A taxonomic revision of the *Pilosella alpicola* group in the Carpathians

Taxonomická revízia skupiny *Pilosella alpicola* v Karpatoch

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A taxonomic study of the *Pilosella alpicola* group growing in the Carpathians revealed the presence of two morphologically distinguishable taxa: *P. ullepitschii* (Błocki) Szeląg and *P. rhodopea* (Griseb.) Szeląg. While *P. ullepitschii* is endemic to the Carpathians, *P. rhodopea* is a Balkan subendemic with two isolated localities in the Southern Carpathians (Mt Cozia and Mt Zmeuretu). The core area of distribution of *P. ullepitchii* is the natural subalpine and alpine meadows of the Western Carpathians (the Vysoké and Západné Tatry Mts in Slovakia and Poland). In addition, only three isolated localities are known from the Nemira Mts (Romanian Eastern Carpathians) and one from the Bucegi Mts (Romanian Southern Carpathians). Interestingly, the Romanian populations occur in man-made habitats (secondary pastures). Karyological and flow cytometric analyses of 305 plants from 13 populations of *P. ullepitschii* revealed only diploid plants (2n = 2x = 18). One Carpathian population of *P. rhodopea* from Mt Cozia is also diploid. This is the first report of diploidy in this species. However, the populations from the main part of the distribution of this taxon in the Balkan mountains include other cytotypes. Detailed morphological descriptions and distributions for both taxa are given.

K e y w o r d s: chorology, chromosome number, distribution, *Hieracium*, flow cytometry, karyology, Poland, Romania, Slovakia

Introduction

The genus *Pilosella* Vaill. (syn. *Hieracium* subgenus *Pilosella*)[1] includes seven sections – *Pilosellina*, *Auriculina*, *Alpicolina*, *Pratensina*, *Cymosina*, *Echinina* and *Prealtina* – according to Zahn (1930). Members of section *Alpicolina* are characterized by their large capitula with a silky hairy involucrum, long acladia and absence of aboveground and rarity or absence of short underground stolons. This section is considered to be the most closely related to section *Auriculina*, because of the similar number and arrangement of inflorescences, only sparsely leafy stems and tendency to occur at high altitudes. Nägeli & Peter (1885) distinguished two taxa at the species level within this section: *H. alpicola* Steud. et Hochst. and *H. oreades* Heuff., nom. illeg. (= *Hieracium heuffelii* Janka). The latter species was subsequently classified as an intersectional hybrid between the putatively parent

[1] Genus *Pilosella* is often treated as a subgenus of the widely accepted genus *Hieracium* L. However, the members of *Hieracium* s.str. and *Pilosella* differ in many aspects: morphology, parthenogenetic reproduction, cytotype pattern, rate of present-day hybridization, haploid genome size, ITS sequences and ecology (Zahn 1930, Nogler 1984, Mráz 2003a, Bräutigam & Greuter 2007, Fehrer et al. 2007, Suda et al. 2007, Krahulec et al. 2008). In this paper, we use a narrow generic concept, but often keep the original names (in the genus *Hieracium*) as in the original sources.

taxa *H. alpicola* and *H. cymosum* L. (section *Cymosina*) (Zahn 1930). In the same work, Zahn (1930) included in sect. *Alpicolina H. breviscapum* DC. (as *H. candollei* Monn., nom. illeg.), an endemic species from the Pyrenees, formerly included in sect. *Auriculina*. Six taxa are traditionally recognized within *Hieracium alpicola* at the subspecies level (Zahn 1930): *H. alpicola* subsp. *alpicola*, *H. alpicola* subsp. *rhodopeum* (Griseb.) Zahn, *H. alpicola* subsp. *ullepitschii* (Błocki) Zahn, *H. alpicola* subsp. *furcotae* Degen et Zahn, *H. alpicola* subsp. *glandulifolium* Nägeli et Peter and *H. alpicola* subsp. *micromegas* (Fr.) Nägeli et Peter. The most important characters for distinguishing the above-mentioned subspecies are plant height, number of capitula, length of the acladium and character of the indumentum (type, density and colouring of simple eglandular hairs) (Zahn 1930). Szeląg (2008) recently published a taxonomic overview of the *Pilosella* section *Alpicolinae* comprising six taxa at the species level: *P. alpicola* s.str., *P. breviscapa* (DC.) Soják, *P. petraea* F.W. Schultz et Sch. Bip. (= *Hieracium heuffelii* Janka), *P. rhodopea* (Griseb.) Szeląg, *P. serbica* (F.W. Schultz et Sch. Bip.) Szeląg and *P. ullepitschii* (Błocki) Szeląg. However, a molecular study based on nuclear (ITS) and chloroplast sequences showed that *H. alpicola* (sequenced plant corresponding to *Pilosella ullepitschii*) and *H. breviscapum* are phylogenetically distinct taxa (Fehrer et al. 2007). It seems likely that their shared morphological features are the result of parallel evolution. In addition, based on morphology and a morphometric study (P. Mráz & B. Šingliarová, unpublished) it seems that *P. petraea* does not belong to sect. *Alpicolinae*. Therefore, the circumscription of the section sensu Zahn (1930) and Szeląg (2008) is questionable and requires critical revision.

