The rare plants of the Howardian Hills, North Yorkshire, 1794–1988

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ABSTRACT

The lists of rare plants growing in the Howardian Hills compiled by Robert Teesdale and Henry Ibbotson have been pooled to provide a picture of the plant life in the area for the period 1794–1843. Modern records have been examined and extensive field work carried out to determine the fate of the rare plants post-1943. The *Atlas of the British flora* was used to provide an objective definition of rarity. Woodland species have shown the greatest survival; plants of other habitats, including arable, showed the poorest survival; plants of 1) grassland, 2) aquatic habitats and river margins, and 3) mire occupy intermediate positions. The number of sites occupied by surviving species has declined. Two very rich sites, Terrington Carr and Malton Fields, have each lost 100% of their rare flora. Extinctions appear to be due to changes in land use rather than any other factors, emphasising the need for conservation of threatened habitats, especially arable ones. This insight into the plant-loss/land-use relationship is only possible because accurate site records were made by Teesdale and Ibbotson.

INTRODUCTION

The great expansion of field botany in the nineteenth century led to the recognition of several classic areas in the British Isles which contained a particularly rich diversity of rare plants (Gilmour & Walters 1972; Allen 1986; Noltie 1986). Some of these areas have maintained their complement of rare species through to the present decade with little or no significant loss, e.g. The Breck (Trist 1979); The Burren (Webb & Scannell 1983); The Lizard (Margetts & David 1981); Teesdale (Clapham 1976). Others, on the other hand, have undergone radical transformation with a major loss of the rare flora, e.g. the Huntingdonshire Fens (Sheail & Wells 1980, 1983). The third alternative is a progressive reduction of the floral interest as component habitats are modified or destroyed in a piecemeal fashion. A short, preliminary account of this process has been previously published for the Howardian Hills, North Yorkshire (Gulliver 1985). This area, though comparatively little-known today, was botanically famous in the nineteenth and early twentieth century; Baker (1907) wrote "The Howardian tract furnishes a great variety of situation and although it has none of the more decidedly montane plants, yet we obtain here as many of the rare species as are to be found anywhere in North Yorkshire within an equal area, with the exception of Upper Teesdale, as the following list [not included here] will testify." An account of the fate of this rare flora follows hereafter.

THE STUDY AREA

The Howardian Hills form a distinct area c. 15 km north-east of York and take their name from the presence therein of Castle Howard. Their location is shown in Fig. 1. The Howardian Hills Area of Outstanding Natural Beauty (A.O.N.B.) includes a zone of land to the north and west of the hills themselves, to allow the A.O.N.B. to be contiguous with the North York Moors National Park. This north-western zone of the A.O.N.B. has been excluded from the botanical study area, which otherwise follows the boundary of the A.O.N.B. with the exception of the small area of high ground immediately west of Malton, which has been included (see Fig. 1). Most of the area is on the north-western side of the river Derwent, and therefore falls into v.c. 62; but that part south-east of the Derwent is in v.c. 61.

