Evolution of the American *Hieracium* subgenus *Chionoracium*

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The rather little explored American *Hieracium* subgenus *Chionoracium* is distributed from Alaska to Patagonia and consists of approx. 150 species all of which are diploid sexuals as far as known. We investigated their relationships using two non-coding chloroplast intergenic spacers (*trnT-trnL* and *trnV-ndhC*) and the nuclear ribosomal external transcribed spacer (ETS). Previous analyses that included only a few taxa suggested that *Chionoracium* nests within *Hieracium* s.str., but the resolution of the markers (*trnT-L*, *matK* and ITS) used in that study was relatively low.

TrnV-ndhC was more variable and also longer than *trnT-trnL*, and combined analyses of both cpDNA regions provided relatively high resolution. These results suggest that subgenus *Chionoracium* is monophyletic and nests near the base of several *Hieracium* s.str. lineages, i.e., none of the present-day *Hieracium* subgen. *Hieracium* taxa show particular affinities to the American lineage. Monophyly in the cpDNA tree may suggest a single introduction of the ancestral taxon into the New World with subsequent speciation and colonization of the entire continent.

The ETS tree revealed that *Chionoracium* is derived from the 'Eastern' clade of *Hieracium* s.str. species. This fits to the relatively high genome size of three *Chionoracium* taxa analyzed so far. Interestingly, two *Chionoracium* lineages were found in the ETS tree, which reflect the disjunct distribution of *Chionoracium* in North America fairly well. One of these lineages consisted of species endemic to NW America (Alaska to California) whereas the other comprised the rest of the analyzed taxa. The two lineages insert at the base of the 'Eastern' clade suggesting early rapid speciation from an 'Eastern' *Hieracium* ancestor, comparable to the lineages of *Hieracium* s.str. taxa that belong to this clade. The colonization of North America by *H. umbellatum* / *H. canadense* occurred independently.

Both datasets are partly congruent with respect to species relationships. Almost all South American species are apparently derived from Central American species and from taxa endemic to southern North America, with the exception of *H. antarcticum* (Patagonia). This species clusters with *H. gracile* and *H. triste* (both from Alaska / NW North America) in accordance with taxonomic treatments. One possibility for this disjunct distribution is long-distance dispersal via migratory birds. Particularly close relationships and relatively late speciation events were found for the South American radiation (except *H. antarcticum*) and for three, mainly NW American taxa (*H. albiflorum*, *H. bolanderi*, and *H. argutum*); according to cpDNA, the latter lineage may be derived from species occurring mostly in eastern North America. Some discrepancies between the ETS and cpDNA trees are not readily explained and may reflect a complex speciation history of which maternally and biparentally inherited markers reveal different aspects.

A denser taxon sampling and more molecular markers may provide better insight into *Chionoracium* species relationships and colonization events.

Biometrical approach to the genus *Andryala* L. (Asteraceae)

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A biometrical approach to the genus *Andryala* L. (Asteraceae) is presented. Taxonomic and nomenclatural aspects are discussed. Studied plants include taxa from Macaronesia, Iberian Peninsula and North Africa. The taxonomic characters' variability was revised based on the study of herbarium specimens from different herbaria and specimens collected during field work (2005-2010). Character selection resulted from protologue analysis of all described taxa complemented with other taxonomically informative works. Macroscopic analysis and photography were performed with a binocular microscope Zeiss model SV 11 APO. Microcharacters were photographed using a Scanning Microscope (JEOL-TSM T330A). The numerical analysis was performed with different similarity or dissimilarity measures and coefficients. The ordination methods applied included PCA and PCoA, and the cluster analysis method used was UPGMA.

