

# Yorkshire's threatened plants: Northern Hawk's-beard *Crepis mollis*\*

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## Introduction

In Britain Northern Hawk's-beard *Crepis mollis* (Jacq.) Asch. (Asteraceae) is a Nationally Scarce tall-herb of submontane pastures and hay-meadows on shallow, slightly flushed, base-rich soils in the uplands of Northern England, the Scottish Borders, and the Eastern and Central Highlands of Scotland (Plate I, centre pages; Braithwaite, 1994; O'Reilly, 2010a). There is also a single record for Denbighshire, North Wales, where it has not been since 1913 (Dines, 2008). Consequently, Yorkshire populations are now the most southerly in the British Isles, extending from Ribblesdale in the south (VC 64) to the River Tees on the northern edge of North-west Yorkshire (VC65) (Abbott, 2005). Old records for North-east Yorkshire (VC62) and South Yorkshire (VC63; Ecclesall Wood) are now thought to be errors or introductions (Cheetham & Sledge, 1941).

Few British botanists will be familiar with *Crepis mollis* and consequently its distribution, habitats and ecology are not well understood. Recent surveys have shown that most British populations occur in meadows, pastures and roadside verges rather than riverbanks and humid gorges, as stated in earlier floras (e.g. Clapham *et al.*, 1962). These mirror its habitats in Europe, which include submontane and montane grasslands of the Trisetum-Polygonion (e.g. Filipová & Krahulec, 2006; Kohler *et al.*, 2004; Wagner *et al.*, 2007) to which the majority of its British habitats belong (Rodwell *et al.*, 2007). In Europe it also occurs in wet and floodplain hay-meadows in the lowlands (e.g. Havlová, 2006; Kull *et al.*, 2002; Simonavičiūtė & Ulevičius, 2007; Wotavová *et al.*, 2004).

In Britain most *C. mollis* populations are submontane (150-400m) but it ascends to 725m on base-rich crags in Caenlochan, Scotland, and to 1500m in montane meadows in the Krkonoše Mountains in the Czech Republic (Filipová & Krahulec, 2006). It is a member of the European Temperate element occurring throughout Central and Southeast Europe, from the Pyrenees and Northern Italy northwards to the Baltic States and from Britain eastwards to Ukraine and western Russia. Three subspecies are currently recognised on the continent (ICN, 2010): subsp. *mollis* appears to be the widespread taxon whereas subsp. *succisifolia* and subsp. *velenovskyi* appear to be restricted to Eastern Europe and the Czech Republic respectively. The identity of British plants has yet to be investigated.

The map for *C. mollis* in the *New Atlas* (Plate I, Centre pages) showed a dramatic decline in the number of hectads recorded since 1970 (Preston *et al.*, 2002). Therefore it was categorised as 'endangered' in the British *Red Data List* (Cheffings & Farrel, 2005), based on an inferred decline of greater than 50% (Criterion A2c), and listed as a 'priority' species in the UK Biodiversity Action Plan in 2007. However, the reasons for this apparent decline are unclear. Although there have undoubtedly been losses due to agricultural improvement, overlooked colonies continue to be found, particularly in its core areas in Durham and Northumberland. A possible explanation is the ease with which it can be confused with other yellow-flowered composites in species-rich swards. These include *Crepis paludosa*, *Leontodon autumnalis*, *L. hispidus*, *Hypochaeris radicata* and microspecies of *Hieracium*, especially *H. prenanthoides* and several species from Section *Foliosa* (O'Reilly, 2010a). When

it is not in flower the basal leaves are also difficult to differentiate from *Centaurea nigra* and *Succisa pratensis*. In fruit a useful character is the clean white pappus which can stand out from those of *C. paludosus* and *Hieracium* species, all of which are dirty white to pale brown, although on many sites inflorescences are removed by grazing animals well before fruiting takes place (M. Braithwaite, pers. comm.)