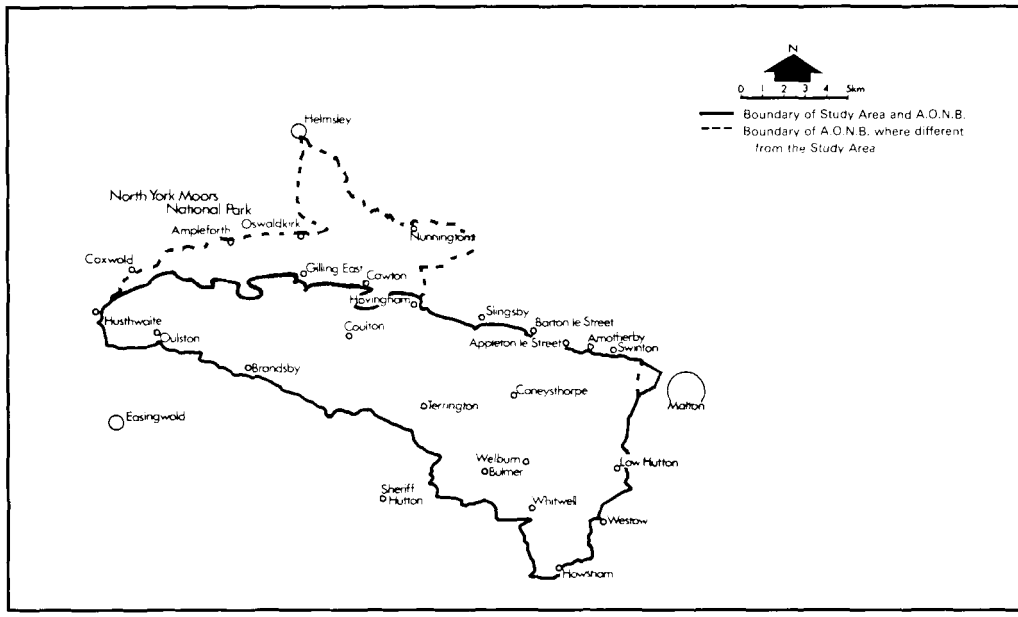

FIGURE 1. The boundaries of the study area and the Howardian Hills Area of Outstanding Natural Beauty.

The small scale of the landscape has the consequence that there is a rich mosaic of habitats. The Jurassic deposits of limestones (sometimes sandy limestones) have produced infertile pastures and light arable lands, both of which were once rich in native plant species, though Oxford Clay deposits do also occur. The limestone has also produced base-rich waters which formerly fed mire systems, allowing acidic peat (above the water table) and base-rich peat (below the water table) to exist in very close proximity. The presence of several large estates has aided the continued survival of many large woodlands. Quite a few of the parishes within the Howardian Hills were not enclosed until the late eighteenth or early nineteenth century, hence ensuring that old-fashioned arable practices, which favoured the presence of arable weeds, persisted in the area. All the above features contributed to the botanical richness of the area.

SOURCE OF PLANT RECORDS

A list of the rare plants of the Howardian Hills was published by Robert Teesdale in 1794 and was followed by a short supplement (Teesdale 1794, 1800); a second list was published quite independently by Henry Ibbotson in 1843 (Ibbotson 1843). Some biographical details of these two botanists are to be found in Rob (1963) and Crackles (1967) for Teesdale, and Gulliver (1979) for Ibbotson. In this study the two lists have been pooled, and all subsequent records of the species examined; see Appendix I for details. During this process it was evident that post 1843 records for Gramineae, Cyperaceae, ferns and mosses were extremely scarce; and therefore attention was focused on spermatophytes but excluding the grasses and sedges. (Ibbotson's second list of 1844 described mosses.) Both Teesdale and Ibbotson described the plants they listed as rare. However the use of the *Atlas of the British flora* (Perring & Walters 1962; Perring & Sell 1968), does allow an objective assessment of plant rarity to be made. The 100-km square 4/4, which includes the Howardian Hills, has been employed, and all species on the pooled Teesdale and Ibbotson (T. & I.) lists present post-1930 in thirty or fewer 10-km squares have been considered to be regionally rare and used in this investigation. Species present in fifteen or fewer 10-km squares in 4/4 have been additionally designated regionally very rare. Those species on the T. & I. lists but present in more than thirty 10-km squares will be referred to as residual species. For a brief, early account of the

study using all the entries on the T. & I. lists see Gulliver (1985). One major feature of both the T. & I. lists is that site information is given for virtually every species listed. However occasionally this information was omitted, and such species have not been included in this investigation, as one cannot be absolutely certain that they did actually grow in the study area. In addition the micro-species of *Rubus* and *Hieracium* have been excluded.

The published and manuscript records of plants in the Howardian Hills decline a little through the 19th century, reach a trough in the 1920s and 1930s, and then rise somewhat after the second world war. Accordingly the two best recorded periods have been compared, i.e. 1794–1843 with 1943–1988. Since 1976 extensive fieldwork in the area has been carried out by the author and his wife; examples of all the habitat types have been examined, and each part of the hills visited. Significant rediscoveries include *Trollius europaeus* at Scackleton Low Moor, *Convallaria majalis* at Wath Wood, *Gagea lutea* at Stittenham Wood and *Paris quadrifolia* in Coldwell Plantation, all these being long-lived perennials, strongly shade tolerant (or moderately so in the case of *Trollius europaeus*). In the course of field work one site was discovered with several regionally rare species which has since been designated a Site of Special Scientific Interest and a Yorkshire Wildlife Trust Nature Reserve. Names and designations of native status follow Clapham *et al.* (1987). As the seeds of many wild plants can survive in a dormant state in the soil for decades, no scrutiny of any one area can ever be absolutely comprehensive, though the present study has been both carefully and thoroughly executed. Fieldwork is continuing to establish the current validity of those records from the 1940s and 1950s. The theme of the study is not an investigation of a single species (cf. Foley 1987), but the use of the records of many species to detect trends within habitats and within the study area as a whole.