Taxonomic and nomenclatural studies support the proposal of two new combinations: *A. tenuifolia* (Tin.) DC. ssp. *arenaria* (DC.) Z. Fer., I. Álvarez, M. Seq. and *A. tenuifolia* (Tin.) DC. ssp. *cossyrensis* (Guss.) Z. Fer., I. Álvarez, M. Seq. Furthermore, according to these studies, A. *laxiflora* (Salzm.) DC. is the homotypic synonym of *A. rothia* Pers., although *A. rothia* Pers. is often referred to as the basionym of *A. arenaria* (DC.) Boiss. et Reut. by different authors. Numerical analysis based on qualitative (binary and multistate) and quantitative characters support the distinction of at least 24 taxa, and the coherence of the different methods was used for the delimitation of these taxa. These comprise a new Canary endemism (*Andryala perezii* Z. Fer., M. Seq., R. Jardim & Álvarez Fernández) along with at least three endemic taxa included in *A. pinnatifida* Aiton from the Canary Islands, four endemic taxa from Madeira (*Andryala crithmifolia* Aiton with two varieties and *Andryala glandulosa* Lam. with two subspecies), seven endemics from North Africa, and nine taxa mostly common to Europe and North Africa.

Keywords: biosystematics; taxonomy; numerical analysis

Phylogeography of the species *Hieracium intybaceum* L.

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Hieracium intybaceum (Asteraceae) is a well-defined species that grows only on silicate rocks in high altitudes in the Alps, Vosges and Schwarzwald Mts. Though traditionally recognised as a part of genus *Hieracium* (subgenus *Hieracium*), molecular data suggest an older isolated lineage.

We have collected 43 populations throughout the Alps and one population from an outlying locality in the Vosges Mts. Surprisingly, diploid sexual and allogamous plants prevail. Tetraploid populations seem to be confined to the western Alps and the Vosges Mts. This distribution pattern of cytotypes is in conflict with most phylogeographic studies in the Alps. Previously published triploid plants have not been found so far.

AFLP molecular data revealed a very low variation among diploid populations and high variation between ploidy levels. The latter might indicate an allopolyploid origin of the tetraploid plants. For final conclusions, more tetraploid populations will have to be sampled.

Cytotype and genetic variation of *Pilosella echioides* (Asteraceae) in Central Europe

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Pilosella echioides is a perennial, predominantly sexual and self-incompatible herbaceous plant distributed in Central and Eastern Europe and in steppe regions of Asia. Five ploidy levels have been previously discovered in Central Europe, namely 2x, 3x, 4x, 5x and 6x, and several mixed-ploidy populations have been found.

Principal objectives of the present study were to elucidate the distribution of particular cytotypes (i) in Europe (large-scale pattern), and (ii) in a model area with previously detected mixed-ploidy populations in SW Moravia and the adjacent part of Lower Austria (small-scale pattern), and to detect the pattern of genetic variation with respect to geography and ploidy level.

Diploid populations seem to prevail throughout Europe; mixed ploidy populations with two to four intermingled sexual cytotypes (2x, 3x, 4x, 5x) occur in the Czech Republic and Lower Austria. Populations consisting exclusively of tetraploid apomictic plants were discovered in northern Hungary and southern Slovakia (Danube Basin); their taxonomic position is still unclear. Besides, sexual tetraploids were found in NW Hungary. A detailed survey of mixed-ploidy populations at the Havraníky heathland (SW Moravia, Czech Republic) and adjacent areas revealed a common co-occurrence of up to four cytotypes (2x, 3x, 4x and 5x) even at a fine spatial scale (several square centimetres).

AFLP data for the complete data set (Central Europe) did not show a clear structure with respect to both geographic provenience and ploidy level. However, some geographic structure was found in SW Moravia and the adjacent part of Lower Austria. The low genetic differentiation can be explained by rather recent fragmentation of the former geographic range (it is supposed that *P. echioides* was a common species in the periods with steppe vegetation in Central Europe) and/or gene flow between populations. A close relationships between di- and polyploids supports the hypothesis of autopolyploid origin of the higher ploidy levels. A detailed study of population dynamics of mixed-ploidy populations in SW Moravia is now in progress.

