EDINBURGH JOURNAL OF BOTANY 59 (3): 351–372 (2002)
DOI: 10.10M/S0960428602000215

DISTRIBUTION MAPS AND IUCN THREAT CATEGORIES FOR *HIERACIUM* SECTION *ALPINA* (*ASTERACEAE*) IN BRITAIN

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Distribution maps and IUCN threat categories for the 30 named species of *Hieracium* section *Alpina* (*Asteraceae*) in Britain are given, based on taxonomic and distribution studies by D.J. Tennant and others over the last 30 years. Twenty-seven taxa are endemic to Scotland, one to England, one to Britain and one also occurs in mainland Europe and the Arctic. There are three main centres of diversity in Scotland: the Eastern Highlands (especially the Cairngorm Mountains), the Western Highlands and the Northern Highlands. Under the IUCN threat categories, seven taxa are Critically Endangered, seven are Endangered, two are Vulnerable, ten are Near Threatened and seven are Nationally Scarce. The main threats are collecting, natural events such as rock falls and avalanches, global warming, acid rain, over-grazing and tourism. There is particular concern for the long-term survival of four taxa.

Keywords. Compositae, conservation, endemism, hawkweeds.

Introduction

In the British Isles, the genus *Hieracium* L. (*Asteraceae*) contains over 400 species (Sell & Murrell, *Flora of Great Britain and Ireland*, Volume 4, in prep.). Over 150 of the taxa are endemic (Rich *et al*., 1999); many are very rare and confined to fewer than five sites, and a few are extinct (e.g. the only known site of *Hieracium hethlandiae* (F.J. Hanb.) Pugsl. was quarried away in 1976; Scott & Palmer, 1987).

The difficulties of identifying *Hieracium* taxa and the consequent lack of detailed knowledge on their distribution and status has resulted in them being largely ignored by the statutory conservation agencies until recently. The British Vascular Plant Red Data Book (Wigginton, 1999) provided the first significant attempt to identify which species might be priorities for conservation, and listed 79 species recorded from five or fewer hectads (10km × 10km squares) in the *Hieracium* database compiled by D. McCosh. Unfortunately, it gave no World Conservation Union threat categories (IUCN, 1994) for *Hieracium*, *Rubus* or *Taraxacum* on grounds of lack of knowledge. This puts them at a disadvantage for conservation, because threat categories were provided for other critical groups (e.g. *Limonium* and *Sorbus*) and for all other rare species, allowing decisions to be made on their claim to allocation of limited conservation resources.

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One section of *Hieracium* which is taxonomically well researched and for which detailed information is available, and therefore for which IUCN categories can be given, is section *Alpina* (Griseb.) Gremli. This is one of the most difficult groups of species in the British Isles, but has been the subject of detailed study in the field and in cultivation by D.J. Tennant, P.D. Sell, C. West, A.G. Kenneth and others since the 1950s. Plants of this group are typically found on rock detritus, rocky knolls and ledges in gullies and on cliffs mostly above 500m. There are currently 30 named and four unnamed species in Britain, four of which have infraspecific variants. Comparison of the morphological variation with cytology, RAPDs, isozymes and rDNA ITS2 sequences showed that all taxa are molecularly distinct (Stace *et al.*, 1995, 1997; Shi *et al.*, 1996). Updated morphological descriptions of the taxa will be presented by D.J. Tennant & P.D. Sell in Volume 4 of the *Flora of Great Britain and Ireland* (in prep.).

This paper has three aims: (i) to summarize current knowledge on the distribution of section *Alpina* in the British Isles; (ii) to present IUCN criteria to indicate priorities for conservation; and (iii) to highlight the principal avoidable threats to their survival. We refrain from presenting data on the four new species until they have been formally published.

Methods

Data on the distribution of the taxa have been compiled by D.J. Tennant from herbaria (herb. D.J. Tennant, herb. J.E. Raven (now held by D. McCosh), BM, BON, CGE, DBN, DEE, E, GL, GLAM, LDS, LIV, MANCH, NMW, PTH and RNG, some of which contain only duplicate material) and c.30 years of field work investigating historic and new localities. The bulk of the field work by D.J. Tennant was carried out between 1972 and 1993. Other botanists who have provided significant numbers of records since the 1960s are A.G. Kenneth, B.A. Miles with R.W. Jones, P.D. Sell, A.McG. Stirling and C. West. About 1500 records from over 700 sites have been collated, most supported by critically determined herbarium material. Unconfirmed records have been excluded wherever there is doubt.

The distribution maps have been prepared at the hectad level, which is the standard scale in Britain (Palmer *et al.*, 1997). Historic records have been allocated either to hectads with equivalent modern records, or to the most likely hectad where the exact original site is not known. The maps have been plotted without distinguishing date classes due to the huge amount of work involved in searching remote, inaccessible areas; the collection of such data is a lifetime's work by a specialist! Also, many species are extremely persistent in their localities, and there are only a few cases mentioned in the text where taxa are genuinely thought to be extinct at particular sites. There are unlikely to be significant numbers of historic herbarium or literature records which have been overlooked.

The following seven geographical areas have been devised to summarize distributions. These phytogeographical groupings, which are shown in Fig. 1, delimit the

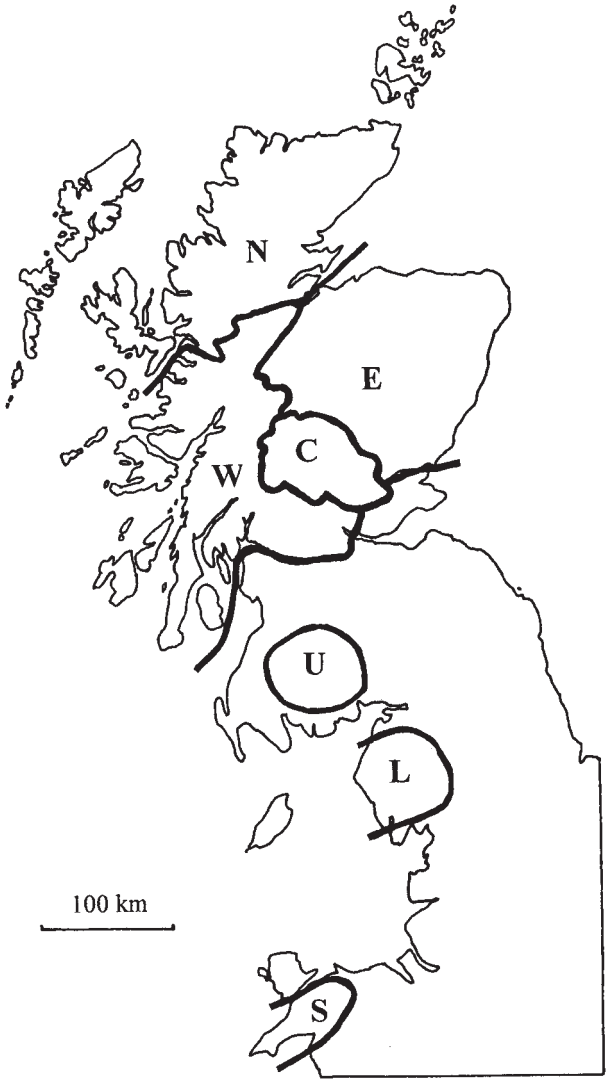

FIG. 1. Map of Northern Britain showing phytogeographical areas used to summarize distributions of *Hieracium* section *Alpina* taxa. S, Snowdonia; L, Lake District; U, Southern Uplands; W, Western Highlands; C, Central Highlands; E, Eastern Highlands; N, Northern Highlands. See text for definition of areas.

distributions of species within the section well, and also almost fully follow the boundaries of the Watsonian vice-counties (Dandy, 1969) from which the species in *Hieracium* section *Alpina* have been recorded. These vice-counties are also listed below.

