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## Iconography of the Genus *Hieracium* in central Europe – Part 1 General Description and Morphotypes

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### Abstract

The genus *Hieracium* comprises more than one thousand sexual and apomictic species in Europe, with numerous intermediates and microspecies. Only a small fraction of the members of the genus *Hieracium* has been illustrated or photo-documented in the literature. Since many of these publications are difficult to obtain, only a few specialists are familiar with most of the species and subspecies described in the literature. In order to overcome this problem and encourage geobotanical research on the genus *Hieracium*, we decided to edit an iconography of central and southern European Hieracia in an electronical journal (Forum geobotanicum) with free international access through the internet. Part I of this endeavour contains descriptions and photographs of the morphological spectrum of the genus *Hieracium*. Here, we categorize the genus into 15 basic morphotypes. These types conform partly to the sections and subsections of the genus *Hieracium*, but are in some cases informal and may even include members of different sections. Classification of morphotypes is considered helpful to obtain a first rough picture of an unknown species that then can be traced to the species and subspecies level by using keys or, after completion of this iconography, simply by screening the relevant images. One particularly novel aspect of the present endeavour will be the regular inclusion of magnified images and scanning electron micrographs.

### Keywords

*Hieracium*, iconography, classification, scanning electron micrographs

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### Introduction

According to Wagenitz (1996) an iconography is defined as “Abbildungswerk, in der Botanik ein Buch, das die Arten einer Gattung, Familie oder auch eines Gebietes in Abbildungen (ohne oder mit kurzem Text) darstellt“ [an illustrated work, in botany mainly a book, which illustrates species of a genus, family or a certain geographical area, with or without accompanying text]. The first known botanical iconographies date back to ancient Greece. The most important example of these early iconographies is the magnificently illuminated work of the Viennese Dioscorides, originally created by the Cilician physician Dioscorides Pedanios (1<sup>st</sup> century A.D.) as a book of medicinal plants entitled “De Materia Medica” (Mazal 1981). This ancestral work had a strong influence on following books on herbs and medicinal plants in later centuries which during the Renaissance gave rise to the development of scientific botany. In the early days of scientific botany, illustrations of plants remained the main source for unequivocal determination of species. Botanical terminology became increasingly important as artists began to reproduce plants true to life, thereby becoming aware of new structural details that required definition by new terms. Even after development of a sophisticated Latin botanical terminology by Jungius (1678), Linnaeus (1751), de Candolle (1813), Bischoff (1830-44) and others, illustrations of plants remained important for the precise description of all the detailed morphological information difficult to put into words. Latin descriptions accompanied by illustrations or photographs of plants continue to the present day to be basic requirements for valid publication of new taxa. The human brain has a limited capacity to create a realistic view of a given complicated structure (i.e. a plant) from textual descriptions. By contrast, the linear and three-dimensional information provided by an image of the same structure allows an immediate and realistic understanding of its complex habit and morphology, characteristics that are difficult and to some extent impossible to describe.

Until recently, the publication of iconographies depicting complicated plant genera and families was hampered by the rather high publishing costs dictated by the limited demand from specialists interested in this field. Exceptions are several well illustrated guides to orchids, medicinal plants and attractive geographical areas that enjoy a more general interest by the public.

During the past several years, the situation has been profoundly changed by development of digital cameras and high resolution scanners. These new technologies offer the opportunity to electronically publish iconographies of notoriously difficult genera, circumventing both the high costs and the limited access to printing media. In view of these fascinating new possibilities, we decided to take advantage of an electronic journal to publish a comprehensive iconography of central and southern European Hieracia with free access through the Internet.

In central Europe, the genus *Hieracium* comprises more than one thousand sexual and apomictic species with numerous intermediates and microspecies. Only a small fraction of all these species has ever been illustrated, and this has taken place mainly in the form of scattered articles in journals that are often difficult to access. There are only few scientific books and book series that illustrate a greater number of central European Hieracia, mostly focused on smaller regions (Reichenbach, 1858-60; Fiori & Paoletti, 1904; Murr et al., 1906-11; Bonnier, 1924; Hegi, 1929, 1987; Hess et al., 1972; Rothmaler, 1988; Schou, 2001). The genus *Hieracium* is not well represented in most photographic guides to the central European flora (Aeschimann et al., 2004). The only exception is the richly illustrated part of the German flora (Gottschlich in Haeupler & Muer, 2000). But even this book has its limitations, because in most cases the space available did not allow the depiction of structural details (particularly of the indumentum) which are required for precise determination of most species. A further problem of photographic documentation of Hieracia, notably of tall species, is the problem of clear visualization of the entire habit, including stolons, against the background vegetation.

