct), and Red Hemp-nettle *Galeopsis angustifolia* (scarce in Bucks). Starfruit became locally extinct in 1960 when the farm pond where it grew was filled in. It has been seen more recently in two restored ponds on Downley and Naphill Commons close to our area, but is no longer present there (although the long-lasting seeds may survive in the soil).

Another 19 species are "Endangered", of which 8 were "Never present", 7 are now locally extinct, two are locally rare and two locally uncommon. These last four are Nettle-leaved Goosefoot *Chenopodium murale*, Shepherd's-needle *Scandix pecten-veneris*, Yellow Bird's-nest *Hypopitys monotropa*, and Narrow-fruited Cornsalad *Valerianella dentata*. The first two are in serious danger of becoming locally extinct (if they are not already so). Three are annuals of arable land, now restricted to just a few field-margins. Yellow bird's-nest is difficult to assess because it does not flower every year and grows in just a few dark woods, but it does not appear to be any less frequent than formerly.

43 plants are "Vulnerable" on the English list. 11 of these were "Never present" and 18 are now locally extinct. That leaves 14 that are still present in our area, of which three are rare, seven uncommon, two occasional and two even locally common! These last two are Dwarf Spurge *Euphorbia exigua* and Yellow Archangel *Lamiastrum galeobdolon ssp galeobdolon*. The first is prevalent in arable field edges and in other cultivated ground (e.g. on the Lovell Estate in Prestwood), while the second is common in our ancient woods. Neither appears to be under threat, although the archangel is losing some ground to the aggressive garden subspecies in the margins of its distribution near houses. Stinking Chamomile *Anthemis cotula* is less frequent but scattered across arable land, while White Helleborine *Cephalanthera damasonium* seems to have had a recent resurgence, small colonies appearing in new areas where it has not been recorded before. It has been protected from deer-predation by Prestwood Nature conservation volunteers at one of its new sites. Of the seven uncommon species placed here,

three have well-established colonies in a few sites - Basil Thyme *Clinopodium acinos*, Bird's-nest Orchid *Neottia nidus-avis* and Chiltern Gentian *Gentianella germanica*. The last of these has large colonies (over a hundred plants) at two local sites, at both of which Prestwood Nature volunteers have been involved and numbers have increased. PN has also been involved with protecting bird's-nest orchid from deer predation at one site (although combating slugs is another matter). Of the rare species, Fly Orchid *Ophrys insectifera* has not been reported for a while and is in imminent danger of joining our extinct list; Chalk Eyebright (see above) is constant in small numbers at two sites; and Night-flowering Catchfly *Silene noctiflora* appeared in our area for the first time in 2013 and persisted through 2019 after seeding abundantly. It is also protected by a member of Prestwood Nature who happens to be the landowner.

The BSBI list also includes two of our plants under the heading "Data deficient", meaning that for various reasons it is difficult at the moment to assess their status. One of these is Box *Buxus sempervirens*, which is occasional in our area but whose status as native or introduction is often ambiguous. The other, Narrow-lipped Helleborine *Epipactis leptochila*, is uncommon and probably decreasing.

In addition to these English Red List plants (of which 20 are extant in our area), we also have 22 species on the Bucks rare list (6 extant plus 7 extinct) and 51 on the scarce list (21 extant plus 8 extinct) that can be added to our list of Notable plants. On the rare list we have the only Bucks populations of Brittle Bladder-fern *Cystopteris fragilis* and Corky-fruited Water-dropwort (locally "Prestwood Parsley") *Oenanthe pimpinelloides*. The former is protected by the managers of the church were it grows, but could easily be wiped out by a series of drought years. The latter grows in vast numbers in and around a single core site and is still expanding its distribution, although limited in one direction by insensitive road-verge cutting (the cause of several local extinctions). Meadow Clary *Salvia pratensis* is close to extinction in the county and also at the one site where it still grows in our area, where despite efforts by PN volunteers and others (brush-cutting and caging plants from deer) it is still not receiving appropriate management from the landowners. As a long-lived plant it will probably persist for some years yet, but it does not seem to be regenerating. From the Bucks "scarce" list, 16 are locally rare, including Lesser Hairy-brome *Bromopsis benekenii* which may have already become extinct, Heath Spotted-orchid *Dactylorhiza maculata* which appeared inexplicably once in chalk pasture, Toothwort *Lathraea squamaria* and Water-purslane *Lythrum portula* both vulnerable because established just at one site each. Neither Hybrid Gentian *Gentianella x pamplinii* nor Hard Shield-fern *Polystichum aculeatum* appear threatened, although they grow only at a couple of sites each. Of the four that are locally uncommon, their chance of survival appears to be good. Three grow at Prestwood Picnic Site and Nature Reserve (Fragrant Agrimony *Agrimonia procera*, Wild Pear *Pyrus communis* and Sweet-briar *Rosa rubiginosa*), while Pale Lady's-mantle *Alchemilla xanthochlora* continues to grow well at several sites. Harsh Downy-rose *Rosa tomentosa* has also been noted at the Prestwood Nature Reserve and in several other areas of scrub and hedges.

We have records of five plants said to be extinct in Bucks, one "Never present", three locally extinct, but one, Cornflower *Centaurea cyanus*, that survived for some years recently in one field after being deliberately introduced. It is not clear whether its seed survives there and whether it might therefore re-appear in future years when conditions are appropriate.

Thus in total we have 48 notable plants that are still, as far as we can tell, extant in our area, although quite a few of these have not been reported recently and may be approaching

extinction. I would assess 12 as Critically Endangered, 7 as Endangered, 17 as Vulnerable and 12 as Not Threatened (see Table VIII at the end of this chapter).

Table I: national versus local frequencies

No. 10km GB squares	Never present	Locally extinct	Rare	Uncommon	Occasional	Common	Dominant
0-1250	80%	73%	77%	59%	35%	9%	0%
1251-1750	4%	11%	12%	17%	24%	16%	2%
1751-2805	15%	15%	12%	23%	41%	75%	97%

The frequency of local plants is strongly correlated with their frequency nationwide (table I above). Of our 40 dominant plants, 36 (90%) grow in over 2250 (80%) of the 2805 10-km squares in Britain. Three-quarters of our 243 common plants exist in over 1750 squares, while over three-quarters of our rare plants are found in fewer than 1250 squares. What is more interesting is the minority of plants that buck the national trend. Almost two-thirds of these (13 of 21) are inhabitants of chalk soils (which excludes large parts of the country) - Hoary Plantain *Plantago media*, Greater Knapweed *Centaurea scabiosa*, Salad Burnet *Poterium sanguisorba*, Dogwood *Cornus sanguinea*, Wild Marjoram *Origanum vulgare*, Dwarf Spurge *Euphorbia exigua*, White Bryony *Bryonia dioica*, Hairy Violet *Viola hirta*, Traveller's-joy *Clamatis vitalba*, Pyramidal Orchid *Anacamptis pyramidalis*, Wayfaring-tree *Viburnum lantana*, Dark Mullein *Verbascum nigrum*, and Whitebeam *Sorbus aria*. The last was only recorded nationally in 225 10-km squares, even though it is to be found at the edge of almost any woodland in our area. Others are planted trees for which only native national squares were counted, or those where the tree was naturally regenerating. These are Lime *Tilia x europaea*, Scots Pine *Pinus sylvestris*, and Lawson's Cypress *Chamaecyparis lawsoniana*. The others are native plants, and one well-established neophyte, which have more limited national distribution for less evident reasons - Southern Woodrush *Luzula forsteri* and Wood Spurge *Euphorbia amygdaloides* (both of which require very warm summers), Cherry-plum *Prunus cerasifera* (the one neophyte), Yellow Archangel *Lamiastrum galeobdolon*, and Early Dog-violet *Viola reichanbachiana*. Apart from the planted trees, these comprise a good list of typical Chilterns species, although shared with other southern chalk areas. To these might be added the 52 "occasional" species that are also of low national incidence.

At the other end of the spectrum are the locally rare species that are nationally common (20). These are more mixed in character. They include two annual species of open dry conditions, usually on somewhat acid soils, Squirreltail Fescue *Vulpia bromoides* and Changing Forgetmenot *Myosotis discolor*. There are also several other species associated with acid soils - Polypody *Polypodium vulgare*, Heath Spotted-orchid *Dactylorhiza maculata*, Golden-scaled Male-fern *Dryopteris affinis ssp affinis* (although our record was probably a transcription error for *ssp borreri*), Short-fruited Willowherb *Epilobium obscurum*, Heath-grass *Danthonia decumbens*, and Heather *Calluna vulgaris*. Many are plants of wet places - Butterbur *Petasites hybridus*, Small Sweet-grass *Glyceria declinata*, Amphibious Bistort *Persicaria amphibia*, Tufted Forgetmenot *Myosotis laxa*, Sharp-flowered Rush *Juncus acutiflorus*, Ragged-robin *Silene flos-cuculi*, and Common Spike-rush *Eleocharis palustris*. The rest are varied - Spreading Meadow-grass *Poa humilis*, Spring-sedge *Carex caryophyllea*, Early Purple Orchid *Orchis mascula*, Zigzag Clover *Trifolium medium* and Common Valerian *Valeriana officinalis*. All these are more

associated with regions of lower average temperature than pertain locally, and this applies to virtually all the previous plants as well, so that this may be the main limiting factor. In this case, in the event of rising average temperatures with climate change, we can expect further restrictions and extinctions in this group of species. I look at this in more detail below.

Change

Past changes in frequency of different plants are represented in PLANTATT by an index for change in number of occupied 10km squares between 1930-60 and 1987-99, thus more or less over the second half of the last century. An index exists for 737 or our plants and they occupy the whole range of national variation. The index fails to correlate with present frequency in our area, with over half of currently common plants (51%) having suffered decreases nationally, some of them very considerable ones. It is likely that this is a statistical artefact, as an already common plant can hardly increase its abundance and is more likely to show a decline than an uncommon one. Declines are therefore only really significant if they occur in species that are already scarce. So it is probably meaningful that 66% of our locally extinct plants had suffered national declines over this period, their disappearance part of a wider trend.

It might be thought that perennial plants (which make up 70% of our flora) would be better able to survive than annual or biennial ones. It is certainly true that our common plants are more likely to be perennials (77%), but the difference from the less common groups is not marked. The annuals' strategy of producing a lot of seed and relying on chance to find suitable germination sites is more successful than one might think.

A further analysis of change in our flora, based on local data, is presented in the next section of this Introduction.

Biome and climate

Our plants can be classified according to their wider distributions across the world according to longitude (Arctic, Boreal, Temperate, Mediterranean) or latitude (Atlantic, European, Eurasian or worldwide). (As noted above, there are very few British endemics.) The largest proportion (29%) belongs to the Temperate European "biome" (biological region), and almost half are members of the exclusively Temperate zone. Of the rest, more are associated with warmer climates (Mediterranean or Temperate-Mediterranean 33%) than with cold-temperate ones (19%). There is no consistent relationship between biome and local frequency, and probably there is no reason to expect that worldwide distribution would be of relevance to local occurrence.

It may be of some interest, however, to look at those plants that belong to biomes other than the Temperate one to which we would expect this area to belong. Even among the 40 dominant species there are 14 associated with hot temperate regions, but all of these have wider distributions spanning both the Mediterranean and temperate zones. There are, however, three common plants associated with the "Mediterranean-Atlantic suboceanic" zone, where temperatures are moderated somewhat by oceanic influences. They include two mentioned above as having particular association with our area while being uncommon nationwide - Southern Woodrush and White Bryony. The other is Black Bryony *Tamus communis*.

Similarly there are 8 of our dominant species associated with Boreal-temperate zones, but none associated with colder regions only. It may be worth listing these, however, as plants that might become less common in the event of a warming climate. They are Red Fescue,

Germander Speedwell, Common Nettle, White Clover, Common Mouse-ear, Cow Parsley, Hogweed and Yarrow. It is difficult to contemplate these species declining, as they are so familiar, but if we were to gain a more Temperate-Mediterranean climate, perhaps it could happen. Would our common nettle be replaced by Roman nettle, prevalent in warmer parts of Europe?

There are two common species described as "Boreal-montane Eurasian", perhaps surprising for our area, but it turns out that both are planted trees from northern climes - Scots pine and Norway spruce. There is no evidence of local regeneration of either of these plantation trees (seedlings may occur but never mature), which is not surprising on climatic grounds.

Within England the Chilterns form a distinct chalk ridge clearly different botanically from the heavy clays of the Aylesbury plain to the north and the Thames Valley and Eocene sands to the south, but they hardly have a distinct flora of their own, being part of the broader southern chalk-hill eco-system, most of which is south of the Thames. It is thus a northern outpost of this system and many of the associated plants are at their limits here. Only a few plants - I have listed just 19 in Table IX at the end of this chapter - have their British distribution concentrated in the Chilterns, although even most of them do have a wider range (based on Preston et al. 2002). They are all chalk species. That large part of the Chiltern flora on the clays is not distinct from that elsewhere in England, or at least southern England. A few of these "Chiltern specialities" are endangered species or rare even within the Chilterns, but 12 are present in our area (4 rare, 4 uncommon, 3 occasional and 1 common), limited more by the paucity of good chalk grasslands than anything else. Only one of the 19 was ever present and now extinct, so that these are species that are generally well-adapted to the area, even if they are mostly uncommon.

We can take a closer look at the effects of temperature and rainfall, as PLANTATT supplies the mean temperatures for January and July for the 10-km squares where each plant occurs in Britain, and similarly the annual precipitation. These are all averaged over the period 1961-90.

January mean temperatures across Britain range from -1.3°C to 7°C, but locally our plants do not include those from the extreme ends of this range. The current mean January temperature for our area (High Wycombe weather station) is 3.8°C. Nevertheless, over half of our plants have PLANTATT averages of 3.5-3.7. More than half our common plants are in an even lower range, 3.5-3.6 (where 87% of our dominant plants lie). January temperatures have got warmer since 1961-90 and it appears that our most prevalent plants are lagging behind in terms of this change. Vegetation change is far slower than the speed with which our climate is currently changing, limited by availability of other plants to spread naturally from nearby areas. As the composition of our flora changes we can be expected to lose many of our less common plants adapted to low January temperatures and this may not be compensated by new arrivals, at least for some time. If we take those plants that are adapted to a mean January temperature of less than 3.5°C, these total 99 species that may be seen as in danger of local extinction. This includes 29 common plants and two of our dominant ones - Hairy Bittercress (a weed of bare places) and Wild Cherry (once the mainstay of the local orchard industry, a plant sufficiently iconic to be used in the logo of Prestwood Nature). It would take a long time for these common plants to disappear, although they may gradually become less frequent or more confined to shadier or cooler micro-habitats. They may also be common because they are adapted to a wider range of climate conditions, in which case they may be less affected by

changing temperatures. More desperate may be the plight of those low-temperature adapted species that are already rare (28 in total, with 21 more uncommon). Particularly in danger are Brittle Bladder-fern *Cystopteris fragilis* (one site, mean January temperature index 2.6), Lesser Hairy-brome *Bromopsis benekenii* (which may already have become extinct, index 3), Sweet Cicely *Myrrhis odorata* (which has also not been seen for several years, index 3), Pale Sedge *Carex pallescens* (one site, index 3), Hard Shield-fern *Polystichum aculeatum* (2 sites, index 3.2), Crosswort *Cruciata laevipes* (2 sites, index 3.2), Toothwort *Lathraea squamaria* (2 sites, index 3.3), Hairy Rock-cress *Arabis hirsuta* (2 sites, index 3.3), Common Bistort *Persicaria bistorta* (2 sites, index 3.3) and Narrow Buckler-fern *Dryopteris carthusiana* (2 sites, index 3.3).

On the other hand, some plants already growing in our area that have indices above 3.8 may become more frequent. None of these are currently dominant, but 16 common ones may be poised to become so with warmer winters. These include Southern Woodrush *Luzula forsteri*, Pyramidal Orchid *Anacamptis pyramidalis* (which has certainly been increasing of late), Wood Spurge *Euphorbia amygdaloides*, Scarlet Pimpernel *Anagallis arvensis*, Wild Carrot *Daucus carota*, Traveller's Joy *Clematis vitalba* and Common Centaury *Centaurium erythraea*. It may be, however, that dependence on particular habitats will prevent these species from making any great leap forward, a factor we consider later on. There are also 38 species not currently in our area that have been found nearby and are adapted to higher January temperatures. These might be thought to be potential immigrants to our area, but all are rare and none seem likely colonists, apart from a few wasteland species such as Hound's-tongue *Cynoglossum officinale* and Annual Wall-rocket *Diplotaxis muralis*. The most likely new colonists are probably new aliens whose seeds are capable of dispersal over a long distance (as is occurring currently with several fleabanes *Conyza spp*).

July mean temperatures across Britain range from 10.4°C to 17°C, and our plants span all but the extreme ends of this range. The current mean in our area (High Wycombe weather station) is 17°C, right at the upper boundary of the 1961-90 range. As with the January temperatures, over half of our plants cluster in the lower range 14.4 to 15.3°C, where 87% of our common plants appear. 87% of our dominant plants lie in the lowest part of this range, 14.4 to 14.7°C. Many of them grow in shady habitats, such as woods or hedgerows, which limits the effect of summer radiation. Those species (55) not adapted to higher July temperatures (indices 11.7-14.3°C) may be particularly disadvantaged in future. These include two common plants, but one is the planted Scots Pine, which already fails to regenerate. The other, which might well be in the process of becoming less frequent, is Procumbent Pearlwort *Sagina procumbens*, of which there are fewer recent records than earlier ones. Three "occasional" species also occur in this group and could well be vulnerable - Wild Thyme *Thymus polytrichus*, Slender StJohn's-wort *Hypericum pulchrum*, and Heath Woodrush *Luzula multiflora*. On this basis, 12 uncommon and 16 rare species are under threat. Interestingly, 22% of species known to have become extinct in our area fall in this low July temperature band.