DESIGNATION OF HABITAT CATEGORY

The original site descriptions in the T. & I. lists have been used to assign species to habitat categories, though sometimes this does result in a species being allocated to a category which may seem anomalous at the national level, e.g. *Atropa bella-donna* under arable.

The categories of woodland and arable are self-explanatory. However there is a continuous gradation amongst wetland plants from totally submerged aquatics, right through to terrestrial species tolerant of damp soils. Haslam *et al.* (1975) has therefore been used as the basis for designation to the aquatic habitats and river margins category, together with the following species: *Bidens cernua*, *Hottonia palustris*, *Rorippa islandica*, *Sium latifolium*, *Stellaria palustris*.

Species occuring in wet, peaty sites with acid ground water were assigned to the mire category. All such species had Terrington Carr as at least one of their stations. One mire species, *Utricularia minor*, is included in Haslam *et al.* (1975).

The residue of species were placed in the other habitats category. This does include some species which are border-line cases, e.g. *Helleborus viridus* from a ditch bank rather than from woodland and similarly with *Prunus padus* from hedges; *Lythrum portula* from a damp area rather than aquatic habitats; and *Empetrum nigrum* from heathland ('other habitats') rather than mire.

RESULTS

OVERALL FINDINGS

Woodland species show the greatest overall percentage survival and arable species the least; see Table 1. Taking the mean survival figure of 38% as a guide; survival is greater than average in both grassland (47%) and woodland (72%); and is markedly lower in both 'other habitats' (22%) and arable (16%); with aquatic habitats and mire occupying positions near the average with 37% and 33% survival respectively.

25 of the 44 regionally rare species (pooled over all habitat categories) were still in evidence post-1943, a survival rate of 56%. Conversely only 17 of the 71 very rare species were still present, a survival rate of 24%. Carrying out a chi-square statistical test on the data reveals that this difference in survival rates between the two rarity categories is very highly significant ($\chi^2 = 12{\cdot}66$, 1 d.f.). Hence those species which were least common in the region as a whole were more likely to become

TABLE 1. THE PRESENT-DAY (i.e. POST-1943) NUMBERS OF RARE, NATIVE PLANTS OF THE HOWARDIAN HILLS, NORTH YORKSHIRE, ARRANGED BY HABITAT CATEGORIES

Rare plants are those spermatophytes recorded by Teesdale (1794, 1800) and Ibbotson (1843) which now occupy up to 30 10-km squares in the 100-km square 4/4 (Perring & Walters 1962); excluding Cyperaceae and Gramineae. See also Appendix 2.

	Woodland	Grassland	Aquatic habitats & river margins	Mire	Other habitats	Arable	Total
CONFIRMED							
Regionally rare[a]	7 (39%)	6 (35%)	4 (16%)	2 (22%)	3 (11%)	3 (16%)	25 (22%)
Regionally very rare[b]	6 (33%)	2 (12%)	5 (21%)	1 (11%)	3 (11%)	0 (0%)	17 (15%)
Total	13 (72%)	8 (47%)	9 (37%)	3 (33%)	6 (22%)	3 (16%)	42 (37%)
UNCONFIRMED, ASSUMED EXTINCT							
Regionally rare[a]	1 (6%)	5 (29%)	5 (21%)	1 (11%)	3 (11%)	4 (21%)	19 (16%)
Regionally very rare[b]	4 (22%)	4 (24%)	10 (42%)	5 (56%)	19 (67%)	12 (63%)	54 (47%)
Total	5 (28%)	9 (53%)	15 (63%)	6 (67%)	22 (78%)	16 (84%)	73 (63%)
Grand Total	18	17	24	9	28	19	115

[a] present in 16–30 10-km squares in 100-km square 4/4
[b] present in 0–15 10-km squares in 100-km square 4/4

extinct in the Howardian Hills. Rarity at the regional level will often be due to very restricted habitat requirements, which in turn will make the species more vulnerable to small changes in environmental conditions.

Looking at the interaction between habitat type and level of rarity (upper part of Table 1) one important trend emerges. The comparatively low incidence of regionally very rare species (and corresponding high incidence of regionally rare species) in the grassland habitat is statistically signficant ($\chi^2 = 4{\cdot}65$, 1 d.f.). Hence the grassland habitat does show a real deficiency in very rare species compared with the pattern for all other habitats (pooled). This phenomenon is probably due to the once widespread occurrence of species-rich grassland, with the consequence that uncommon species were unlikely to be very rare as there would have been several suitable individual sites throughout the region. This situation may well have changed radically since the 1950s when field survey work for the *Atlas* (Perring & Walters 1962) was carried out.

