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Hieracium lanceolatum (Asteraceae) does not occur in Britain

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Abstract
The status of *Hieracium lanceolatum* Vill. in Britain has been reviewed against the original descriptions and material from the western Alps. British plants named as *H. lanceolatum* show a poor match with *H. lanceolatum* and fit *H. prenanthoides* Vill. better. It is concluded that *H. lanceolatum* does not occur in Britain.

Keywords: *Hieracium* section *Prenanthoidea*; *Hieracium prenanthoides*

Introduction

Hieracium prenanthoides Vill. and *H. lanceolatum* Vill. (*Hieracium* section *Prenanthoidea* W. D. J. Koch) were both described from Dauphiné, France in the western Alps by Domínique Villars. *Hieracium prenanthoides* was briefly described as having an erect stem, a conical, finely branched inflorescence, and elliptic, hairy leaves with amplexicaul bases (Villars, 1779). In its broad sense, *H. prenanthoides* has been recorded from Greenland, Iceland and Scandinavia to central Europe as far as western Asia and Siberia (cf. Pugsley, 1948, Sell & West, 1976; Tyler, 2010; Gottschlich & Raabe, 2011; Chrtek et al. 2020). A range of ploidy levels occur; diploids (2n=18) occur in the SW Alps in France and Italy (but not elsewhere), triploids (2n=27) are widespread in Europe and the Carpathians, and tetraploids (2n=36) have been recorded from Central Europe and Iceland (Chrtek et al., 2004, 2007, 2020; Ilnicki & Szeląg, 2011; Kocián, 2013).

Hieracium lanceolatum was described as having erect, rigid stems, lanceolate, toothed leaves and a subcorymbose inflorescence, and was illustrated in Tab. 30 (Villars, 1788). Villars also contrasted his new *H. lanceolatum* with *H. prenanthoides* and *H. sabaudum* L. noting that *H. lanceolatum* had a straight, rigid stem 1-2 feet high, had all leaves on the stem semi-amplexicaul, had numerous, elliptic-lanceolate, hairy, pale leaves which were toothed on the margins, with an inflorescence of 10-12 flowers with a small black 'calyx' (i.e. involucral bracts). Villars' description is not particularly helpful in separating *H. lanceolatum* from all the other hawkweeds known today, and consequently it has been interpreted in slightly different ways in Europe (e.g. Arvet-Touvet 1873; Zahn, 1922; Tison & de Foucault, 2014). In its broad sense, *H. lanceolatum* has been recorded as widespread in the mountains of central Europe in Austria, Czech Republic, France, Germany, Poland, Romania, Spain, Switzerland and the former Yugoslavia (Sell & West, 1976). The only chromosome count traced is triploid (2n=27) from Slovakia (Májovský, 1974); the

triploid count from Turkey (Hayirlioğlu-Ayaz & İnceer, 2004) does not clearly belonging to the same taxon.

Zahn (1922) in his monograph of European *Hieracium* included both taxa under his Species Principalia Collectiva *H. prenanthoides* Vill. in different groups, *H. prenanthoides* in grex *H. prenanthoides* (Vill.) Zahn with 30 other subspecies and *H. lanceolatum* in grex *H. lanceolatum* (Vill.) Zahn with 20 other subspecies, the latter grex differing in having narrower, lanceolate leaves 3-6 times as long as wide.

Hieracium prenanthoides and *H. lanceolatum* have also been variably treated in British *Hieracium* accounts. Some British authors cite both *H. prenanthoides* and *H. lanceolatum* as present in Scotland and some authors cite only *H. prenanthoides*. It is undisputed that *H. prenanthoides* in its broad sense is widespread in northern and western Britain, with one record for Ireland (McCosh & Rich, 2018).

Williams (1902) cited the "first certain and definite" record for *H. lanceolatum* as the plants described as *H. strictum* Fr. by Hooker & Arnott (1850). However, it is not clear which species Hooker & Arnott were actually referring to from their description, and the name *H. strictum* has been applied to several species in *Hieracium* section *Foliosa* but none in section *Prenanthoidea*. Williams (1902) included both *H. prenanthoides* and *H. lanceolatum* in his account and augmented Villars' original description of *H. lanceolatum* with the addition of pilose hairs on the bracts, and he cited specimens from E. F. and W. R. Linton's Set of British *Hieracia* no. 73 from Inverey, Braemar, Aberdeenshire, which are clearly *H. strictiforme* (Zahn) Roffey in section *Foliosa*; Williams' treatment of *H. lanceolatum* is therefore rejected. According to Sell (1987), William's work has generally been ignored as he did not possess any intrinsic knowledge of *Hieracium,* though Pugsley (1948) is a little more circumspect.