To gain a better understanding of the status of *Crepis mollis* in Britain, the Botanical Society of the British Isles (BSBI) undertook a national survey of populations in 2008. This project included a survey of a random selection of historic sites to record information on distribution, population size and extent, habitat, management and threats and, for sites where it had disappeared, the probable reasons for loss. In this paper we summarise the history of the plant in Yorkshire and present the results of the survey of Yorkshire populations in 2008. Nomenclature follows Stace (1997) for vascular plants and Watsonian vice-counties and Rodwell (1992) for National Vegetation Classification communities.

### Historical records of *Crepis mollis* in Yorkshire

*Crepis mollis* appears to have always been a rare plant in Yorkshire, having only been recorded from 21 sites in 18 1 km squares (Table 1; Fig.1). With the exception of two unconfirmed records, all localities are within vice-counties 64 and 65. The most southerly sites are near to Settle (where it was last recorded in 1875) although the precise localities are unclear as the place-names “Stainforth Wood” and “Major Spring’s Wood” (where it was first recorded for Yorkshire in 1811) do not appear on modern maps. A further record for “Ingletton” is presumably the same as F.A. Lees’ (1888) record for “Greta Stream” [River] listed in his flora under “*C. hieracioides*”. Today the only extant population is in Colt Park Wood National Nature Reserve (NNR), near to Ribbleshead, where plants are scattered along the edge of a wooded limestone pavement (Plate IIa, Centre pages).

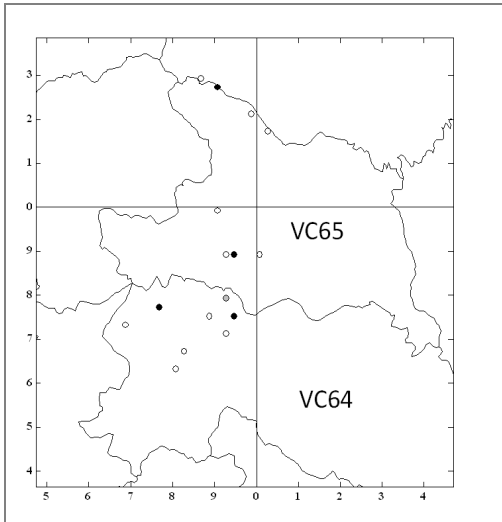


Figure 1. The distribution of *Crepis mollis* in Yorkshire (VCs 64 & 65) at the tetrad scale.

Open circles: recorded before 1970;  
filled grey circle: recorded 1970-1999;  
filled black circle: recorded after 2000.

Upper Wharfedale appears to be the headquarters of this species in Yorkshire. Three localities are listed for Littondale and its tributaries but it has not been recorded there since 1956. Records for “Hesletine Beck” presumably refer to Heselden Beck, where it was last recorded “under Pen-y-Ghent Farm” by Augustin Ley in 1902. This locality is thought to be the wooded gill below Pen-y-Ghent House, which is now too heavily grazed for *C. mollis*, although it could

still survive on inaccessible rock outcrops where hawkweeds are still abundant (B. Burrows, pers. comm.). It was also recorded by Lees near to Arncliffe in “bushy places by [the] stream below [the] village” but, again, the exact locality is unclear. Today the most likely localities are the wooded limestone pavements on the valley sides (e.g. Scoska Wood), as most of the valley-bottom grasslands have been improved. The Wharfe above Kettlewell is the current stronghold for *C. mollis* in Yorkshire. Here it grows in limestone grassland on steep, northeast-facing wooded hillsides extending from Starbottan to Buckden, where it was first discovered by J. Cryer (1909) in 1908 (Plate IIb). There is also an intriguing record for Cray Gill at the head of the valley, made during a Wildflower Society meeting in 1986 (T. Fowler, pers. comm.). Although there is much suitable habitat surrounding the gill, *C. mollis* has not been refound despite repeated searches.

In Wensleydale *C. mollis* has been recorded in three separate localities, although only one appears to be extant. This is located on an unimproved, species-rich bank in a semi-improved pasture near to Worton (Fig. 3c). This site was discovered by Ian Lawrence on a YNU field meeting in 1978 and described incorrectly as “Field below Wooton [*sic*] Scar. 34/98” (Anon., 1981) and “Attleborough” in the Biological Records Centre Database. In 2008 it was re-discovered after a search of suitable fields below the scar. The second site, “Bain Gill Top”, is probably the gorge to the north of Semer Water but very little suitable habitat survives today due to agricultural improvement and over-grazing. The precise location of the “Carperby” record, made in 1906, is unknown.