On the other hand, the future may truly be bright for a substantial number of species adapted to higher July temperatures. Those at the highest level (index 16.2-16.9°C), 38 in total, already include four common plants - Whitebeam *Sorbus aria*, Southern Woodrush, Dark Mullein *Verbascum nigrum*, and Wayfaring-tree *Viburnum lantana*. These all have the potential to become even more prevalent. There are also five occasional species that may also expand their populations - Box *Buxus sempervirens*, Grass Vetchling *Lathyrus nissolia*, Violet

Helleborine *Epipactis purpurata*, White Helleborine *Cephalanthera damasonium* and Round-leaved Fluellen *Kickxia spuria*. Many of these species have already shown a tendency to increase in the last few years.

July temperatures show a strong relationship with local frequencies, as Table II shows. Frequency is low for the lowest temperature band, but then high for temperatures just above this, frequency then gradually declining with higher temperatures. As the condition of our flora lags behind changes in climate, one can expect the peak (currently at 14.4-14.5 °C) to rise to 15 °C or more. With the distribution in this table skewed as it is, this would favour more plants than it disadvantages, higher temperatures being associated with greater diversity.

Table II: July mean temperatures against local frequencies

July mean temperature °C index for each plant	**% Local plants extinct, rare or uncommon**	**Total in sample**
11.7-14.3	91	55
14.4-14.5	24	117
14.6-14.7	27	90
14.8-14.9	40	93
15.0-15.1	47	81
15.2-15.3	49	88
15.4-15.7	68	146
15.8-15.9	73	83
16.0-16.9	80	99

Higher diversity, however, depends on how readily species not currently present in the area can become established to replace the inevitable extinction of species adapted to cooler summers. 72 species currently recorded from the wider 10-km squares but not from our area (55% of all such species) favour average July temperatures of 15.4 °C or higher. Some species not yet present in the region at all, however, may be able to expand their distributions markedly (as has happened with the alien fleabanes *Conyza* spp).

Table III: precipitation levels against local frequencies

Annual precipitation index for each plant (mm.)	**% Local plants extinct, rare or uncommon**	**Total in sample**
596-750	83	54
751-800	76	78
801-850	67	108
851-900	64	96
901-950	49	92
951-1000	46	90
1001-1050	34	74
1051-1100	30	118
1101-1150	36	98
1151-1930	93	44

Annual precipitation in our area is quite low (815mm annually at High Wycombe 1970-2010) compared to the country generally. The PLANTATT indices range from 553-3218mm nationally, but only 596-1930 for our local plants. The current median rainfall index for our plants is about 950mm, and the median for our dominant plants is between 1050 & 1100mm. Thus comparison of local plant frequencies in Table III shows current flora adapted to the wetter levels, frequency regularly increasing with precipitation levels up to 1150mm, when it suddenly plunges. Although it is agreed that our climate is on a warming trend, the overall effects on rainfall are less clear, with wetter winters and drier summers predicted. If our climate overall does get drier, averaged over the year, then many of our plants will in trouble. If rainfall increases to 1150mm, however, a small group of 44 wet-adapted plants might be favoured, although they are almost all currently uncommon, only one being common (those planted Scots Pines again!) and two being occasional (Wild Thyme *Thymus polytrichus* and Tutsan *Hypericum androsaemum*). Such an increase, however, seems very unlikely.

Habitat

Habitats more frequently associated with local plants compared to the national flora, of which they comprise 45%, are: built-up areas & gardens (75% of the national flora), improved grassland (68%), arable, horticultural and orchards (66%), broad-leaved and mixed woodland (66%), neutral grassland (64%), boundary and linear features (e.g. hedgerows, roadsides) (63%), standing water (52%) and calcareous grassland (49%). Acid grassland, rocks, and other wetland habitats are all *under*-represented. This confirms the earlier observation of our local habitats being mostly associated with man's influence, although all habitats, even those like woodlands and chalk grassland, are radically affected by human management or the effects of pollution, and we cannot pretend to *any* purely natural habitat.

Our dominant plants are mainly those of boundary features (60%), neutral grassland (40%), and woodlands (35%). [Note that many plants occupy more than one habitat.] Common plants (which include the dominant species) are again mainly found in boundary features (41%), woodlands (36%) and neutral grassland (24%). Although overall our flora is largely affected by obviously man-made features, it is interesting that our common plants are associated with more natural environments, and less with built-up areas.

Different habitats show quite different implications for frequency.

Boundaries are associated with the largest number of species (40%), but many of these plants grow in other habitats as well (apart from wetlands), and are therefore such a generalised group that they show no consistent tendency in terms of plant frequency. Typical plants include Garlic Mustard *Alliaria petiolata*, Cow Parsley *Anthriscus sylvestris*, Blackthorn *Prunus spinosa*, Field Rose *Rosa arvensis* and Hedge Woundwort *Stachys sylvatica*.

The next most common habitat is broad-leaved woodland (24%), unsurprising in view of its extent in the Chilterns as against much of the rest of the country. Plants in this group are much more like to be common and less likely to be locally extinct to uncommon. They even include 14 of our dominant species. Typical members are Wild Cherry, Holly, Ash, Beech, Greater Stitchwort and Wood Avens, which all also occur in hedgerows.

The third most common habitat is built-up areas and gardens (20%). These species are concentrated in the rare to occasional frequencies, with fewer than expected extinct and common plants. Highly adapted to man's presence, these species are missing from semi-natural habitats such as grasslands and woods and so seldom able to become really common, although

the persistence (even increase) of this habitat means that there is low danger of local extinction. Typical plants are Lawson's Cypress *Chamaecyparis lawsoniana* (planted), Annual Pearlwort *Sagina apetala/filicaulis*, Spanish Bluebell *Hyacinthoides hispanica* and the Periwinkles *Vinca major/ minor.*

Another major habitat is arable land (15%), which shows no association with frequency, which is surprising because of the great losses that have been suffered by many arable annuals. While there have been undoubted local extinctions in this group (18) and many are rare to uncommon (45), there are still many denizens of cultivated ground that doing very well, including 6 dominant species. Typical of those doing well are Dwarf Spurge *Euphorbia exigua*, Field Pansy *Viola arvensis*, Scarlet Pimpernel *Anagallis arvensis* and Perennial Sow-thistle *Sonchus arvensis*. Some of this group also grow in built-up areas and hedgerows/roadsides, which enables them to be quite general in their coverage of the area (e.g. Cleavers, one of our dominant plants).

Good quality calcareous grasslands have become increasingly rare, but they are still associated with 13% of our species. A slightly above-average number are common or occasional, although few have become dominants because of their absence from other soils. The scarcity of well-maintained chalk grasslands has led to some species becoming locally extinct (10) or uncommon (35), but there are plenty of representatives which are more robust in their demands and are doing quite well. Examples of the latter are Hedge Bedstraw *Galium album*, Perforate StJohn's-wort *Hypericum perforatum*, Hoary Plantain *Plantago media* and Salad Burnet *Poterium sanguisorba*. Those which have declined are those that need warm dry short turf with bare patches, associated with a particularly high level of calcium and probably only achievable with sheep-grazing.

Neutral grasslands support almost as many species as the calcareous ones (12%) and a high proportion of these are common (56%, almost double the general rate) or dominant (15%, three times the general rate). This may be because of this habitat increasing in extent, coupled with the loss of truly calcareous and acid pastures, largely because of farming practices, although air pollution has also played a part in changing the typical chemistry of our soils. Dominants from this group include Creeping Cinquefoil, Cock's-foot grass, Yarrow, White Clover and Common Mouse-ear. Some species are equally happy on calcareous soils and these are often now the commonest species in our chalk grasslands - the likes, for instance, of Ribwort Plantain *Plantago lanceolata*, Self-heal *Prunella vulgaris*, Yellow Oat-grass *Trisetum flavescens*, Oxeye Daisy *Leucanthemum vulgare* and Red Clover *Trifolium pratense*.

Marsh habitats support 12% of our local flora. These species, however, are highly over-represented in our extinct to uncommon categories, only 12 are common and none dominant. We have lost 15 species and a further 52 are rare or uncommon. The drying out of the area, partly a matter of recent climate shifts and partly because of over-extraction of ground water for a growing population, has much reduced the extent of this important habitat, with its unique range of species. This drying-out has been a long-term influence, as streams regularly ran in local valleys in Anglo-Saxon times that have now been dry for centuries. Many are now occupied by roads and suffer after exceptionally long periods of heavy rainfall, when rivers once again flood down them. The clays on the hill-tops, however, often hold water for sufficiently long to create wet hollows, including tractor-ruts in woodlands, while some old ponds have survived, and these support many of our commonest remaining marsh plants. These include Soft-rush *Juncus effusus*, Yellow Iris *Iris pseudacorus*, Floating Sweet-grass *Glyceria fluitans* and Water-

starworts *Callitriche agg*. An anomaly in this category is that this is where PLANTATT assigns Common Spotted-orchid *Dactylorhiza fuchsii*, which certainly grows in damp places (as it does in Crooks Wood), but is much more associated in our area with chalk grassland, usually quite dry.

The next most frequent habitat (11%) is "inland rock", which with us is essentially walls and chalk scree, but these are too infrequent to support this number of species (95), which mostly survive because they can also make use of other habitats like woodland (e.g. Wall Lettuce *Mycelis muralis*), roadsides (e.g. Shining Cranesbill *Geranium lucidum*) and built-up areas (e.g. Purple Toadflax *Linaria purpurea*). Those actually confined to walls in our area are all uncommon or rare (e.g. Intermediate Polypody *Polypodium interjectum* and Rusty-back fern *Asplenium ceterach*).

Next, both with 9% of our species, come streams and standing water. Membership of both overlaps considerably with the marsh species. Both are characterised by very low proportions of common species and high proportions of extinct to uncommon ones. Species in these groups are generally unable to survive without more or less permanent water, like Blue Water-speedwell *Veronica anagallis-aquatica*, Rigid Hornwort *Ceratophyllum demersum*, and Fool's Watercress *Apium nodiflorum*. (Some classified here in PLANTATT, however, are also capable of growing on wasteland, such as Indian Balsam *Impatiens balsamifera*.)

Acid grassland only accounts for 4% of our species and has become so rare that it is only over-represented in one of the frequency groups - locally extinct! The latter even includes Tormentil *Potentilla erecta*, dominant in many parts of the country. Common Bent *Agrostis capillaris* and Foxglove *Digitalis purpurea* are still quite common, Gorse *Ulex europaeus* occasional, but Heather *Calluna vulgaris* and Heath-grass *Danthonia decumbens* are only just hanging on at one site, where they suffer a rigorous mowing regime (although some mowing is necessary to prevent invasion of more aggressive common species).

It is remarkable that one of our commonest habitats - improved grassland - accounts for only 2% of our species, as it is inherently impoverished in terms of biodiversity, even though the species that do occur are usually common or even dominant. They include many grasses like Meadow Barley *Hordeum secalinum*, Annual Meadow-grass, Smooth Meadow-grass *Poa pratensis*, Red Fescue, and Italian Rye-grass *Lolium multiflorum*. Herbs include Greater Plantain *Plantago major*, Thyme-leaved Speedwell *Veronica serpyllifolia*, Broad-leaved Dock, Dandelion, and Spear Thistle *Cirsium vulgare*.

Another way of looking at plants' environments is by looking at their different needs in terms of light and shade, moisture, soil acidity, and soil nitrogen (enrichment), for all of which PLANTATT supplies relevant data.

In terms of light values, the top score (9) "full sun" is represented only by 17 plants in our area; none of them are common and only 3 occasional. They include Great Burdock *Arctium lappa*, Dwarf Thistle *Cirsium acaule*, Annual Pearlwort *Sagina apetala* and Large-flowered Evening-primrose *Oenothera glazioviana*. Most of our plants (82%) are covered by scores 6-8, light shade to light-loving. Among the semi-shade plants 4-5 (15% of species) common species are over-represented, perhaps reflecting a reduction in open habitats in our area in recent times (overgrown woodlands, building). Only two species score 2 (deep shade) - Violet Helleborine *Epipactis purpurata* (occasional) and Bird's-nest Orchid *Neottia nidus-avis* (uncommon).

In terms of moisture the extremes are represented by relatively few species in our area (Table IV). Very dry conditions (score 2) apply to only 8 plants, all extinct to uncommon. These include the extinct Red Hemp-nettle *Galeopsis angustifolia* and the uncommon Basil Thyme *Clinopodium acinos* and Biting Stonecrop *Sedum acre*.

Table IV: moisture values against local frequencies

Moisture values	**% Local plants extinct, rare or uncommon**	**Total**
2 Very dry	100	8
3 Dry	80	49
4 Dry to moist	53	199
5 Moist	41	285
6 Moist to damp	43	119
7 Damp	55	56
8 Damp to saturated	73	51
9 Saturated	72	25
10 Shallow water	81	31
11-12 Deeper water	97	29

The largest proportion of our plants score 5 (moist) and these have the highest proportion of common species, including most of our dominants (e.g. Broad-leaved Dock, False Oat-grass). Plants that score 6 (moist to damp) are similar and include the rest of the dominants. The dominants are thus totally confined to these two levels of soil moisture content. Slightly drier and slightly moister groups have less than half their species common and rarity increases as one moves towards the ends of the scale. Over two-thirds of our plants are confined to grades 4-6, as are 90% of our common plants. It is plain that beyond a moisture value of 7 plants struggle to survive in our area, although in grades 10-12 rarity is more associated with lack of water features in the area rather than with moisture levels *per se*.

Table V: soil acidity against local frequencies

Soil acidity values	**% Local plants extinct, rare or uncommon**	**Total**
1 extremely acid	100	2
2	86	7
3 acid	76	17
4	59	34
5 moderately acid	63	95
6	49	226
7 weakly acid	50	381
8	64	87
9 calcareous	100	3

In terms of soil acidity, our plants are very clustered at score 7 'weakly acid' (45%), with a further 27% at score 6 (slightly more acid). These scores cover 78% of all our common plants and 89% of our dominants. Hardly any reach score 9 'calcareous' (1 locally extinct, Military

Orchid *Orchis militaris*; 1 rare, Narrow-lipped Helleborine *Epipactis leptochila*; and 1 uncommon, Fly Orchid *Ophrys insectifera*). 87 species, however, score 8 (somewhat calcareous to neutral) and these do include 15 common plants. At the opposite end of the scale, only two extinct plants score 1 'extreme acidity' and most of the seven that score 2 are extinct to uncommon, with the one exception being planted Scots Pines. They include the locally uncommon Wavy Hair-grass *Deschampsia flexuosa* and locally rare Heather *Calluna vulgaris*. Table V shows frequency peaking at scores 6-7 and decreasing with greater acidity or basicity. Most of our soils are on clays of varying degrees of acidity, from neutral to slightly acid on the 'clay-with-flints' and more acid on the 'sandy clay with pebbles'. Areas of very high acidity were the least useful for farming and in the past were generally devoted to common land, most of which is now built over.

Common indicators of more acid soils (3-4) are: Rowan *Sorbus aucuparia*, Creeping Soft-grass *Holcus mollis*, Bracken *Pteridium aquilinum*, Silver Birch *Betula pendula*, Downy Birch *B. pubescens*, Yellow Pimpernel *Lysimachia nemorum*, Sweet Vernal-grass *Anthoxatum odoratum*, Common Bent *Agrostis capillaris*, Broad Buckler-fern *Dryopteris dilatata*, Wood-sorrel *Oxalis acetosella*, Soft Rush *Juncus effusus*, and Foxglove *Digitalis purpurea*. Apart from the grasses and the rush, these are plants of woodland, where most of our acid soil habitat now exists. Soils over chalk often get leached of calcium over time, so that calcareous soils exist only on slopes where soils are thin and calcium is regularly renewed from underlying chalk. Common indicators of moderately calcareous soils (8) are: Traveller's Joy *Clematis vitalba*, Hairy Violet *Viola hirta*, Pyramidal Orchid *Anacamptis pyramidalis*, Salad Burnet *Poterium sanguisorba*, Spindle *Euonymus europaeus*, Common Mallow *Malva sylvestris*, Mugwort *Artemisia vulgaris*, Field Bindweed *Convolvulus arvensis*, Barren Brome *Anisantha sterilis*, Common Toadflax *Linaria vulgaris*, Greater Knapweed *Centaurea scabiosa*, Field Scabious *Knautia arvensis* and Black Medick *Medicago lupulina*. (Spindle is often planted in new hedgerows these days and its distribution is therefore becoming more general, no longer specifically related to chalk, although it may only self-sow on chalk.)

Table VI: soil nitrogen against local frequencies

Soil nitrogen values	**% Local plants extinct, rare or uncommon**	**Total**
1 extremely infertile	100	5
2	69	65
3 somewhat infertile	65	96
4	56	126
5 intermediate	48	169
6	45	205
7 rich soil	54	149
8	64	33
9 extremely rich (polluted)	50	4

Our plants are more variable in terms of the index of soil nitrogen values, i.e. in the degree to which they require rich or infertile soil. Although rarity increases at the ends of the scale, the association is less strong than with the other variables above. Our common plants are mostly (87%) in the range of intermediate to high fertility (4-7). Due to a combination of soil

enrichment by fertilisers for improving farmland and atmospheric pollution, infertile soils are now relatively infrequent and their typical plants less common than they used to be. 24 plants with values 2-3 are still relatively frequent, however. The common ones with score 2 are: Scots Pine *Pinus sylvestris* (but always planted, sometimes on richer soils), Southern Woodrush *Luzula forsteri*, Field Woodrush *L. campestris*, Lady's Bedstraw *Galium verum*, Common Birdsfoot-trefoil *Lotus corniculatus*, Glaucous Sedge *Carex flacca* and Hairy Violet *Viola hirta*. These are often associated with chalk grasslands, reflecting the infertility of their soils rather than their calcium levels.