1 Snowdonia, Wales: Vice-county 49 Caernarvon (S; Fig. 1).

2 Lake District, England: Vice-counties 69 Westmorland, 70 Cumberland (L; Fig. 1).

3 Southern Uplands, Scotland: Vice-county 73 Kirkcudbright (U; Fig. 1).

4 Western Highlands, Scotland: Vice-counties 86 Stirling, 87 West Perth, the part of 96 Easterness west of Loch Ness, 97 Westerness, 98 Main Argyll, 99 Dumbarton (W; Fig. 1).

5 Central Highlands, Scotland: Vice-counties 88 Mid Perth, 89 East Perth (C; Fig. 1).

6 Eastern Highlands, Scotland: Vice-counties 89 East Perth, 90 Forfar, 92 South Aberdeen, 94 Banff, the part of 96 Easterness east of Loch Ness (E; Fig. 1).

7 Northern Highlands, Scotland: Vice-counties 104 North Ebudes, 105 West Ross, 106 East Ross, 107 East Sutherland, 108 West Sutherland (N; Fig. 1).

The use of vice-county boundaries to define the phytogeographical areas agrees well with the geographical segregation of taxa, except in Perthshire (Vice-counties 87, 88 and 89) and in Stirling (Vice-county 86). Geographically, Vice-county 87 West Perth is predominantly 'central' in location but the section *Alpina* taxa which occur there are found only near its western border, and as a consequence include species which have a western distribution. Vice-county 88 Mid Perth has been included in the Central Highlands although three, or possibly four, species with a western distribution are found just within its western border. Geographically Vice-county 89 East Perth includes both Central and Eastern Highlands with no clear dividing line between them, and at least one species with an eastern distribution occurs within its eastern boundary. Vice-county 86 is predominantly central in location and is not strictly 'Highland', but a single species is recorded on the highest mountain in its northwestern corner, and it has therefore been included in the Western Highlands phytogeographical area for the same reasons given for Vice-county 87. Other phytogeographical divisions currently present no such difficulties. Although Vice-county 96 Easterness is split between the Western and Eastern Highlands as above, there is no overlap between western and eastern taxa in these two areas. We have also listed the vice-counties in which each taxon occurs, citing only the vice-county number for brevity.

Data on population sizes have been collected for many of the rarer species in the field, though these must be regarded as approximate due to the difficulties of covering large areas of remote and difficult terrain; many species favour crevices and rock ledges, often on inaccessible cliffs. Another problem is the identification of immature, vegetative or grazed plants, which frequently out-number those in flower. Many species are shy-flowering, especially at their lowest altitudinal range or in unfavourable seasons. Some population estimates are from memory rather than being precise counts noted in the field. The number of sites for each species was estimated from the records, though it is always difficult to be certain that plants found recently were in exactly the same place as historic records. For all these reasons the distribution,

TABLE 1. Thresholds for IUCN threat criteria in Britain (based largely on Palmer *et al*., 1997 and Wigginton, 1999)

	IUCN threat category				
	Critically Endangered	Endangered	Vulnerable	Near Threatened	Nationally Scarce
Population size	<50	<250	<1000	1000+	1000+
Number of sites	1	2	3–5	<10	10+
Area of occupancy (no. of hectads)	1	2–5	6–15	6–15	16–100

locality and population data must be regarded as minima. We have taken these problems into account when applying the IUCN criteria.

We have insufficient data to apply all the IUCN threat criteria (IUCN, 1994), but in most cases the data available allow clear decisions to be made. Application of some criteria (those concerning limited geographical areas and population size and decline) require data on temporal changes which we have been unable to assess due to uncertainty about the exact location of historic sites or their populations (see above); similarly we cannot calculate the probability of extinction. Threat categories have therefore been ascribed using the thresholds set out in Table 1, based on those set out for Britain by Palmer *et al*. (1997) and Wigginton (1999) for comparability. Area of occupancy has been calculated using hectads as the grid square size, though like Palmer *et al.* (1997) we note this is probably too large for arctic-alpines, which may have a large extent of occurrence in widely scattered sites but a tiny area of occupancy; 1 km^2 might be more appropriate. We have generally weighted the criteria in favour of number of plants and number of sites over number of hectads, as these give a better indication of the population sizes.

As the 1992 Rio Convention on Biodiversity requires that conservation be carried out at ecosystem, species and genetic levels, we have also included an assessment of the threat categories for the infraspecific taxa.

CHECKLIST WITH DISTRIBUTION MAPS AND IUCN THREAT CATEGORIES

Hieracium alpinum L.

Widely distributed in the Eastern Highlands, scattered in the Western and Northern Highlands, scarce in the Central Highlands (Vice-counties 86, 87?, 88, 90, 92, 94, 96–99, 105–108). Recorded from at least 34 hectads (Fig. 2), and still present in most. Also widely distributed in Greenland, Iceland, Scandinavia and continental Europe east to the Eastern Carpathians. **Nationally Scarce**.

Hieracium backhousei F.J. Hanb.

Endemic. Confirmed from four localities (possibly present at one other) in three

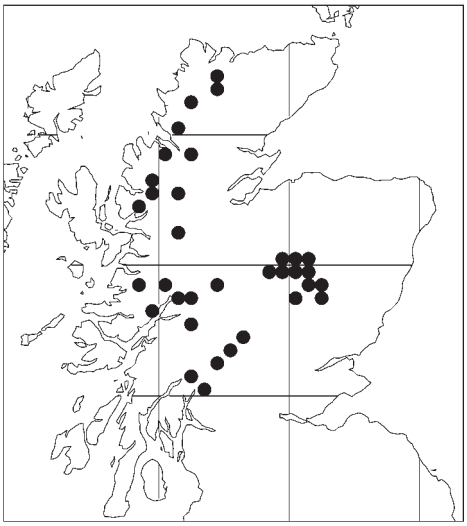

FIG. 2. *Hieracium alpinum* L.

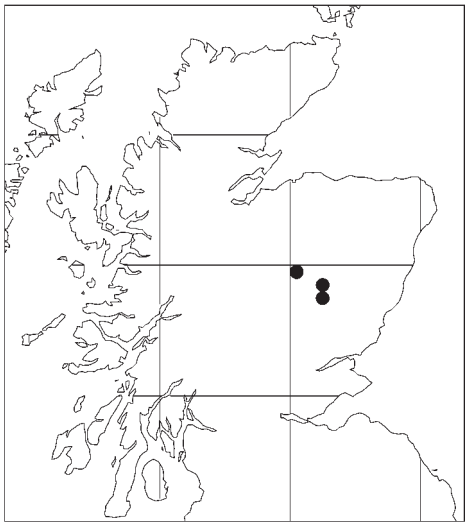

FIG. 3. *Hieracium backhousei* F.J. Hanb.

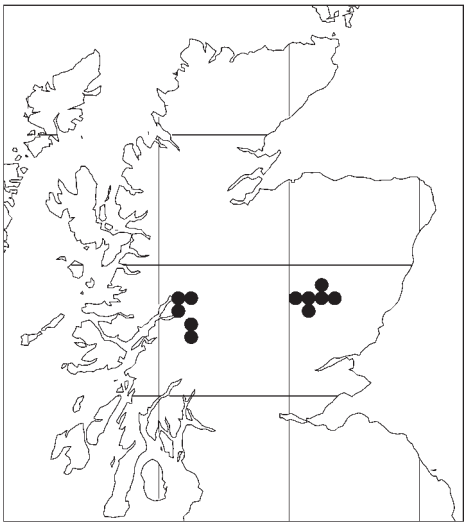

FIG. 4. *Hieracium calenduliflorum* Backh.