The only record for Swaledale is “Kisden”, probably Kisdon, a small hamlet just above Muker. Although it could have occurred there in the past, no suitable habitat survives today. An F.A. Lees (1888) record for “Gunnarside” could refer to the same site as Kisdon Side is situated on the slopes facing Gunnarside opposite Crackpot Hall.

In Teesdale *C. mollis* still occurs on both sides of the River Tees. It appears to be more common on the Yorkshire (south) side, having been recorded from at least six localities close to the river, although only two were found in 2008. These include two small banks in meadows and pastures near to Holwick, one of which has an exceptionally rich flora including *Alchemilla subcrenata*, *Gentianella campestris* and *Pseudorchis albida* (Fig. 3d). The precise localities of the remaining four sites are unknown. There are numerous herbarium specimens of *C. mollis* for VC65 labelled “High Force”, the last of which appears to have been collected in 1925, **BIRM**<sup>1</sup>. T.J. Foggitt knew it there and showed it to Eleanor Vachell on 8 July 1920 (Forty & Rich, 2005), although it is not clear whether they visited the south (VC65) side of the river. Populations further down the Tees were also known to William Foggitt of Thirsk who recorded it as “plentiful” from Winch Bridge to Holwick [where it still occurs] and down to Middleton, and also in Deepdale and between Ronaldskirk and Hunderthwaite nearer to Barnard Castle in 1903. There is also an intriguing Lees record in 1874 from a “Rocky field bank near Fairy Knowle on S. of Tees just where basalt crosses valley from Lunesdale to Eggesburn, alt. 1800 feet [must be 800 ft which is 244 m]”. This is a very precise description but as yet we have been unable to discover the exact location. Lees later added that “in fields, “drift” covered, close to Barnard Castle, it is clearly adventive if not out of its element” suggesting that he considered meadow plants to be recent colonists from higher up the dale (Dallman, 1939). Lees also gives a record for a “meadow” near to Ecclesall Wood, Sheffield, VC63 (T. Gibbs, 1895) where again he considered it to have been introduced (Cheetham & Sledge, 1941).

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<sup>1</sup>Editor's note: BIRM refers to the Birmingham Herbarium

### ***Crepis mollis* in Yorkshire in 2008**

In 2008 the authors visited sites where locality details allowed us to pinpoint them with some accuracy (Table 1).

Table 1.

Records of *Crepis mollis* in Yorkshire (VCs 64 & 65) with the year of last record.

Codes for 'Status' are as follows: P, searched in 2008 and refound; X, searched in 2008 but not found; NV, not visited in 2008; ?, status uncertain.