One common (and dominant) plant is associated with over-enriched soils (score 9) - Broad-leaved Dock. The other plants in this rarified group are Greater Burdock *Arctium lappa*, the rare Wormwood *Artemisia absinthium* and the locally extinct Henbane *Hyoscyamus niger*. Soils with a score of 8, however, are also seriously enriched and they support a wider range of often common plants. Several are dominants - Garlic Mustard, Common Nettle and Cleavers. The other common plants are Hedge Woundwort *Stachys sylvatica*, Bearded Couch *Elymus caninus* and White Dead-nettle *Lamium album.* Soils dominated by these plants have low plant diversity (although some support a wide range of insects).

Summary

Our local flora, in common with the Chilterns generally, is typical of southern England, although it does not include some species associated with the highest temperature regions close to the south coast. Despite the paucity of very calcareous habitats because of the influence of farming and building, it still includes typical chalk flowers, whereas the more acid communities, which were always rarer, mostly limited to the old commons, are very depleted. Our flora is more adapted to lower temperatures and higher rainfall than the climate evident recently in the Chilterns, and the trend to warmer, drier conditions appears likely to continue, which may well entail a gradual change in the composition of our flora favouring a Temperate-Mediterranean element against the purely Temperate element typical in the past. Most of our plants are robust enough in their requirements, however, to be able to survive substantial climate change. The main threats to the rarer plants are more immediate in terms of chemical pollution, increased building and water-extraction pressures, and adverse management of land, most of which is in private ownership, which between them account for virtually all the local extinctions suffered in the past. Of 48 established plants (omitting casuals) that became extinct in our area in the 20th or early 21st centuries, 21 (44%) were because of inappropriate habitat management (6 insensitive road-verge management, 5 fertilisation of chalk grasslands, 4 woodland allowed to become too crowded, 3 neglect of ponds, and 3 withdrawal of grazing). A further 14 were due to habitat destruction altogether (8 loss of heathland, 4 loss of bare dry habitat and wasteland, 1 filling in pond, and 1 cleaning up church walls). Another 7 could be put down to the use of chemicals on arable land, and 2 to pollution (over-nutrification). Only 4 are probably attributable to climate change. These forces are only likely to be exacerbated in future. Most of the plants currently "rare" in our area will probably be extinct within 30 years. Of 25 locally rare plants in Table VIII below, 11 (44%) are critically endangered (some probably gone already), 6 endangered, 6 vulnerable and only 2 appear unthreatened. The sad thing is that these plants are so rare that hardly any local residents have ever seen them and they will not miss them when they are gone. Loss of biodiversity is out of sight and out of mind, so one might say that much of this loss is due simply to human ignorance.

TABLE VII: 40 COMMONEST SPECIES IN THE AREA ("DOMINANTS")

Annual meadow-grass *Poa annua*
Ash *Fraxinus excelsior*
Beech *Fagus sylvatica*
Blackthorn *Prunus spinosa*
Bramble *Rubus fruticosus agg.*
Broad-leaved dock *Rumex obtusifolius*
Chickweed *Stellaria media*
Cleavers (goosegrass) *Galium aparine*
Cock's-foot *Dactylis glomerata*
Cow parsley *Anthriscus sylvestris*
Creeping bent *Agrostis stolonifera*
Creeping cinquefoil *Potentilla reptans*
Creeping thistle *Cirsium arvense*
Dandelion *Taraxacum agg.*
Dog-rose *Rosa canina*
Elder *Sambucus nigra*
False oat-grass *Arrhenatherum elatius*
Garlic mustard *Alliaria petiolata*
Germander speedwell *Veronica chamaedrys*
Greater stitchwort *Stellaria holostea*
Hairy bittercress *Cardamine hirsuta*
Hawthorn *Crataegus monogyna*
Hazel *Corylus avellana*
Herb-robert *Geranium robertianum*
Hogweed *Heracleum sphondylium*
Holly *Ilex aquifolium*
Ivy *Hedera helix*
Mouse-ear *Cerastium fontanum*
Nettle *Urtica dioica*
Perennial rye-grass *Lolium perenne*
Red fescue *Festuca rubra*
Redleg *Persicaria maculosa*
Ribwort plantain *Plantago lanceolata*
Selfheal *Prunella vulgaris*
Sycamore *Acer pseudoplatanus*
White clover *Trifolium repens*
Wild cherry *Prunus avium*
Wood avens (herb bennet) *Geum urbanum*
Yarrow *Achillea millefolium*
Yorkshire-fog *Holcus lanatus*

Grassland dominated by Yorkshire fog

TABLE VIII: LIST OF NOTABLE PLANTS

Major sub-headings are statuses from the Red List of threatened species published by BSBI in 2014, followed by plants not on the BSBI Red List, but which are natives or archaeophytes designated Extinct (not seen since 1970), Rare (3 or fewer sites) or Scarce (4-10 sites) in Buckinghamshire (source: Bucks Rare Plants Group). "Data deficient" covers plants thought to be threatened but for which there is not currently sufficient data to assess the level of threat. "Waiting list" is for plants for which it has not yet been possible to make a final decision. Statuses in italics refer to incidence in our area. Status of locally extant plants is given as C critically endangered, E endangered, V vulnerable and NT not threatened.

Extinct in the wild 1

Extinct 1

Interrupted brome	*Bromus interruptus*		

Critically Endangered 9

Never Present 6 (2 Bucks rare)

Extinct 3

Pennyroyal	*Mentha pulegium*	Bucks extinct	
Starfruit	*Damasonium alisma*	Bucks rare	
Red hemp-nettle	*Galeopsis angustifolia*	Bucks scarce	

Endangered 19

Never Present 8 (2 Bucks extinct, 1 Bucks rare, 2 Bucks scarce)

Extinct 7

Corn chamomile	*Anthemis arvensis*		
Slender eyebright	*Euphrasia micrantha*		
Field gromwell	*Lithospermum arvense*		
Man orchid	*Orchis anthropophora*		
Heath cudweed	*Gnaphalium sylvaticum*	Bucks extinct	
Lesser butterfly-orchid	*Platanthera bifolia*	Bucks extinct	
Spreading hedge-parsley	*Torilis arvensis*	Bucks scarce	

Rare 2

Nettle-leaved goosefoot	*Chenopodium murale*		C
Shepherd's-needle	*Scandix pecten-veneris*	Bucks scarce	C

Uncommon 2

Yellow bird's-nest	*Hypopitys monotropa*		E
Narrow-fruited cornsalad	*Valerianella dentata*		V

Vulnerable 43

Never Present 11 (2 Bucks rare, 3 Bucks scarce)

Extinct 18

Green-winged orchid	*Anacamptis morio*	
Chamomile	*Chamaemelum nobile*	
Good-King-Henry	*Chenopodium bonus-henricus*	
Corn marigold	*Glebionis segetum*	
Henbane	*Hyoscyamus niger*	
Wild candytuft	*Iberis amara*	
Stag's-horn clubmoss	*Lycopodium clavatum*	
Perfoliate penny-cress	*Microthlaspi perfoliatum*	
Lousewort	*Pedicularis sylvatica*	
Upright chickweed	*Moenchia erecta*	Bucks extinct
True fox-sedge	*Carex vulpina*	Bucks rare
Mezeron	*Daphne mezereum*	Bucks rare
Military orchid	*Orchis militaris*	Bucks rare
Heath dog-violet	*Viola canina ssp. canina*	Bucks rare
Lesser marshwort	*Apium inundatum*	Bucks scarce
Dodder	*Cuscuta epithymum*	Bucks scarce
Petty whin	*Genista anglica*	Bucks scarce
Weasel's-snout	*Misopates orontium*	Bucks scarce

Rare 3

Chalk eyebright	*Euphrasia pseudokerneri*		V
Fly orchid	*Ophrys insectifera*		C
Night-flowering catchfly	*Silene noctiflora*	Bucks rare	E

Uncommon 7

Chicory	*Cichorium intybus*		V
Basil thyme	*Clinopodium acinos*		V
Chiltern gentian	*Gentianella germanica*		NT
Bird's-nest orchid	*Neottia nidus-avis*		V
Lesser spearwort	*Ranunculus flammula*		V
Corn spurrey	*Spergula arvensis*		V
Sainfoin	*Onobrychis viciifolia*	Bucks scarce	V

Occasional 2

Stinking chamomile	*Anthemis cotula*		NT
White helleborine	*Cephalanthera damasonium*		NT

Common 2

Dwarf spurge	*Euphorbia exigua*		NT
Yellow archangel	*Lamiastrum galeobdolon ssp.galeobdolon*		NT

Data Deficient 2

Uncommon 1

Narrow-lipped helleborine	*Epipactis leptochila*		C

Occasional 1

Box	*Buxus sempervirens*		NT

Waiting List 1

Extinct 1

Corncockle	*Agrostemma githago*		

Other Bucks Extinct 5

Never Present 1

Extinct 3

Whorled water-milfoil	*Myriophyllum verticillatum*		
Common wintergreen	*Pyrola minor*		
Autumn lady's-tresses	*Spiranthes spiralis*		

Rare 1

Cornflower	*Centaurea cyanus*		C

Other Bucks Rare 22

Never Present 9

Extinct 7

Fine-leaved sheep's-fescue	*Festuca filiformis*		
Mudwort	*Limosella aquatica*		
Shoreweed	*Littorella uniflora*		
Alternate water-milfoil	*Myriophyllum alterniflorum*		
Lemon-scented fern	*Oreopteris limbosperma*		
Small water-pepper	*Persicaria minor*		
Chalk milkwort	*Polygala calcarea*		

Rare 3

Brittle bladder-fern	*Cystopteris fragilis*		E
Small-leaved sweet-briar	*Rosa agrestis*		C
Meadow clary	*Salvia pratensis*		C

Uncommon 3

Spear-leaved willowherb	*Epilobium lanceolatum*		NT
Common fumitory	*Fumaria officinalis ssp. wirtgenii var. wirtgenii*		V
Corky-fruited water-dropwort	*Oenanthe pimpinelloides*		NT

Other Bucks Scarce 51

Never Present 22

Extinct 8

Silver hair-grass	*Aira caryophyllea*	
Field mouse-ear	*Cerastium arvense*	
Little mouse-ear	*Cerastium semidecandrum*	
Perennial wall-rocket	*Diplotaxis tenuifolia*	
Green-flowered helleborine	*Epipactis phyllanthes*	
Elecampane	*Inula helenium*	
Blinks	*Montia fontana*	
Knotted clover	*Trifolium striatum*	

Rare 16

Slender parsley-piert	*Aphanes australis*	E
Wormwood	*Artemisia absinthium*	C
Lesser hairy-brome	*Bromopsis benekenii*	C
Rye brome	*Bromus secalinus*	E
Heath spotted-orchid	*Dactylorhiza maculata*	C
Golden-scaled male-fern	*Dryopteris affinis ssp. affinis*	NT
Common ramping-fumitory	*Fumaria muralis ssp boraei*	E
Fine-leaved fumitory	*Fumaria parviflora*	C
Hybrid gentian	*Gentianella x pamplinii*	NT
DesEtang's StJohn's-wort	*Hypericum x desetangsii*	E
Toothwort	*Lathraea squamaria*	V
Water-purslane	*Lythrum portula*	V
Cornfield knotgrass	*Polygonum rurivagum*	C
Hard shield-fern	*Polystichum aculeatum*	V
Fan-leaved water-crowfoot	*Ranunculus circinatus*	V
Ivy-leaved crowfoot	*Ranunculus hederaceus*	V

Uncommon 4

Fragrant agrimony	*Agrimonia procera*	NT
Pale lady's-mantle	*Alchemilla xanthochlora*	V
Pear	*Pyrus communis*	V
Sweet-briar	*Rosa rubiginosa*	V

Occasional 1

Harsh downy-rose	*Rosa tomentosa*	NT

Heath dog-violet - once prevalent on Prestwood Common, now extinct in our area

TABLE IX - LIST OF TYPICAL CHILTERN SPECIES

(ie. species mainly restricted to the Chilterns or most common in the Chilterns)

Species		Status in our area	Habitat
Asperula cynanchica	Squinancywort	Never present	Chalk grassland
Atropa belladonna	Deadly nightshade	Rare	Chalk grassland/scrub
Campanula glomerata	Clustered bellflower	Occasional	Chalk grassland
Cardamine bulbifera	Coralroot	Uncommon	Woodland
Chaenorhinum minus	Small toadflax	Occasional	Arable
Clinopodium acinos	Basil thyme	Uncommon	Chalk grassland
Epipogium aphyllum	Ghost orchid	Never present	Woodland
Euphrasia pseudokerneri	Chalk eyebright	Rare	Chalk grassland
Fumaria densiflora	Dense-flowered fumitory	Uncommon	Arable
Fumaria parviflora	Fine-leaved fumitory	Rare	Arable
Fumaria vaillantii	Few-flowered fumitory	Never present	Arable
Galium tricornutum	Corn cleavers	Never present	Arable
Gentianella ciliata	Fringed gentian	Never present	Chalk grassland
Gentianella germanica	Chiltern gentian	Uncommon	Chalk grassland
Gentianella x pamplinii	Hybrid gentian	Rare	Chalk grassland
Hordelymus europaeus	Wood barley	Occasional	Woodland
Iberis amara	Wild candytuft	Extinct	Chalk grassland/arable
Pulsatilla vulgaris	Pasque flower	Never present	Chalk grassland
Valerianella dentata	Narrow-fruited cornsalad	Uncommon	Arable
Verbascum nigrum	Dark mullein	Common	Rough grassland

Coralroot in dappled shade of a Chiltern beechwood

Dark mullein - common in our area

Our Flora Over Time

Excluding micro-species of bramble *Rubus fruticosus* agg. and dandelion *Taraxacum* agg., which have been insufficiently examined locally, a total of 1182 taxa had been recorded in the area of study at some time or another up to 2014. Of these 139 were extinct in the area, 377 rare (recorded from only 1 or 2 sites), 264 uncommon (recorded from up to 10 sites, although not all of these may be extant), 151 occasional (up to 20 sites recorded), and 251 common (more than 20 sites, usually substantially more). Of these taxa, however, 357 are non-naturalised garden escapes or deliberately planted, 31%, or nearly a third, of all recorded taxa. While this appears to be a large number, many will only have been recorded once, so that the prevalence of recently introduced species across the area is much exaggerated by these figures. Their inclusion, however, grossly inflates the number of "rare" plants, while under-estimating the proportion of "extinct" taxa (because many have been recorded comparatively recently). Subsequent analyses have therefore been carried out excluding this group of 357 and only includes introduced species that are of long standing (eg green alkanet *Pentaglottis sempervirens* and honesty *Lunaria annua*). Most of these 357 are of trivial importance, as extremely few will ever become established; even fewer will ever become a "problem" like Japanese knotweed *Fallopia japonica*, although garden yellow-archangel *Lamiastrum galeobdolon ssp argentatum* and hybrid bluebell *Hyacinthoides x massartiana* are increasingly common and may have the potential to disrupt natural populations of native congeners in future.

Omitting these species, then, we are left with 825 taxa, whose status is given in Table I.

Table I

Current status of all recorded taxa (other than recent introductions)

Status	*Number*	*Percentage of all taxa*
Extinct	124	15%
Rare	159	19%
Uncommon	178	22%
Occasional	130	16%
Common	234	28%

I have included in "extinct" all taxa that have not been seen in the area since 1999 and where I have searched unsuccessfully for them at all recorded sites. I have not included some taxa, difficult to find or identify, which may have not been thoroughly recorded more recently, so that it is likely that the number of lost taxa is under-estimated. Indeed, 154 species have not been seen since 1999 and if none of these are now present the percentage loss would be 19%.

Change in the flora of an area is perennial and losses may be balanced by new acquisitions, so that it is useful to look at the dates of the last record for each taxon (Table II). Some of the older records are not precisely dated, hence some complication in the table to allow for this. Assuming that all taxa not seen after 1999 are lost, then the average rate of loss is 15.5 species per decade, or over one a year. The rate up to 1979, however, is 8.4, while since 1980 it is 42.5, or over four a year. While the data are not entirely robust, there are good data for the 1920s, the time of Druce's *Flora of Buckinghamshire*, for the 1980s when the BBOWT received a grant to send specially trained teams out in the field to record natural habitats quite exhaustively, and since 1990 when local recording for the area began in earnest. While taxa may have been overlooked in early years (so that we may never know of some species that have been lost), it is much less likely that this would have happened from the 1980s onwards, so

Table II

Latest date recorded for taxa not seen since 1999

Date of last record	*Number of taxa*
1900-1909	1
1910-1919	4
1920-1929	7
After 1920s	20
Before 1970	14
1950-1959	4
1960-1969	5
1970-1979	8
Before 1986	6
1980-1989	23
After 1987	24
1990-1999	38

that the rates of loss are under- rather than over-estimates. If the rate to 1979 is taken as approximating the natural rate of loss of species, then there has been a massive fivefold increase in that rate during the last two decades of the twentieth century, which can really only be explained by the effect of man, both changes in agricultural practice and, more particularly, large increases in loss of land to building which happened in this area from the 1980s onwards.