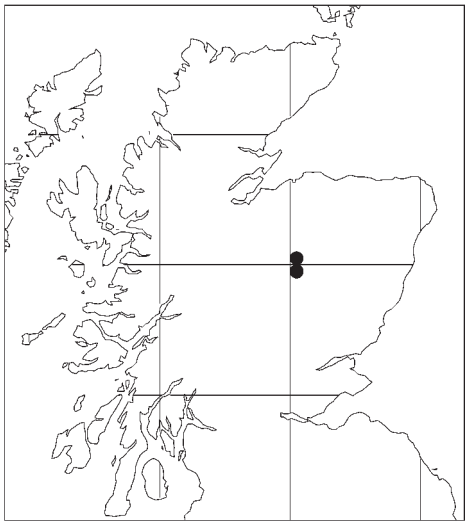

FIG. 5. *Hieracium calvum* P.D. Sell & D.J. Tennant

hectads in the Eastern Highlands (Vice-counties 90, 92) (Fig. 3). Population sizes of 50, 5, 5 and c.20+ plants (total 80+ plants) were recorded between 1976 and 1993 (updated from Tennant, 1986). **Endangered**.

Hieracium calenduliflorum Backh.
Endemic. There are two forms of this species which are currently not recognized as separate taxa. One is scattered in the Western Highlands (Vice-counties 97, 98), and the other in the Eastern Highlands (Vice-counties 90, 92) with a single old record which may be in Vice-county 89. In total, it has been recorded from over 25 sites in 11 hectads (Fig. 4). **Near Threatened**.

Hieracium calvum P.D. Sell & D.J. Tennant
Endemic. Extremely local and very scarce in three localities in two hectads in the Cairngorms in the Eastern Highlands (Vice-counties 92, 96) (Fig. 5). Four populations with 9, 4, 8 and 3 plants (total 24 plants) were recorded between 1978 and 1989. **Critically Endangered**.

Hieracium completum P.D. Sell & C. West
Endemic. Known from over 20 localities in 11 hectads in the Eastern Highlands (Vice-counties 89, 90, 92, 96) (Fig. 6). **Near Threatened**.

Hieracium eximium Backh.
Endemic. Two forms of this species were recognized historically, though the differences are minor. Widespread in the Eastern Highlands, rather rare in the Central Highlands and local in the Western Highlands (Vice-counties 88–90, 92, 94, 96–98). It has been confirmed from 30 hectads in possibly 80 or more sites (Fig. 7) and is probably still present in most of them. **Nationally Scarce**.

Hieracium globosiflorum Pugsl.
Endemic (records from Scandinavia refer to other species). A local plant of five hectads restricted to the Cairngorms in the Eastern Highlands (Vice-counties 92, 94, 96) (Fig. 8). There are post-1970 records in most of the c.14 sites, in some of which it is local and rather scarce. **Near Threatened**.

Hieracium graniticola W.R. Linton
Endemic. Recorded from four (possibly five) localities in two hectads restricted to the Cairngorms in the Eastern Highlands (Vice-counties 92, 94, 96) (Fig. 9). The population sizes at the four extant sites are 6, 24, 4 and 6 plants (total population 40 plants) recorded between 1976 and 1993. **Critically Endangered**.

Hieracium grovesii Pugsl.
Endemic. A local and rare species occurring in very small numbers in four hectads restricted to the Cairngorms in the Eastern Highlands (Vice-counties 92, 94, 96) (Fig. 10). The population estimates for seven of the eight sites recorded between 1975 and 1993 are <10, <5, 15, 3, 14, 3 and 4 plants (total population likely to be fewer than 50 plants). **Critically Endangered**.

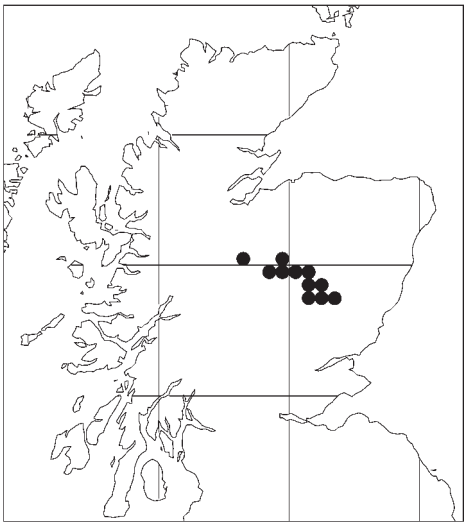

FIG. 6. *Hieracium completum* P.D. Sell & C. West

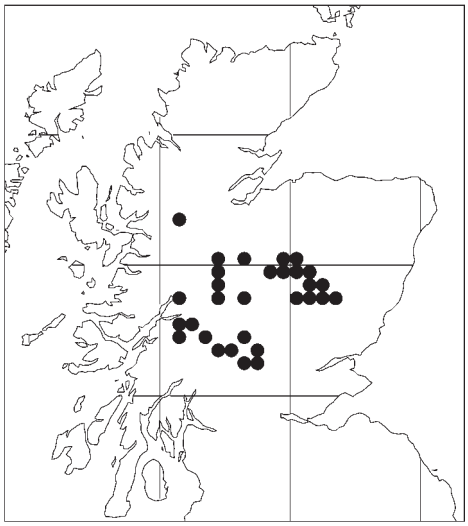

FIG. 7. *Hieracium eximium* Backh.

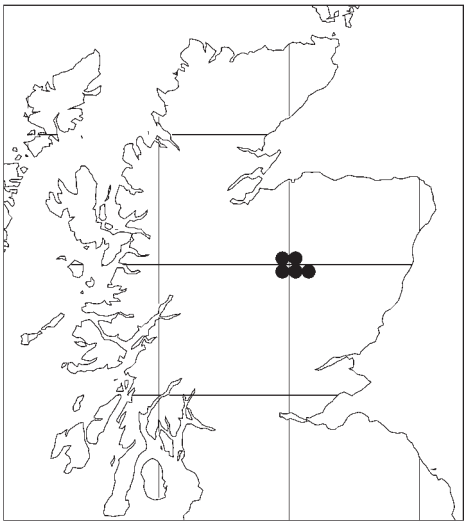

FIG. 8. *Hieracium globosiflorum* Pugsl.

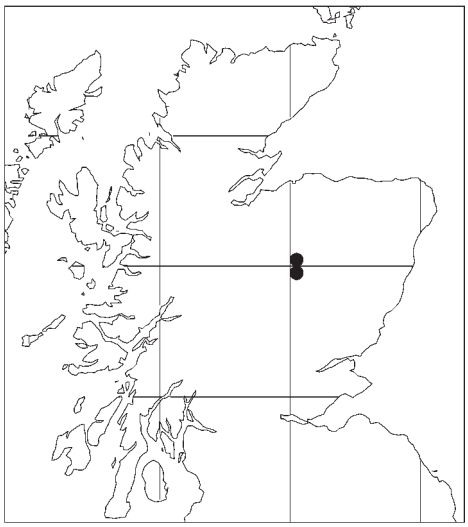

FIG. 9. *Hieracium graniticola* W.R. Linton

Hieracium hanburyi Pugsl.

Endemic. Widespread and not infrequent throughout Scotland, where it has been recorded from over 100 sites in 44 hectads.

There are three forms. Forma ***hanburyi*** is widespread in the Western, Central, Eastern and Northern Highlands (Vice-counties 87–90, 92, 94, 96–98, 105, 106) and is **Nationally Scarce** (Fig. 11). Forma ***atraticeps*** P.D. Sell & D.J. Tennant is rarer

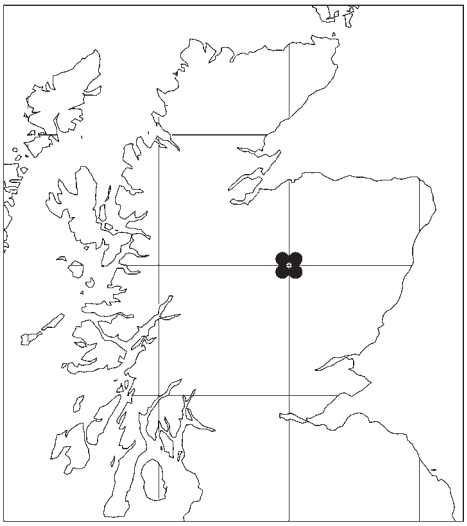

FIG. 10. *Hieracium grovesii* Pugsl.