The distribution of the *Pilosella alpicola* group is polydisjunctive (Bräutigam 1992). *P. alpicola* s.str. is very rare in the Swiss and Italian Alps. There are a few localities recorded for the Austrian Alps (Gurktaler Alpen, Hohe Tauern), but the taxon is probably extinct there (Schuhwerk & Fischer 2003, Aeschimann et al. 2004). In addition, this species is reported from the Col de Larche (Zahn 1930) in France (Alpes Maritimes), but the occurence at this locality seems improbable based on its remoteness and habitat (calcareous bedrock) (J. M. Tisson, personal communication). *Pilosella serbica* (syn. *H. alpicola* subsp. *glandulifolium*) is a Balkan taxon occuring in the mountains of Albania, Serbia, Macedonia, Bulgaria and Greece. The most frequent Balkan taxon, *P. rhodopea* is reported from Greece, Macedonia and Bulgaria, and two isolated localities in the Southern Carpathians (Nyárády 1965). Finally, *P. ullepitschii* is endemic to the Carpathians Mts (Zahn 1930, Šingliarová et al. 2008).

Compared with the other groups in the genus *Pilosella*, the *P. alpicola* group has been neglected from a karyological point of view (see Schuhwerk 1996). Three cytotypes are reported. Favarger (1959) published two tetraploid counts (2n = 4x = 36) for plants belonging to *P. alpicola* s.str. from the Swiss Alps. Subsequently, the diploid chromosome number (2n = 2x = 18) was recorded for *P. ullepitschii* from the Western Carpathians (Murín et al. 1999). For the same taxon Uhríková & Dúbravcová (2000) reported tetraploidy in plant(s) from the Furkotská dolina valley (Vysoké Tatry Mts, Western Carpathians), but this is questioned by Mráz (2003b, 2007). A triploid ploidy level (2n = 3x = 27), quite rare in the genus *Pilosella*, is recorded for *H. alpicola* from the Pirin Mts (Bulgaria) (Vladimirov & Szeląg 2001). Recently, a diploid level was published for *H. alpicola* subsp. *glandulifolium* (Szeląg et al. 2007) from its classical locality in Serbia.

The aim of the present study is to summarize data gathered during a detailed biosystematic study of the *Pilosella alpicola* group, with particular emphasis to those occurring in the Carpathians.