The total of 73 extinct species does include six *British Red Data Book* species (Perring & Farrell 1983). None of the 42 confirmed taxa are *B.R.D.B.* species.

The balance of survival in the different habitat categories (Table 1) is markedly different from that in Bedfordshire, where Dony (1977) studied extinction rates for the entire vice-county flora in eleven habitat categories. In Bedfordshire, marsh showed the highest extinction rate (35·3%) and acid pasture the next highest (19·0%). The arable extinction rate of 10·7% was fifth in rank. The extinction rate of woodland taxa was 5·3%, seventh in rank. Overall survival was best amongst hedgerow species (1·5% extinction) and riverside plants (1·6% extinction). The alien species category has been excluded from the foregoing comparisons, following Dony (1977).

Conceivably woodlands have suffered a greater degree of change in Bedfordshire; and the arable flora was possibly less well recorded in the early years than in the Howardian Hills.

SPECIES DECLINE

A further measure of changes that have taken place in the area is provided by examining the reduction in the number of sites occupied by those species that do survive. Thus *Trollius europaeus* has been lost from the three sites where it was formerly recorded (using all available 19th century records), but discovered in 1984 at a fourth. Similarly *Coeloglossum viride* has become extinct at its

five former sites, but located post-1943 at a sixth; and *Vicia sylvatica* is now only known from one of its six former stations in the hills.

A parallel picture emerges for several of those species now extinct in the area, for example *Neottia nidus-avis* has declined from five sites to zero and *Orchis ustulata* from four to zero in the Howardian Hills.

LOSSES AT INDIVIDUAL SITES

TERRINGTON CARR

Terrington Carr (GR 44/685.715) was the most important single site in the Howardian Hills, and one of the richest locations for plants in Yorkshire. The fate of those rare species recorded there by Teesdale (1794, 1800) and Ibbotson (1843) is traced in Table 2; the species for which Terrington Carr was their only station are indicated (all available sources used). Following the wet summer of 1860 the carr was drained and then planted in part with spruce and Scots pine. In 1926 these were observed to have been recently cut down. Much of the area was then replanted. A small section of the site, west of the main carr, still exists in an unplanted condition (1988) but contains no rare plant species, suggesting that originally the cessation of grazing associated with afforestation may have been almost as important as the development of a dense tree canopy. Recently the drainage channels have been further deepened. Today other sites in the Howardian Hills are considerably

TABLE 2. THE FATE OF THOSE PLANTS OF THE HOWARDIAN HILLS (AS DEFINED IN TABLE 1) RECORDED FROM TERRINGTON CARR BY TEESDALE (1794, 1800) AND IBBOTSON (1843)

	1794–1843	1898[a]	1947[b]	1988[c]
Mire habitat				
Drosera anglica[d]	+	–	–	–
D. intermedia[e]	+	(+)	+	–
D. rotundifolia[d]	+	(+)	+	–
Galium uliginosum	+	+	+	–
Gentiana pneumonanthe[e]	+	–	–	–
Hypericum elodes	+	–	–	–
Scutellaria minor[d]	+	–	–	–
Utricularia minor[d]	+	+	–	–
Vaccinium oxycoccos	+	–	–	–
Aquatic habitats & river margins				
Berula erecta[e]	+	–	–	–
Bidens cernua[e]	+	–	–	–
Callitriche autumnalis[e]	+	+	–	–
Littorella uniflora	+	–	–	–
Ranunculus lingua[e]	+	–	–	–
Utricularia vulgaris[e]	+	–	–	–
Other habitats				
Gentianella campestris[e]	+	–	–	–
Parnassia palustris	+	+	–	–
Radiola linoides[e]	+	–	–	–
Woodlands				
Cephalanthera longifolia	+	–	–	–
Trollius europaeus	+	–	–	–
Total	20	6	3	0

\+ present; (+) assumed present as recorded subsequently; – absent.

[a] *Trans. Yorks. Nat. Union* **26** and circular no. 138.

[b] Rob (1963) and *The Naturalist* (1947) p. 22.

[c] Visit by author; *Viola palustris* (a residual species) and *Hydrocotyle vulgaris* were present.

[d] Recorded only from Terrington Carr.