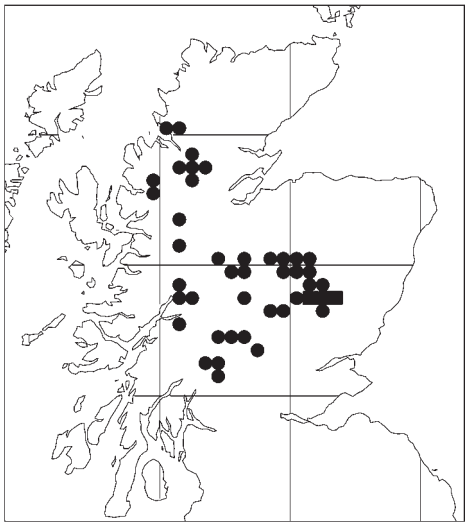

FIG. 11. *Hieracium hanburyi* Pugsl.: ●, forma *hanburyi*; ■, forma *pusillum* and forma *hanburyi*

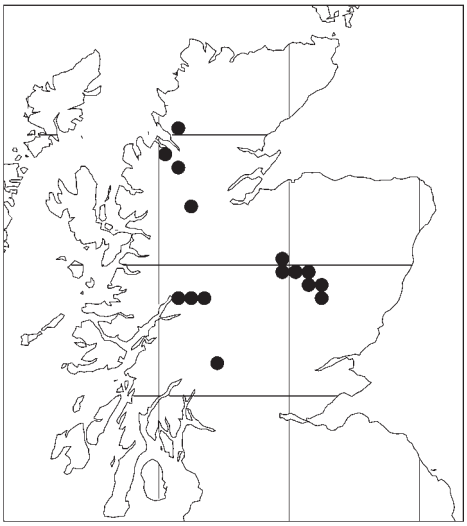

FIG. 12. *Hieracium hanburyi* Pugsl. forma *atraticeps* P.D. Sell & D.J. Tennant

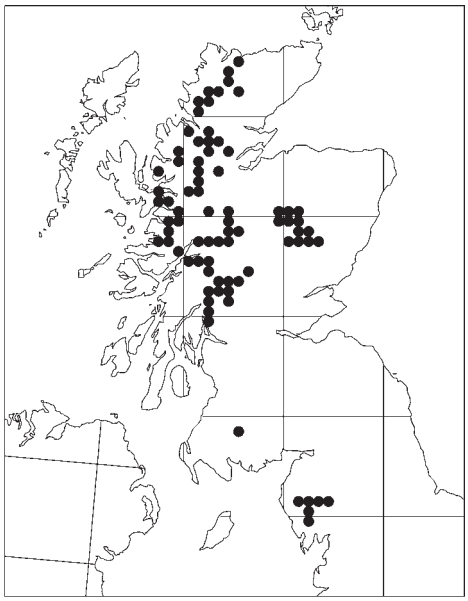

FIG. 13. *Hieracium holosericeum* Backh.

but occurs throughout the range of forma *hanburyi*, usually in small numbers (Vice-counties 88, 90, 92, 96, 97, 105) (Fig. 12), and is probably **Near Threatened**. Forma ***pusillum*** P.D. Sell & D.J. Tennant is rare in about six localities in the Eastern

Highlands (Vice-county 90) (Fig. 11) with population sizes in four of these of 5, 8, 2 and 2 plants (total 17 plants) recorded between 1972 and 1983; **Critically Endangered**.

Hieracium holosericeum Backh.
Endemic; the plants reported in the mountains of Central Europe and Scandinavia are no longer considered conspecific. Rare in Snowdonia, the Lake District and the Southern Uplands, widespread and locally frequent in the Western, Central, Eastern and Northern Highlands (Vice-counties 49, 69, 70, 73, 87–90, 92, 94, 96–99, 105–108).

Pugsley (1948) noted that it failed to flower in many seasons and appeared to be dying out in Snowdonia and the Lake District, and that it was not faring much better on some Scottish hills (there is little current evidence for the latter). It has been seen recently only in three out of five sites in Snowdonia (Hand & Rich, 2000) and in one out of six sites in the Lake District (Halliday, 1997), and has not been refound in Kirkcudbrightshire (D. McCosh, pers. comm. 2002). In total, it has been recorded in over 120 sites in at least 80 hectads (Fig. 13). **Nationally Scarce**.

Hieracium insigne Backh.
Endemic. There are two forms. Forma ***insigne*** is confined to one cliff in the Eastern Highlands (Vice-county 92), where 20 plants were recorded in 1978, but fewer than 10 were found in 1995 (Fig. 14). It is probably the population of most concern in the whole section. **Critically Endangered**. Forma ***celsum*** P.D. Sell & D.J. Tennant is known from three sites in the Eastern Highlands (Vice-counties 92, 96) where population sizes of 12, 6 and 9 plants (total 27 plants) were recorded between 1974 and 1986 (Fig. 14). There is another population in the Western Highlands (Vice-county 97) with c.40 plants in 1980, which has a different chromosome number. The total population of forma *celsum* is about 70 plants. **Endangered**.

Hieracium kennethii P.D. Sell & D.J. Tennant
Endemic. Three populations of this species are known from the Northern Highlands (Vice-counties 105, 108) (Fig. 15). There are limited population data: about 30 plants were recorded for one site, it is 'scattered' in another, and there is no information available for the third site. Likely to qualify as at least **Endangered**.

Hieracium larigense (Pugsl.) P.D. Sell & C. West
Endemic. Local and rather rare in four sites in two hectads confined to the Cairngorms in the Eastern Highlands (Vice-counties 92, 96) (Fig. 16). Population sizes of 6, 11, 5 and c.60 plants (total 80+ plants) were recorded between 1973 and 1987. **Endangered**.