Taxonomic history of the *Pilosella alpicola* group in the Carpathians

Hieracium alpicola was first reported from the Western Carpathians by Fritze & Ilse (1870). However, the oldest herbarium specimen of *P. alpicola* subsp. *ullepitschii* is that collected at Mt Kriváň (Vysoké Tatry Mts, Slovakia) (BP Herb. Kit. XXVI/130, Mt Kriváň, ut *H. alpinum*) by P. Kitaibel when he visited the Tatry Mts in either 1795 or 1804 (Gombocz 1945–1946). Rehmann (1873) published a detailed morphological description of this Carpathian taxon, but under the name *H. alpicola*, which is an Alpine species. Later, Nägeli & Peter (1885) used the name *Hieracium alpicola* var. *rhodopeum* (Griseb.) Nägeli et Peter, a taxon originally described from the Balkan Peninsula, for the Western Carpathian populations. Błocki (1887) recognized that Western Carpathian plants differed from the Alpine *H. alpicola* and described a new species *Hieracium ullepitschii*. At the same time he suggested incorrectly, that *Hieracium pilosella* L. and *Hieracium alpinum* L. (a member of *Hieracium* s.str.), were involved in the origin of this taxon. Although Sagorski & Schneider (1891) mention that plants from the Tatry Mts (the Western Carpathians) are described as distinct species (*H. ullepitschii*) by Błocki, they did not accept this name and used *H. alpicola* var. *rhodopeum*, following Nägeli & Peter (1885). In 1894 Rehmann described *H. amphibolum* from the Vysoké Tatry Mts, pointing out its probable hybrid origin resulting from a cross between *H. lactucella* Wallr. (originally *H. auricula* L., misapplied name) and *Hieracium alpinum* (Rehmann 1894). Zahn (1906) states that *H. amphibolum* Rehm., nom. illeg. could be a hybrid between *H. alpicola* subsp. *ullepitschii* and *H. lactucella* Wallr., and used a new name for this taxon – *Hieracium alpicola* subsp. *furcotae* Degen et Zahn. In the same work Zahn (1906) ranks *H. ullepitschii* as a subspecies of *H. alpicola* – *H. alpicola* subsp. *ullepitschii* (Błocki) Zahn. Jávorka (1925) lists five subspecies of *H. alpicola* from the Western Carpathians. Beside *H. alpicola* subsp. *ullepitschii* and subsp. *furcotae*, three subspecies (*H. alpicola* subsp. *quasadnatum* Elfstr., subsp. *depannatum* Elfstr. and subsp. *rufotectum* Elfstr.) from Mt Kriváň are added. However, the three latter names were not included in subsequent publications. Zahn's concept of a subspecies was followed by Hayek (1929), Dostál (1950), Pawłowski (1988), Chrtek (1998) and Oprea (2005). However, most of the Slovak and Polish authors do not separate subspecies and only report *P. alpicola* (e.g., Dostál & Červenka 1992, Szeląg 2001, 2002). Szeląg (2008) synonymized *P. alpicola* subsp. *furcotae* and all of Elfstrand's taxa with *P. ullepitschii*.

The first record of the *Pilosella alpicola* group from the Romanian Carpathians is dated to the end of the 19th century (Grecescu 1898, as *H. petreum* Friv., nom. illeg.). As far as we know the oldest existing voucher originating from Romania was collected in the Nemira Mts (Mt Sandru Mare) in 1909. Prodan (1957) thought that the Romanian plants deserved separate taxonomic status and described a new form, *Hieracium alpicola* f. *romanicum* Prodan. Nyárády (1965) put this form within *Hieracium alpicola* var. *ullepitschii* (Błocki) Nyár. Interestingly, this author also reports the occurrence of another variety, *Hieracium alpicola* var. *rhodopeum* (Griseb.) Zahn, from the southernmost part of the Romanian Carpathians (Mt Cozia). In a recent Checklist of the vascular flora of Romania (Oprea 2005) only *P. alpicola* subsp. *ullepitschii* is listed.

Material and methods

Plant material

The results are based on a study of natural populations of the *Pilosella alpicola* group in the Carpathians in 2000–2007, cultivated plants in experimental fields at the Institute of Botany, Slovak Academy of Sciences in Bratislava, the Botanical Garden of P. J. Šafárik University, Košice (for detailed list of localities and number of plants see Table 1) and a thorough revision of herbarium material deposited in the following institutions (acronyms according to Holmgren et al. 1990): B, BP, BRA, BRNM, BRNU, BUC, BUCA, CL, G, GLM, KO, KRA, KRAM, LW, LWS, P, PRC, SAV, SB, SLO, SO, SOM, TNP, W, WU.

The distribution records are arranged from west to east. In the list of revised herbarium specimens we use following abbreviations: s.coll. – lacking a collector's name, s.d. – without a date, s.n. – without a specimen number (if the specimens in particular herbarium are usually numbered). Unreadable data are replaced by "?". If the original spelling of locality's names was given in Hungarian or German, the currently used Slovak/Romanian topographic name is given in square brackets. For distribution maps, approximate coordinates for localities from the herbarium specimens were found from tourist maps at a scale of 1:50000 and our field collections were localized using a GPS receiver.

Morphology

Morphological descriptions of the *Pilosella alpicola* taxa from the Carpathians are based on a large but unpublished morphometric study of the whole group (B. Šingliarová et al., in preparation). Measurements were made on 115 plants originating from nine populations in the Carpathians (for details see Table 1). Characters (values) in the descriptions are expressed as "(minima–) 10th percentile – 90th percentile (–maxima)".