Backhouse (1856) and Linton (1905) only included *H. prenanthoides* in their monographs of British *Hieracium*.

Zahn (1922) cited material of *H. lanceolatum* (as *H. prenanthoides* subsp. *lanceolatum* (Vill.) Zahn) from Braemar and material of *H. prenanthoides* subsp. *strictissimum* (Froel.) Zahn from Fortingall, Perthshire and Braemar, but did not cite any British material under *H. prenanthoides* subsp. *prenanthoides.* Unfortunately, as the collections on which Zahn's work was based on were destroyed in Berlin during the Second World War (Stafleu & Cowan, 1988), it is not possible to examine the British specimens that Zahn saw.

Pugsley (1948) only accepted *H. prenanthoides* Vill. for Britain, and, noting Zahn's records, stated "the varying examples of this group occurring in these stations are shown (in herbarium specimens) by their pale achenes to be forms of *H. prenanthoides*".

Most recently, Sell & Murrell (2006) accepted *H. lanceolatum* for Britain stating "A series of specimens collected from the banks of the River Clunie at Braemar in Aberdeenshire seem to fit this species which differs from *H. prenanthoides* by its more rigid habit, numerous simple eglandular hairs in the inflorescence and almost black, broader involucral bracts. However, typical *H. prenanthoides* also grows at the same locality and the situation needs examining in the field". Sell & Murrell (2006) also regarded Zahn's Braemar record for *H. prenanthoides* subsp. *strictissimum* as *H. lanceolatum,* but noted the only specimens seen from Fortingall were typical *H. prenanthoides*.

Field work by T. Rich at the River Clunie, Braemar in 2016 showed that the plants at Braemar had relatively broad, dark involucral bracts but there was much variation in the quantity of simple hairs in the inflorescences and that further studies were needed (McCosh & Rich, 2018). The status of *H. lanceolatum* in Britain has now been examined in more detail, drawing on the original descriptions and material, with an analysis of herbarium material, examination of additional populations in Scotland and cultivation of two populations from seed.

Characters separating *H. prenanthoides* and *H. lanceolatum* from Villars (1779; 1788) and Zahn (1922) are summarised in Table 1 and from Sell & Murrell (2006) in Table 2. These emphasise the different characters used in Europe and Britain, the key differences being use of leaf shape and toothing in Europe and use of simple hairs on the peduncles and bracts in Britain.

Table 1. Characters separating *H. prenanthoides* and *H. lanceolatum* in Europe (Villars 1779, 1788; Zahn 1922).

Character	***Hieracium prenanthoides***	***Hieracium lanceolatum***
Stem	90-120 cm	Stout, rigid, 30-60 cm high
Number of stem leaves	Up to 40	15-25(-40)
Leaf shape	Ovate to oblong-lanceolate	Elliptic or lanceolate 3-6 times as long as wide
Leaf margins	Subentire to remotely denticulate	Denticulate to serrate
Leaf base	Amplexicaul	Attenuate, semi-amplexicaul
Involucre length	(7-)8-9 mm	9-12 mm
Achenes	Grey or yellow-brown	Reddish-brown or dark brown, rarely yellowish-brown

Methods

Original material

Images of Villars herbarium at Muséum d'Histoire Naturelle de Grenoble (**GRM**) were provided by M. Lefebvre (pers. comm. 2019). Images are available on the GRM website.

Comparative morphology

Characters were examined on 95 specimens in **BM**, **CGE**, **E** and **NMW**, comprising 60 *H. prenanthoides* and 35 *H. lanceolatum* specimens of which 54 were from Britain and 41 from Europe. The numbers of specimens of each group examined was primarily determined by the availability of good specimens, and very little material of *H. lanceolatum* was available from Britain where it is rare.