Not all habitats have suffered equally from loss of plants. Table III shows the differences in status distributions for different habitats. (A few taxa were assigned to more than one habitat type, eg woods and hedges, but this was avoided whenever possible. Two taxa associated with orchards or parks were omitted for statistical reasons.)

Table III

Plant status by type of habitat

Habitat	*E*	*R*	*U*	*O*	*C*	***Number***	*%E*	*%R*	*%U*	*%O*	*%C*
Grassland	28	30	27	32	46	**163**	17	18	17	20	28
Disturbed	16	23	33	28	39	**139**	12	17	24	20	28
Woods	11	19	21	15	44	**110**	10	17	1	14	40
Hedges	5	16	10	14	36	**81**	6	20	12	17	44
Water	23	26	20	7	2	**78**	29	33	26	9	3
Marshes	12	8	16	9	7	**52**	23	15	31	17	13
Casual	15	20	4	3	0	**42**	36	48	10	7	0
Wasteland	6	17	11	6	1	**41**	15	41	27	15	2
Waysides	4	9	5	6	1	**25**	16	36	20	24	4
Bare	9	4	2	5	4	**24**	37	17	8	21	17
Walls/rocks	3	7	6	3	2	**21**	14	33	29	14	10
General	3	16	23	16	80	**138**	2	12	17	12	58

E extinct, R rare, U uncommon, O occasional, C common. "Number" is number of taxa associated with that habitat. "Disturbed" includes arable. "Hedges" includes scrub. "Water" includes ponds and streams. "General" includes all taxa that cross several habitat types.

Some habitats clearly have greater biodiversity than others. Despite the large area covered by woodland, the number of plants associated with grassland (of which there is only a small area left unimproved and therefore flower-rich) and arable land (where chemicals to protect crops limit natural vegetation to the margins, if that) is substantially greater. Whether this shows the importance of preserving the remnants of untreated grassland and cultivated land, or whether it shows the impoverishment of local woods through centuries of timber operations, I am not sure - perhaps both. Despite the sparsity of water features in the area, there is still a good diversity of plants associated with them.

The percentage table also shows large differences between habitats in plant status. Naturally, the "general" group has a high rate of common species, because these are the most adaptive in being able to survive in many different conditions. Casuals have one of the highest loss rates, but this is to be expected for a group of plants that, by definition, comes and goes, and does not reliably remain at any particular site. It is noticeable that none of them could be described as common. A similarly high loss rate (37%) applies to plants of bare ground, which are unable to survive too much competition from other species, indicating that this type of habitat is one that has become less common, either because of over-zealous tidying up in residential areas or of neglect of rural land and the expansion of scrub and shady conditions. Water habitats also show a large loss (29%), which is partly explained by the loss of ponds, and partly by the reduced flow of streams because of much increased water extraction and reduction in rainfall, so that there has been a general "drying up" of the environment. This also explains the large loss of marsh plants. Hedges and woods have the two lowest loss rates (apart from the "general" group) and the highest proportions of common plants.

I also compared plants with propensities for calcareous or acid soil. While the calciphiles (N=117) showed a fairly typical distribution of statuses, the acidophiles had a 34% loss rate, reflecting the nutrification of soils with increasing pollution from a variety of sources. Indeed, there is probably only one markedly acidic wood now left in the area (Sandwich Wood). The effect on grasslands has been even more severe, with heathy grassland showing a 72% loss, with only five species out of 18 still in existence (and three of these at only 1 or 2 sites). Neutral grasslands, on the other hand, show only a 9% loss rate and a high number of common species (33%). High proportions of common plants were also associated with fertilised soils and shady situations.

The flora of our area clearly has to be seen in the context of a massive change in environmental conditions over the last hundred years. These changes show no sign of abating, with the nutrification of soils, pollution, population pressures and the economic decline of traditional farming continuing to affect habitats from year to year, coupled with a failure by local authorities to take seriously the environmental crisis that is clearly imminent.

Cow parsley has become more abundant because of indiscriminate fertiliser spray from agricultural fields

Ecology of Plants

1. Are There Plant Communities?

There are few direct relationships between different plant species. (Minor, and partial, exceptions are mistletoe, which tends to favour particular sorts of tree - especially apple and lime; common broomrape, which is mainly parasitic on clovers; toothwort which grows particularly on hazel, but will sometimes use other trees like elm; red bartsia and yellow rattle, parasitic on grasses; and yellow birdsnest, birdsnest orchid and ghost orchid, which appear to be associated only with beech, although this may actually be an association with a soil fungus that is associated with beech.) Each species is the base of its own ecological community of other life-forms, many of which are not shared with other plants. A nettle-patch in an oakwood does not create a wider ecological community - they are distinct communities that happen to intersect (except in trivial ways, as when fallen oak-leaves are processed by fungi to create humus for nettles to grow in). Correlation may be found between the frequencies of two species across a number of sites, such that one is more likely to occur where the other does (the basis of the National Vegetation Classification, NVC - see Rodwell 1991), but such correlation does not necessarily imply any direct relationship: it is much more likely to be the result of common environmental requirements. There is nothing meaningful in the fact that yellow archangel and woodruff tend to occur at the same sites - they just have similar needs, such as shade and calcareous soil. They may also have different requirements in other respects, so that one may occur where the other does not. Even at a single site each tends to form mono-specific patches.

This makes the NVC unsatisfactory. If the correlations are based not on relationships between plants but on their common relationships to the local habitat, it would be more meaningful to define communities in terms of the geological, chemical, physical, climatic and other features of the environment, irrespective of the individual plant species present. Species colonising a particular site will be a matter of historical accident (whether they were able to reach the site in a particular time period, and whether they have suffered a local extinction event at some time in this place), although the longer similar sites remain stable, the more their populations are likely to converge towards all species in the area that are appropriate to conditions at the site (in much the same way as Hooper 1974 showed that hedges gained one new woody species every hundred years). Older woods in a particular region, disregarding the effect of man's interference, will have a greater mix of plant species than new woods. The NVC works best in practice at the national level, comparing habitats country-wide. In a local region the categories are too broad, failing to reflect finer differences in environmental conditions, and often relate poorly to observed examples. (Compare the replication of the NVC analysis for local woodlands in our area, which failed to identify the national categories - see Appendix 47.1. Each woodland's individual character and history tended to overwhelm any similarities in their botanical make-up.)

While habitats can be classified mostly in terms of pre-existing physical characteristics - wet/dry, low/high pH, elevation - there is one important factor that is directly plant-related, although it has been determined by man. At one time, before man reached our island, particularly in an area like the Chilterns, there would have been more or less continuous forest cover (admittedly with some more open habitats where the ground was too swampy or lacked nutrients, or from grazing pressure and accidental influences such as fire caused by lightning). Man's economic activities are responsible for the mix of distinct habitats we see today. By

cutting down forest to small remnants he created "woods" with defined boundaries instead of continuous forest; by creating bounded fields he created "hedgerows"; by pasturing animals he maintained large areas of open habitat as "grasslands"; by growing crops he created "arable land". He also built walls and concrete or tarmac surfaces - areas similar to bare rock or cliffs previously unknown in a chalk and clay region like the Chilterns. He created "orchards" and "parklands" that were unlike any prior natural habitat. He left disturbed areas with high nutrient pollution, introducing a new physical factor to which plants are variably suited to adapt. Of these, woods, hedges, orchards and parklands are defined in terms of certain types of plant (mostly trees), while woods and hedges continue the once-prevalent shade conditions of the primeval forest. So woods are groups (one can hardly say communities) of larger trees, which may replicate the diversity of the original forest, but most often reflect a selection based on man's tastes and needs. Hedges are primarily groups of shrubs (with some trees), selected for impenetrability or fruit-bearing. Orchards are collections of artificially spaced-out fruit trees. Parklands are dominated by well-spaced larger trees chosen specifically by man and often made up mostly of introduced species. Even certain grasslands - the so-called "improved" pastures - are composed of grasses selected by farmers as being the most nutritious for stock, thus creating a new constellation of grass species.

These are all habitats - conjunctions of plant species with shared characteristics (their relation to man or to environmental constraints), not with any form of interrelationship. They are not communities in their own right. Considering the plants alone, the most one can say in terms of community is, for instance, that some plants need the shade provided by other plants (often trees, but the species is relatively unimportant), or that some plants are more likely to grow where a good layer of humus has accumulated under trees on more or less level ground. These are very general relationships although they do exhibit commonality between broadly-defined groups of plants. It is interesting that the above examples are applicable only to woodlands (to a lesser extent hedgerows) and these basic aggregations are actually remnants of the ancient forest community.

What is much more important for community are plants' individual relationships with species of other natural orders - most obviously fungi, invertebrates and vertebrates, although one should not forget the role of microscopic organisms like bacteria, even though this is under-studied, little understood and difficult to survey. If we stick to the woodland example (for the reason that such relationships had millennia to form in the post-glacial forests and are far more developed than in any other local habitat), then we can see a great variety of vital associations that begin to seem like a viable eco-system or community. Most crucially, soil-inhabiting fungal hyphae create microrrhizal relationships with the roots of plants. (This applies to almost all plants, the main exceptions being members of the *Brassicaceae* and *Amaranthaceae*, which are not, by and large, woodland plants.) This is a two-way symbiotic relationship whereby the fungus, good at absorbing nutrients and minerals from the soil, can share these with the plants in exchange for sugars and proteins only the latter (and algae) can manufacture in their green parts by harvesting sunlight, splitting water into free oxygen and hydrogen, and fixing carbon from atmospheric carbon dioxide using a an enzyme known as RuBP Carboxylase Oxygenase (thus also ameliorating climate warming). Fungi and plants/algae have evolved from their earliest beginnings in such a relationship, so that some species of plant rely on specific types of fungus and neither can survive without the other, although there are also

many generalised fungi and plants able to make use of each other indiscriminately. The exchange of substances is vital for the healthy growth of both fungus and plant.

If one compares compartments in one local wood (Angling Spring) which were clear-felled and replanted towards the end of the C20th with those compartments which remained relatively untouched (and have not been clear-felled for at least a hundred years), there is a marked difference between the ground flora, fungi (at least those that produce fruit bodies above-ground and can be surveyed) and molluscs, the uncleared compartments having a far greater diversity of fungi and molluscs - often readily noticeable even with just a casual walk across each in autumn. The ground flora is not so simply comparable, because the cleared areas, being more open to light, have more of certain plants - sometimes "intruders" not generally associated with woodland - and uncleared areas, some in the deep shade of beech and on shallow soil, naturally have a reduced ground flora typical of such mature woods (often early-flowering species like bluebells that get away before the beech leaves expand to create full shade). Other uncleared areas, which have more light from an inter-mixture of other trees such as hornbeam and cherry, or have more humus, still maintain something of an original ground flora with dog's-mercury, woodruff, primrose, violets, tutsan, elegant StJohn's-wort and so on.

These fungal-plant relationships are the ultimate basis of the woodland eco-system, but there are many other organisms involved in a complex web of other interrelations, some co-operative, others exploitative. Many of these are specific to particular plants, although some (such as pollination) are also generalised. We look at these in the next section.

2. What Relationships do Plants have with Species of Other Natural Orders?

Relationships may be purely exploitative (predator-prey for instance), symbiotic (where each partner receives some benefit at some expense to the resources of each - which might be more accurately described as mutual exploitation, as "symbiosis" might be taken to imply a perfect balance of benefits, whereas this is probably quite rare), or neutral (where one species uses another without affecting it).

Exploitative relationships can be very destructive - such as the effect of a plague of locusts on grassland or crops, or a fungus causing an internal rot that brings down a tree. Such purely destructive relationships, however, are relatively uncommon - in the course of evolution prey species develop protections (structural or behavioural) that limit predation, or at least its destructiveness. Trees grow more leaves than they strictly need, so that it matters little if some are eaten by caterpillars. Fish spawn in huge numbers, knowing that their fry have low chances of survival. (There is a vast amount of apparent "waste" in natural systems that only makes sense as the mechanism by which mutually interactive eco-systems can be maintained.) Predator numbers are self-limiting so as to maintain sustainable populations of prey. This balance builds up over millions of years of competitive relationships and is a by-product of adaptive evolution, evolution which continues indefinitely as relationships, eco-systems and balances themselves evolve and species continually struggle for dominance. Imbalance can be created by catastrophic events - such as the introduction of a new predator into a formerly balanced eco-system, or the widespread destruction of particular habitats - events that have often in recent years been caused by man. Given time new balances inevitably evolve, although species may be lost, as competition drives continual mutual adaptation. In the longer perspective the predation of species is even beneficial to the evolution of more efficiently adapted and protected prey-species.

As far as plants are concerned, their tissues are nutritious food for a vast range of epiphytic fungi, insects, bacteria and mammals. Only a few of these are totally destructive - wood-rots and goat-moth larvae in living trees, elephants tearing down vegetation, colonial caterpillars such as the lackey moth that can defoliate whole shrubs. Even in these cases it is individuals that suffer, not species as a whole, as long as the eco-system is in balance. In most cases plants adapt. Galls are a special case of adaptation, whereby the progress of a predator within its tissues is limited by the growth of special tissues, which may themselves become food, plants sacrificing certain resources in order to prevent damage to more vital areas, a symbiosis of a sort, but one very weighted in favour of the predator. These adaptations have resulted from aeons of co-evolution between particular plant and predator species, so that most galls are specific to a particular predator and to one group of closely related plants.

In the case of the leaf-miners and wood-borers, plants seem not to have evolved protective mechanisms other than the production of excess tissue as a matter of course, so that a certain amount may be lost without the plant losing its vital functionality. The recent invasion of Britain by the horse-chestnut leaf-miner is an example of a suddenly created imbalance, so that most trees have extensive mines in all their leaves, but this does not seem to have prevented the trees' survival (although weakening over time might threaten this). In most cases parasitic species that prey on the leaf-miners evolve (some already existing species may for instance adapt to this suddenly pervasive new food resource). This appears to be happening already with the similar invasion of the harlequin ladybird, whose early explosions of populations now seem to be limited by parasites of other ladybird species successfully moving to the new invader.

Mines of the fly *Monarthropalpus flavus* in a box leaf, opened by blue tits to feed on the yellow grubs

Parasitic insects (which feed on the plant-feeders) have no direct relationship to the plants affected, but nevertheless are highly beneficial to the latter as part of an eco-system that maximises species survival. In a sense this is again symbiosis, but a complex system involving more than two species.

More obviously symbiotic are soil-inhabiting fungi that form microrrhizal links between fungal rhizomes and plant roots, with a notionally equal (as far as one can tell) sharing of resources, as detailed in the previous section. Such connections are particularly important for the larger plants - trees - that need to receive vast amounts of nutrients to produce and maintain their structures.

Similarly symbiotic are plants' relationships with pollinators (mostly insects), whereby co-evolution of species has resulted in total dependence of one on the other, the plant, as part of its "normal" mode of existence, producing sugars and excess pollen sacrificed to the appetites of the insects in exchange for a chance to use these highly mobile resources (and the flying ones are most significant here) to transfer male pollen from one plant to female styles of another plant of the same species to effect cross-pollination. Most plants use this system to reproduce, so that one can truly say that plants have evolved with the insects so closely, like the twin strands of the double helix of DNA, that neither is capable of survival without the other. In some cases specific flower-structures attract specific insects or particular types of insects. Almost all the time this works to mutual advantage, although occasionally an insect may "cheat" by, say, cutting a hole in the base of a tubular flower to which it is not adapted by having a long enough tongue, in order to remove nectar while by-passing the pollen structures and thus not contributing to pollination. Again such losses are not material to the plant, which creates far more blooms than it strictly needs to effect species survival. Some plants, too, produce little or no nectar, relying on the wind to distribute spores (a much less efficient process because an insect is much more likely to visit the right plant, while a breeze is indiscriminate), and others have the ability to self-pollinate (some not reproducing in any other way), although this sacrifices the ability to mix genes and to evolve, an evolutionary dead-end.

The final group of plant relationships is one where other species make use of the plants without causing them either damage or any direct benefit. These are the many creatures that use plants - and most obviously trees - for shelter, support, or micro-habitats. A stand of bramble or a nettle-bed is a wonderfully protective environment for many small creatures, making use of the plants' protective structures for their own benefit. Epiphytic fungi (and some other plants such as ferns or mistletoe) employ trees as support, most doing no harm to the plant. Some insects lay their eggs in the permanently moist knot-holes in old trees; others, like birds, bees and wasps, use tree hollows for nesting. Birds build nests in trees whose branching twigs provide suitable platforms and whose leaves disguise their whereabouts. There are also mammals that use the same advantages, plus the opportunity trees provide for living away from ground-based predators. Most birds seem to spend almost all their lives discretely in trees and bushes, to the chagrin of people with binoculars.

This group of relationships, although not very specific in terms of which plants or which creatures, is one of the most prevalent. Plants provide habitat, one of their most important eco-system services. From the point of view of their own interests this seems neutral, but in the larger scheme they do benefit - for instance by the concentration of excrements that fertilise the soil in which the plants grow. They also benefit by providing the platform on, and within which, the general eco-system is maintained, an eco-system on which they are as reliant as any other species group.

3. Are Some Plants More Ecologically Important Than Others?

It is well known that the native oak *Quercus robur* supports more other species than any other British plant. It is therefore no surprise that in our own local records not far short of 200 species have been found on or using pedunculate oak. (No specimens of our other native oak, sessile oak *Quercus capraea* have been recorded in our area, although it would no doubt be equally as important ecologically if it were present.) This is far more than for any other plant species, or group of closely-related species.

Old oaks have more ecological associations than any other plant

The grass family *Poaceae* is the next most important with 119 known associates locally. (Most grass-associates are not dependent on any particular species of grass. The grass for which most associates have been recorded is cocksfoot *Dactylis glomerata*.)