Chromosome numbers and estimates of DNA ploidy level

The chromosome counts were performed on somatic mitoses in root-tips cuttings of cultivated plants after pre-treatment with colchicine (for details see Mráz et al. 2008). Selected permanent slides are deposited at the Institute of Botany, Slovak Academy of Sciences in Bratislava.

Flow cytometry was used to detect the ploidy level of 280 plants that originated from 13 populations (Table 1) of *P. ullepitschii* and 14 individuals from one population of *P. rhodopea*. Analysis of relative DNA content was performed using a FACSCalibur instrument (Becton Dickinson, USA) equipped with an argon-ion laser exciting at 488 nm in the Laboratory of Flow Cytometry, Institute of Biology and Ecology, P. J. Šafárik University in Košice. For details of how the samples were prepared see Mráz et al. (2008). Clones of diploid (2n = 2x = 18) plants of *Pilosella lactucella* (see Rotreklová et al. 2002, 2005) were used as an internal reference standard for measuring the relative DNA content.

Study of breeding system

Isolation, castration and open pollination experiments were carried out in order to ascertain the mode of reproduction of plants (for details see Gadella 1984, 1987, Richards 1997). As only plants of *P. ullepitschii* flowered in the garden experiments it was the only

Table 1. – Plants from populations of *Pilosella ullepitschii* and *P. rhodopea* in the Carpathians used in the karyological analysis and flow cytometry. NCC – number of plants used for chromosome counts (BŠ – counted by B. Šingliarová, PM – counted by P. Mráz), NPL – number of plants used for estimating ploidy level using flow cytometry (by BŠ). Abbreviations: PO – Poland, RO – Romania, SK – Slovakia, BŠ – B. Šingliarová, JC – J. Chrtek jun., JM – J. Mráz, PM – P. Mráz, RL – R. Lakoštík, VM – V. Mrázová. Populations marked with an asterisk were also used in the morphometric study. Initial letters of each population's code indicate the species studied – U = *ullepitschii*, R = *rhodopea.*

Code	Locality	NCC / NPL
U-BAR	SK, Západné Tatry Mts, Trnovecká dolina valley, N 49°09'46.5", E 19°44'04", 1885 m a.s.l., 27.7.2007, coll. BŠ & RL	– / 21
U-LAL*	SK / PL, Západné Tatry Mts, Ľaliové sedlo saddle, N 49°13'35", E 19°59'30", 1952 m a.s.l., 25.8.2005, coll. BŠ	1 (BŠ) / 22
U-KR25*	SK, Vysoké Tatry Mts, SW slope of Mt Kriváň, meadow above *Pinus mugo* communities, green-marked tourist path, N 49°09'27", E 19°59'25", 1900 m a.s.l., 27.8.2005, coll. BŠ	– / 20
U-KR55*	SK, Vysoké Tatry Mts, Mt Kriváň, SE ridge, above blue-marked tourist path, N 49°09'02", E 19°59'55", 1890 m a.s.l., 16.8.2001, coll. PM & VM	2 (PM) / –
	SK, Vysoké Tatry Mts, SE slope of Mt Kriváň, slope above blue-marked tourist path, N 49°09'05", E 19°59'55", 1900 m a.s.l., 27.8.2005, coll. BŠ	– / 20
U-FUR*	SK, Vysoké Tatry Mts, Furkotská dolina valley, below the Nižné Wahlenbergovo pleso tarn, N 49°09'12", E 20°01'43", 1910 m a.s.l., 11.9.2002, coll. PM & JM	14 (PM) / –
	SK, Vysoké Tatry Mts, Furkotská dolina valley, along the tourist path, below the Nižné Wahlenbergovo pleso tarn, N 49°09'10", E 20°01'40", 1900 m a.s.l., 18.8.2005, coll. BŠ & RL	– / 23
U-MLY1	SK, Vysoké Tatry Mts, Mlynická dolina valley, below Capie pleso tarn, N 49°09'56", E 20°02'14", 2017 m a.s.l., 11.9.2002, coll. PM & JM	2 (PM) / –
U-MLY2*	SK, Vysoké Tatry Mts, Mlynická dolina valley, meadows below vodopád Skok waterfall, N 49°09'00", E 20°02'48", 1675 m a.s.l., 18.8.2005 and 26.7.2007, coll. BŠ & RL	– / 25
U-MEN*	SK, Vysoké Tatry Mts, Mengusovská dolina valley, Satania dolinka valley, N 49°09'57", E 20°03'40", 1800 m a.s.l., 29.8.2005, coll. BŠ	– / 20
	SK, Vysoké Tatry Mts, Mengusovská dolina valley, Satanov žľab, N 49°10'00", E 20°03'27.8", 1875 m a.s.l., 12.8.2001, coll. PM & VM	1 (PM) / –
U-OST*	SK, Vysoké Tatry Mts, SSE slope of Mt Ostrva, N 49°08'58", E 20°05'22", 1959 m a.s.l., 16.8.2006, coll. BŠ & RL	– / 20
U-BUC*	RO, Bucegi Mts, 0.5 km NE of the chalet Cabana Babele, 45°24'24", E 25°28'30", 2160 m a.s.l., 13.7.2004, coll. PM & JC	2 (PM) / –
	RO, Bucegi Mts, Mt Babele, eroded meadows, N 45°24'29", E 25°28'22", 2204 m a.s.l., 5.8.2006 and 16.7.2007, coll. BŠ	– / 39
U-NMA	RO, Nemira Mts, Mt Nemira Mare, rocks on the top of the mount, N 46°15'21.5", E 26°19'25.5", 1641 m a.s.l., 18.7.2007, coll. BŠ & RL	– / 18
U-NMI	RO, Nemira Mts, Mt Nemira Mica, rocks on the top of the hill, N 46°13'59", E 26°19'55'', 1600 m a.s.l., 18.7.2007, coll. BŠ & RL	– / 6
U-SMA	RO, Nemira Mts, Mt Sandru Mare, top of the mount, clearing, N 46°11'57", E 26°20'21", 1640 m a.s.l., 2.8.2006, coll. BŠ	– / 27
	RO, Nemira Mts, Mt Sandru Mare, secondary clearing in *Juniperus sibirica*, SW slope, N 46°11'59", E 26°20'29", 1590 m a.s.l., 15.7.2004, 2.8.2006 and 18.7.2007, coll. PM & JC, BŠ & RL	4 (PM), 1(BŠ) / 19
R-COZ*	RO, Cozia Mts, Mt Cozia, secondary meadows in the summit area, N 45°19'04", E 24°20'17", 1592 m a.s.l., 14.7.2007, coll. BŠ & RL	– /14