Hieracium section *Alpestria* in Britain

Tim C. G. Rich & Walter Scott

Hieracium section *Alpestria* is represented in Britain by 21 species. An illustrated monograph has been prepared based on the existing taxonomy of Sell & Murrell (2006) with the revision of two species – *H. carpathicum* from central Scotland was found to be a distinct species *H. perthense*, and NW Scottish *H. dovrense* is recognised as a new species, *H. maccoshiana*. Many species are rare and threatened with extinction.

The monograph will be published by the Botanical Society of the British Isles in association with National Museum Wales in summer 2011.

Hieracium sect. *Oreadea* (Asteraceae) in Sweden

Torbjörn Tyler

Abstract of publication (Nordic Journal of Botany, in press 2011)

Among Swedish *Hieracium* sect. *Oreadea* (Fr.) Arv.-Touv., more than 100 taxa have been recognized by various experts but, except for a regional monograph from 1894 there are no thorough revisions of the group published and many of the names used have never been validly published. At the same time, some of the oldest names have been variously applied to morphologically clearly different species. In the present study, 5000 specimens in Swedish herbaria have been revised using both traditional and statistical morphometric methods and the complicated nomenclature has been disentangled. Twentyeight species are recognized and described with diagnostic keys and illustrations aiding identification and their known distributions are mapped. Six species are described as new to science (viz. *H. marinum* T. Tyler, *H. eulasium* Dahlst. ex T. Tyler, *H. victoriae* T. Tyler, *H. falcifolium* Johanss. ex T. Tyler, *H. guldbergense* Folin ex T. Tyler and *H. hispidosum* Dahlst. ex T. Tyler) and 3 additional names are raised to the specific rank (viz. *H. gigantocybe* (Dahlst.) T. Tyler, *H. hilare* (Dahlst. ex Omang) T. Tyler and *H. tanyphyllum* (Dahlst. ex Zahn) T. Tyler). Lectotypes are designated for 50 names based on material from Sweden, Norway or Finland and one name is neotypified. Except for a few infraspecific names for which all original material appear to be lost, all names based on material from Sweden are typified. However, it is concluded that albeit the number of taxa is relatively low, the species of *H.* sect. *Oreadea* are morphologically less distinct and clear-cut than those of other widespread Scandinavian sections of the genus. Many of the characters that are most important in other sections of the genus are either invariable or unreliable in *H.* sect. *Oreadea*. Thus, the taxonomy has to rely on characters more subjected to environmentally-induced modification. Further, members of this section exhibit great morphological plasticity, possibly connected to their preference for exposed rocky habitats where the environmental conditions may be both severe and unpredictable. In addition, due to their ecological demands, they are confined to habitats that have always been both strongly fragmented and restricted in size giving rise to multiple small and locally adapted local populations. The section is here circumscribed in agreement with previous Scandinavian authors, i.e. including both the *H. schmidtii*-group sometimes referred to *H.* sect. *Stelligera* and the *H. norvegicum* group approaching *H.* sect. *Tridentata*, but it is concluded that the section is relatively heterogeneous and that further studies aiming at the identification of more natural supraspecific taxa are much needed.

Recent molecular results (not included in the publication)

- Most species are triploid, but *H. eulasium* and *H. extensum* (both local endemics intermediate between *schmidtii*/*Stelligera* and *saxifragum*/*Oreadea*) are tetraploid.
- Most species have cp-haplotypes of 'group V' shared with e.g. *H. umbellatum* and sect. *Vulgata* spp., but *H. eulasium* and *H. extensum* have haplotypes of group 'H' shared with sectt. *Hieracium*/*Bifida* spp. and *H. crinellum* (a typical member of *schmidtii*/*Stelligera*) have a unique variant of group 'H'.
- Based on nuclear microsatellite analysis, multiple samples of each of *H. lindebergii, H. latifrons, H. saxifragum, H. crinellum, H. lythrodes, H. eulasium* and *H. lecanodes* form well-defined clusters, whereas samples of the widespread and morphologically variable *H. extensiforme* and *H. anodon* form an unresolved/paraphyletic basal mess/cluster/grade/matrix.