Cocksfoot, along with other grasses, is second only to the oak in ecological importance

Knowing that the oak and grasses are very common, as also are the next 29 species in descending order of number of known local associates, we have first to address the question whether this finding is no more than an artefact. It would not be surprising that our most common species were more involved in the web of life than our rarer ones. There is indeed a slight (but non-significant) correlation between frequency of occurrence and number of known ecological associates, but there are 73 common plants that have never been found to have any associates in our area (including most speedwells *Veronica spp* and the pearlworts *Sagina spp* for instance), and another 106 that have no more than five such associates recorded. So being common does not guarantee that a plant will be strongly involved in any wider eco-system. Nor, apparently, does dissociation from other species sharing the same habitat prevent a plant becoming common.

The same goes for whether the plant is native or introduced, as it might be thought likely that native species would have become more involved ecologically, but, despite a low correlation between nativity and number of associates, there are again so many exceptions that this can be dismissed as an important factor. In fact, the eighteenth species in the descending order of number of associates is the Scots pine *Pinus sylvestris*, which occurs in the Chilterns only as a planted tree. Despite only growing in artificial plantations, the pine has managed to become part of a thriving eco-system (even if this is impoverished compared to the number of associated species in its native Scotland). Many species will have been introduced with the trees, living on them or in the soil round their roots.

Much more important is whether a species is perennial or annual. Annuals have a much lower chance of being involved with relationships with other species when they flower, fruit and die within a relatively short time. There is a strong relationship between being annual and having few ecological connections. Even so, there are exceptions. Oil-seed rape *Brassica napus ssp oleifera* is high on our list (nineteenth) despite being annual and growing in cultivated ground that is disturbed every year, preventing the establishment of an extensive soil-based eco-system. At the same time there are a number of perennials not so far recorded as having any associates at all, such as the speedwells mentioned above, or silverweed *Potentilla anserina*.

Another important factor is clearly size. Most of our trees are towards the top of the list, reflecting both that they are perennial and have a greater mass and surface area to interact with other species. Yet grasses as a whole have more associates than any particular species of tree apart from the mighty oak, and the top ranked 15 plants include five others that are not trees. Our lowest ranking tree, silver maple *Acer saccharinum*, has only one known associate, although it is likely that there has been some under-recording in relation to this tree, of which there are only a few publicly accessible specimens locally.

This last remark raises another issue. The number of known local associates with a particular plant species will be strongly affected by the recording effort and chances of observation. This is a fundamental limitation to our data. Where species are common it is much more likely that associates will have been observed. Even so, their *relative* rankings are probably reliable, although there will always be more relationships to document. Where species are uncommon there is a much higher chance that their ecological involvement is poorly known and under-estimated. Another bias in the data is that there are certain organisms that are much less likely to be recorded, especially when one reaches the microscopic realm. This bias affects all plants equally, however, so that it is relatively unimportant for the subject of this account.

To return to the findings, the first five most important plants from an ecological perspective are either grasses or trees, the oak and *Poaceae* being followed by beech *Fagus sylvatica*, the birches *Betula spp* (mostly *Betula pendula*) and the willows *Salix spp* (dominated by goat willow *Salix caprea*). These five are all habitat-defining species - dominating woodlands and (in one case, by definition) grasslands, which together make up a large proportion of all local habitats. It is therefore not surprising that they should be the centre of thriving eco-systems. Because of man's interference local woodlands are currently dominated by beech, although the aboriginal forest would probably have included as many or more oak, which are locally reduced to the occasional tree, if often dominant in themselves from age and size. ("Oaken Grove" near Hampden is now a beech woodland!) Birch woodlands would have been natural on very acid soils, typical of many of the former Chiltern commons, but the only current site in our area that has the capacity to approach this is Sandwich Wood near Little Kingshill, although the name of Birchmore Wood nearby shows that this was once dominated by that tree. Since the planted beech in Sandwich Wood were clear-felled a few decades ago, young birch have taken over large swathes of the wood (accompanied by large numbers of the associated toadstool fly agaric *Amanita muscaria*).

Fly agaric is characteristic of birch woodland

This wood is on acid sandy clay that supports several locally rare plants like hard fern *Blechnum spicant* and pill sedge *Carex pilulifera*.

Although wet areas could in theory support willow carr, marshland locally is now too inextensive for this to occur, although willow carr might have occurred along rivers such as the Misbourne and the Hughenden stream many centuries ago. Although willows survive only as individual trees all over the district without defining any tract of woodland, they still maintain a large suite of associates, including the purple emperor butterfly *Apatura iris*, for which it is the larval food-plant.

In relation to grasslands, it should be noted that improved grassland with its low plant species variety, despite the number of species that may still be associated with the grass itself, will have a low overall biodiversity. Moreover, those grasslands that are intensively grazed, effectively eliminating tall flowering grass-stems, will not support many species that would otherwise be associated with the *Poaceae*. Grassland as a functioning eco-system therefore relies on plenty of ungrazed grass and unfertilised soils enabling the establishment of other plant species. Interestingly, the predominance of grass species among crops - wheat, barley, oats, maize - adds to the prominence of grasses ecologically, as the many acres of such crops provide a huge natural resource, even though farmers with modern chemicals do their best to combat natural competitors. Despite such efforts, some do get through, and crop species also self-sow and may escape the next round of sprays in arable margins.

The sixth plant on our list has been documented as having 70 species to date and this is the stinging nettle *Urtica dioica*. It often occurs in dense beds that provide shelter and food for myriads of insects, some of which are more specialist on the nettle than others. Although much maligned by mankind the nettle is one of the most important of our low plants: it is unfortunate for us that it is so fond of a human presence, because we create the ideal conditions for it. Its abundance has increased in the last few decades because of pollution from industrial and agricultural sources increasing the nitrogen levels in our soils. Where it displaces other plants, associated with other constellations of invertebrate and fungal species, in hedgerows for instance, it may reduce overall biodiversity while advancing its own associated eco-system. That does not take away from its ecological importance, however, which is unmatched by any low plant other than the grasses. As the defining plant of a distinct ecological community the nettlebed could be described as the assemblage typical of high-nutrient soils, whether in grassland, hedgerows, rough ground or woods.

Nettles at Nettlebed, a settlement that got its name from the plant, which was used in a major local industry making fibre

Not far below nettle are our hawthorns with 67 associates. These are the basic hedge-defining shrub (as a result of human selection going back millennia, the Anglo-Saxon *haga* meaning both "hedge" and "hawthorn", and being the origin of both these words). The main hawthorn in our hedges is *Crataegus monogyna*; the Midland hawthorn *C. laevigata* also occurs occasionally, as does their hybrid *C. x media*, although both the latter may have been predominantly planted in recent times along with other alien *Crataegus* species. All these hawthorns, however, operate in an identical manner ecologically and are crucial to a thriving hedgerow, although they are bolstered by several other hedge-shrubs that also have high ecological value (see below).

Hawthorn flowers, "may", significant enough to have been named to the mark the month when they appear

With 60 associates the next plants are the apples. Although the crab-apple *Malus sylvestris* is our native species, this is very rare, and almost all the apples seen locally are planted apples *Malus domestica* or their naturalised descendants in our hedgerows. While contributing to the ecology of hedgerows where they grow, the main local occurrence of apples is in orchards, which as a habitat was historically of far greater local prominence than it is now. Surviving old orchard apples, many now in private gardens that have replaced orchards, support a large variety of other species - many invertebrates and even one plant, the mistletoe *Viscum album*. Their ecological value continues, as with all trees, even after death, for there is much life for other creatures in association with a slowly-degenerating tree. Had they occurred in sufficient numbers the pears, the orchard pear *Pyrus communis* and the wild pear *P. pyraster*, which has only one known local location, they might have been found to have made a contribution not far short of the apples. The other main orchard species, the cherries and plums are dealt with below, but are not as significant ecologically as the apples.

Domestic apple descendants in a wild hedge

The next most important plants, with 53 associates, are the hazels. These are predominantly the common native hedgerow plant *Corylus avellana*. The filbert *C. maxima* was often planted in orchards, mainly in the boundary hedges, and persists to this day in many local hedges along with its hybrid with native hazel, which was both planted as such and also generated naturally from cross-pollination. In hedges close to old orchards and habitations there is a great deal of genetic crossing between the different species and pure native hazel is less common there than is usually supposed. All make the same ecological contribution, however, so the purity of species is of little concern in that respect.

Hazel catkins, an early sign ofspring

At 47 associates the next species (or constellation of species) is bramble *Rubus fruticosus* agg. It can be locally dominant in hedges and woods, and even wasteland, but is best seen as the main species defining most of our scrub communities (of which hedges are essentially a special linear example). A patch of flowering bramble in full sun attracts an impressive number of pollinators, which have surely not yet been fully documented locally, so that bramble's position in our list may be under-estimated. (You can use a sweep-net to sample populations among nettles, but this does not work with brambles that tear the net to shreds.) It could well be of equal value to the nettle in its ecological contribution.

Bees, beetles and flies are much attracted to bramble flowers

At number 11, and number 5 among the large trees (43 associates), comes ash *Fraxinus excelsior*. Old ash trees, which contribute most, are unfortunately nowhere near as common as old oaks or beeches. In fact, there have never been any ash-woods in our vicinity as there are in some limestone districts, which may be part of the reason for the ash's lower ecological significance. It does, however, seed abundantly and in several places has recently formed large dense populations of saplings, exploiting areas no longer used for farming or woodland re-planting. In these cases the ash does define, almost to the elimination of all other plants, a community of its own, although it may well be temporary, due to natural succession and replacement by other trees, by its being cut while still saplings for wood-fuel, or because of the currently rampant ash die-back disease *Hymenoscyphus fraxineus* (ironically, one of its "associates").

For all intents and purposes equal to the ash, at 42 associates, is the sycamore *Acer pseudoplatanus*, which may be a surprise to many who see this as an alien tree with few eco-system services. It has, however, been with us for over a thousand years and it spreads readily by seed, so that it has become one of our most prevalent trees, especially in secondary woodland, of which it is usually the defining species (along sometimes with ash) if this woodland has developed naturally. It is even possible that it was an infrequent native, its pollen undocumented in peat remains. Many of our oldest sycamores were certainly planted, however

(in parklands for instance), so that it remains to be seen in future centuries whether self-seeded sycamores are able to achieve the same age and size. Certainly foresters are likely to remove it. It should be noted, however, that the other commonly planted parkland trees - horse- and sweet-chestnuts and common lime - have many fewer ecological associates, so that sycamore can be said to be punching far above its weight.

Old sycamore with the added bonus of many holes and crannies for many creatures

The 13th plant or group of plants on our list comprises the thistles *Cirsium* spp (39 associates). A large thistle-patch in flower or seed is a hub of activity only just below a patch of nettle or bramble, although like these two its unapproachability may inhibit human appreciation of this fact. This discouragement of humans, based on stings or prickles, may even have helped the growth of strong ecological communities in each case because of the protection it provides to smaller creatures. The role of thistles in supporting a large range of pollinators, like the brambles, is of particular importance at the present time when there is concern for pollinating insects. Indeed, a patch of bramble or thistles is of far greater value in this respect than an artificially sown patch of phacelia *Phacelia tanacetifolia* or any other fashionable foreign import. In terms of ecological associates there is large overlap between the various species, so that creeping, spear and marsh thistles (*Cirsium arvense, vulgare* and *palustre*) are more or less equivalent, while dwarf thistle *C. acaule* is of similar value in the context of short chalk grasslands but does not form thickets.

At more or less the same rank as the thistles, with 38 associates, come the elms *Ulmus* spp. This only emphasises the loss that has occurred with the advent of Dutch elm disease and the decimation of these trees throughout our countryside. Whether disease-resistant strains currently being planted will have the same ecological value remains to be seen (their disease resistance reduces the number of associates by at least one!). Elms only develop the disease

when they are 15 years old or so, and there are still plenty of young elms in our hedgerows and woodlands. These are mostly *U. glabra* (wych elm) and *U. procera* (english elm). Some have been able to grow to sufficient height to support colonies of white-letter hairstreak butterfly *Satyrium w-album*, whose populations were much impacted by the loss of the big trees. Moreover, a few large mature elms have been found locally that have escaped the disease (perhaps having genetic resistance), both Midland and Huntingdon varieties. For the moment, however, the elms' capacity to support other life is severely limited. This is the first species on the list that cannot be said to define a particular community, and this also applies to most species below it.

In equal 15th place (36 associates) come ivy *Hedera helix* and our native roses (predominantly *Rosa arvensis* field rose, and *R. canina* dog rose, but with contributions too from *R. tomentosa* harsh downy rose and *R. rubiginosa* sweetbriar). Ivy, with its rather inedible leaves, is something of a surprise so high on our list, but it makes one very important and unique ecological contribution - it flowers late in the autumn and its berries ripen in late winter, providing nectar, pollen and fruit for a range of species at a time of the year when all these are in short supply. One wonders how many species would not be able to over-winter with us were it not for ivy. This applies to ivy in full light on walls and in hedgerows where it can flower abundantly - it does not apply to the non-flowering vegetative shoots that can carpet a woodland floor, suppressing other plants, and which are relatively unproductive. It is therefore a plant of rather schizoid character.

Ivy flowers are a welcome resource in the fall. Here with a drone fly *Eristalis tenax*

The roses are quite abundant in our hedgerows (although never as rampant as bramble), where they make an important ecological contribution, as well as assisting in the impenetrability of a proper hedge, along with hawthorn, bramble and our next species.

Blackthorn with 35 associates could effectively be grouped with the last two species, and it is an even commoner constituent of hedgerows than the roses, to which it is related as members of the *Rosaceae* family along with hawthorn and apple. It is universally present, often in good numbers, in any good old hedge, thus increasing the biodiversity of this habitat, despite its being essentially man-made. It can also be a scrub species - it is a defining member of scrub on many sea-cliffs - but there is hardly any example of blackthorn scrub in our area, despite its occurring in mixed scrub with dogwood, spindle, and hazel.

Number 18 (33 associates) on our list is rather a surprise - Scots pine *Pinus sylvestris* - which only grows in our area where it has been planted in timber plantations. As a British native in Scotland it has an astonishing number of invertebrate and fungal associates to rival our oaks, and somehow a small selection of these have managed to join it in our artificial habitats (sometimes interspersed with native trees in older woodlands). It rarely regenerates by itself in the Chilterns (as it does in sandy and heathy areas), so that its ecological contribution is temporary and limited. Nevertheless, species associated with pine are rarely associated with anything else, so that it defines an ecological community of its own, even the impoverished sample of the Scottish original that is witnessed locally. It is unfortunately a species in the wrong place - and, with global warming becoming ever more firmly established, the wrong time as well.

Scots pine were planted after WWII to replace a prisoner-of-war camp in Peterley Wood.
They are now mature and ready for removal

In equal 19th place (32 associates) are the clovers and - another surprise - oil-seed rape *Brassica napus ssp oleifera*! The clovers are well-known in agricultural circles for their capacity for storing nitrogen and releasing it to planted crops, an eco-system that has been exploited by farmers from earliest times to restore exhausted land. It is now almost impossible to separate native populations of the common clovers from those that were planted. Most members of the family to which clovers belong, the *Fabaceae*, have similar properties, but the clovers move ahead of the bunch by also providing good nectar and pollen supplies and supporting a good number of leaf-feeders (especially weevils). In other words, they are all-round "good eggs". The main species are white clover *Trifolium repens*, red clover *T. pratense*, and (almost solely planted in our area) alsike clover *T. hybridum*.

The *Brassicaceae* are characterised by some strong chemicals that inhibit attack by many creatures, although there are specialist groups that relish them (of which the "cabbage white" butterflies are well-known), but the highest number of associates with any native member of this family (garlic mustard *Alliaria petiolata*) is 11, so that it is very odd that the introduced oil-seed rape should be so popular. It is a crop planted for its oily seeds, and as such, like grass crops such as wheat, is protected by chemicals, but the latter are not totally effective and in any case oil-seed rape self-sows and may establish in the wild away from sprays. It is a large-scale crop these days, which provides abundance, although it is still somewhat surprising that so many other native creatures make use of it. It cannot, of course, be said to define an ecological community (other than as a mono-specific crop) so that its high number of associates can hardly be said to constitute an ecological community. Many people decry the acres of yellow fields, but it needs to be remembered that not all wild creatures share their aversion and such crops are not all "bad" - even if people object to cabbage-flavoured honey!

Sharing 21st place are "Umbellifers" (*Apiaceae*) and diverse members of the *Asteraceae* - welted thistle *Carduus crispus*, ox-eye daisy *Leucanthemum vulgare*, knapweeds and common ragwort *Jacobaea vulgaris*.

Most umbellifers share the same associates, so that it is best to treat them as a group, although hogweed *Heracleum sphondylium* is the probably the best example, as size does count for something! The umbellifers are defined as a group by having their flowers in a flattish head, which makes their nectar easily available to insects by providing a feeding platform - it is additionally used as a display platform by some species, as visits by potential mates are very likely. Although as a group they share many ecological characters, they are disparate in many other respects, and few of them come near to defining a distinct community - a flush of cow parsley *Anthriscus sylvestris* along a hedgerow or roadside comes the nearest, but in this it is only replicating the nettle's ability to dominate in high-nutrient conditions caused by fertiliser sprays and car exhausts.

Welted thistle is in a different genus from the other thistles listed above and, despite similar appearance and habitats, proves to be slightly less popular with other species, although certainly not to be disparaged.