species studied. Control hybridization was used to evaluate the level of compatibility among plants that originated from the same or different populations. The inflorescences of plants were enclosed in nylon bags until anthesis to prevent cross-pollination. The crosses were made when the stigmas were receptive by rubbing the capitula together if possible 1–2 times per day for 2–5 consecutive days, which facilitates the transfer of pollen to the stigmas.

The achenes were collected and classified as either well developed or poorly developed. Well-developed fruits were stiff, plump and well-pigmented, whereas poorly developed achenes were narrow, flimsy and weakly pigmented. Fruit-set was measured as the proportion of well-developed achenes among the total number within a capitulum. If there were no well-developed achenes within a capitulum, the number of plants with no well-developed achenes was recorded. The list of plants used in breeding system experiments are given in Appendix 1.

Results and discussion

Taxonomic and chorological survey

Pilosella alpicola taxa are traditionally treated as subspecies (Zahn 1930). Our recent and mostly still unpublished results of a biosystematic study of the whole group revealed that the recognized taxa are morphologically very well differentiated (based on multivariate morphometrics) and without transitory morphotypes. They also differ in genome size, in cytogeographical pattern, in some functional traits (specific leaf area, carbon isotope discrimination) and in some allozyme loci (B. Šingliarová et al., unpublished). Moreover, they are geographically vicariant. Therefore we consider the species concept of the *Pilosella alpicola* group as appropriate. At the same time, the nuclear and plastid sequences clearly show that these taxa are very closely related (B. Šingliarová et al., unpublished).

Our study revealed two species in the Carpathians: *P. ullepitschii* and *P. rhodopea*. In the present paper, we include a detailed morphological description of both taxa, as well as data from a DNA-ploidy level analysis, karyological and reproduction mode studies, and a detailed chorological survey as well as notes on their ecology. We do not include a detailed nomenclatural overview in this paper, because the synonymy and typifications are published in Szeląg (2008). Therefore, we list only the most important synonyms (nomenclatural "≡", taxonomic "=", and invalid names and missaplications "–", as well). The details of the protologues and type specimens are given in Szeląg (2008).