Locality	1-km	Last record	Status	Recorder	Comment
<i>MID-WEST YORKSHIRE (VC64)</i>					
Ingleton	SD6973	1958	NV	Anon.	An F.A. Lees "Greta Stream" record is probably this site
Colt Park Wood, Ribblesdale	SD7777	2008	P	KJW	Wooded limestone pavement
Major Springs Wood, Settle	SD8163	1811	NV	Windsor	Precise locality unknown (not marked on modern maps)
Stainforth Scar, Settle	SD8266	1875	NV	Tatham	Precise locality unknown (not marked on modern maps)
Littondale	SD8-7-	1956	?	Roche	Precise locality unknown. Includes Arncliffe & Hesleden
Under Pen-y-Ghent Farm, Littondale	SD8874	1902	X	Ley	Borrer's record for "Hesletine" probably refers to this site
Arncliffe, Littondale	SD9371	1888	NV	Lees	"Bushy places by stream below village"
Bounty, near Starbotton	SD9574	2008	P	KJW	Steep calcareous pasture on valley side
Firth Wood, N of, Buckden	SD9474	2008	P	KJW	Steep calcareous pasture on valley side
Firth Wood, below, Buckden	SD9475	2008	P	KJW	A 1908 J. Cryer "Buckden" record is probably this site
Cray Gill, Upper Wharfedale	SD9378	1986	X	Fowler	Suitable habitat remains; possibly overlooked
<i>NORTH-WEST YORKSHIRE (VC65)</i>					
Bain Gill, Wensleydale	SD9288	1888	X	Anon.	No suitable habitat found; probably extinct
Worton Scar, Wensleydale	SD9488	2008	P	KJW	Discovered by I. Lawrence in 1976; relocated in 2008
Carperby, Wensleydale	SE0089	1906	NV	Baker	Date of publication. Precise locality unknown
Kisdon, Swaledale	SD9098	1907	X	Foggitt	Precise locality unknown. Foggitt's specimen is in HDD
High Force, Teesdale	NY8628	1925	NV	Heath & Foggitt	Specimen in BIRM. Many earlier records for this site
Egglesburn, Teesdale	NY9027	1874	NV	Lees	The precise locality is unclear
Wynch Bridge, Teesdale	NY9027	2008	P	KJW & LR	New site; species-rich bank adjacent to the River Tees
Holwick, Teesdale	NY9027	2008	P	KJW & LR	Re-find; in wet pasture next to R. Tees
Hunderthwaite-Ronaldkirk, Teesdale	NY9821	1903	NV	Foggitt	Precise locality unknown
Deepdale	NZ0216	1903	NV	Foggitt	Precise locality unknown

*C. mollis* was found at three well-known sites (Colt Park, Bounty and Firth Wood) and re-discovered at two others where it had not been seen for many years (Worton Crag and Wynch Bridge). In addition, two new populations were discovered near to Starbotton and Holwick, giving a total of seven extant sites. No plants were found at Kisdon, Bain Gill, Cray Gill or Hesleden Beck. However, plants could still occur at all these sites and further searches are planned in the future.

### Population size and extent

With the exception of Bounty, populations hold less than 50 plants (Table 2). Plants in the two largest colonies, at Bounty and Firth Wood, were scattered at low density across three hectares of limestone grassland on a steep ENE-facing slope. All other populations were much more restricted in extent: at Worton around 50 plants occur over about a 50 × 40 m area on a species-rich bank whereas at Holwick and Wynch Bridge populations extend over just a few square metres. The population at Colt Park may be much more extensive as scattered plants have been found in the past but always at very low density (J. Roberts, pers. comm.).

### Habitats and vegetation

Yorkshire populations occur between 210-270m altitude and, with the exception of Colt Park, all occur on relatively steep, sheep-grazed slopes with a northerly aspect (Table 2). Extant populations occur in three distinct habitats; wooded limestone pavement, steep limestone pasture on valley sides and grazed species-rich banks within otherwise improved pastures or hay-meadows (Table 2; Plate II).

Table 2. Details of *Crepis mollis* sites in Yorkshire surveyed in 2008. National Vegetation Classification communities (Rodwell, 1992) were assigned using Tablefit (Hill, 1996).

Site name	Number	Area (ha)	Slope (°)	Aspect	Alt. (m)	Habitat type/management	NVC type	Conservation
Colt Park Wood	6	<0.1	5	N	340	Wooded limestone pavement	MG2	NNR
Bounty	c.200	1.1	40	ENE	240	Grazed pasture on steep valley side	MG3b	SSSI
Firth Wood, below	48	2.8	35	NE	245	Grazed pasture on steep valley side	U4c	SSSI
Firth Wood, near	1	<0.1	35	ENE	250	Grazed pasture on steep valley side	Not recorded	SSSI
Worton Scar	44	0.1	25	NNE	210	Grazed bank in pasture	MG2a/CG2c	None
Wynch Bridge	25	<0.1	15	NE	270	Grazed bank in pasture	MG5c	None
Holwick	7	<0.1	30	NW	260	Grazed bank in hay-meadow	MG5c	None