[e] Recorded from Terrington Carr and one other site (using all available records).

richer in wetland species (e.g. Aireyholme Marsh, GR 44/672.737, and Scackleton Low Moor by the Dalby Bush Beck, GR 44/645.715).

The post-1860 changes in the land management regime have had a drastic and almost certainly irreversible effect on the rare flora of this site, and consequently of the Howardian Hills as a whole. Parallel changes have taken place in the Huntingdonshire fenland (Sheail & Wells 1980, 1983).

MALTON FIELDS

Malton Fields was the richest site for arable species in the Howardian Hills (Table 3). Enclosure of these open fields, which happened shortly after Teesdale made his records, appears to have led to changed agricultural practices and the loss of the rare flora. Four of the ten species have not been recorded from any other site within the Howardian Hills at any time (i.e. considering all available records). Parallel development took place at Bulmer Fields and Coneysthorpe Fields (Table 3).

The publication of the *British Red Data Book* (Perring & Farrell 1983) has highlighted the rapid decline of many arable plants, and hence the need to conserve both arable species and arable habitats. Three of the plants once found at Malton Fields now qualify for entry in the *B.R.D.B.* Conversely Terrington Carr contained no *B.R.D.B.* species.

TABLE 3. THE NUMBER OF RARE PLANTS RECORDED FROM MALTON FIELDS AND TWO OTHER ARABLE LOCATIONS WITHIN THE HOWARDIAN HILLS

	Date of enclosure		Number of rare native & introduced species	Number of rare native species	Number of British Red Data Book species	Post-1943 situation	
	Act	Award				Survival at site	Survival in the Howardian Hills
Malton Fields (no 1843 records)	1794	1805	10	7	3	0	1
Bulmer Fields (no 1843 records)	1777	1779	5	4	0	0	1
Coneysthorpe Fields (no 1794 records)	—[a]	—[a]	3	3	0	0	0

[a] no documentation survives as far as is known; presumably enclosure was undertaken by private agreement.

HABITAT FACTORS

WOODLAND

The survival of the woodland flora in the region as a whole is excellent; though the number of rare species at one single wood is normally small, an average of 0·7 per wood was obtained when fourteen ancient woods were surveyed. For the six woods with at least one presence, the figure was 1·7 per wood. The high plant survival rate is partly due to the lack of destruction of this habitat, and partly due to the nature of the woodland species, many of which are able to live over long periods of sub-optimal conditions of dense shade.

Most of the woods are now heavily grazed by rabbits, a process which reduces the competitiveness of susceptible species and thereby aids the survival of rabbit-proof plants like *Actaea spicata*, *Campanula latifolia* and *Lithospermum officinale*. *Stellaria nemorum* and *Crepis paludosa* are normally found in the dampest parts of woods where levels of rabbit grazing are low. Several of the woods have a dense canopy producing a sparse shrub layer, and a poorly developed (in terms of biomass) ground flora. This combination is often the result of woods being managed mainly for pheasant rearing rather than timber production. In such densely shaded woods the less common woodland plants may often be confined to the margins, as is the case with *Euonymus europaeus* and

Gagea lutea, or occur completely in the open but adjacent to woodland as with *Trollius europaeus* and *Vicia sylvatica*.

Conversion of broad-leaved woods to conifers (as at Oxcarr and Kirkham Woods) can produce conditions disfavourable to the survival of broad-leaved plants. Even where broad-leaved woods survive conditions may not be suitable for seed production and/or establishment at the scale necessary to ensure the long term survival of the rare species.

GRASSLAND

Survival of grassland species has been moderate. Most of the unconfirmed species are either large flowered, or are orchids which tend to be noticed if present; hence all unconfirmed species are probably now extinct in the area.

AQUATIC HABITATS & RIVER MARGINS

Several of the pools beside the River Derwent are now covered with a dense tree and shrub canopy, and this has undoubtedly contributed to the decline in wetland species. Large water bodies like Wiganthorpe Lake and Castle Howard Lake have also experienced a decline in rare species, possibly due to eutrophication of the inflow water. There have also been apparent losses from banks of the River Derwent, which might seem a stable microhabitat, of *Berula erecta*, *Lysimachia vulgaris* and *Sagittaria sagittifolia*. Despite these observations the continued existence of a good range of water-bodies of a variety of sizes is likely to ensure the survival of a fair selection of wetland species.