Pilosella ullepitschii (Błocki) Szeląg

Pilosella ullepitschii (Błocki) Szeląg, Ann. Bot. Fenn. 45: 302, 2008.

≡ *Hieracium ullepitschii* Błocki, Deutsche Bot. Monatsschr. 5: 24, 1887. Lectotype selected by Szeląg (2008).

≡ *Pilosella alpicola* subsp. *ullepitschii* (Błocki) Soják, Čas. Nár. Muz., Odd. Přír. 141: 42, 1972.

≡ *Hieracium alpicola* subsp. *ullepitschii* (Błocki) Zahn, Allg. Bot. Z. Syst. 12: 39, 1906.

≡ *Hieracium alpicola* var. *ullepitschii* (Błocki) Nyár., Fl. Rep. Pop. Rom. 10: 244, 1965.

= *Hieracium alpicola* f. *romanicum* Prodan, Bull. Ştiinţ. Secţ. Biol. Ştiinţ. Agric., Ser. Bot. 9: 312, 1957.
Ind. loc.: "Reg. Bacău, in mte. Sandrul Mare (r. Ceahlău) in saxosis ad "Figarea", (r. Stalin): Bucegi, Caraiman".
Lectotypus **(hoc loco designatus)**: Slanic (Mold.) Sandru (Branză & Solacolu VII 1914 CL 618596, det. Prodan as *Hieracium alpicola* f. *romanicum* Prodan). Isolectotypus: CL 618648.

= *Pilosella alpicola* subsp. *furcotae* (Degen et Zahn) Soják, Čas. Nár. Muz., Odd. Přír. 141: 42, 1972.

≡ *Hieracium alpicola* subsp. *furcotae* Degen & Zahn, in Zahn, Allg. Bot. Z. Syst. 12: 39, 1906. Lectotype selected by Szeląg (2008).
– *Hieracium alpicola* var. *rhodopeum* auct. non (Griseb.) Nägeli & Peter: Nägeli & Peter, Hierac. Mitt.-Eur. I., p. 283, 1885; [as "β"] Sagorski & Schneider, Fl. Carp. Centr. I., p. 289, 1891; Fritze & Ilse, Verh. K. K. Zool.-Bot. Ges. Wien 20: 467–526, 1870; Scherfel in Rehmann & Wołoszczak, Fl. Pol. Exsicc. Nr. 194, 1894.
– *Hieracium scepusiense* Simk., Természettud. Közl. 22: 490, 1890, nom. inval. [nom. nud.].
– *Hieracium petraeum* auct. non Friv., Flora 19: 436, 1836, nom illeg.: Grecescu, Consp. Fl. Rom., p. 365, 1898; Grecescu, Suppl. Consp. Fl. Rom., p. 104, 1909; Grecescu, Analele Acad. Rom. 33: 125, 1910.
– *Hieracium alpicola* auct. non. Steud. & Hochst., Enum. Pl. Germ. Helv. p. 112, 1826: Rehmann, Österr. Bot. Z. 23: 154, 1873; Dostál & Červenka, Veľký kľúč na určovanie vyšších rastlín 2, 1998; Szeląg in Zając & Zając, Distribution atlas of vascular plants in Poland, p. 276, 2001; Szeląg in Mirek, Piękoś-Mirkowa, Zając & Zając, Flowering plants and pteridophytes of Poland, a checklist, p. 89, 2002.