At Colt Park plants were partially shaded and rooted in shallow soils that had accumulated on the tops of limestone clints. This supports luxuriant *Arrhenatherum-Filipendula* tall-herb grassland (MG2) under a canopy of *Fraxinus excelsior* with abundant *Mercurialis perennis*, *Festuca rubra* and *Heracleum sphondylium* (Table 3). *Crepis mollis* occurs in similar

vegetation partially shaded by trees at Worton in Wensleydale (MG2a). All other Yorkshire populations grow in open grassland. The Wharfedale populations occur on uniformly steep (30–40°) ENE-facing slopes. The majority of plants at Bounty occur on colluvial soils that have accumulated over limestone scree and support *Anthoxanthum odoratum*-*Geranium sylvaticum* northern hay-meadow grassland (*Briza media* sub-community; MG3b), presumably due to flushing of base-rich water down the slope. Here the vegetation is very species-rich (33 species per quadrat) with abundant *Anthoxanthum odoratum*, *Dactylis glomerata*, *Galium verum*, *Potentilla erecta* and the tall-herbs *Centaurea nigra*, *Filipendula ulmaria* and *Geum rivale*. The grassland below Firth Wood is similar but with more *Cirsium heterophyllum*, *Deschampsia cespitosa*, *Geranium sylvaticum*, *Lotus corniculatus* and *Succisa pratensis*. This grassland most closely resembled *Lathyrus linifolius*-*Stachys officinalis* sub-community of *Festuca ovina*-*Agrostis capillaris*-*Galium saxatile* grassland (U4c), which typically occurs on deeper soils on slopes flushed by base-rich water. The vegetation at Worton in Wensleydale was similar but with a greater calcareous element, presumably because of the greater influence of the underlying limestone. As a consequence, the calcicoles *Helianthemum nummularium*, *Leontodon hispidus*, *Pimpinella saxifraga* and *Sanguisorba minor* were all abundant and the community closely resembled *Holcus lanatus*-*Trifolium repens* sub-community of *Festuca ovina*-*Helictotrichon pratensis* grassland (CG2c).

Weighted mean Ellenberg values were calculated for each site to provide an overall summary of Yorkshire habitats. Each species was weighted by its DAFOR value after conversion to a numeric score (1: rare to 5: dominant). Across the sites light (L) varied from 6–7.2 with an average of 6.8 ( $\pm 0.2$ ), indicating that this is a plant of well-lit places but able to tolerate some shade. Moisture (F) ranged from 5.1 to 5.7 with an average of 5.4 ( $\pm 0.1$ ), indicating a plant of 'moist' soils, while reaction (R) ranged from 5.2 to 6.5 with an average of 5.8 ( $\pm 0.2$ ), indicating relatively neutral to slightly acid soils, presumably reflecting the high precipitation and leaching at all the sites. Nitrogen (N) ranged from 3.2–5.3 with an average 4.0 ( $\pm 0.3$ ), indicating a plant of soils of intermediate fertility. Interestingly, with the exception of F, the mean weighted Ellenberg values were a single unit lower than those given by Hill *et al.* (2004) suggesting that, in Yorkshire at least, *Crepis mollis* inhabits slightly more closed, less fertile and more acidic habitats than has previously been thought to be the case.

Both sites in Teesdale were associated with intrusions of basalt and were assigned to the *Danthonia decumbens* sub-community of *Cynosurus cristatus*-*Centaurea nigra* grassland (MG5c) with abundant *Agrostis capillaris*, *C. nigra*, *C. cristatus*, *Holcus lanatus*, *Plantago lanceolata* and *Succisa pratensis*. The grassland at both sites was very rich, supporting a number of national rarities including *Alchemilla glomerulans*, *A. subcrenata*, *A. wichurae*, *Gentianella campestris*, *Persicaria vivipara*, *Pseudorchis albida* and *Trollius europaeus*.

Table 3. Associates of *Crepis mollis* at six sites in Yorkshire (recorded in eight 1m radius circular quadrats). Only species recorded in four or more quadrats are shown (additional species are listed below). Mean abundance was calculated by converting 'DAFOR' scores to a numeric scale i.e. Dominant = 5, Abundant = 4, Frequent = 3, Occasional = 2, Rare = 1.