Two aquatic plants were known to have been introduced into Castle Howard Lake by Robert Teesdale, but the original source of the material is not known. *Nymphoides peltata* still grows there (last recorded 1962); but *Stratiotes aloides* appears to have become extinct in the middle of the last century.

MIRE

Most of the mire species grew in the sites where drainage was such that an acid peat developed, dependent on rainfall for its water supply and for the nature of its leaching regime; this was particularly the case at Terrington Carr. Such habitats are easily destroyed by drainage and the subsequent oxidation of the upper peat deposits. Only three mire species survived post-1943 at Terrington Carr and none by 1988 (Table 2). No further rediscoveries seem likely.

OTHER HABITATS

This group of habitats is strongly characterised by a high overall loss of rare plants. Dry heaths and commons have disappeared due to enclosure and/or 'improvement', with the consequent loss of *Antennaria dioica*, *Empetrum nigrum*, *Mentha pulegium*, *Radiola linoides* (Coulton Moor and Terrington Carr) and *Silene otites*. *Mentha pulegium* (a plant of damp areas within heath and common) and *Silene otites* are both *B.R.D.B.* species, underlining the national significance of the decline of this type of habitat. Roadside verges have changed in nature, partly due to cessation of grazing by farm animals-on-the-move, and reduced levels of mowing, resulting in a disappearance of *Calamintha ascendens*, *Helleborus viridus* and *Nepeta cataria*. In addition quarries and sand-pits have been abandoned, causing *Ophrys apifera* and *Trifolium striatum* to become extinct in the Howardian Hills.

The results demonstrate the need, as a long term objective, for the conservation of whole blocks of the landscape in a few specially selected areas within the country as a whole, so that the full range of habitats can be sympathetically managed, all within a narrow geographical compass (e.g. at the scale of an English parish).

ARABLE

Arable habitats show the greatest loss of species. Four arable species once found in the Howardian Hills now qualify for *B.R.D.B.* status. These are the native plants *Bupleurum rotundifolium*, *Galium spurium* and *Rhinanthus angustifolius* together with the introduced *Caucalis platycarpos*. The first-named is now extinct in the British Isles (Perring & Farrell 1983).

The management changes associated with enclosure were a major factor associated with the decline of many of the arable species recorded by Teesdale. Subsequent developments have further

reduced the variety and abundance of rare arable species. These include a) more efficient seed cleaning, b) non-use of home-grown seed, c) higher levels of application of fertiliser and lime, d) planned crop rotations involving non-arable break-crops, e) use of autumn-sown cereals (with loss of spring establishment possibilities for arable weeds), and f) selective herbicide application (Fryer & Chancellor 1970). Within the hills *Bupleurum rotundifolium* and *Rhinanthus angustifolius* have become extinct as a result of better seed cleaning techniques; *Myosurus minimus* has almost certainly succumbed to more vigorous crop growth, and several species have probably been adversely affected by the use of selective herbicides (e.g. *Papaver argemone*, *Ranunculus parviflorus* and *Torilis nodosa*).

At least two of the plants recorded from arable habitats (*Acinos arvensis* and *Jasione montana*) are more commonly associated with other habitats at the national level, and demonstrate the former importance of infertile arable sites as a refugium for a wide range of native species characteristic of disturbed, light soils.

The arable habitat has suffered a major loss of rare plant species. Only the more common species still persist in this habitat, and these are normally now only found in gateways, field margins and in broad-leaved crops where the spraying regime is less disfavourable to their survival.

It is probably now too late to reinstate old-fashioned forms of agriculture at one or more selected locations within the Howardian Hills in order to conserve the associated rare arable flora. However, the fact that the arable habitat has proved so vulnerable to date does demonstrate the need for stronger conservation measures for arable plants in the future, at both a regional and national level.

DISCUSSION

Both Teesdale and Ibbotson provided site details with their records. This has allowed the records to be allocated precisely to the study region. It also allows the original site to be revisited to check on the subsequent survival of the species. Such information provides a base-line for studying botanical and ecological change. Its value cannot be overstated. For historical data it lends confidence to source data; and for modern botanical surveys it provides the foundation for future investigations.

Having the wealth of accurate plant data that have been collected from Yorkshire in the nineteenth century to draw upon, Baker (1906) was able to deduce that certain plant species were characteristic of primary woods (as defined by Peterken 1981), many decades before the more famous work on indicator species of ancient woods undertaken by Peterken (1974, 1981). Describing *Helleborus viridus*, in North Yorkshire, Baker (1906; but first published in serial form in 1889) wrote "a plant of *aboriginal* woods of calcareous dales, where it grows with *Actaea*, *Aquilegia*, *Melica nutans*, *Rubus saxatilis* etc." (p. 251). This is an important demonstration of the value of site-specific data collected from a large number of locations.