D e s c r i p t i o n: Phyllopodous. Underground stolons usually absent, if present then up to 4 cm long. Stem (5–) 7–15 (–19) cm tall, single-headed or with 2–3 single-headed short branches, slender, with rare simple eglandular and glandular trichomes and sparse to subnumerous stellate trichomes along whole length of the stem, with towards the apex scattered to numerous, dark brown glandular trichomes, numerous, (2.5–) 3.0–5.0 (–6.0) mm long, smoky grey simple eglandular trichomes with often a pale (greyish-white) terminal part and scattered to moderately dense stellate trichomes. Acladium 0.2–1.0 (–1.2) cm long. Rosette leaves (6–) 8–15 (–23) at the time of flowering, greyish-green, lanceolate (younger leaves from the inner part of the rosette oblong-lanceolate), without petiole, (1.8–) 2.7–6.2 (–10.0) × (0.2–) 0.4–0.9 (–1.1) cm, at the apex rounded or slightly mucronate, entire, older leaves very rarely slightly shallowly denticulate, adaxial surface with few stellate and numerous eglandular trichomes, abaxial surface with few stellate trichomes, margins and abaxial surface with a few, light brownish glandular trichomes. Cauline leaves (0–) 1–2 (–3), narrowly lanceolate, the lowest one (0.4–) 0.7–3.8 (–7.2) cm long, further if any are short and bract-like, with numerous stellate and eglandular trichomes, and scattered, light brown glandular trichomes. Heads 1–3. Involucral bracts linear lanceolate, (4.1–) 4.9–6.8 (–7.5) × (0.4–) 0.5–0.8 (–1.1) mm, black-greyish, with very dense, dark smoky grey, (1.9–) 2.8–4.7 (–6.0) mm long eglandular trichomes, stellate and glandular trichomes are usually invisible due to the high density of simple eglandular trichomes. Ligules yellow, (8.7–) 12.1–14.3 (–15.9) × (1.6–) 2.2–2.6 (–2.8) mm. Styles pure yellow, (6.0–) 7.4–10.2 (–12.0) mm long. Achenes dark brown, 2.1–2.5 mm long. Flowers produced from the begining of July (plants from the Nemira Mts) to the first half of September.

P l o i d y l e v e l: All the plants (305 individuals) of *P. ullepitschii* analysed were diploid (2n = 2x = 18 / ~ 2x), which accords with the first record of Murín et al. (1999) for plants from the Vysoké Tatry Mts and unpublished counts (Mráz 2003b) (Table 1). The accuracy of the tetraploid count (2n = 4x = 36) published by Uhríková & Dúbravcová (2000) is questionable, because we found no tetraploid plants amongst more than 300 plants analysed. Moreover, the 37 plants (Table 1) we analysed from the same locality (Furkotská dolina valley) were all diploid (Fig. 1A).

B r e e d i n g s y s t e m: *Pilosella ullepitschii* is a strictly allogamous, sexually reproducing taxon (Table 3 and Appendix 1). Interestingly, we obtained a low percentage of ripe achenes (about 50%, Table 3) from open pollinated (15 plants) and experimental crosses (7 pairs). This might be biased by the fact that a few (4) individuals produced only ca 20–30% mature fruit and the majority more than 60% well-developed achenes. Moreover, not all pairs of plants flowered synchronously, and thus the pollination might not have been

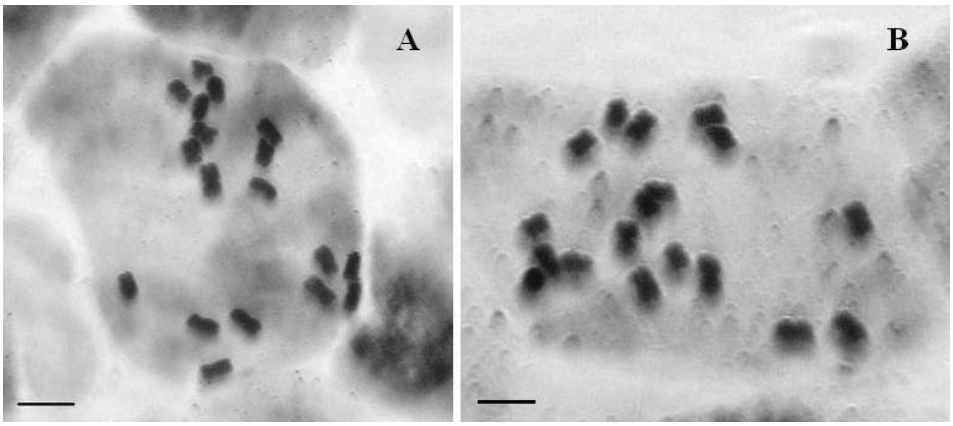

Fig. 1. – Mitotic metaphases of *Pilosella ullepitschii*. A – plant from the Western Carpathians (Vysoké Tatry Mts, the Furkotská dolina valley, cult. no.1287; B – plant from the Eastern Carpathians (Nemira Mts, Mt Sandru Mare, cult. no. SAN5). Scale bar = 5 μm.

completely effective. Cultivated plants of *P. alpicola* rarely flower when grown at low altitudes. No evidence for reproductive isolation was observed in intra- (3) / interpopulation (3) or interregional crosses (1 cross between the plant U-SMA-1710 and U-MLY-5 yielded 73.1% ripe achenes), although we cannot exclude that ripe achenes might result from self-pollination stimulated by foreign pollen (e.g., Krahulcová et al. 1999).