Ox-eye daisy is the most fruitful of the common meadow flowers and usually occurs in large numbers, providing an obvious target for pollinators. The bright white "petals" (rays) act as guides towards the mass (hundreds) of small yellow nectariferous flowers comprising the centre or "eye". Pollinators may spend considerable time on each eye because of this wealth of disc flowers.



Along with the thistles, several other members of the *Asteraceae* are of ecological importance. Here, from left, ox-eye daisy, chalk knapweed, and common ragwort

Knapweeds (common, chalk and greater) are also frequent in meadows, especially on chalk. Greater knapweed in particular is a favourite nectar-source for marbled whites.

Common ragwort, like the umbellifers, provides a feeding platform and is very popular with pollinators. It also has a specialist suite of other associates and thus proves to be an important component of something approaching a distinct ecological community, as it can form large stands where conditions are right - disturbed ground with bare earth and plenty of nutrients, conditions that are most associated with over-stocked horse paddocks. Although horses do not eat live ragwort, because they can detect the dangerous chemicals it contains, they cannot detect them if incorporated into dry hay, which has earned the plant the reputation among horse-breeders of public enemy number one. Given that with simple precautions the plant actually provides no danger, and that no proven cases of stock-poisoning seem to have occurred, the campaigns whipped up by the Horse Society are over the top. Away from horse paddocks, and outside hayfields, there is plenty of scope for this useful plant to be allowed to flourish along with its associates.

It would be tedious to continue down the list. In the following group manifesting 12 to 24 associates are many more plants that make important ecological contributions, including plums and cherries, field maple, hornbeam, elder, honeysuckle, broad-leaved dock, dandelion, vetches, gorse, rowan and plantains. They include many of our common native plants as well as a few less common ones (alder, campions, wild marjoram) and the odd alien (common lime, snowberry, buddleia). Corn marigold would probably join this list if we had more data. Even the large number of plants with 6-11 associates have a definite role in the wider ecology - plants as disparate as holly, mulleins, melilot, sedges and rushes. There are 307 species that have just one to five associates, and play only a minor ecological role, including 106 common natives and 69 introduced plants. Finally there are 73 plants with no known ecological associations locally and 23 of these are common natives, while only four are introduced.

These findings raise several issues.

First, it is clear that not all plants - not even all common ones - can be said to be part of any "ecological community". There are a great many "free-riders" that grow among other plants in particular habitats (from which they may receive some non-specific benefits such as shade or physical protection) but lack associations with other species and contribute little to overall diversity. Which species occur in any particular site is largely a matter of historical accident and of their methods of spreading, vegetatively or by seed. This leads to an apparently bewildering variety of aggregations and great difficulty in defining plant communities, for many of the members are adventitious. Insofar as there is a meaningful community it will be defined by a relatively limited number of plant species that dominate ecological associations. That community can survive and thrive whether or not the adventitious free-riders are present or not. This means that the number of different plant species at a particular site is not a true measure of "biodiversity". Only the number of plants that support or interact with other species can be seen as an ecologically relevant measure of diversity, and then they should really be weighted according to the range of other life-forms with which each engages.

This, however, is based on a static picture of what is a continually evolving structure. Even the "free-riders" over time are likely to become implicated in relationships - they are a potential unused resource, after all, for many creatures. Initially they may be competitors with established species - hybrid bluebells introduced into a natural woodland may attract the same pollinators as native bluebells, forming a complex of hybrids and detracting from the survival of the native species. In the long term, however, they are certainly adding to the gene-pool and may fuel evolution of new forms that are totally integrated into the local eco-system. There are no good or bad species - all species are eventually forced to interact and will evolve self-sustaining systems as long as environmental circumstances do not change too radically or too suddenly. There are wastelands in metropolitan areas that are developing eco-systems almost entirely composed of "alien" plants. These are often very rich in invertebrate life.

In the past I have always inclined towards counting only native (or long-established) species in obtaining "biodiversity scores", on the basis that only these contribute to "natural" eco-systems, but the findings above lead one to question such a rationale. If you include "non-natives" some gardens, and even more so, batches of allotments, might well have greater scores for plants at least (but also probably invertebrates) than many nature reserves. To a botanical "purist" this seems wrong, but is this just some form of "plantist" elitism, prejudice against all newcomers? Entomologists these days are very excited by east London wastelands. What is "native" anyway? Is the harlequin ladybird an "alien" because it has only just reached this country, or, because it flew over the Channel of its own accord, is it just part of natural spread and not really different from established "natives" which came in also of their own accord at different times?

Botanists now tend to distinguish "native" from "archaeophytes" - the former (Stace 2019) being "a taxon that colonised BI [British Isles] by natural means, often long ago, from other native areas", the latter a "plant that is mostly associated with man's activities (e.g. a weed of cultivated ground) and has existed in BI since at least Medieval times (i.e. since before 1500); often uncertain whether native or introduced". They use the term "neophyte" for "an alien that arrived in BI after 1500", an alien being defined as "not native, introduced to BI deliberately or accidentally by man". This attempt to sort the problem only gets us further

into the quagmire. What do you make of a plant whose seed travels by wind from a "native area" over the Channel and establishes itself here? Not being deliberately or even accidentally introduced by man, it cannot be called an "alien" (which therefore excludes "neophyte" by definition) and it cannot be an "archaeophyte" because it is too recent, so that the only category into which it can fit is "native", as that does not specify a time period, despite the prevaricating phrase "often long ago". We cannot even qualify it as a "neo-native", because that term is used for new plants arising indigenously by natural hybridisation. The fact is that there are no such categories, but plants that have been with us more or less long, along a complete continuum of colonisation dates. In many cases we cannot even be sure whether many taxa are alien or not, because we do not know whether or not they came in by means of man. And even if they did - is this any different from a creature or a seed carried by a migrating bird? Bird or man, what difference? We cannot even say that plants that have been with us longer are more integrated into our eco-systems, because the above results disprove that, and some recently introduced plants can spread rapidly and become well integrated into our flora in a few decades (eg green alkanet *Pentaglottis sempervivum*). With other natural orders the situation is even more fluid - invertebrates for instance (although mammals other than bats, which cannot arrive unaided since the disappearance of the land-bridge with Europe, apart from the most prodigious kangaroos, can usually be safely classified as natives or introductions).

Green alkanet - an alien now an established part of our flora

Japanese knotweed - an unwelcome alien

Maybe all we can ask is, is it here or not? If it is, then we have to live with it. If people want to eliminate Japanese knotweed *Fallopia japonica*, by all means let them try, as there is very little going for it, although they will probably never get rid of it altogether. Man's attitudes

are just one of the environmental factors natural species have to contend with these days (see the next section), so nothing fundamental has changed. In actual fact, very few "aliens" - especially garden plants - successfully establish, even if they crop up now and again as short-lived escapes. Those few that do become naturalised become part of our flora, whether we like it or not.

I am not sure what value to put on taxon counts as crude biodiversity scores. The more different plants there are, the more likely that a wider range of creatures and fungi will be supported (ignoring attempts by man in some cases to limit such associates with insecticides, fungicides and herbicides), so diversity on the whole counts for something. If we could measure something like an "ecological community", implying integration only achieved over time, we might get a bit further, but it is difficult to define or even to see how it exists meaningfully at all. In our area it can really only be approximated in relation to woodland (perhaps extended to hedgerows), because they represent our only survival (much altered) from the pre-human native forest. (In other regions one might make a similar argument in relation to heather moorlands, say, or maritime cliffs.) With woodland there is the prime importance of mycorrhizal fungi and their nexus of relationships with the plants, and the best measure of such a community is probably the number of fungi, rather than that of plants, especially as fungi are rarely manipulated by man whereas plants, at least trees, are very much so.

In terms of other habitat types, there are a few remaining unfertilised grasslands that have apparently been unchanged over centuries and can potentially approximate more or less stable communities - some chalk grasslands, or even rarer remnants of grass-heath once associated with the hill-top commons (often rich waxcap-grasslands and so best defined in terms of fungi yet again). With all these one needs to be able to define what species distinguish a long-established and little-interfered-with habitat from such a habitat that is not so, the sort of thing that is attempted, in relation to plants, with existing "Ancient Woodland" or "Chalk Grassland" Indicators, although these are best defined on a regional rather than a national basis. Another habitat that might also be assessed in such a way is that provided by veteran trees, for which entomologists have developed "Saproxylic Indexes". All other local habitats are too disturbed to approach in this way and a simple count of species recorded is probably all one can manage, although some partial indices might be used for cultivated ground based on naturally-occurring annual plants, such indices having no ecological significance but at least supporting the conservation of a group of plants that is particularly endangered.

Conservation has always, and for good reason, concentrated on "rare" species. This follows from the fact that in the modern age many species have come close to disappearing or are in severe decline, so that effort must be concentrated in a last-ditch attempt to prevent their extinction. Recently it has been found that even such efforts may be doomed to fail if suitable sites are too small or provide no opportunity for spread or exchange of genes - hence landscape-wide conservation plans that seek to preserve whole ecological communities and communication pathways between them, although this is difficult in a country like ours that is so dominated by human settlements and economic production, and virtually all land is divided into a myriad of privately-owned tracts.

There is, however, still scope, when management for rare species is established, to consider what is best for natural biodiversity more generally, either at the same site or at other sites where there is no particular rarity on which to focus. When it comes to woodland, insuring that some trees can reach veteran age and preserving the integrity of the all-

important soil layer (mycorrhizal fungi, invertebrates) are paramount, along with controlling invasive species and ground-carpeting ivy *Hedera helix*. "Opening up" to light is advantageous where there is a seed-bank in the soil of ancient woodland plants (as was maintained by coppicing cycles in the past), but otherwise only encourages alien invaders, of which pendulous sedge Carex *pendula* is particularly aggressive locally (the result of garden throw-outs, as it is not native to our woods as it is in some other regions). That said, leaving open spaces where possible for brambles, nettles and thistles always represents a plus in any sort of habitat, and, if there is little chance of re-establishment of herbs like primroses and violets, that may be the best that can be achieved.

In unfertilised grassland, where there is space away from more sensitive species of plant, the same policy of encouraging limited areas of scrub and patches of nettle, bramble, roses and thistles can be followed, which allows also for the need to maintain some long-grass areas as well as short turf. Only in the case of the few surviving waxcap-grasslands would scrub and long-grass be limited more strictly, although there may still be less rich corners that can be devoted to taller vegetation. Disturbed ground does not lend itself to conservation management, but many of the best patches of nettle, bramble and so on will be found on these. Where there is annual tilling, sacrificing some space unplanted and untreated with chemicals, would best ensure the survival of a whole suite of transient native annuals, many of which are near extinction. This is done with field margins on some farms (and can apply to whole crops on organic farms), but more might be done to encourage allotment-holders (and gardeners) to be less punctilious in their weeding out small plants when getting rid of the more intrusive sow-thistles, docks and dandelions.

Experimental cornfield plot, including seven different annuals in this one picture

4. Plants and man

Man, as mentioned above, is just one among all the other ecological relationships that affect the lives of plants, possibly the most influential of all, and plants, of course, have an intimate role in our lives too. At the most general level plants generate oxygen that is the basis of all animal life on earth, including ourselves, and absorb carbon dioxide, helping to reduce the effects of pollution. In return, sad to say, humans have been responsible for air, soil and water pollution, habitat destruction, and climate change. At this level, then, the relationship is very unequal. But our relationships with different plant species are very varied and at this more particular level our effect has not always been negative (as far as the plants are concerned).

Edible plants

Many plants have been found useful to man at different times and places, but those that are most useful have become "crops", so that their distributions and abundance have been hugely magnified. Although crops are managed and confined, some will usually find a way to "break out" and become established in the wild, so that even their "natural" distribution is affected. Annual crops are usually harvested and not allowed to seed themselves, but even then exceptions occur, as when one sees the odd plant of oat waving above a field of wheat, having seeded itself the year before. Longer term crops, such as trees, may even be encouraged to seed themselves, so that they act much more like natural communities.

Field of bread wheat with common poppies

The commonest crops have traditionally been for human food - staples such as bread wheat, barley, oats, rice (not locally); vegetables such as potatoes, tomatoes, cabbage and pulses; fruit such as apples, blackberries, strawberries and nuts; and a few plants used on a large scale as flavouring, such as hops and mints. All of these may be found as escapes in the wild, although in small numbers and seldom establishing for very long, so that the existence in the wild of such non-natives is dependent on continued introduction as crops. Man also seeks to improve the food value of the wild species that are domesticated, manipulating their gene structures, so that crop plants are often very different from the wild original. Most of these cannot maintain their qualities as escapes - as apple varieties from seed all tend to develop towards the wild

original with small and less sweet fruit, although the frequency of domestic-origin apples in our hedgerows now means that the foreign *Malus pumila* is far more common than the native *M. sylvestris*, which is rare. Similarly hybrids between filbert *Corylus maxima* and our native hazel *C. avellana* are more frequent than the latter in the vicinity of habitations and orchards.

Most of our crop plants are alien species. Many native plants (including ancient introductions) are edible but have not been found suitable for large-scale cultivation, or are of only minor food value. Edible plants found in the wild locally are listed below, including potentially self-sustaining aliens (marked *):

Native plants used as food crops (often modified as domestic varieties)
Wild cherry, wild plum, gooseberry, redcurrant, blackcurrant, hops (for flavouring beer after treatment), watercress, horse-radish (roots when treated), white and black mustard (seeds when treated), cabbage, burdock (roots used in making drink), chamomile*, cornsalads.

Introduced as food crops
Sweet chestnut*, filbert* (including hybrids with hazel*), cherry-plum*, apple*, domestic pear*, medlar (when bletted), grapes (fruit and, when treated, leaves), broad beans*, lucerne* (seedlings as "alfalfa"), garden strawberry*, marrow, courgette, garden cress, oil-seed rape* (seeds when treated), turnip*, buckwheat, rhubarb, garden orache, root beet*, amaranths (seeds as grain), borage*, potato, tomato, Japanese-lantern (fruit), spearmint (and other garden mints)*, balm*, sage, safflower (for vegetable oil), salsify*, chicory*, sunflower (seeds), fennel*, alexanders*, oat*, barley*, wheats*, rye*, maize.

Native and often collected in the wild for food
Hazel nuts, ramsons leaves, wild strawberry, blackberries, raspberries, stinging nettle (young tips cooked), hedge garlic (salad leaves), dandelion (leaves in salad & making drink).

Blackberries - still the most popular wild food

Native and often collected in the wild for flavouring

Blackthorn (sloe), rowan berries, crab apple, elder flowers and berries, meadowsweet flowers, heather (flowers).

Native but not widely used in current times

Wild service tree berries ("chequers"; for flavouring liqueurs), juniper berries (for flavouring gin; these are now imported), common poppy seeds (for flavouring breads etc; now imported), barberry (for flavouring), white and red clovers (nectar can be sucked for sugar), rest-harrow (roots can be chewed), broom (buds and flowers), salad burnet (leaves in salads, cucumber flavour), parsley-piert (leaves in salads), dewberries, wood-sorrel (leaves in salad), several cresses - hairy bittercress, wavy bittercress, lady's-smock, and wintercress (salad leaves), common sorrel, water-pepper, common bistort, common chickweed (salad leaves), common orache (salads), fat-hen, Good King Henry and red goosefoot (cooked like spinach), self-heal (salads), ground ivy (herbal tea), white dead-nettle, henbit, wild marjoram and thyme (herb, tea), water mint (flavouring), sow-thistles (salad leaves), elecampane (roots), wormwood (flavouring drinks), tansy (bitter herb in cooking), guelder-rose (fruit cooked - not edible raw), pignut (tubers), sweet cicely, floating sweet-grass (seeds).
(Although this list appears to represent a large under-exploited food resource, most are either rather poor food or not common enough to be viable.)

"Chequers" fruits of wild service tree, once used to flavour liqueurs

Introduced as decorative plants

Three cornered garlic* (bulbs can be used as a mild form of garlic), giant rhubarb (*Gunnera*; stalks can be used like rhubarb), alpine strawberry* (edible fruit), Japanese wineberry* (edible fruit), fig* (edible fruit), nasturtium (leaves and flowers), Japanese knotweed* (shoots and young leaves when cooked), spring beauty* (salad leaves), Indian balsam* (seeds), tea-plant (ripe fruit).

Used as fodder for domestic animals

(Some plants above for human consumption are also used for animals - eg windfall apples, chickweed, sunflower seeds.)

Beech-mast and acorns (for pigs), holly leaves (once cut for cattle), fodder vetch*, lucerne, sainfoin, melilots, fodder burnet*, white and black mustards, fodder radish, shepherd's purse (birds), cleavers (chickens), comfrey (especially goats), groundsel (birds), niger seeds (in wild bird-seed), a wide range of grasses (grazing, hay), millet and cockspur seeds (bird-seed).

Medicinal plants

In former centuries, before national health services, resort was frequently made to wild plants for remedies, some illusionary (based on the "doctrine of signatures" whereby parts of plants seeming to resemble parts of the body were thought effective against maladies of those parts), many questionably effective (or even downright dangerous when more than a tiny amount of the plant could be poisonous), and only a few that can still be considered potentially useful. Many medicinal plants, often imported from abroad, were grown in "cottage gardens" for domestic use, while for other remedies the help of local herbalists was sought - in the vicinity of nunneries, often the nuns took this role and grew useful herbs in their own gardens (the explanation for the survival of birthwort in the former grounds of Godstow Nunnery near Oxford). Quite a lot of these cottage garden plants found their way into the wild and are now established in our countryside. While herbalists still operate today, the great majority of people prefer to use services that are more scientifically based. While medicinal uses of plants are mentioned throughout this book, it is not recommended that people try any other than those with which they are already familiar or on the basis of professional advice.