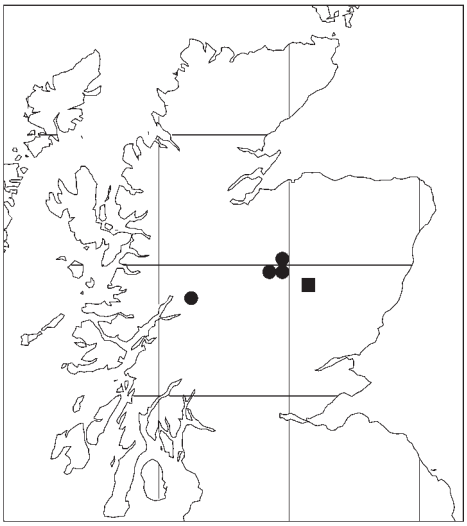

FIG. 14. *Hieracium insigne* Backh.: ■, forma *insigne*; ●, forma *celsum*

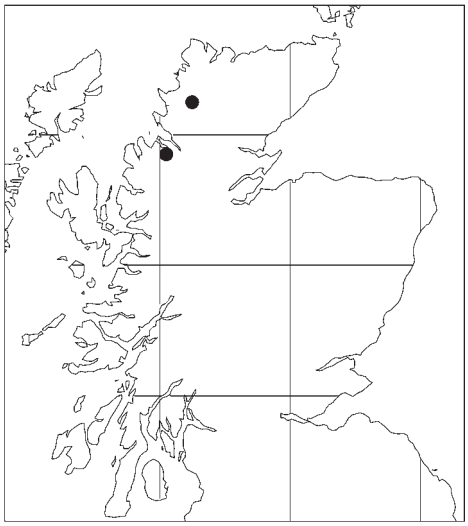

FIG. 15. *Hieracium kennethii* P.D. Sell & D.J. Tennant

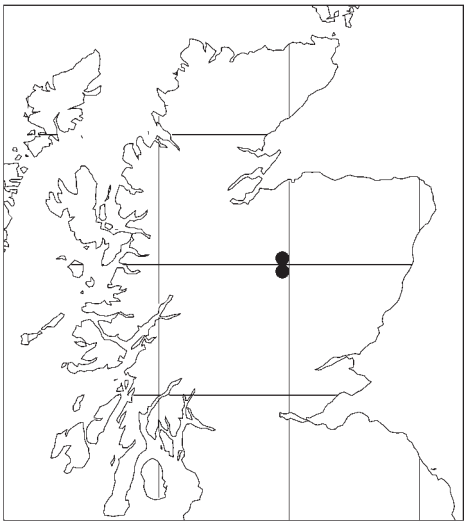

FIG. 16. *Hieracium larigense* (Pugsl.) P.D. Sell & C. West

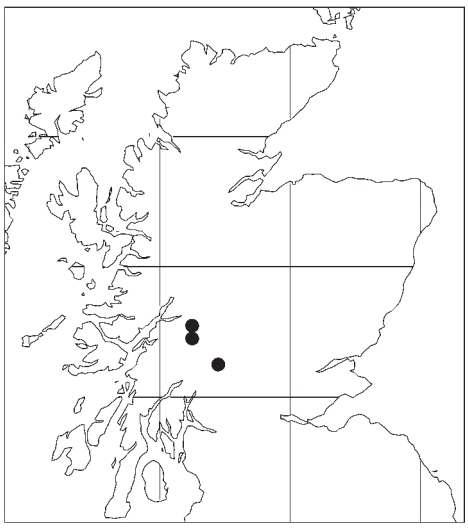

FIG. 17. *Hieracium leptodon* P.D. Sell & D.J. Tennant

Hieracium leptodon P.D. Sell & D.J. Tennant

Endemic. Restricted to one site in the Central Highlands just within the western boundary of Vice-county 88, where c.60 plants were recorded scattered in several places between 1978 and 1981, and to another in the Western Highlands

(Vice-county 98) where 11 plants were recorded between 1979 and 1994 (Fig. 17). Another site in Vice-county 98 has not been refound. **Endangered**.

Hieracium macrocarpum Pugsl.
Endemic. Rare or local in four hectads in the Eastern Highlands (Vice-counties 92, 96) (Fig. 18), in nine localities (eight within and one just outside the Cairngorms) with population sizes estimated as few, 8, 30, 5, ?2, 14, c.90, c.40 and 8 (total 200+ plants). A population of 20 plants in the Northern Highlands (Vice-county 106) represents a marginally different taxon which cannot be satisfactorily separated from *H. macrocarpum*. **Vulnerable**.

Hieracium marginatum P.D. Sell & C. West
Endemic. Probably on most hills in the Northern Highlands, scarce in the Western Highlands (Vice-counties 97, 105–108). There are two forms which often occur in the same populations and occur mostly throughout the range of the species, but only forma *chaetocephalum* P.D. Sell & C. West occurs at the southern end of its distribution. Recorded from 22 hectads (Fig. 19). **Nationally Scarce**.

Hieracium memorabile P.D. Sell & C. West
Endemic. Recorded from 16 hectads in the Western, Central and Eastern Highlands (Fig. 20), where it is a local and uncommon species (Vice-counties 90, 92, 94, 96–98). A number of records in Vice-county 88 require verification. In half of its c.20 sites it has been seen since 1980, and it is unlikely to be declining. **Nationally Scarce**.

Hieracium milesii P.D. Sell & C. West
Endemic. Local and scarce in about 19 localities in 10 hectads in the Eastern Highlands (Vice-counties 89, 90, 92) (Fig. 21). It has been recorded recently in at least 12 sites which support at least 150 plants, so the total population is likely to exceed 200 plants. **Near Threatened**.

Hieracium mundum P.D. Sell & C. West
Endemic. Recorded from nine hectads in the Northern Highlands (Vice-counties 105–108) where it has been recorded in most of its c.13 localities between 1967 and 1989 (Fig. 22). **Near Threatened**.

Hieracium notabile P.D. Sell & C. West
Endemic. Probably extinct on Ben More, Central Highlands (Vice-county 88) where it has been searched for on many occasions, including using roped access; it may have been exterminated by E.S. Marshall who collected numerous *exsiccatae* when he first found it. It is now known from only three localities in two hectads in the Western Highlands (Vice-county 97) (Fig. 23). About 60 plants are scattered in one site, but no population details are available for the other two sites. **Endangered**.

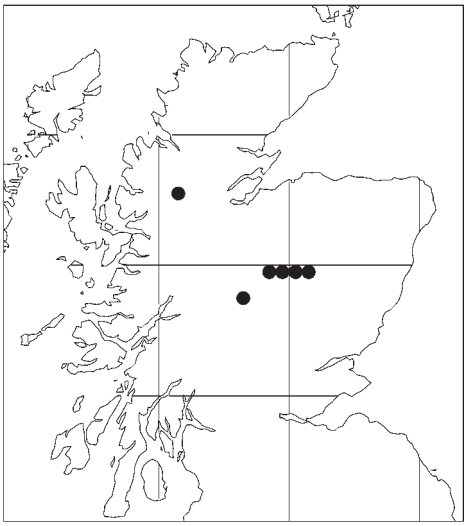

FIG. 18. *Hieracium macrocarpum* Pugsl.

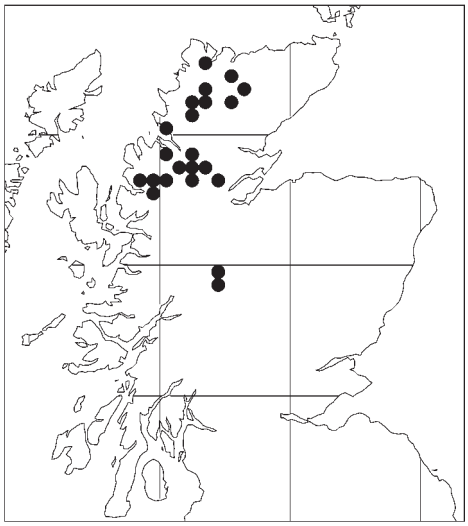

FIG. 19. *Hieracium marginatum* P.D. Sell & C. West

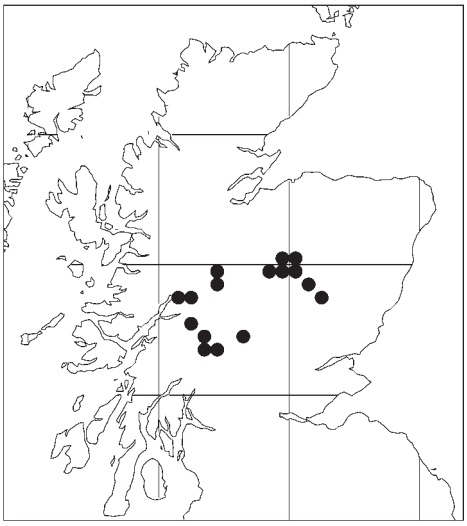

FIG. 20. *Hieracium memorabile* P.D. Sell & C. West

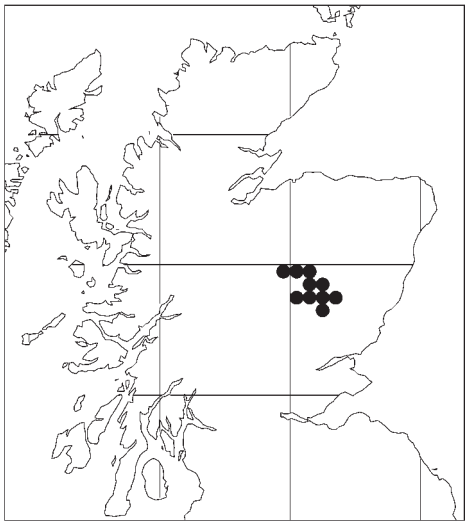

FIG. 21. *Hieracium milesii* P.D. Sell & C. West

Hieracium optimum P.D. Sell & C. West

Endemic. Very rare, restricted to two sites in one hectad in the Western Highlands (Vice-county 98) (Fig. 24). Twenty plants were seen in 1990 at one site, but the size of the population at the other is not known. **Critically Endangered**.