To overcome these problems, we decided to use herbarium specimens as the main source for this iconography. In addition, images of freshly collected specimens will be included wherever possible. Since in many cases identification requires visualization of structural details at the magnifying glass level, we will include a series of photographs at various levels of magnification accompanied by scanning electron micrographs of surface structures. In a survey of several taxa, we realized that the structure and occurrence of epicuticular wax crystalloids, shape and density of cuticular papillae and microstructural details of indumentum characters (hair cover) may provide helpful taxonomic information. Accordingly, the photodocumentation of most species will be supplemented with scanning electron micrographs.

## Taxonomy

The traditional central European taxonomy of the genus *Hieracium* is based on the monographic studies of Nägeli & Peter (1885, 1886-89) and Zahn (1906, 1921-23, 1922-38), who subdivided the genus *Hieracium* into a basic stock of "Hauptarten" ("species principales collectivae", basic species) and several "Zwischenarten" ("species intermediae collectivae", intermediate species). Intermediate species are understood to be intermediate in morphology between the basic species. Direct proof of the hybrid character of these intermediate species is, however, mostly lacking although generally assumed. Interme-

diate species can be further divided into (a) spontaneous hybrids (which may be sterile or fertile) rarely occurring in the absence of the parent species and (b) fixed new species with full reproductive (sexual or apomictic) and independence from parent species. Such fixed ("hybridogenic") species probably evolved in great numbers after the last ice age and are characterized by a high percentage of apomictic reproduction. Mutations of these hybrids may have given rise to further microspecies stabilized by apomixis. This combination of hybridization, mutation and apomixis can be considered the main reason for the development of a bewildering diversity of central European *Hieracium* species. For further details and comprehensive discussions of the central European *Hieracium* concept, see Gottschlich (1987, 1996), Schuhwerk (1997) and Schuhwerk & Fischer (2003).

## Habit

### General characters of the genus<sup>1</sup>

Hemicryptophyte with horizontal to vertical rhizome; plants without hairs (then often glaucous) or some or all parts of plant regularly or irregularly hairy. Hairs of three types, in various proportions: a) denticulate (toothed) to plumose eglandular hairs; b) unstalked to short stalked stellate hairs with several radiate rays; and c) glandular hairs with pale, yellow or black stalk and yellow or black head. Stem with leaves or scapose, sometimes (only subgenus *Pilosella*) either with procumbent stolons with well developed leaves or underground scaly stolons, developing from the axils of rosette leaves, rarely from the lower caudine leaves, or with upwards curved flowering flagella; rosette leaves numerous to few or lacking; caudine leaves lacking to numerous, petiolate, subpetiolate or sessile, the base rounded, cordate, or more or less amplexicaul (clasping); lamina simple, very variable in shape and in type of margin; synflorescence unbranched, furcate, racemose, paniculate, corymbose or umbellate with various transitions; involucral bracts imbricate or in several or few rows, pale green to blackish, rounded to long-acute; appressed or squarrose, rarely with recurved apices; outer involucral bracts lacking or short, rarely green and leaf-like; clinanthium without scales, with little pits, margins of pits smooth, or short to long toothed, sometimes glandular-toothed; flowers usually yellow, rarely (only subgenus *Pilosella*) ligules with red stripes outside, or all flowers reddish; styles yellow to black; achenes narrowly obconical, never beaked; pale yellowish-brown to blackish; papus of 2 rows of unequal, brittle, white to pale yellowish-brown hairs.

The description shows that in contrast to other apomictic genera, such as *Rubus*, *Taraxacum* and *Ranunculus auricomus* group with rather uniform habit, the genus *Hieracium* is characterized by a broad morphological spectrum. This morphological variability includes reproductive characters (type of inflorescence, length of acodium [peduncle of the terminal capitulum],

<sup>1</sup> A detailed anatomical and microscopical description will be published in part 2 of this series.

size of heads, morphology of involucral bracts) as well as variability of almost all vegetative parts (length and type of branching of the stem, number and arrangement of cauline leaves, type of arrangement and insertion of leaves, shape and margin structure of leaves and presence/absence of stolons).