The following list is of medicinal uses that have some justification as possibly efficacious in terms of modern knowledge, although in many cases there are manufactured equivalents that are safer, easier and more effective. Most need processing before use.

Hedge woundwort got its name from its astringent properties

Astringents (for stopping bleeding, healing wounds, preventing infection etc)
Wych elm bark, rowan berries and bark, tormentil roots, periwinkle, comfrey, ribwort & greater plantains, self-heal, hedge woundwort, betony, mouse-ear hawkweed, yarrow, devil's-bit scabious, common valerian.

Painkillers
Willow bark, meadowsweet, bridewort*, feverfew.

Purgatives
Elderberries, yellow iris roots, spindle leaves and bark, fairy flax, betony roots.

Diuretics (increasing urine flow, useful for certain conditions)
Stinging nettle, pellitory-of-the-wall, dandelion, mouse-ear hawkweed.

Sedatives
Hops (beer!), wild thyme, periwinkle leaves*, balm*, common valerian.

Anaesthetics
Water mint (menthol).

Histamines (useful against, eg, arthritic pains)
Stinging nettle.

Antioxidants (for respiratory problems)
Lungwort*.

Verbenaline (like quinine, useful against malaria)
Vervain.

Inulin (useful against asthma and chest complaints)
Elecampane roots*.

Vitamin C (useful for colds)
Blackcurrant, rose hips, blackberries, watercress, wintercress, scurvy-grass.

General tonics
Agrimony, fragrant agrimony*, ground ivy, dandelion, chamomile, common valerian.

Improving complexion
Wild strawberry fruits and leaves (crushed).

All the traditional intoxicant drugs have plant origins, but none of our native plants seem to have a very potent effect. Some introduced drug-plants may be found as escapes (cannabis or hemp, tobacco and opium poppy, for instance) but they fail to develop the active substances in our climate and are therefore harmless.

Poisonous plants

Many plants contain chemicals that could cause harm if taken in sufficient quantity, even those used for medicinal benefits. There are, however, some that are poisonous even in small quantities, and they remind us that while all our plants can be admired and valued, closer interactions are to be undertaken with caution.

Some are potentially dangerous to the touch, although individuals are differently susceptible to these, as they are to bee or wasp stings. Effects may vary from mild stinging sensations that may last for up to a day to more serious forms of dermatitis. In our local flora these plants are: Cuckoo-pint, Welsh poppy, stinging nettle, rock-rose (stamens only), leopardsbane, hogweed, giant hogweed (particularly pernicious), and bullwort (a rare escape). The effects are usually exacerbated by exposure of the skin to sunlight.

Other plants are poisonous only if ingested. The following list comprises all in this flora that could cause upsets in this way, although few are likely to be deadly unless eaten in large quantity (unlikely in most cases because of the unpalatability of the plant). Those highlighted tend to be the most serious. Some common native plants are included, but many of our poisonous plants are the result of introduction from abroad. Some other plants are sometimes mentioned as being toxic and so no plant should be eaten unless one is sure of its edibility.

Horse-chestnut*, cherry-laurel*, Portugal-laurel*, **laburnum***, false acacia*, box*, **privet** (berries), **rhododendron*** (flowers only), dogwood (berries), holly (berries), **yew** (bark and seeds), bracken, **cuckoo-pint**, black bryony, herb-Paris, meadow saffron*, **autumn crocus***, **daffodils*** (bulbs), **snowdrops***, bluebell (not deadly), butcher's broom (berries), greater celandine, meadow and bulbous buttercups (mild), marsh marigold (leaves), green hellebore (mild), stinking hellebore*, winter aconite*, **larkspur***, corn-cockle, lucerne* (seeds), goat's-rue* (mild), broom (foliage, mild), buckthorn (berries and bark), white bryony, wood-sorrel (in large quantity), StJohn's-worts (in large quantity), tutsan (berries, mild), dog's mercury, wood spurge, sun spurge, caper spurge*, spurge-laurel, mezereon, hedge mustard, treacle mustard (seeds), **mistletoe**, **rhubarb*** (leaves), spotted laurel*, **bittersweet**, black nightshade, potato* (except non-green tubers), tomato* (except fruit), **deadly nightshade**, **henbane**, **thorn-apple***, Japanese-lantern*, tobacco*, tea-plant*, **foxglove**, great lettuce, ragworts, groundsel, coltsfoot, wayfaring tree (berries), guelder-rose (berries), snowberries*, **ivy**, fool's parsley, **hemlock**, **hemlock water-dropwort**, corky-fruited water-dropwort.

Deadly nightshade is well-named

In addition to the above, mention should also be made of the ability of plant pollen to cause breathing problems in hay-fever sufferers. Many kinds of pollen are implicated, but that of grasses is both prevalent and the most likely to be involved with causing problems. Some pollens collected by bees may also end up in honey, and two most likely to cause it to be distasteful, or even mildly toxic, are oil-seed rape and rhododendron.

Other economic uses

Apart from food and medicine, plants have found many other uses. Trees are grown for timber (plus firewood, charcoal, basketry, paper, and much else) to such an extent that our native woodlands have been almost all transformed into assembly-line plantations, slow farming. Quick-growing conifers are imported for a faster buck. Just as open land is dominated by uniform stands of ripening crops or by botanically-impoverished high-protein grass swards, woodland too is devoted to profit, and our whole landscape is transformed into a softer kind of cityscape, where wild vegetation is replaced by plants in the service of man. So successful have many of our wild plants been that they have become the downfall of their own wildness. Not satisfied by what plants have managed to produce through evolution, commercial growers improve on their innovations by selection of sports, hybridisation and genetic modification to produce more, bigger and better - for man at least - never mind that these cultivars may never, without human protection and nourishment, have withstood the rigours of natural selection. Less regimented oases in this landscape, "nature reserves", are still managed by man (to assist "access" or to protect species more valued by man, if only for their rarity that was itself created by man, although "orchids" also tend to be favoured over more easily overlooked knawels and pearlworts), so that they become "zoos" where plants are displayed under comfortable conditions, or perhaps "museums" would be more apposite, given that these native species hardly survive anymore beyond the boundary of the reserve.

Leafing through the descriptions in this "flora" will reveal a multitude of uses too long and varied to list - dyestuffs, rope, bedding, mulch, insecticides, starches, fuel, perfumes, oils, playthings (like conkers), waterweeds for aeration of aquaria, game coverts, hedges, fixing soil nitrogen (clovers, vetches).

Traditional cottage garden

Gardens and parks

The earliest cottage gardens were functional, for growing subsistence vegetables or medicinal plants, but the growth of leisure time and spare wealth, initially confined to the nobility, led also to the opportunity to indulge aesthetic pleasures beyond mere survival, the wish to create beauty in one's surroundings. Many plants are valued for their own sakes, for their colour (poppies), shapes (irises) and scents (mints), and these were selected to create everything from small flower-beds to whole landscapes (parks). A crop might be sown and then largely left to its own devices, but most gardens are highly managed, often with daily "weeding", dead-heading, pruning, planting-out, protection from "pests", removal of excess growth, and so on.

Plants were appreciated for marking seasons, especially the arrival of spring (primrose, lilac) or of autumn (beech trees), or for colour at drab times of the year (crocus, daffodil, autumn berries, Christmas rose). Some plants were collected for domestic decoration (as well as to ward off witches), such as holly, ivy, mistletoe, fir-cones and, later, a Victorian innovation, the imported Christmas tree or Norway spruce. Wild flowers were also picked to bring colour and fragrance into the home - bluebells, primroses and others, a practice now less common as a consequence of the easier availability and better survival of garden and shop-bought flowers.

Old trees were also admired for their size, longevity, strength, or the Gothic shapes assumed by veterans in their slow decline. Some of our largest trees have been given names - the Druids' Oak at Burnham Beeches, or Major Oak in Sherwood Forest, for instance. Until the middle of the C20th Ordnance Survey maps showed a named tree in our area, the King's Beech, in the centre of the large triangular junction between Rignall Road (west out of Great Missenden) and King's Lane (north to Cobblershill). Unfortunately this tree is now no more, and despite my efforts to find out more there is no living memory or surviving record of the nature of this tree. The tree must have been impressive to have earned the exceptional distinction of being named as an individual, but it also clearly marked an important landscape feature, not only in terms of the roads but also by being situated precisely on the boundary between Great Missenden and Great Hampden parishes. Most of our surviving large trees (which have been documented - their girths measured, GPS readings taken, and photographed - by Prestwood Nature) are landscape markers, usually on the corners of fields where several boundaries coincide.

Prestwood Park

Other large trees are concentrated in survivals of C18th parklands (Abbey Park, Great Missenden; Great Hampden Park; Hughenden Park) where well-separated plantings have allowed unimpeded growth and survival, while their appreciation as landscape features has outweighed their economic value as timber. While the great park-lovers, the Elizabethans and subsequent generations, right down to the Victorians (Prestwood Park was planted in 1850 to commemorate the founding of the new church of Holy Trinity), created rather barren landscapes largely devoid of natural biodiversity, with engineered lakes and artificially arranged trees conforming to austere and grandiose conceptions of "ideal" natural scenery *à la* Capability Brown (dotted with statuary, fountains and grottoes), and while they were too keen to show off their wealth by importing costly alien trees such as common lime, sycamore, horse- and sweet-chestnut, less valuable in our countryside today than native trees would have been, they at least must be praised for having the foresight to plant and protect for posterity what were to become the most magnificent trees of our present time, just as the royal family did at Windsor Great Park.

The planting of elms along many of our major roads occurred at a similar time to the creation of the great parklands. While these were again imported hybrids, they did form monumental trees that became the signature of the English landscape (one variety even came to be called "English elm" despite its foreign provenance), while the fact that they were closely related to our native elms meant that they supported the same wildlife and fitted into natural eco-systems. The devastation caused by Dutch elm disease made a noticeable difference to the landscape. The elms did not die out, but survive as young trees in hedgerows until they succumb at about 15 years of age, to the still-prevalent disease. Very few large mature elms survive, although in this area we are privileged to have two magnificent Huntingdon elms (possibly the oldest surviving in the country) by Hare Lane in Little Kingshill, and several Midland elms at the edge of Rook Wood that are over 50 years old. These survivors may have some genetic quirk that gives them immunity to the disease.

Huntingdon elm, Little Kinghshill (photo Paul Heath)

The modern-day equivalent of the manorial estates are local authorities that plant street trees for ornament and straight lines of cultivated daffodils. Their decisions are determined for the most part by cheapness, ease of management, disease resistance (the famous so-called London plane has naturally peeling bark that combats the effects of air pollution) and limited potential size, rather than any concern about protecting our natural diversity, so that most of the trees and shrubs are aliens and often very dull (falling flowers and fruit are frowned upon for littering the pavement), while those cultivated daffodils gradually die off, being unable to reproduce themselves, when native species could at least have created self-sustaining communities.

In the present day there is much less appreciation of plants than there was in the past. The typical householder today is more concerned that any tree near their house might fall upon their property, leading to a rash of fellings of notable trees in our area, which local authorities find it difficult to resist for fears of legal liability fostered by insurance companies. In past centuries, when food came from cottage gardens and local farms rather than supermarkets, plants were more respected and much better known. The average person would have known the names of hundreds of plants, whereas I have met people in the area today unable to recognise a beech, and many cannot name any flower other than a "daisy", a portmanteau word often used to cover many different plants. (Schools could be doing much more to inform young people, if only the national curricula would leave them alone. See, e.g. Wilson 2019.) It was as a result of the former significance of plants in people's everyday lives that we get our rich vocabulary of vernacular names, often with fascinating etymologies, which I have tried to capture in the individual plant descriptions in this work. Many place-names are derived from plants. Locally we have Birchmore Wood, Furze Wood, Oaken Grove, and fields such as Strawberry Close, Beech Close (near that old King's Beech), Apple Tree Close, Heathey Field, while Missenden itself is thought to be derived from an Anglo-Saxon word *mysse* for a water plant, possibly water forget-me-not, still prevalent along the Misbourne.

Colour-names derived from flowers show that appreciation of our plants has not wholly been economic but also aesthetic - primrose, gentian, chestnut, rose; as also girls' names - Hazel, Holly, Iris, Daisy - including Primrose and Rose again; although these words mostly came into usage no earlier than the Victorian era and were reinforced by the Romantic poets. You do not find such "pretty" flowers represented in medieval place-names.

The rise of the modern garden is relatively recent. Until the Victorian era the garden was a vegetable and herb patch - the old name for the oldest part of Prestwood in the Kiln Common area was "Cabbage Row", both prosaic and evocative at the same time. The cottage garden,

with many medicinal plants, but some also of purely aesthetic value, came into existence in the C19th and was reinforced by the romanticised vision of the countryside fostered by many painters of the time. In the C20th it became possible for "ordinary" residents to purchase exotic plants at reasonable expense and gardens of multi-coloured hues rocketed. This has had some benefits. Such gardens support many more pollinating insects than the wider countryside does today and other forms of wildlife can prosper too, in the right conditions, from molluscs to mammals, while over half of local householders attract birds by providing food. Putting all these gardens together creates a sizeable area of habitat that can be used by wildlife and is often characterised by a huge diversity of plant species. Where the plants concerned are native or close relatives to these (as long as they have not lost their nectar or other qualities through hybridisation) they can form a decent substitute for many of the natural habitats that have been lost, although the extent to which self-sustaining eco-systems can build up is limited by man's continual management interference. One can hope that the appreciation of plants and of their variations extends to appreciation of their wild relatives, although I have not always found that this is so. Many gardeners seem to have little appreciation of plants in the wild. With the current pressure to build more housing on limited available land, gardens are now becoming much smaller, which decreases their capacity to compensate for the degradation of our countryside.

The downside is that the fad for gardening has led to the introduction of huge numbers of alien species, or cheap foreign imports of native species, which, along with the danger of importing with them harmful wildlife and diseases, has, through garden escapes and deliberate dumping of garden rubbish, led to a wholesale change in the make-up of our plant communities, such that a good third of species in a "wild" community are often of foreign origin. Where some of these eliminate native species by competition or potentially hybridise them out of existence, this can harm natural eco-systems while apparently boosting "biodiversity" if the latter is crudely measured by number of plant species present. The disasters here are well known - Japanese knotweed, Indian balsam, garden yellow-archangel, Spanish bluebell, bamboo, cotoneaster, cherry-laurel, and several waterweeds.

Garden yellow archangel is a rampant invader

Only a small proportion of introduced plants cause such problems and garden escapes help beautify built-up areas, although they face a high risk of removal in street-cleaning and other maintenance. Some garden plants have become well-established in the countryside, even well away from houses, and most cause no problem - examples are green alkanet and wood forget-me-not (a rare native, but all our local stock comes from garden introductions). Whatever one's attitude to this great outpouring of garden plants into the countryside, there is nothing that can be done and one might as well appreciate the variety that this brings, while trying to control the worst excesses. It is by no means a recent phenomenon. Many of our common plants, accepted as native, were actually imported from Europe by early Neolithic farmers as corn-seed impurities, or more deliberately by other settlers like the Romans. There is nothing to be achieved by being purist about these things - and new plants can, after all, introduce themselves by, for instance, seed blowing in the wind across the sea or lodged in the muddy feet of migrating birds. If the sycamore is not native, it might as well be, as it is here to stay.

Agriculture and horticulture have led to the denigration of some annual native species that need regularly broken ground and bare soil to live their brief lives without competition from greedy perennials. These are seen as interlopers, competitors with our carefully nurtured crops and garden flowers, and dismissed as "weeds", although there is no such thing, only plants that are in the wrong place (from the landowner's point of view). So a hollyhock that might be deliberately sown in a flower bed becomes a weed when it self-seeds into a vegetable plot. While growers certainly need to control some of the most vigorous interlopers, such as the docks and thistles, some of these annual natives are relatively frail and often as beautiful as garden cultivars, though often in miniature, necessitating a close look to appreciate them. These are not competitive, their lives are short, and in modest quantity only serve to add an aesthetic character to the vegetable patch or even the flower-border. With modern chemicals such as fertilisers and herbicides having destroyed the natural habitat of these native annuals in the greatest number of our arable fields, many are among our rarest native flowers and in danger of national extinction (some have already gone that way), so a little compassion for those that occur by chance in the garden or allotment would achieve a great deal in preserving the general biodiversity. A particular local example is the rare Night-flowering Catchfly, which appeared out of the blue in one small garden in Prestwood in 2013 and was lucky enough to have found a welcoming host (Jeanette Hedley) sufficiently interested to enquire what it was and willing to nurture its survival when she discovered how endangered it was, so that it grows there to the present day.

Night-flowering catchfly

Gardens have also been used proactively to conserve endangered species, particularly of our threatened annuals, ensuring the survival of populations in an "artificial" habitat when they in danger of dying out in the wild. Thus in our area we once had a thriving population of Interrupted Brome, but this mysterious grass survives now only in a few botanists' gardens, including one in Hughenden Valley. BBOWT, at its College Lake reserve, just a short drive from our area, has a whole cornfield dedicated to the preservation of endangered and extinct-in-the-wild traditional "cornfield weeds". With the help and advice of the volunteers running this project, Prestwood Nature have locally established a small "mini-cornfield" where such plants have similarly been sown amidst rows of corn, dug up and sown to a wheat mix annually, the aim being that some at least of these plants will be able successfully to self-seed and germinate from year to year. Already such plants as the extinct Thorow-wax and endangered Corn Cleavers, Field Cow-wheat and Corn Buttercup have responded well, although whether permanent populations will survive into the future remains to be seen.