Species	Frequency	Abundance	Species	Frequency	Abundance
<i>Crepis mollis</i>	8	1.5	<i>Conopodium majus</i>	5	1.8
<i>Centaurea nigra</i>	7	2.6	<i>Festuca rubra</i>	5	1.8
<i>Succisa pratensis</i>	6	3.0	<i>Ranunculus acris</i>	5	1.6
<i>Potentilla erecta</i>	6	2.3	<i>Veronica chamaedrys</i>	5	1.6
<i>Plantago lanceolata</i>	6	2.2	<i>Prunella vulgaris</i>	5	1.4
<i>Campanula rotundifolia</i>	6	1.5	<i>Dactylis glomerata</i>	4	2.8
<i>Anthoxanthum odoratum</i>	5	2.8	<i>Agrostis capillaris</i>	4	2.3
<i>Festuca ovina</i>	5	2.6	<i>Briza media</i>	4	2.3
<i>Filipendula ulmaria</i>	5	2.2	<i>Geum rivale</i>	4	2.0
<i>Cynosurus cristatus</i>	5	2.0	<i>Lotus corniculatus</i>	4	2.0
<i>Holcus lanatus</i>	5	2.0	<i>Potentilla sterilis</i>	4	1.8
<i>Cerastium fontanum</i>	5	1.8	<i>Trifolium repens</i>	4	1.5

Additional species. 3 quadrats: *Arrhenatherum elatius*, *Carex panicea*, *Carex pilulifera*, *Cruciata laevipes*, *Deschampsia cespitosa*, *Galium verum*, *Helictotrichon pratense*, *Helictotrichon pubescens*, *Leontodon hispidus*, *Luzula campestris*, *Primula veris*, *Ranunculus repens*, *Sanguisorba minor*, *Viola riviniana*.

2 quadrats: *Ajuga reptans*, *Carex flacca*, *Crataegus monogyna* (seedling), *Euphrasia agg.*, *Festuca pratensis*, *Geranium sylvaticum*, *Lathyrus pratensis*, *Linum catharticum*, *Mercurialis perennis*, *Pilosella officinarum*, *Rhinanthus minor* subsp. *monticola*, *Rumex acetosa*, *Senecio jacobaea*, *Trisetum flavescens*.

1 quadrat: *Achillea millefolium*, *Alchemilla glabra*, *Allium ursinum*, *Asplenium viride*, *Brachypodium sylvaticum*, *Carex caryophyllaea*, *Carex pallescens*, *Carex pulicaris*, *Cirsium heterophyllum*, *Dactylorhiza fuchsii*, *Epilobium montanum*, *Festuca arundinacea*, *Festuca vivipara*, *Fraxinus excelsior* (seedling), *Galium aparine*, *Galium odoratum*, *Galium sternerii*, *Gentianella campestris*, *Geranium robertianum*, *Geum urbanum*, *Gymnadenia conopsea* subsp. *borealis*, *Helianthemum nummularium*, *Heracleum sphondylium*, *Hieracium agg.*, *Hyacinthoides non-scripta*, *Hypochaeris radicata*, *Juncus acutiflorus*, *Koeleria macrantha*, *Lapsana communis*, *Lathyrus linifolius* subsp. *montana*, *Leontodon autumnalis*, *Lysimachia nemorum*, *Oxalis acetosella*, *Persicaria vivipara*, *Phleum bertolonii*, *Phyllitis scolopendrium*, *Pimpinella saxifraga*, *Poa trivialis*, *Prunus spinosa* (seedling), *Ranunculus bulbosus*, *Rubus caesius*, *Rubus idaeus*, *Sanguisorba officinalis*, *Scabiosa columbaria*, *Serratula tinctoria*, *Silene dioica*, *Stachys officinalis*, *Stellaria graminea*, *Stellaria media*, *Taraxacum officinale*, *Trifolium medium*, *Trifolium pratense*, *Trollius europaeus*, *Vicia sepium*.