Table 2. Characters separating *H. prenanthoides* and *H. lanceolatum* in Britain (Sell & Murrell 2006).

Character	***Hieracium prenanthoides***	***Hieracium lanceolatum***
Stem	40-100 cm	40-70 cm
Number of stem leaves	12-30	(Not stated)
Upper leaf shape	Lanceolate, narrowly elliptical, oblong-lanceolate and ovate	Lanceolate, ovate or elliptical
Leaf margins	Entire to denticulate, sometimes with a few large teeth	Entire to remotely denticulate
Leaf base	Cordate-semiamplexicaul	Auriculate-amplexicaul
Simple hairs on peduncles	Sometimes an occasional simple hair	Numerous
Involucre length	3-10 mm	3-10 mm
Involucral bract width	0.8-1.3	1.0-1.5 mm
Involucral bract colour	Dark olive green	Blackish
Simple hairs on involucral bracts	Sometimes an occasional simple hair	Few to numerous

It was evident from examination of herbarium material that the stem height was very variable and the poor pressing of many specimens meant that leaf shape was too hard to quantify consistently, so the following characters were selected from the characters from Tabs. 1 and 2 and scored:

1. Number of stem leaves including withered leaves or leaf scars at the base of the stem and bracts in the synflorescences. Specimens were selected as far as possible as those with a complete stem; where lower stems were missing the number of leaves was excluded from some analyses.
2. Toothing of middle stem leaves (0=entire, 1 = denticulate, 2 serrate).
3. Length of middle stem leaf auricle as a measure of how clasping the stem leaves were (measured as length from the node, though this was not easy to assess on some pressed leaves).
4. Presence of simple hairs on peduncles on a quantitative five-point scale (0=absent, 1 = rare, 2 = occasional, 3 = frequent, 4 = numerous).
5. Length of involucral bracts (mm, measured from base of the capitulum to tip of longest bracts; cf. Sell & Murrell 2006).
6. Average width of three broadest bracts (mm) using a micrometre eyepiece with 0.1 mm intervals.
7. Presence of simple hairs on bracts on a quantitative five-point scale (0=absent, 1 = rare, 2 = occasional, 3 = frequent, 4 = numerous).

The data were analysed in Excel, though the analysis was somewhat unsatisfactory due to the small sample sizes of British *H. lanceolatum* and European *H.*

prenanthoides. Principal Components Analyses (PCA) were carried out using PAST3 (Hammer *et al.* 2001)

Field surveys
Field work in August 2016 and August 2019 was targeted on Fortingall, Inverey and Braemar where *H. lanceolatum* had been reported. The Dess locality was not visited. Fresh plants at these three sites were compared with fresh *H. prenanthoides* at five sites elsewhere.

Cultivation
Plants of *H. lanceolatum* from Braemar with simple hairs on the peduncles and bracts and *H. prenanthoides* from Tarren-yr-Esgob (v.c.42) without simple hairs were grown from seed side by side in a garden in Cardiff 2016-2019.

Results

Original material
Villars' herbarium is housed at Muséum d'Histoire Naturelle de Grenoble (**GRM**) and contains original material of both *H. prenanthoides* and *H. lanceolatum* (pers. comm., M. Lefebvre 2019). As there is only one sheet of each species labelled in Villars' handwriting, these can be regarded as holotypes.

The one sheet of *H. prenanthoides* (ref. MHNGr.1837.27515) has a small left-hand label "*Hieracium prenanthoides* V./ Lans [=Lans en Vercors]". The sheet has three specimens showing the numerous stem leaves (one specimen has up to 24 stem leaves and is up to 60 cm tall) with strongly auricled, clasping bases, and branched inflorescences, and only glandular hairs on the peduncles. A visual comparison of British *H. prenanthoides* specimens gives a reasonable match against Villars' material.

The one sheet of *H. lanceolatum* (MHNGr.1837.27531) has two specimens; the left-hand specimen, composed of a lower stem part and an upper stem part, has a label "Barcelonette *Hierac. lanceolatum*". The specimen is somewhat damaged and has lost all the capitula but is about 60 cm tall with an estimated 15 stem leaves which are weakly serrate, oblong-lanceolate and have small auricles, and there are mixed frequent simple and abundant glandular hairs on the few remaining peduncles. The right-hand specimen is from Auguste Mutel's herbarium replacing a plant from Villars' herbarium and is *H. umbellatum* L. (redetermined by P. Mraz in 2001); it is not original material.