In Huntingdonshire accurate botanical information, both written and on herbarium sheets, has allowed a detailed reconstruction of the former nature of the fenlands to be undertaken by Sheail & Wells (1980, 1983).

Accurate botanical data may also be of relevance to other academic disciplines. An Ibbotson herbarium sheet at **NCE** of *Erysimum cheiranthoides* tells us that it was collected from a turnip field at Ganthorpe. Similarly *Galium spurium*, recorded by Teesdale (1794) from Malton Fields, is stated by Lees (1941) always to be associated with flax crops, allowing us to deduce that flax was being grown in this open field system. Hence it is possible to begin to build up a picture of past land-use in the landscape using botanical information.

Drawing on the data of Teesdale and Ibbotson it has been possible to demonstrate that the Howardian Hills have passed from an area that was botanically famous to one which today has very little regional significance. The quality of the data allows one to state the case with confidence; the magnitude of the change serves to indicate the way in which species and habitats can be lost, though hopefully such changes are less likely to occur in the late 20th century due to the existence of voluntary and statutory conservation bodies.

Baker (1907: see Introduction section for quotation) indicated that the Howardian Hills were second only in botanical importance in North Yorkshire to Upper Teesdale. The Howardian Hills are a lowland area which once contained a very mixed flora, including six species now qualifying for *B.R.D.B.* status, all of which have become extinct. By contrast Upper Teesdale is an upland area

with a rather specialised flora, fifteen species of which now qualify for *B.R.D.B.* status. However only one of these (*Polemonium caeruleum*) has become extinct, and this is apparently the only extinction in Upper Teesdale (Clapham 1976), compared to 73 extinctions of 'rare' and 'very rare' species in the Howardian Hills (not to mention many others not falling within this definition). The extensive nature of land-use in Upper Teesdale has ensured to a large degree the survival of its flora. It would seem logical to conclude that areas subject to more intensive land-use pressure should attract a correspondingly higher level of conservation protection for their component species and/or habitats. Although some of the extinctions in the Howardian Hills did take place in the 19th century, continuing fieldwork will almost certainly indicate a further loss in the last two decades of species that were present in the 1940s and 1950s.

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APPENDIX I

DESCRIPTION OF SOURCES USED TO ASSESS THE POST-1843 STATUS OF THE RARE PLANTS OF THE HOWARDIAN HILLS.

Manuscript sources consulted include the card-index of plants in v.c. 62 held by the vice-county recorder, the field notebooks of T. F. Medd Esq., entries in the diaries of Wild Flower Society members submitted to the vice-county recorder, record cards completed during the B.S.B.I. Atlas survey and B.S.B.I. visit notes, reports of meetings of the York & District Field Naturalists' Society.

Herbaria consulted include W. W. Reeves at **SCAR**, H. J. Wilkinson and W. Middleton at **YRK**, general at **WARMS**, all with Ibbotson sheets, and computer print-outs of Ibbotson sheet details at **NCE**; plus C. M. Rob's at **YRK**. Journals consulted include all relevant issues of *The Naturalist*, together with the advance notices of Yorkshire Naturalists Union excursions giving details of local flora and fauna, i.e. the circulars; *Nature Notes*, the journal of the Malton and District Field Naturalists' Society, the *Natural History Journal and School Reporter*, plus Rob (1963) and Crackles (1967).

Books consulted include Auden (1906) and Warburton (1978); floras consulted include Baines (1840: for pre-1843 sites), Baker (1854), Baker (1906), and Lees (1941). Personal communications were received from Professor S. R. Eyre, Mrs A. Freer, Miss J. Lambert, Mr T. Medd and others.

APPENDIX 2. PLANTS OF THE HOWARDIAN HILLS CONSIDERED RARE BY TEESDALE (1794 & 1800) AND IBBOTSON (1843) WHICH OCCUR IN THIRTY OR FEWER 10-KM SQUARES POST-1930 (PERRING & WALTERS 1962; PERRING & SELL 1968), IN THE 100-KM SQUARE 4/4: ARRANGED BY HABITAT AND POST-1943 STATUS. POSITION AS AT JUNE 1988.