## Management

With the exception of Colt Park and Holwick, Yorkshire populations were all grazed at low intensity by sheep and rabbits at the time of the survey. As with many Dales pastures, these are grazed for part of the year, usually with the livestock being removed for short periods to allow flowering to take place. This would certainly be the case in Wharfedale and Wensleydale

where sites are managed sympathetically either as SSSIs or by tenants of the National Trust. In comparison, the Holwick population occurs within a hay-meadow that had been 'shut-up' for hay for at least two months prior to our July survey and is currently being managed sympathetically for its rich meadow flora, despite receiving no formal protection or support through agri-environment schemes. The Wynch Bridge site appeared the most 'improved' pasture but still retained an interesting flora. However, it is unlikely that any of the slopes on which *C. mollis* occurs on these sites are cut for hay. In comparison the Colt Park population occurs on an ungrazed, wooded limestone pavement.

### Threats

The results presented in Table 2 suggest a dramatic (67%) decline from 21 to seven populations. However, we were only able to confirm, with some confidence, its absence at three of the 14 sites for which there are no recent records. Many older records were too imprecise to resurvey and could therefore have been easily overlooked and await rediscovery. Furthermore, many records could actually relate to the same site while new overlooked populations may remain to be found. These figures therefore undoubtedly overestimate the scale of decline.

However, the species has certainly been lost from at least three sites and their condition in 2008 suggests that over-grazing and/or conversion from hay to silage production are probably the main causes. Indeed, the restriction of the majority of surviving populations to steep banks or valley sides has probably afforded protection from reseeding and improvement. Changes in grazing regimes could also threaten populations, although fortunately most known sites are managed sympathetically as conservation areas.

### Conclusions

*Crepis mollis* has probably never been a common plant in Yorkshire and now only survives in a handful of sites that have escaped agricultural improvements and increases in stocking levels. Typical habitats include steep slopes or banks in upland hay-meadows or pastures that are not practical to mow, fertilise or reseed. Although it is clearly one of Yorkshire's most threatened plants we are cautiously optimistic about its future, given that the majority of populations are on nature reserves (SSSIs, NNRs) or in grassland managed under agri-environment schemes. We also expect additional populations to be discovered in the future as recorders become more familiar with its habitats as a result of targeted surveys such as these. However, the isolation and small size of Yorkshire populations is likely to make it highly vulnerable to changes in management as well as climate change and increased eutrophication from atmospheric sources. Indeed, recent surveys in the Yorkshire Dales and North Pennines have revealed a decline in the overall richness and quality of meadows over the last few decades (Pacha & Petit, 2008; O'Reilly, 2010b) as well as a decline in the abundance of characteristic hay-meadow species e.g. *Alchemilla* spp., *Cirsium heterophyllum* and *Geranium sylvaticum*; (Bradshaw, 2008; Pacha & Petit, 2008). Although some of these losses have been linked directly to habitat loss as a result of agricultural improvement, shifts may also be occurring on high quality sites due to subtle changes in management, even on land managed for conservation (O'Reilly, 2010b). In North Pennine hay-meadows these have included increases in weedy species, annual herbs and damp-loving species (O'Reilly, 2010c) possibly in response to changes in management. This includes the cessation of liming, introduction of new livestock breeds, less variability in the timing and intensity of cutting and grazing and changes in the content, timing and application of farm-yard manure. In addition, major environmental changes such as milder, wetter winters combined with increased eutrophication may also be affecting the composition of upland grasslands, in particular populations of poor competitors such as *C. mollis*, due to a general increase in the productivity of upland swards.



On a more practical level, land managers were often unaware of the presence of *C. mollis* on their sites and, consequently, management prescriptions rarely took its needs into account. It is, therefore, no surprise that, with the exception of a few sites, *C. mollis* is now restricted to relatively 'unmanaged' areas that are too steep for agricultural operations such as mowing, fertilizing or reseeded. These habitats now provide vital refuges for many grassland species dependent on traditional management; their protection and continued management is vital not only for threatened plants such as *C. mollis* but also upland grassland species more generally.

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