A comparison of British *H. lanceolatum* with Villars' original *H. lanceolatum* material is less clear due to the damaged original specimen. The Braemar plants named as *H. lanceolatum* (by P. D. Sell in **CGE** or by D. McCosh in **BM**) have elliptic-oblong to elliptic-lanceolate leaves which are denticulate (rarely serrate) and strongly clasping at the base with involucres mostly 8-9 mm long and thus show a poor match with the original descriptions and material other than in having many simple hairs in the inflorescence, and they have mid-brown seeds rather than grey seeds (grey seeds may be present in immature fruiting heads). The Braemar plants are a good match for the detailed description of *H. lanceolatum* by Sell & Murrell (2006) as expected as the description is largely based on that material.

Comparative morphology

The morphological data are summarised in Table 3.

Table 3. Summary of characters of herbarium material of *H. prenanthoides* and *H. lanceolatum*. The data are averages with ranges.

Character	*H. prenanthoides* Europe (n=10)	*H. prenanthoides* Britain (n=50)	*H. lanceolatum* Europe (n=31)	*H. lanceolatum* Britain (n=4)
1. No. stem leaves	13.3 (range 5-24)	19.8 (range 10-30)	16.7 (range 9-27)	17.3 (range 14-23)
2. Length auricle (mm)	2.2 (range 0-6)	2.8 (range 1-6)	1.8 (range 0-5)	3.3 (range 3-4)
3. Leaf toothing	1.1 (range 1-2)	1 (range 1)	1.2 (range 1-2)	1.3 (range 1-2)
4. Simple hairs on peduncles	0.9 (range 0-3)	1.9 (range 0-4)	1.7 (range 0-4)	3 (range 3)
5. Involucral length (mm)	9.7 (range 9-11)	9.3 (range 8-11)	9.4 (range 8-11)	8.8 (range 8-9)
6. Involucral bract width (mm)	1.3 (range 1.2-1.5)	1.2 (range 0.8-1.5)	1.2 (range 0.9-1.5)	1.5 (range 1.3-1.6)
7. Simple hairs on involucral bracts	0.7 (range 0-3)	1.6 (range 0-4)	2.1 (range 0-4)	3 (range 3)

The number of stem leaves is variable within each group and overlaps completely. In Europe the leaf bases have slightly less clasping auricles in *H. lanceolatum* than in *H. prenanthoides* but the differences are not significant (T test, p= 0.56) and overall the auricles are on average about a millimetre longer in all British material than all European material (T test, p=0.0026).

The leaf toothing was variable and hard to quantify objectively, but European material of *H. lanceolatum* was often more noticeably toothed than European *H. prenanthoides* and certainly than any British material of either species (T test, p=0.01). The Braemar material of *H. lanceolatum* was only weakly toothed.

In *H. lanceolatum* there were generally more specimens with at least some simple hairs on the peduncles (24/31=77%) than in *H. prenanthoides* (4/11=36%) but overall there is no difference between in the overall amount of hairs on European material alone (T test, p=0.10) or all material (T test, p=0.78).

Involucre length shows complete overlap with no significant differences between European material alone (T test, p=0.28) or all material (T test, p=0.56) and the measurements for European material exceed the ranges for both species (cf. Table 1).

Involucral bract width shows no difference for European material alone (T test, p=0.27) but is different when all material is included (T test, p=0.009) as all British

material compared with all European material of both species is significantly wider (T test, p=0.02).

In *H. lanceolatum* there were more specimens with more simple hairs on the bracts than in *H. prenanthoides* in European material alone (T test, p=0.002) and for all material (T test, p=0.004). However, one of the surprises in the analysis of herbarium material was the number of specimens of British *H. prenanthoides* with at least some simple hairs on the peduncles (84%) or bracts (80%), or more hairy ones with frequent to numerous simple hairs on the peduncles (45%) and bracts (20%). The quantity of simple hairs on the peduncles is highly correlated with the quantity of simple hairs on the bracts (r=0.02; p<0.001). Specimens with at least frequent to numerous hairs were widespread throughout the range of *H. prenanthoides* in Britain including Craig Cerrig-gleisiad (v.c.42), Hawes (v.c.64), Ettrick Bridge (v.c.79), Rose Cleuch (v.c.83), Glen Buckie (v.c.87), Allt Breaclaich, Glen Lochay, Glen Lyon, Killin and Strathfillan (v.c.88), Kindrogan and River Garry (v.c.89), Auchallater, Braemar and River Clunie, Inverey and Potarch Bridge (v.c.92).