Moreover, there is a considerable variability with respect to coverage with the three types of trichomes that occur in the genus *Hieracium*, namely denticulate hairs, stellate (branched) hairs and glandular hairs (glands). Denticulate hairs in Hieracia are multicellular with short scale- or tooth-like side branches (denticuli). Denticuli are mostly not longer than the hair's diameter, but in some species (e.g. members of the Lanata type) they may form conspicuous side projections several times longer than the hair's diameter (plumose hairs). Depending on amount and distribution of these trichomes, some species may appear glabrous, while others almost glutinous (crowded with glands) or conspicuously hairy to villous (covered with rigid or long wavy hairs) and, finally, some species may be entirely tomentose owing to a dense coating of plumose hairs.

#### *Morphotypic grouping*

In view of the high degree of morphological variability it proved helpful to organize the members of the genus *Hieracium* into a limited number of morphotypic groups (Figs. 1 and 2) which provide a rough picture of a given species without the need for lengthy explanations. However, it must be emphasized that these morphotypes conform only in part to the classification of the genus *Hieracium* into two subgenera (*Pilosella*, *Hieracium*) and the numerous sections and subsections. Several morphotypes are only of an informal nature and may include members of different sections and subsections, such as the Lanata type that includes *H. tomentosum*, *H. pannosum* and *H. mixtum* and the Pilifera type, including *H. piliferum* but also *H. alpinum*. Finally, several species meet the criteria for one or more than one morphotypes and, hence, may be members of different morphotypic groups, as for example *H. piliferum* that shares features of both the Villosa type (indumentum) and Acaulia type (habit).

Although we assume that the user of this iconography is familiar with the main classification of the genus *Hieracium* into subgenus *Pilosella* and subgenus *Hieracium*, the following key for discrimination of both subgenera (subg.) is given for convenience:

1. Plant with stolons:.....subg. *Pilosella*
- Plant without stolons:.....2
2. Leaves with well-developed petioles (occasionally only basal or lower cauline leaves):.....subg. *Hieracium*
- Leaves without a petiole or with the blade gradually attenuated towards the insertion of the leaf:.....3

3. Capitula small: involucre 4-8(-9) mm in length, achenes 1-2 mm long:.....subg. *Pilosella*

- Capitula large: involucre (9-)10-12(-15) mm in length, achenes 3-5 mm long:.....subg. *Hieracium*

#### *Brief characterization of morphotypes*

##### A. Subgenus *Pilosella* (Fig. 1)

###### 1. Echinina type

Rosette leaves may fade in flowering; stolons usually lacking; stem 40-100 cm high; cauline leaves numerous, whole plant densely covered with rigid hairs; synflorescence paniculate, corymbose or cymose-corymbose; branches and capitula usually numerous.

###### 2. Cauligera-elata type

Rosette leaves present; stolons present or absent, sometimes pale and hypogeous (underground); stem 30-70(-80) cm high; cauline leaves few; synflorescence paniculate, corymbose, cymose-corymbose or cymose, branches and capitula usually numerous.

###### 3. Laxicephala type

Rosette leaves present; stolons present or lacking; stem 30-40(-60) cm high; cauline leaves few; synflorescence lax paniculate, branches usually long; capitula few to numerous.

###### 4. Acaulia type

Rosette leaves present; plant with epigeous (above ground) stolons; undersides of leaves very densely covered with stellate hairs; stem scapose, i.e. without leaves (rarely with 1 or 2 bract-like leaves) and 1 capitulum.

###### 5. Cauligera-humilia type

Rosette leaves present; stolons present or lacking; stem usually low, 10-20(-30) cm high; cauline leaves lacking or single; synflorescence irregular cymose, cymose or cymose-corymbose, branches and capitula few.