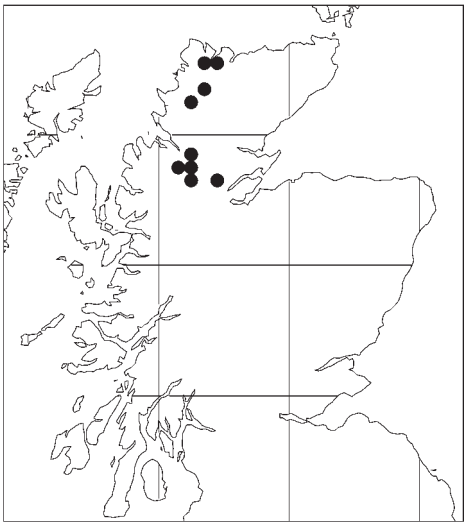

FIG. 22. *Hieracium mundum* P.D. Sell & C. West

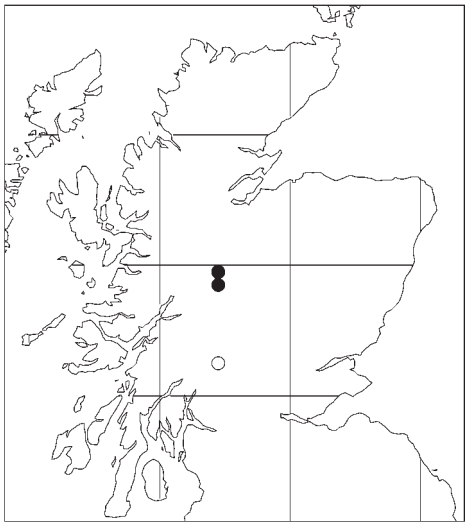

FIG. 23. *Hieracium notabile* P.D. Sell & C. West: ●, 1966 onwards; ○, extinct

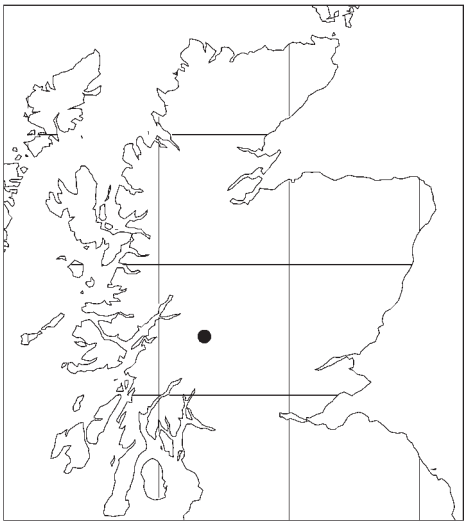

FIG. 24. *Hieracium optimum* P.D. Sell & C. West

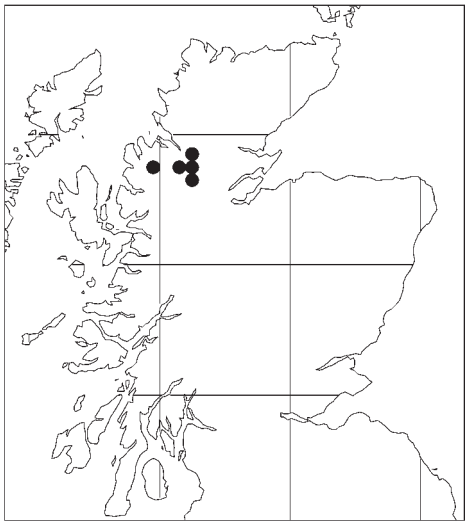

FIG. 25. *Hieracium pensum* P.D. Sell & C. West

Hieracium pensum P.D. Sell & C. West
Endemic. Known from about 16 localities in five hectads in the Northern Highlands (Vice-counties 105, 106; records from Vice-county 108 appear to be errors) (Fig. 25). **Near Threatened**.

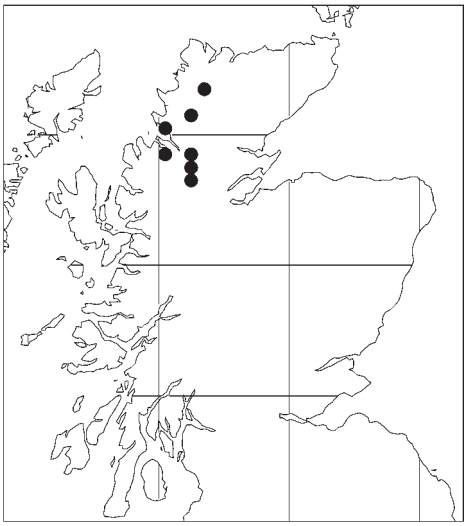

FIG. 26. *Hieracium perscitum* P.D. Sell & C. West

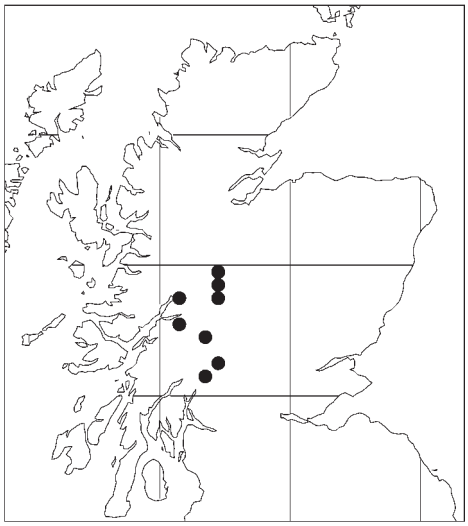

FIG. 27. *Hieracium probum* P.D. Sell & C. West

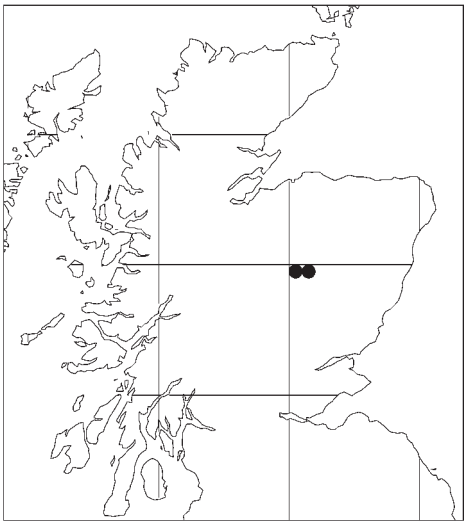

FIG. 28. *Hieracium pseudocurvatum* (Zahn) Pugsl.

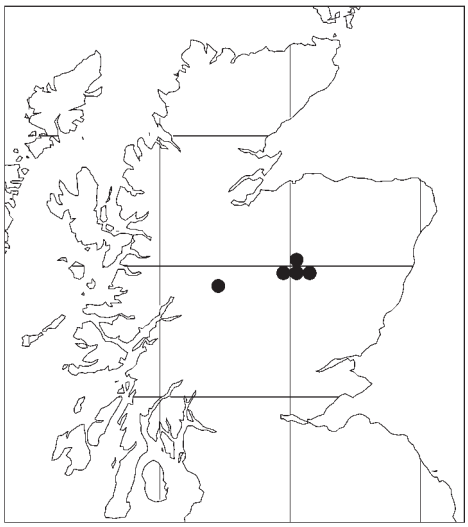

FIG. 29. *Hieracium pseudopetiolatum* (Zahn) Roffey

Hieracium perscitum P.D. Sell & C. West

Endemic. Local and scarce in seven sites in eight hectads in the Northern Highlands (Vice-counties 105–108) (Fig. 26), but possibly also in other sites. The few populations which have been counted are very small. **Near Threatened** (possibly **Vulnerable**).