	Woodland	Aquatic habitats & river margins[a]	Mire	Grassland	Arable	Other habitats
CONFIRMED						
Regionally rare[b]	*Convallaria majalis* *Crepis paludosa* *Daphne laureola* *Euonymus europaeus* *Lathraea squamaria* *Paris quadrifolia* *Stellaria nemorum*	*Hippurus vulgaris* *Myriophyllum spicatum* *Potamogeton pusillus* *Stellaria palustris*	*Drosera rotundifolia* *Galium uliginosum*	*Anacamptis pyramidalis* *Cirsium eriophorum* *Coeloglossum viride* *Filipendula vulgaris* *Gymnadenia conopsea* *Saxifraga granulata*	*Erysimum cheiranthoides* *Silene noctiflora* *Scleranthus annuus*	*Cynoglossum officinale* *Geranium pyrenaicum* *Prunus padus* Introduced *Inula helenium* *Sedum dasyphyllum*
Regionally very rare[c]	*Actaea spicata* *Gagea lutea* *Platanthera bifolia* *Pyrola minor* *Trollius europaeus* *Vicia sylvatica*	*Littorella uniflora* *Nymphoides peltata* *Potamogeton gramineus* *Ranunculus lingua* *Rorippa amphibia*	*Drosera intermedia*	*Colchicum autumnale* *Ornithogalum umbellatum*		*Helleborus viridis* *Orobanche elatior* *Rosa pimpinellifolia*
UNCONFIRMED: ASSUMED EXTINCT						
Regionally rare[b]	*Aquilegia vulgaris* *Frangula alnus*	*Berula erecta* *Hottonia palustris* *Oenanthe aquatica* *Sagittaria officinalis* *Zannichellia palustris*	*Vaccinium oxycoccos*	*Ophrys apifera* *Orchis morio* *Parnassia palustris* *Serratula tinctoria* *Thalictrum flavum*	*Acinos arvensis* *Papaver agremone* *Valerianella dentata* *Veronica polita* Introduced *Allium oleraceum*	*Atropa belladonna* *Dactylorhiza incarnata* *Empetrumnigrum* Introduced *Allium scorodoprasum*

APPENDIX 2 *continued*

	Woodland	Aquatic habitats & river margins[a]	Mire	Grassland	Arable	Other habitats
Regionally very rare[c]	*Cephalanthera longifolia* *Hypericum montanum* *Neottia nidus-avis* *Rubus saxatilis*	*Bidens cernua* *Butomus umbellatus* *Callitriche hermaphroditica* *Lemna polyrhiza* *Myriophyllum verticillatum* *Potamogeton compressus* *Rorippa islandica* *Sium latifolium* *Stratiotes aloides* *Utricularia vulgaris*	*Drosera anglica* *Gentiana pneumonanthe* *Hypericum elodes* *Scutellaria minor* *Utricularia minor*	*Dianthus deltoides* *Ophrys insectifera* *Orchis ustulata* *Spiranthes spiralis*	*Bupleurum rotundifolium*[de] *Fumaria capreolata* *Galium spurium*[d] *Iberis amara* *Jasione montana* *Legousia hybrida* *Minuartia hybrida* *Myosurus minimus* *Papaver hybridum* *Ranunculus parviflorus* *Rhinanthus angustifolius*[d] *Torilis nodosa* Introduced *Caucalis platycarpos*[df] *Galeopsis ladanum* *Lathyrus aphaca* *Malva alcea*	*Antennaria dioica* *Astragalus danicus* *Calamintha ascendens* *Circaea* × *intermedia*[g] *Gentianella campestris* *Geranium sanguineum* *Linum perenne* *Listera cordata* *Lythrum portula* *Mentha pulegium*[d] *Nepeta cataria* *Picris hieracioides* *Potentilla argentea* *Potentilla tabernaemontani* *Radiola linoides* *Rosa mollis* *Silene otites*[d] *Trifolium striatum* *Verbena officinalis* Introduced *Chamaemelum nobile*

Footnotes:
[a] category based largely on Haslam, Sinker & Wolseley (1976)
[b] present in 16–30 10-km squares in 100-km square 4/4
[c] present in 0–15 10-km squares in 100-km square 4/4
[d] included in the *British Red Data Book* (Perring & Farrell 1983)
[e] now extinct in the British Isles (Perring & Farrell 1983)
[f] see Teesdale (1800) which supersedes Teesdale (1794)
[g] recorded as *C. alpina*; now considered to be *C.* × *intermedia* (Perring & Sell 1968)