For all British material of *H. prenanthoides* and *H. lanceolatum,* there was no correlation between the bract width and quantity of simple hairs on the peduncles (r=0.02; p>0.1) or on the bracts (r=0.09; p>0.1), showing no relationship between the character combination used in the key of Sell & Murrell (2006).

A multivariate Principal Components Analysis (PCA) was carried out on all data to see if any overall patterns could be discerned in the data. An initial analysis of all data showed Component 1 was dominated by the number of stem leaves which accounted for 84% of the variation resulting in complete overlap amongst all group. As this character was also rejected as useful from data in Table 3, it was dropped from subsequent analyses. When only European material was analysed using the remaining six characters (Fig. 1), *H. prenanthoides* and *H. lanceolatum* were weakly separated with all characters except auricle length contributing to Component 1 (30%) and involucre length and the amount of simple hairs on the bracts and peduncles contributing to Component 2 (22%).

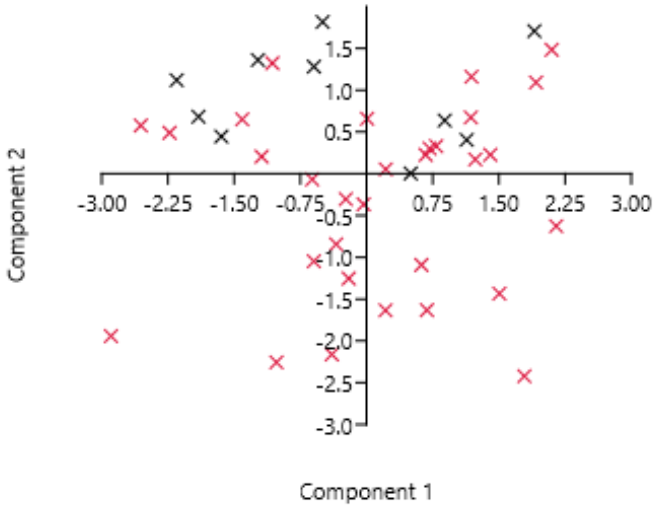

Figure 1. PCA of European *H. prenanthoides* (x) and European *H. lanceolatum* (x) using characters 2-6 from Table 3.

When all material was analysed (Fig. 2), there is overlap between all of the groups, the amount of simple hairs on the bracts and peduncles contributing to Component 1 (47%) and bract width to Component 2 (22%).