General conclusions

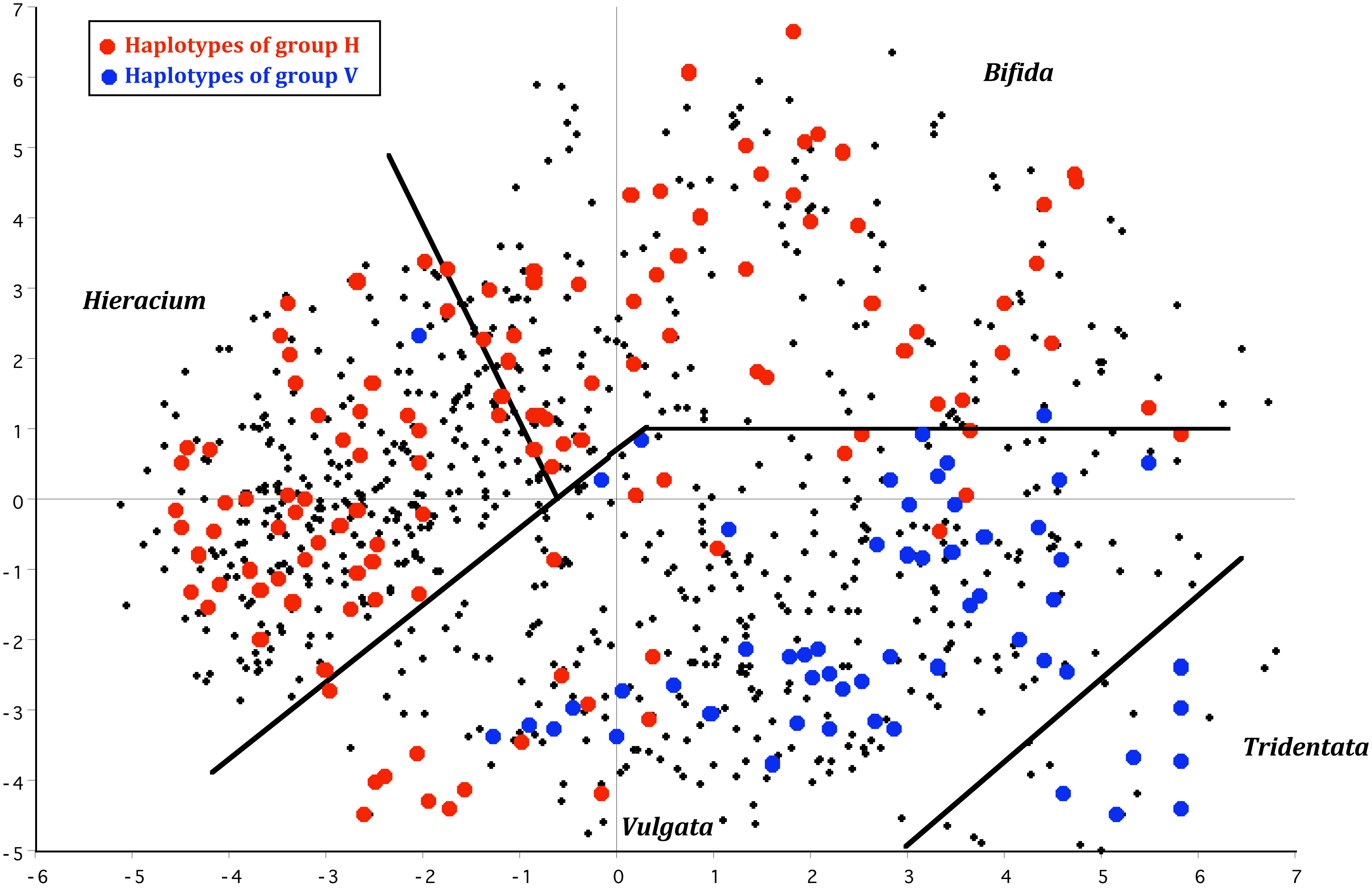
- It is possible (though difficult) to identify a relatively low number of local and regional species based on unorthodox morthological characters, and these species appear to be supported in analysis of molecular/cytological data.
- However, the two most common and widespread species are highly problematic and may possibly represent the basal/old variation from which the other species have evolved.
- Morphological and chloroplast data support the recognition of at least two sections *Stelligera* and *Oreadea* in Sweden, but apart from the most typical representatives more work is needed to find out which species belong where.