Hieracium probum P.D. Sell & C. West
Endemic. Scattered in eight hectads mainly in the Western Highlands (Vice-counties 87, 88?, 97, 98) (Fig. 27). There are about 12 localities, some of which have good populations of 20–60 plants, but the totals are difficult to estimate as plants tend to be scattered widely in some sites. **Near Threatened**.

Hieracium pseudocurvatum (Zahn) Pugsl.
Endemic. Recorded from only two restricted localities in the Cairngorms in the Eastern Highlands (Vice-county 92) with populations estimated in 1978 as 30 + and 4 plants (Fig. 28). **Critically Endangered**.

Hieracium pseudopetiolatum (Zahn) Roffey
Endemic. A rare and local species in seven localities in five hectads in the Cairngorms in the Eastern Highlands (Vice-counties 92, 96), where the population sizes are 10, 60 (but flowering plants very scarce), 4, 20, 6, ?4 and 4 plants (total c.108 plants). One specimen of a plant which differs marginally from the Cairngorm plants was collected in 1979 in an outlying locality in the Western Highlands (Vice-county 97) (Fig. 29). **Vulnerable**.

Hieracium subglobosum P.D. Sell & C. West
Endemic. Widespread in the northern part of the Western Highlands and in the Northern Highlands (Vice-counties 96, 97, 104–108), but often local in its individual localities (Sell *et al.*, 1995). It has been recorded from 30 hectads in at least 50 sites (Fig. 30). **Nationally Scarce**.

Hieracium subgracilentipes (Zahn) Roffey
Endemic. Known recently from eight distinct populations on solid rocks in three mountain ranges in the Lake District (Vice-counties 69, 70; Halliday, 1997) but gone from Striding Edge and Glaramara (Fig. 31). Population estimates for the seven sites seen since 1970 are 20, c.15, c.15, c.15, 1, 25 and c.10 (total 100+) (G. Halliday, pers. comm. 2001). **Endangered**.

Hieracium tenuifrons P.D. Sell & C. West
Endemic. Very local but scattered in 10 hectads, all but one of which are in the Western Highlands (Vice-counties 87, 97, 98), and in at least one site just within the western border of Vice-county 88; other plants in the Central and Eastern Highlands (Vice-counties 89, 92, 96) referred to this species are to be described as a new species (Sell & Murrell, in prep.) (Fig. 32). A total of 220 plants have been recorded in five of its c.18 sites between 1981 and 1994, suggesting reasonably healthy populations. **Near Threatened**.

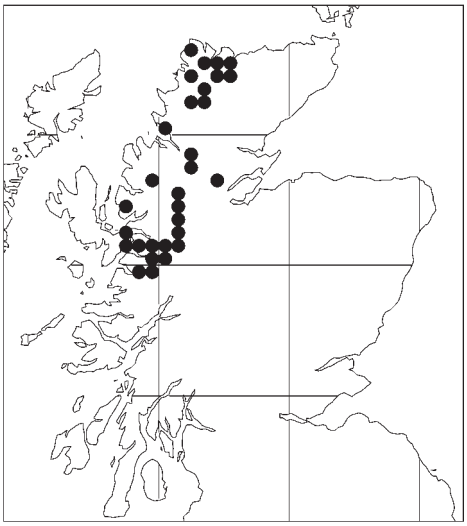

FIG. 30. *Hieracium subglobosum* P.D. Sell & C. West

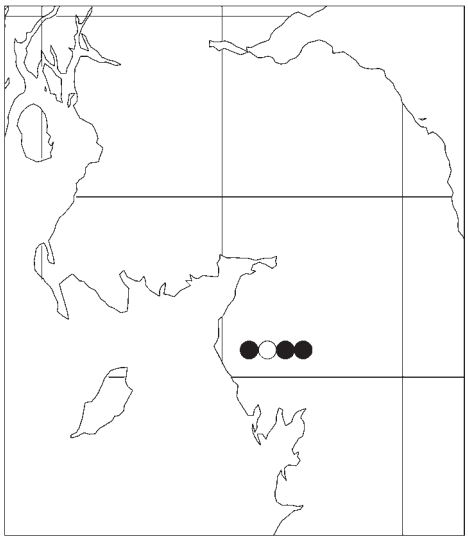

FIG. 31. *Hieracium subgracilentipes* (Zahn) Roffey: ●, 1970 onwards; ○, extinct

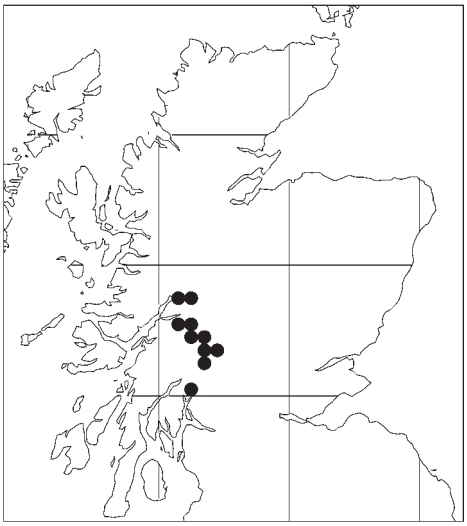

FIG. 32. *Hieracium tenuifrons* P.D. Sell & C. West

DISCUSSION

The maps are either new or update the maps and information in Sell & West (1968), Tennant (1986) and Sell *et al*. (1995); they summarize the current state of knowledge of the distributions of the named section *Alpina* taxa in Britain. Given the remote and difficult nature of the terrain that the species grow in, these will inevitably be

incomplete for the more widespread taxa, but are probably accurate for most of the rarer species. Undoubtedly, there will be further discoveries to be made in remote areas of western Scotland which have been poorly visited compared with the more accessible areas in the Cairngorms. A comparison of maps for *H. alpinum* and *H. holosericeum* with those in Sell & West (1968) shows good overall agreement, though there are many additional records in the present maps and some discrepancies. The Sell & West (1968) maps include field records for which we have not seen specimens.

The maps show that many species have clustered distributions restricted to small areas of mountain range, whilst others are more widespread. Excluding the Lake District endemic *H. subgracilentipes*, the taxa fall into four main phytogeographical groups:

1 **Widespread species**: *H. alpinum*, *H. hanburyi*, *H. holosericeum*.

2 **Western Highlands** (W; Fig. 1): *H. leptodon*, *H. notabile*, *H. optimum*, *H. probum*, *H. tenuifrons*.

3 **Eastern Highlands** (E; Fig. 1): *H. backhousei*, *H. calvum*, *H. completum*, *H. globosiflorum*, *H. graniticola*, *H. grovesii*, *H. larigense*, *H. macrocarpum*, *H. milesii*, *H. pseudocurvatum*, *H. pseudopetiolatum*.

4 **Northern Highlands** (N; Fig. 1): *H. kennethii*, *H. mundum*, *H. pensum*, *H. perscitum*.

Hieracium calenduliflorum, *H. eximium*, *H. insigne* and *H. memorabile* occur in both the Western and Eastern Highlands, and *H. marginatum* and *H. subglobosum* occur in the Western and Northern Highlands. In many cases, related species pairs occur in different areas, supporting evidence of evolution through isolation (Stace *et al*., 1997). The richest single area is undoubtedly the Cairngorms in the Eastern Highlands, where some sites may have up to 12 species (Fig. 33).

The IUCN criteria were relatively easy to apply to the basic data on distribution and population size, as found by Palmer *et al.* (1997) for non-critical British species. The data are summarized in Table 2 and the numbers of taxa in each IUCN threat category are shown in Table 3. The number of hectads that each taxon has been recorded in updates the list in Wigginton (1999). Seven taxa qualify as Critically Endangered, and we are particularly concerned about the long-term survival of *H. calvum*, *H. optimum*, *H. pseudocurvatum*, and especially *H. insigne* forma *insigne*. In some cases rock falls or collecting could eliminate whole populations. More population data are needed for *H. notabile*, *H. optimum*, *H. perscitum* and *H. pseudopetiolatum*.