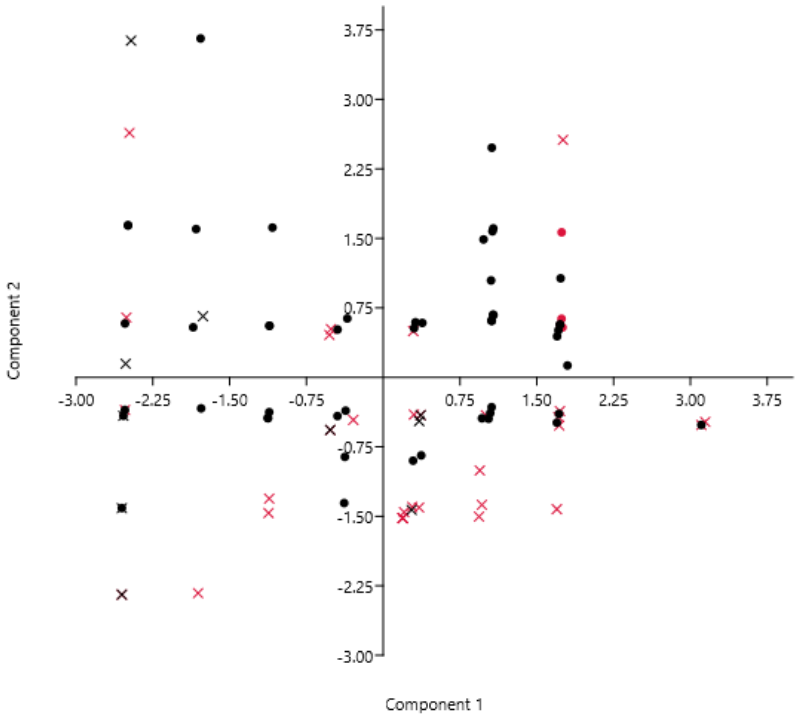

Figure 2. PCA of European *H. prenanthoides* (x), British *H. prenanthoides* (•), European *H. lanceolatum* (x) and British *H. lanceolatum* (•) using characters 2-6 from Table 3.

Field surveys

Plants at the three sites where *H. lanceolatum* had been reported were compared with *H. prenanthoides* from elsewhere; other than the plants having many simple hairs on the peduncles and bracts the plants otherwise matched *H. prenanthoides.* Bract colour in both ranged from dark green in more shaded conditions to blackish in the open. The seeds, where ripe, were all pale chestnut brown.

Cultivation

Both collections in cultivation grown from seed retained the hairs characters on the peduncles and bracts that they had shown in the wild.

Discussion

Examination of the European material indicates *H. prenanthoides* and *H. lanceolatum* are different if variable taxa, differing in degree of toothing, leaf shape and development of auricles, but the small samples do not show significant differences in involucre length. The European material of *H. prenanthoides* and *H. lanceolatum* seen in herbaria is quite varied and, in both cases, may be better treated at the group levels of Zahn (1922) rather than his more closely circumscribed subspecies. A revision of this section across Europe would be beneficial but is unlikely to change the conclusions for *H. lanceolatum* in Britain in this paper.

With the exception of having many simple hairs in the inflorescence and achene colour, the Braemar plants named as *H. lanceolatum* were a poor match with the original descriptions and material of *H. lanceolatum* and fit *H. prenanthoides* better. The simple hairs in the inflorescence character was not cited by either Villars (1788) or Zahn (1922) to separate *H. lanceolatum* from *H. prenanthoides* though simple hairs are present in the inflorescence present in the original material of *H. lanceolatum.* The presence of simple hairs in the inflorescence was used by Sell & Murrell (2006) to characterise *H. lanceolatum* and appears to be unique to the British interpretation. Plants with simple hairs in the inflorescence are scattered throughout the range of *H. prenanthoides* in Britain and also occur in Europe, and the occurrence of simple hairs in the inflorescence is not correlated with other characters. It is therefore concluded that *H. lanceolatum* does not occur in Britain and that all plants previously reported as *H. lanceolatum* belong to *H. prenanthoides*. Pugsley (1948) noted simple hairs occurred on both the peduncles and bracts of *H. prenanthoides*, and rejected the occurrence of *H. lanceolatum* noting plants were typical *H. prenanthoides;* I agree with his interpretation.

Compared to many other *Hieracium* clones/species, *H. prenanthoides* in Britain is also quite variable, especially in terms of size, branching and leaf shape and hair clothing. The stems have many simple hairs, particularly below, and casual observation indicates the occurrence of simple hairs in the inflorescence is related to hairiness of the rest of the plants though this has not been formally quantified. British *H. prenanthoides* were assumed to be apomictic by Sell & Murrell (2006) and stated as such, but further experiments are required to verify this properly (e.g. Kocián 2013); the cultivation of two clones from different sites which retained their original characters indicates this is very likely.

Chrtek et al. (2020) note that across its range *H. prenanthoides* consists of a morphologically rather invariant diploid cytotype, and morphologically extraordinarily variable triploid and tetraploid cytotypes most of which are of allopolyploid origin. The British *H. prenanthoides* material analysed morphologically here was found to have slightly longer auricles and broader bracts than European material which may, with further study, merit taxonomic recognition in its own right.

The elimination of *H. lanceolatum* as a British species is yet another example of European or Scandinavian species reported for Britain being rejected when careful comparisons are made (e.g. *H. carpathicum* Besser, Rich & Scott, 2011; *H. dovrense* Fr., Rich, 2011; 12 Scandinavian taxa, Tyler, 2014, McCosh, 2015).

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