Atlas of British and Irish Hawkweeds (*Pilosella* Hill and *Hieracium* L.)

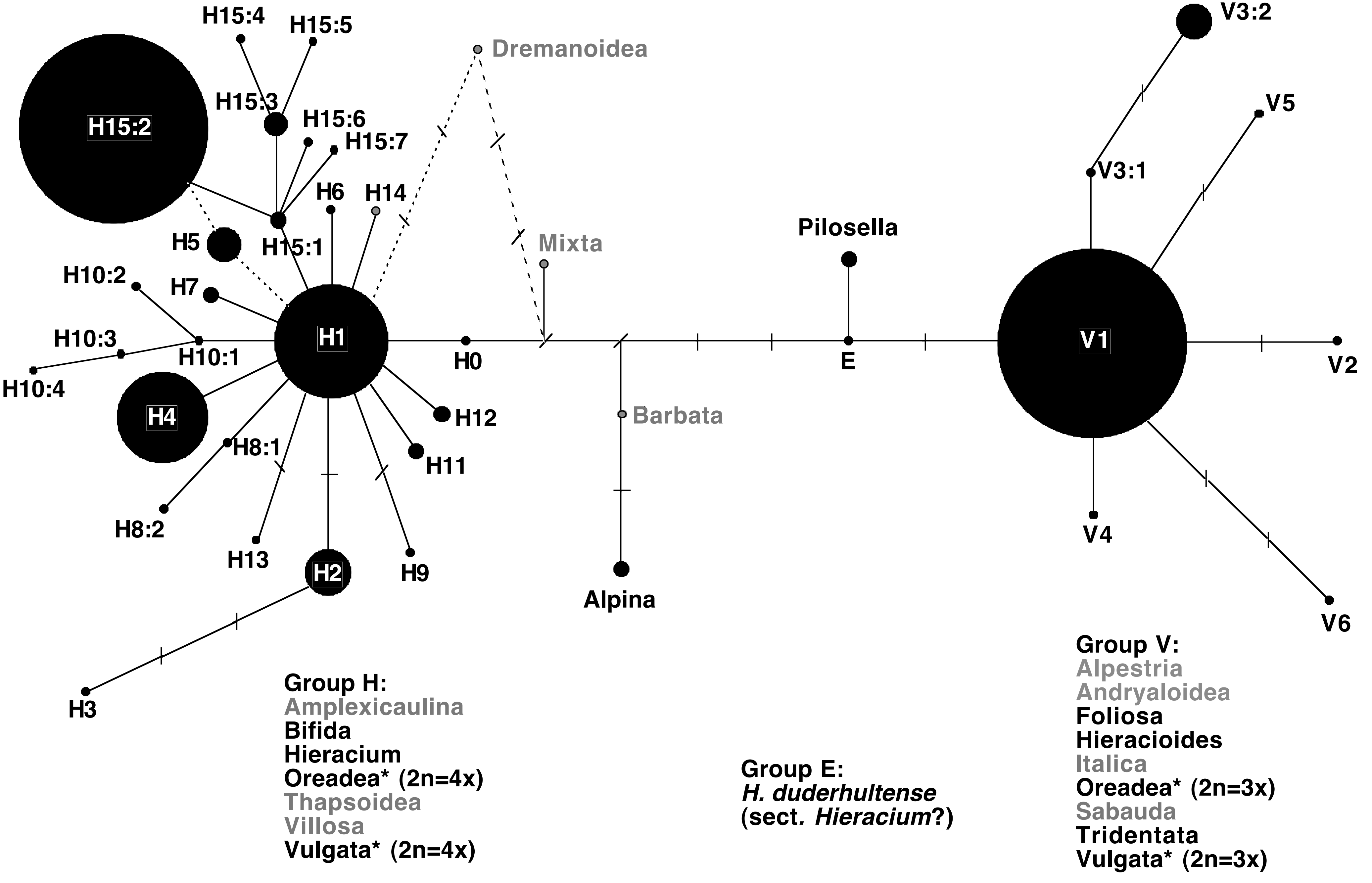
Tim C. G. Rich & David J. McCosh

Over the last 30 years, David McCosh has compiled a database of c. 19000 *Hieracium* and *Pilosella* records representing over 420 species as defined in the latest revision of *Hieracium* in Peter Sell and Gina Murrell's *Flora of Great Britain and Ireland* (2006). The database has been used to produce maps of all the species showing the current situation, significantly updating and revising the last set of *Hieracium* maps published in the *Critical Supplement to the Atlas of the British flora* (1968). The new maps have just been published (June 2011) with brief notes and a representative silhouette of each species to provide an invaluable reference source for botanists and conservationists.

The maps were published by the Botanical Society of the British Isles in association with National Museum Wales.