Thorow-wax growing in Pretwood Nature's experimental cornfield

Similarly one may either see the daisy and other lawn denizens, sufficiently low-living to survive the mower, as beautifying a dull patch of uniform green, or as an intruders or weeds breaking up a smooth expanse. As most garden lawns cannot aspire to the regularity of a bowling-green, however, which takes much daily toil to maintain, then a sprinkling of flowers would seem a better bet.

While horticulture, as a widespread hobby, has led to many foreign introductions, it has also led to modifications of many of our native species to give them valued qualities, such as the "Copper Beech", "weeping" varieties of several trees, more productive crops. These qualities seem to not survive in the wild beyond the planted specimens, so that they have little wider impact on the environment. Genetic modification has taken this centuries-long process much further in recent decades and in this case caution should be exercised in the insertion of genes that destroy plant predators, which could be environmentally disastrous if they escaped the bounds of the crop, which some scientists have claimed they may have already done.

If many of our native annuals now depend on gardens and allotments more than on agricultural land for survival, by supplying the annual disturbance of the soil they require, other of man's activities have had a much more unfortunate effect. Air, water and soil pollution from many industrial and mechanical sources, and particularly overuse, or careless application, of farm fertilisers have steadily increased the level of nutrients in our soil (nitrogen and phosphorus compounds), with the result that certain vigorous plants such as Stinging Nettle, Docks, Cow Parsley, and Cleavers have massively increased their populations, swamping out uncompetitive species. The traditional celebrated hedgerow of Bluebell, Greater Stitchwort, Yellow Archangel, Violets and Foxgloves, for instance, is now under threat and often already supplanted by an overgrowth of the nutrient-loving species, this being a double loss for these plants, which themselves have survived vicariously in hedgerows after being ousted from their natural woodland habitat by neglect or mismanagement. As a result, some of our rarer hedgerow plants, such as Moschatel, Green Hellebore, native Lady's-mantles and Orpine are in danger of being lost altogether.

Plants as fun

While gardens allow man to express their aesthetic appreciation of the great variety of colour and shapes that plants have evolved, plants have also afforded playthings in themselves. There are (or were, as many of these traditions now seem to be vanishing) many children's games employing plants, such daisy-chains, hollow stems and seeds for pea-shooters, rose-hips for itching-powder, and Ribwort Plantain shooters. (Mabey 1996 has many more examples.)

Grubbing for the nutty tubers of Pignut must also have been more fun than for their meagre nutritive value, just as blackberrying is probably more significant as a social event than as an alimentary necessity. It is probably as well, however, when our native flower populations are at a low ebb, that the gathering of bunches of flowers as nose-gays and (very short-lived) pot displays is now largely discontinued. Our Bluebells may not have noticeably suffered, but our Primroses certainly did, and as for the execrable practice of digging up orchids for re-planting in private gardens, the lady's-slipper orchid came very close to national extinction (one remaining wild plant) in this way. Even up to the present day I have encountered evidence locally of the removal of orchid plants from the wild, as well as various others such as Spurge-laurel.

Plants as problems

If people nowadays are generally less aware of our native plants and less able to distinguish various species, there is a certain group of plants of which people tend to be particularly aware because they are seen as threats. The most infamous of these "bogey-plants", of course, is the Japanese knotweed. This is one of various "aliens" (another emotive word) that are similarly regarded with at least suspicion and sometimes hatred. The problem of such "alien thugs" has exercised conservation agencies worldwide and led to the setting up by the government in this country of the Non-Native Species Secretariat, tasked with assessing their threat.

It is far from the case, however, that all aliens are a threat (only a very few in fact), nor do they necessarily constitute the majority of those plants that do threaten native ecology and biodiversity, a point being made increasingly these days by botanists concerned by the even greater threat of over-the-top damaging responses to some species. An example of a more rational approach to the issue is Pearman et al. (2019), who set out to evaluate the greatest

plant threats in a number of local areas, the balance of native and alien species, and the geographical variations. Not only were native species often found to be the major problem, but the main threats in one area were often not so in another.

It is therefore useful to examine our own local flora and evaluate how many species might be seen to constitute some sort of problem and to rank them in terms of seriousness of their threat. The main criterion was the extent to which each species has been seen to damage the local native ecology, although a variety of contributory factors were also considered, such as their ability to form dense colonies and become dominant; their ability to spread across a site, or to spread to new sites; their ability to spread beyond disturbed areas to semi-natural sites; their ability to survive in the current climate, including likely responses to global warming; and, most importantly, how difficult they are to control or eradicate once established.

All told I found 117 species that could be considered, to some degree, a problem, of which 64 were recent introductions (a less emotive term than aliens) and 53 were natives or ancient introductions now part of our established flora. Of these a total of just 18 were judged to be both a major present problem and difficult to eradicate. Recent introductions were again in a majority, but 7 were natives or long-established. There were also 10 that certainly constituted a problem, but were not too difficult to eradicate when necessary (7 recent introductions like Least Duckweed, 3 native/established, such as Ash). In addition, there were 8 species where it was felt that they constitute a major potential problem because of the nutrification of soils from pollution or agriculture, or because of mismanagement of the environment, such as neglect or damage. 19 species were adjudged to pose a moderate problem at present, but were capable of becoming more serious (14 of these recent introductions), along with 2 more introduced species that might become a problem in the future. The remaining 60 species (the majority of the total 117) were seen as not currently posing a serious problem or likely to do so in the foreseeable future (of which a slight majority of 31 were natives).

The 18 species felt to be a serious present and future threat were as follows (in no particular order):

Aliens: **Cherry laurel** *Prunus laurocerasus*, which has already come to dominate extensive areas of woodland to the detriment of other species, which is very costly to eliminate, spreads by underground roots and is continually increasing from introduction of seed by birds from gardens, where it is very common.

Rhododendron *Rhododendron ponticum*, which is a major threat to native heathland because of shading out competitors and inexorable vegetative spread and is notoriously difficult to eradicate. While it has little presence in our area of study, it has proved to be a problem nearby in the restoration of Penn Wood.

Few-flowered garlic *Allium paradoxum*, which spreads both by seed and vegetatively by means of bulbils, forming dense patches in a variety of woodlands, although it does not appear to spread easily to new sites unless deliberately introduced.

Hybrid bluebell *Hyacinthoides x massartiana*, which has formed colonies in several woods and is still spreading, continually reinforced by garden throw-outs. While there is dispute over its ability to back-cross with native bluebell and thus destroy the native as a genetically distinct species, there is certainly at least one example locally where this is occurring, with a small number among largely native plants ten years ago now almost entirely composed of intermediate plants.

Lesser and greater periwinkle *Vinca minor & major*, the former having now colonised a major part of Peterley Wood, escaped from the gardens of Peterley Manor. Very little other vegetation survives amongst its dense creeping mats and it is difficult to remove. There are plenty of other locations where garden throw-outs have established, which could become major problems in the future.

New Zealand pigmyweed *Crassula helmsii*, which will totally cover a pond in just a couple of years and can only be removed by destroying the whole pond. It spreads to new sites relatively easily, probably on the feet of birds or human boots. In our study area there are no major infestations, but constant vigilance will be needed with many large populations nearby (e.g. Penn Street).

'Himalayan Giant' blackberry *Rubus armeniacus*, which is more vigorous and larger in all respects than our native brambles (see below), and is particularly difficult to control. It forms huge stands at Mop End, having probably eliminated several rare native species of bramble. Although it is appreciated by blackberry gatherers for its luscious fruit, it is a major ecological threat, colonising rapidly where established and spread to new sites by birds.

Japanese knotweed *Raynoutria japonica*, whose colonies eliminate all other vegetation and which is incredibly costly to destroy. Not all local colonies have spread and, as even small fragments will root, those are best left alone. Only in a few cases has it become a major problem - e.g. in Missenden Abbey garden and beside the railway in Great Missenden.

Garden yellow archangel *Lamiastrum galeobdolon ssp. argentatum*, which spreads more aggressively than our native yellow archangel, and may well be a threat to the latter's genetic purity, although most extensive patches so far are not at the same sites as the native.

Reed sweet-grass cultivar *Glyceria maxima* 'variegata' - while our native plants are relatively well-behaved beside rivers, although forming dense colonies at times, this decorative white-streaked cultivar, dumped into ponds by irresponsible neighbours, aggressively colonises a whole pond in a few seasons. It has been a major problem at Wibner Pond and remains so despite several clearances.

Wibner pond choked by variegated reed sweet-grass 1995

Natives: **Holly** *Ilex aquifolium*, which has increased its coverage of woodland floors considerably over the last 30 years, tends to exclude other ground flora, is virtually impossible to eradicate, and spreads by suckers or underground roots.

Bracken *Pteridium aquilinum*, which was undoubtedly much more common in the past when there were extensive heathy commons, but then was controlled by harvesting for animal bedding and for burning to make an ash used as a high-phosphate fertiliser. Although its distribution is now more limited it is locally an increasing problem (such as on Hampden Common, and in various hedgerows where it eliminates other plants).

Yellow iris *Iris pseudacorus*, which can totally dominate a pond and is a major problem for pond maintenance, particularly where ponds are shallow - as most local ponds are.

Brambles *Rubus fruticosus agg.*, which is a constant conservation headache, especially in churchyards, but also other grasslands and woodlands. Its impenetrable thickets are almost impossible to eradicate once established. It poses a major dilemma, as these native plants are one of the most important ecologically (see earlier), so that the only resolution is annual control at sensitive sites, without any (vain) attempt to eliminate it.

Creeping yellow-cress *Rorippa sylvestris*, which has a very local distribution in our area but can form huge colonies on cultivated land where it does grow (e.g. Peterley Manor Farm). Fragments of root produce new plants, so it is difficult to eradicate.

Ground elder *Aegopodium podagraria*, which is notorious among gardeners but also forms major exclusive colonies on some roadsides and in some churchyards. The roots go deep and are impossible to remove.

Pendulous sedge *Carex pendula* is an important part of the native ecology of wet woodlands in the north and west, but locally its occurrence is the result of garden escapes. It is spreading in local woodlands, displaces native plants and is almost impossible to eradicate.

To this list might be added another recent introduction, **Three-cornered garlic** *Allium triquetrum*, which has recently been introduced to many local gardens and spreads very aggressively, both by seed and especially by a huge proliferation of underground bulbils, some of which remain by default even after vigorous digging-up. This species has long been established in dense colonies along hedgebanks in the South-west Peninsula and the current warmer climate in the Chilterns means that it is ready to colonise our own waysides similarly - in fact there are already the beginnings of such colonies in a couple of local sites.

Another seven species, all natives, have shown recent signs of expanding their populations and forming dense stands in response to the increase of nutrients in the soil, while not being easy to control when established, and these have in places already displaced a more diverse flora from certain habitats (especially hedgerows) and show signs of becoming an increasing problem: **Elder** *Sambucus nigra*, **Common nettle** *Urtica dioica*, **Broad-leaved dock** *Rumex obtusifolius*, **Cleavers** *Galium aparine*, **Ground ivy** *Glechoma hederacea*, **Ivy** *Hedera helix*, and **Cow parsley** *Anthriscus sylvestris*. All are valuable members of ecological communities, but one can have too much of a good thing if they displace other communities of plants. The spread of these species would be worth monitoring.

This change in our soils may ultimately be responsible for significant shifts in ecological communities, and add to the major problems already posed by the top-18 species above, many of which, like the brambles, also respond to nutrification. It is apparent that, while not all the latter are introduced species, one major issue (one that could in theory be so simply tackled) is the extent to which garden or pond waste is being deposited in semi-natural habitats.

Plants as symbols

In the past, when many people lived close to the countryside they were more cognisant of the plants around them than they are today. Similarities of plant features with objects of significance to people were often noted. One whole branch of folk medicine was based on the "doctrine of signatures", whereby similarities between plant parts and parts of the body was thought to mean they could be effective as remedies for ailments in those parts (see "Medicinal plants" above). The lasting effects of such folk practice is seen in the vernacular names of many of our plants - lungwort, eyebright, liverwort, heartsease, wart-cress, squinancywort (for quinsy) and scurvy-grass.

Other names also make playful allusions to significant features of different plants (and must have been useful as mnemonics) - shepherd's-purse, foxglove, foxtail, dandelion (*dents de lion*), Solomon's-seal (based on a common pattern found on its tubers), mouse-ear, hornbeam - or relate to common uses, like spindle, dyer's-weld, meadow saffron and teasel.

The use of plants in ritual has an ancient history. Norse myths imagined Yggdrasil, a giant ash-tree, supporting the entire cosmos - a conceit not that different perhaps from the modern ecological perspective. The pedunculate, or English, oak, famed for its long-lasting gnarled veterans, has been a symbol of hardiness and survival from the Druids onwards ("hearts of oak"), as have our native evergreens, such as holly, ivy, and mistletoe, all of which had pagan significance and have continued to be used as mid-winter reminders that spring will come, we shall endure, although nowadays attached to the Christian festival of Christmas. Similarly the yew traditionally grown on sacred Druid sites was incorporated as a feature of virtually every churchyard ever since - even the parish church of Prestwood, founded as late as 1849, has its yews. Celebration of approaching spring (a major pagan event) was also accommodated by churchyards in the planting of early-flowering bulbs, particularly the snowdrop (which had the added advantage of its pure virginal whiteness). Great Missenden churchyard has a splendid display of snowdrops every February, and many churches organise celebrations of their snowdrops at this time (eg Swyncombe). Palm Sunday is named for the traditional carrying of "palm" (flowering osiers) to church.

Snowdrops, Great Missenden Churchyard

Even non-religious events may have their plant symbols. Oak Apple Day (29 May) is now only celebrated in a few places, but was for long a reminder of the time that Charles I hid from Parliamentary soldiers in an oak-tree. Locally, Primrose Day was celebrated at Hughenden on 19 April until quite recently, a memorial to the death of Benjamin Disraeli, who lived at Hughenden Manor, and was supposed to have had a particular fondness for that flower (although this is now thought to have been based on a mistake!). The most modern surviving example is Poppy Day to mark the end of the First World Way on 11 November 1918, referring to the fields of poppies that covered the bomb-shattered fields, as poppies have always responded to the breaking of the soil by germinating from their long-buried seed ("*In Flanders Fields*", a poem by John McCrae).

Linnaeus designed a floral clock that would indicate hour of day by the times at which they usually opened or closed. The earliest was Goat's-beard, supposedly opening at 3am (at which time few botanists are around to check!), while much later on was scarlet pimpernel (8am). Certainly goat's-beard usually closes by noon (an alternative name is Jack-Go-To-Bed-At-Noon). Flowering times would of course vary with time of year, weather and geographical location, so I doubt it really worked.

Plants are rather more reliable as indicators of the time of year, according to when they first flower. As there are often individual plants that flower "at the wrong time", it is best to observe when a number of the same plant come into bloom together. Such flowering times are used scientifically in the study of phenology (the timing of natural events) and accumulating data show that over the last few decades first-flowering-times have, on average, advanced by a couple of weeks, a progression certainly borne out by my local observations. This is generally taken as a sign of global warming.

So if you happen not to have your calendar with you, the following are the times of first flowering of a selection of our plants, according to recent local records. I have left out some plants that tend to flower at any time of the year, like annual meadow-grass, shepherd's-purse, daisy, red dead-nettle and garden primroses. I have avoided precise dates, as flowering times vary from year to year according to the weather.

One of the earliest flowerers: winter heliotrope

Floral calendar

Mid-January : forsythia, winter heliotrope, snowdrop.
Late January : hazel, green and stinking hellebores, winter aconite.
Early February : alder.
Mid-February : crocus (all species - "early crocus" does not reliably bloom before the others), lungwort, lesser celandine.
Late February : primrose.
Early March : wild and Tenby daffodils, cherry-plum, ground ivy, wood spurge, wild pansy, sweet violet.
Second week of March : wych elm, wall speedwell, field pansy, wood anemone.
Mid-March : Hidcote and creeping comfreys, hairy violet, early dog-violet, marsh marigold, dog's mercury, meadow buttercup, gorse (although the last may begin in January).
Late March : coltsfoot, moschatel, barren strawberry, fritillary, gooseberry, ivy-leaved speedwell, field woodrush ("Good Friday grass" - only if Easter is early).
Early April : bluebell, cowslip, blackthorn, greater stitchwort, green alkanet, slender and germander speedwells, wood-sorrel, common dog-violet, cow parsley, sun spurge, common fumitory, goldilocks buttercup, wood forget-me-not (the common species in gardens).
Mid-April : garlic mustard, charlock, white mustard, wild plum, shining cranesbill, cuckooflower, wild strawberry, yellow archangel, coralroot, smooth sow-thistle, common wintercress, red campion, field forget-me-not, bush vetch, glaucous sedge, thale cress.
Third week of April : woodruff, ramsons, field maple, apple (domestic and crab), honesty.
End of April : bugle, Solomon's-seal, oak, bulbous buttercup, ox-eye daisy, bladder campion, hedgerow cranesbill, sanicle, wood melick, hoary plantain.
May : By the end of this month many of our species will have started flowering, including, for example, red clover, scarlet pimpernel, mouse-ear hawkweed, rock-rose, honeysuckle, pyramidal orchid, self-heal, and foxglove.
June : Another large suite of plants follow suit during this month, including, for example, bramble, bee orchid, dog and field roses, and common poppy.
Early July : ragwort, StJohn's-worts, great willowherb, devilsbit scabious.
Mid-July : hedge parsley, orpine, ploughman's spikenard, corn mint, red bistort.
Late July : autumn Hawkbit, autumn gentian, wild basil, red goosefoot, common orache, spearmint, broad-leaved and violet helleborines.
Mid-August : Chiltern gentian, autumn hawkweed, sowbread (*Cyclamen*).

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