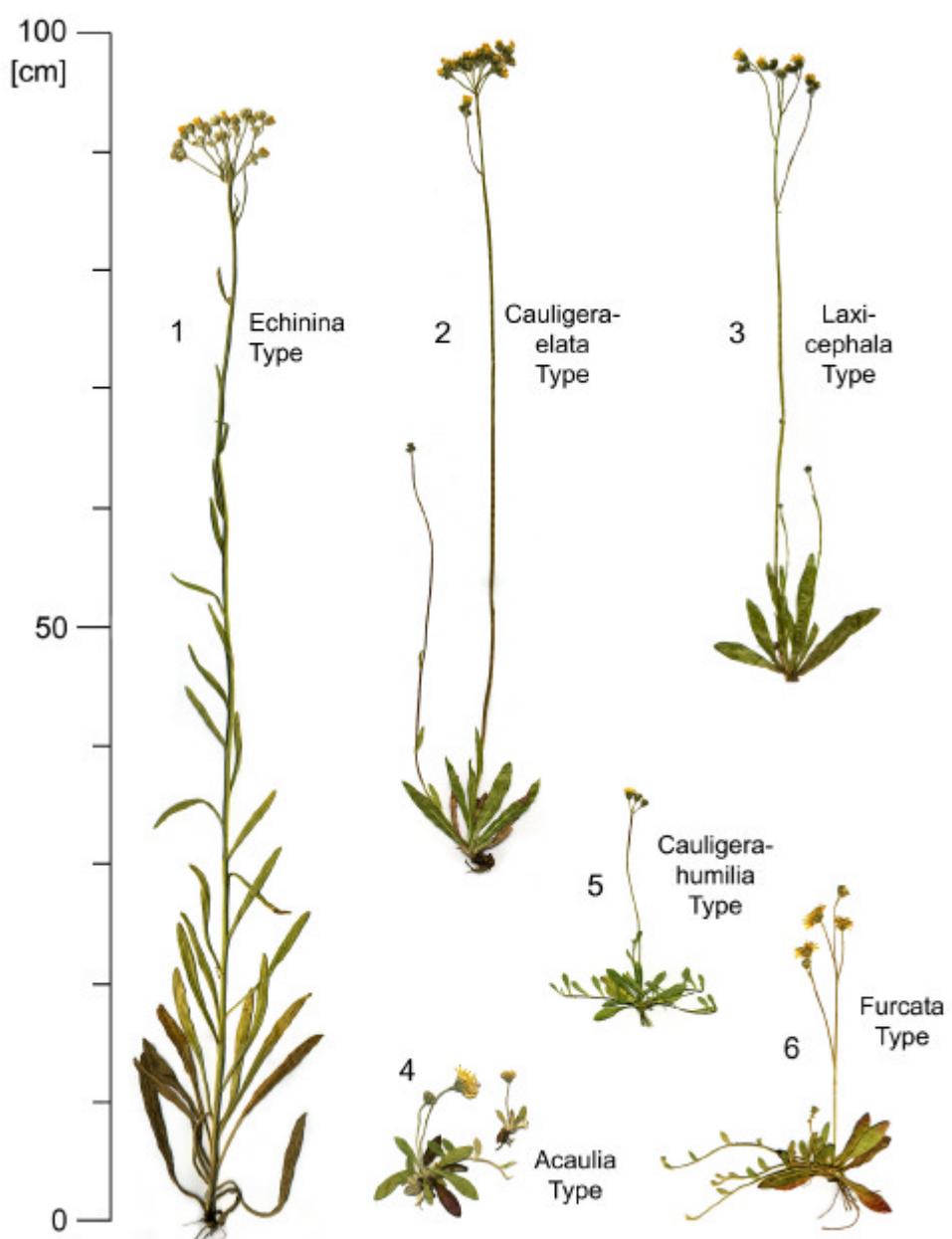
###### 6. Furcata type

Rosette leaves present; stolons usually present, stem low, 10-20(-30) cm high; cauline leaves lacking or single; synflorescence clearly furcate, sometimes laxly paniculate; capitula few.