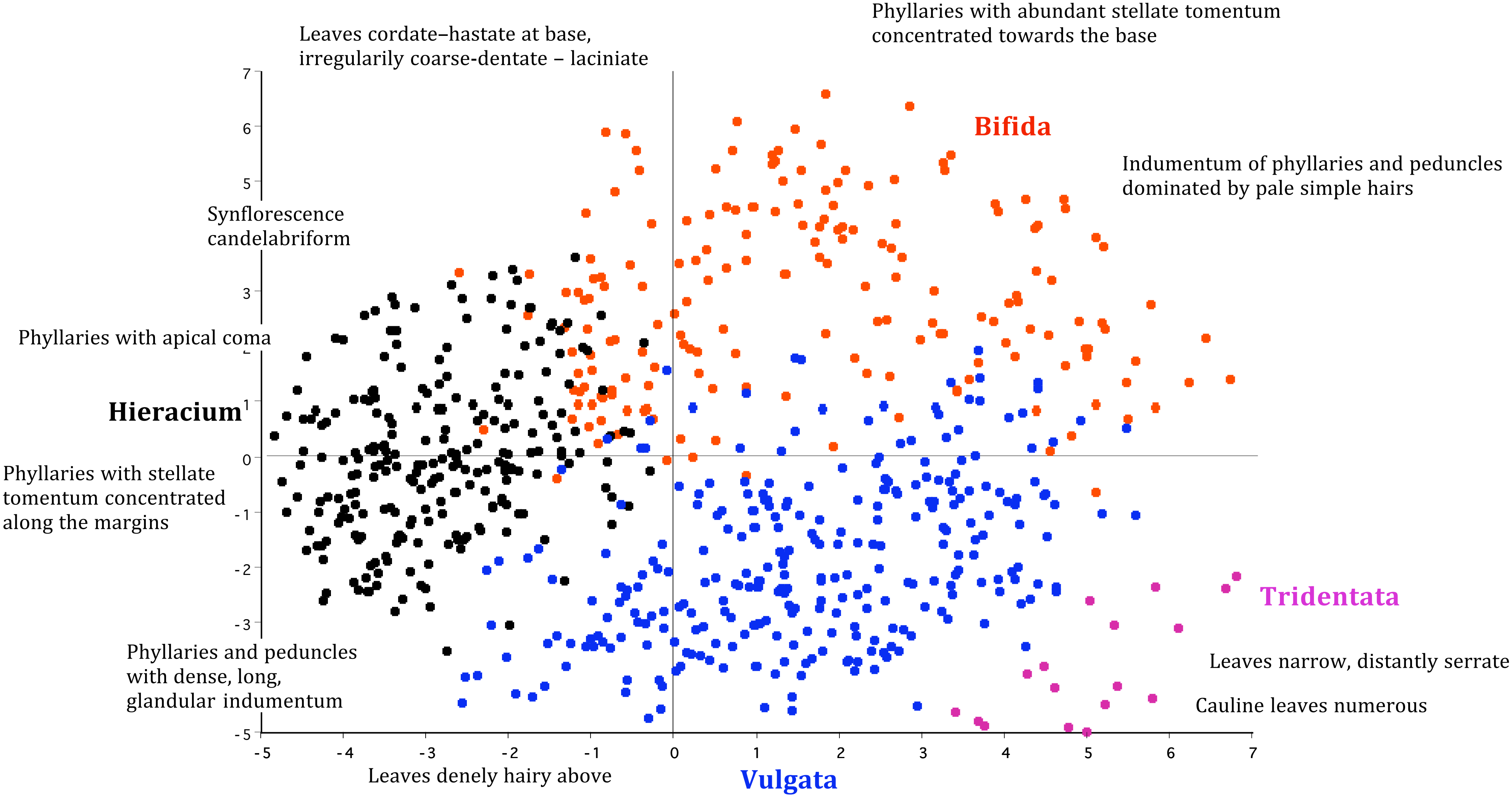


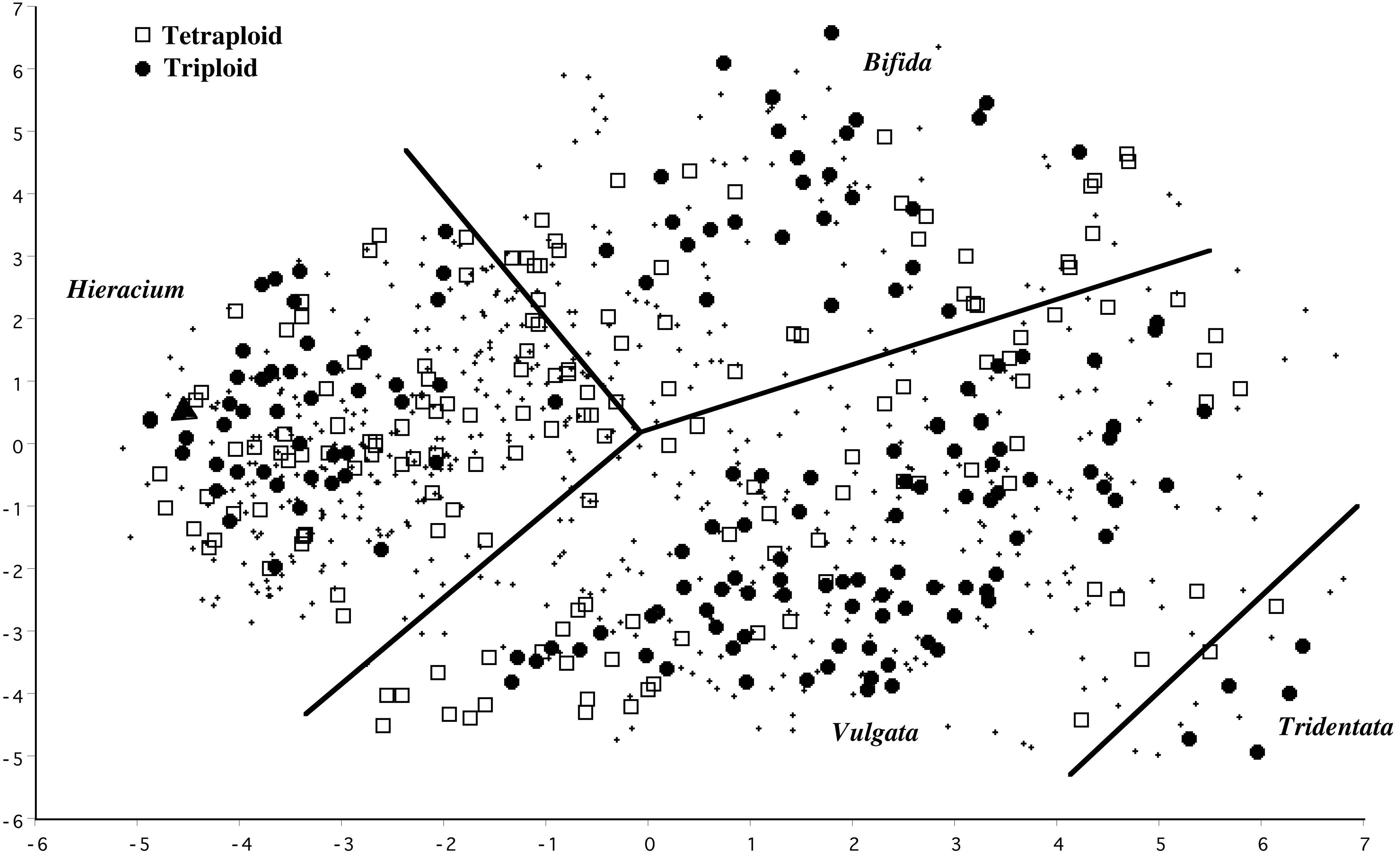
Distribution of the two main groups of chloroplast haplotypes among Swedish microspecies of *Hieracium* sectt. *Bifida, Hieracium, Vulgata* and *Tridentata* plotted onto a PCA scatterplot based 47 independent morphological characters.
– All typical members of sectt. *Tridentata* and *Vulgata* contain haplotypes of ’group V’, whereas all members of sectt. *Bifida* and *Hieracium* have haplotypes of ’group H’. Species intermediate between the sections, incl. the *H. diaphanoides* agg. (with growth-form of *Vulgata* but indumentum as in *Hieracium*), generally have haplotypes of group H (and are all tetraploid).
(Tyler, T. & Jönsson, J., unpublished data 2011-06-10.)