The greatest single threat to the rarer species may be from collecting by botanists. This vulnerability was shown very recently when one botanist removed half of the population of the very rare *H. leptodon* in one of its only two certain sites, in spite of being requested beforehand not to collect in that sensitive locality. The rarest species could be added to Schedule 8 of the Wildlife and Countryside Act

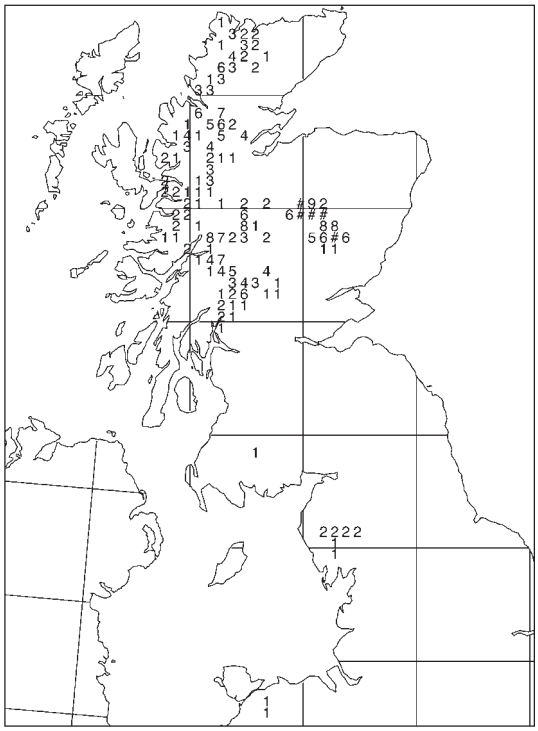

FIG. 33. Coincidence map for *Hieracium* section *Alpina* taxa in Britain. Numbers from 1 to 9 indicate the number of taxa recorded, #=10 or more taxa.

1981 to protect them from collecting, but the legislation might be difficult to enforce as the species are not easy to identify in the wild and a botanist could claim not to know that it was a protected species when collecting it. One response to this would be to argue that as only specialists are likely to be studying the species they should have known what they were doing. Another solution might be to list all species of section *Alpina* on Schedule 8 as a 'catch all'. The provision of a high-quality field identification guide is being considered to eliminate any need for collecting. Another significant threat is the possibility of a serious rock fall or avalanche, which could eliminate a whole population at once.

There is a series of generic environmental threats which may be significant in the longer term. Species often do not flower in the wild when growing significantly below their normal altitudinal range, although, surprisingly, the majority flower well in cultivation at much lower altitudes. However, in cultivation they need to be protected from full sunlight during the warm parts of the day throughout the period of flower-bud formation if successful flowering is to occur, whereas in the wild they usually occur in exposed habitats, where shade from strong sunlight is not possible, and this might explain this phenomenon. Reproduction in the wild is therefore undoubtedly at risk from rising temperatures due to global warming. Acid rain deposition may

TABLE 2. Summary of distribution and population-size data for *Hieracium* section *Alpina* in Britain, ranked in order of IUCN threat criteria. Population estimates marked + are approximate minima, and those marked * are of species for which only a small proportion of populations have been counted. Known extinctions are not included. Note that the infraspecific taxa only of *H. hanburyi* and *H. insigne* are included

Species	Number of hectads	Number of sites	Total population	IUCN category
H. calvum	2	3	24	Critically Endangered
H. graniticola	2	4 (?5)	40	Critically Endangered
H. grovesii	4	8	<50	Critically Endangered
H. hanburyi forma *pusillum*	3	6	c.30	Critically Endangered
H. insigne forma *insigne*	1	1	20	Critically Endangered
H. optimum	1	2	60+	Critically Endangered
H. pseudocurvatum	2	2	34	Critically Endangered
H. backhousei	3	4	80	Endangered
H. insigne forma *celsum*	4	4	c.67	Endangered
H. kennethii	2	3	70	Endangered
H. larigense	2	4	c.82	Endangered
H. leptodon	3	3	71+	Endangered
H. notabile	2	3	60+	Endangered
H. subgracilentipes	3	8	100+	Endangered
H. macrocarpum	6	9	200*	Vulnerable
H. pseudopetiolatum	5	7	108+	Vulnerable
H. calenduliflorum	11	25		Near Threatened
H. completum	11	20		Near Threatened
H. globosiflorum	5	14		Near Threatened
H. hanburyi forma *atraticeps*	15	c.17		Near Threatened
H. milesii	10	19	200*	Near Threatened
H. mundum	9	13		Near Threatened
H. pensum	5	16		Near Threatened
H. perscitum	7	8		Near Threatened
H. probum	8	12	124*	Near Threatened
H. tenuifrons	10	18	200*	Near Threatened
H. alpinum	34	<80		Nationally Scarce
H. eximium	30	c.80		Nationally Scarce
H. hanburyi forma *hanburyi*	43	100+		Nationally Scarce
H. holosericeum	80	120+		Nationally Scarce
H. marginatum	22	c.40		Nationally Scarce
H. memorabile	16	c.20		Nationally Scarce
H. subglobosum	30	c.50		Nationally Scarce

also lower soil pH and make conditions unsuitable for growth; many species occur on granite substrates which are likely to be poorly buffered from acidification. Over-grazing in the uplands also reduces the habitat availability as most species are palatable, especially to deer, which selectively graze them. As many species are specialists at high altitudes on mountains, they are vulnerable to the recent expansion

TABLE 3. Number of *Hieracium* section *Alpina* taxa (species or forms) in each IUCN threat category

IUCN category	Number of section *Alpina* taxa
Extinct	0
Critically Endangered	7
Endangered	7
Vulnerable	2
Conservation Dependent	0
Near Threatened	10
Nationally Scarce	7
Least Concern	0

of countryside recreation and tourism enhanced by the provision of chair-lift and railway access to summits. One section *Alpina* site near Glenshee was destroyed by a summer fire as a direct consequence of such access, and it is probable that the Striding Edge locality for *H. subgracilentipes* has been lost due to erosion by tourists. It was last recorded in 1965.

Ex situ conservation may be a useful tool to augment *in situ* conservation for some threatened species but not all, as some species, for example *H. holosericeum* and *H. alpinum*, flower poorly in cultivation. Other species, such as *H. larigense* and *H. pseudocurvatum*, develop atypical growth forms in cultivation which limits the value of living collections for learning to identify species. Seed of all species except *H. marginatum*, *H. memorabile*, *H. optimum*, *H. pseudocurvatum* and *H. subglobosum* is held in the Millennium Seed Bank (S. Alton, pers. comm. 2002).

As many of the section *Alpina* species are very rare in the wild, frequently having individual populations of fewer than 20 plants, botanists are urged to LEARN THE SPECIES IN THE HERBARIUM and NOT TO COLLECT THEM FROM THE WILD. They are also especially requested not to collect any in sensitive places where rare species are known to occur. The herbarium at the National Museum & Gallery of Wales (NMW) is one of only two with complete and publicly accessible British collections of *Hieracium* section *Alpina*; visitors are very welcome if they make advance arrangements.

ACKNOWLEDGEMENTS

We thank the keepers of the herbaria BM, BON, CGE, DBN, DEE, E, GL, GLAM, LDS, LIV, MANCH, NMW, PTH and RNG for access to the specimens, David McCosh for records from the *Hieracium* database, Geoffrey Halliday for counts of *H. subgracilentipes*, and other botanists who have provided information. The maps were plotted using DMAPW by Alan Morton.

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Received 4 May 2001; accepted after minor revision 28 June 2002