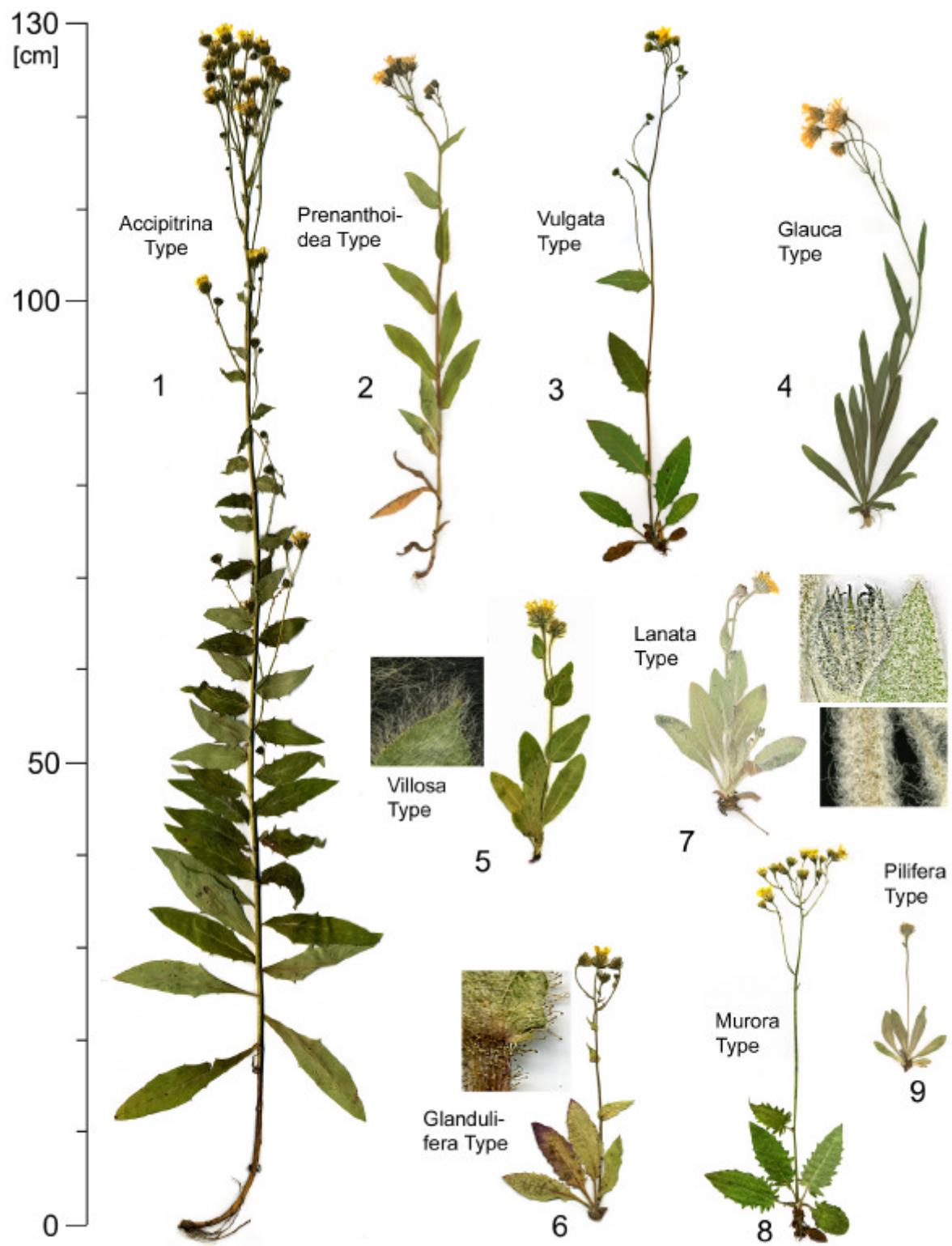
##### B. Subgenus *Hieracium* (Fig. 2)

###### 1. Accipitrina type

Rosette leaves lacking, rarely 1-2, cauline leaves numerous, (5-)10-20(-50), usually without petiole, peduncles and involucral bracts usually with few denticulate and / or glandular hairs.



**Fig. 1** Morphotypic grouping of subgenus *Pilosella*  
1 *H. echioides* 2 *H. piloselloides* 3 *H. visianii* 4 *H. pilosella* 5 *H. lactucella* 6 *H. pilosellinum*



**Fig. 2** Morphotypic grouping of subgenus *Hieracium*

1 *H. sabaudum* 2 *H. prenanthoides* 3 *H. lachenalii* 4 *H. bupleuroides* 5 *H. villosum* 6 *H. amplexicaule* 7 *H. tomentosum*  
8 *H. murorum* 9 *H. piliferum*

## 2. Prenanthoidea type

Rosette leaves lacking, rarely 1-2, caulin leaves usually more than 4, grass-green to glaucous, base often panduriform (truncated) to cordate-auriculate; peduncles and involucral bracts usually with numerous glandular hairs.

## 3. Vulgata type

Rosette leaves present; caulin leaves few to subnumerous, 2-6(10); the lower usually petiolate.

## 4. Glauca type

Rosette leaves present, caulin leaves few to subnumerous, leaves glaucous, linear to lanceolate, often without petiole, or gradually narrowed at base, hairless or with only few simple hairs; synflorescence without or with few denticulate and glandular hairs.

## 5. Villosa type

Whole plant or at least the upper part of plant crowded with silky long denticulate hairs (villous hairs).

## 6. Glandulifera type

Shape of plant variable, but whole plant, including leaves, densely covered with glandular hairs.

## 7. Lanata type

Whole plant densely covered with long, interwoven, plumose hairs.

## 8. Murora type

Rosette leaves present; caulin leaves 1, petiolate.

## 9. Pilifera type

Rosette leaves present; leaves on underside without or with only few stellate hairs; stem scapose, i.e. without leaves (rarely with 1 or 2 bract-like leaves) and with one capitulum. Indumentum very variable.

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