Most parsimonious network of chloroplast (*atp*B–*rbc*L spacer, 1243 bp, 54 variable sites) haplotypes (with some ambiguity within group H due to incomplete sequences) revealed within Swedish (black) and non-Swedish (grey) microspecies (and sections) of *Hieracium.* The size of the circles is approx. proportional to the number of microspecies documented. One step along the branches in the network corresponds to one evolutionary event (substitution or insertion/deletion). Missing haplotypes are indicated as ticks on the branches. The general topology is fully congruent with that of Fehrer et al. (2009) based on *trn*T–*trn*L sequences. (Tyler, T. & Jönsson, J., unpublished data 2011-06-10).

Overview of the pattern of morphological variation in Swedish microspecies of *Hieracium* sectt. *Bifida, Hieracium, Tridentata* and *Vulgata*. (Simplified from a PCA based on 47 independent characters, with the most influential characters as well as the current classification of the species indicated.) (Based on: **Tyler, T.** 2006: Patterns of morphometric variation and a new supraspecific classification of apomictic taxa of *Hieracium* (Asteraceae) from Denmark and southern Sweden. *Plant. Syst. Evol.* 261: 39–88., supplemented with unpublished data and characters 2011-06-10)..





Ploidy level of individual Swedish microspecies of *Hieracium* sectt. *Bifida, Hieracium, Vulgata* and *Tridentata* plotted onto a PCA scatterplot based 47 independent morphological characters.

– NB that species morphologically intermediate between the sections tend to be tetraploid whereas ”typical” members of the sections are mainly triploid. (Modified from Tyler, T. & Jönsson, J. 2009. Ploidy analysis of apomicic *Hieracium* (Asteraceae) reveal unexpected patterns and variation. *Nord. J. Botany 27*: 490–502.)