Distribution

Endemic to the Carpathians (Fig. 2). The range of *P. ullepitschii* is disjunct, split into two areas: Eastern and Southern Carpathians, and Western Carpathians. The core of the area of distribution is in the Western Carpathians, where the species has been recorded in three mountain ranges: the Vysoké Tatry Mts (scattered occurrence), Západné Tatry Mts (rather rare) and Belianske Tatry Mts (only one locality, not recently confirmed) (Fig. 2A). Herbarium specimens indicate ca 40 localities in the Western Carpathians. Only four populations are known from the Southern Carpathians (one in the Bucegi Mts) and the Eastern Carpathians (three in the Nemira Mts) (Fig. 2B). Three other localities for *P. ullepitschii* are given in the most recent Romanian checklist of vascular plants (Oprea 2005): Mt Farcău (Maramureş Mts, Coman 1939), Mt Pietrosul Mare and Mt Galaţi (both in the Rodna Mts, Oprea 2005 ex Resmeriţă 1975–1987 unpubl.). However, there are no voucher specimens supporting these records. Moreover, this species is not mentioned in a survey of the vegetation in the alpine and subalpine belts in the Rodna Mts (Coldea 1990).

Pilosella ullepitschii is probably the only *Pilosella* species endemic to the Carpathians. This contrasts with the closely related genus *Hieracium*, where thorough taxonomic revision revealed numerous endemic taxa in this area (e.g., Chrtek & Marhold 1998, Chrtek & Mráz 2007). The difference in the level of endemism between both genera is likely due to the different breeding systems. Sexual reproduction and facultative apomixis prevail in *Pilosella*, while the obligate apomixis is the most common system in *Hieracium* (see also Introduction).

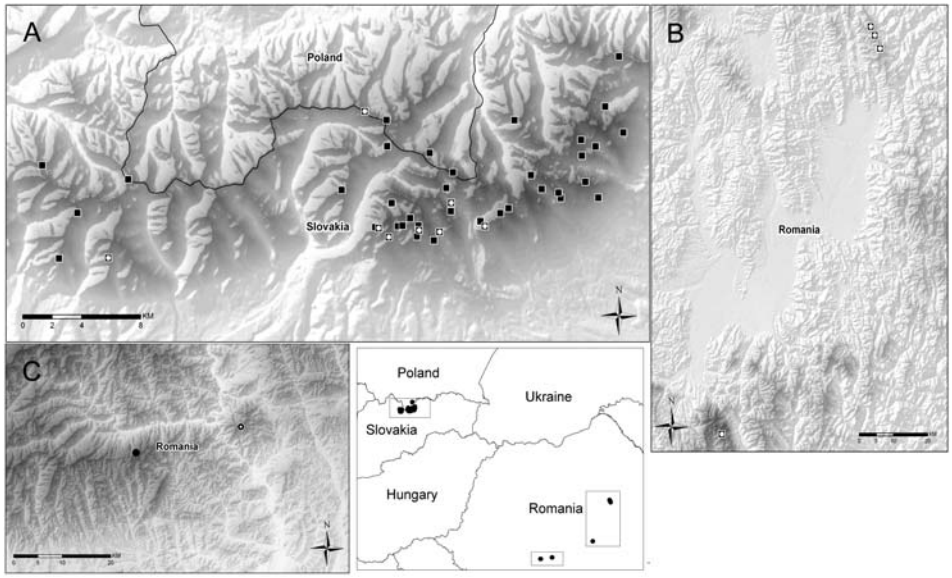

Fig. 2. – Distribution of two *Pilosella alpicola* taxa in the Carpathians – *Pilosella ullepitschii* (squares) in the Western Carpathians (A) and Southern and Eastern Carpathians (B) and *P. rhodopea* (circles) in the Southern Carpathians (C). Distribution based on original data (black symbols with white dot) and data from herbarium specimens (black symbols).

Specimina visa:

Specimina exsiccata visa: Fl. Polon. Exs. no. 77. Tatrie Wysokie (Tatri Alti): Wyżnia Prehyba (w grupie Kryvania – ad Krywań), w kameniestem *Trifidi-Distichetum*, ok. 1900 m, na granicie (solo granitico) (Pawłowski & Wallisch 20. VIII 1925; CL 160179; LW; KRAM 146144, 336754; BRNU 202648; G s.n.; ut *Hieracium alpicola* subsp. *ullepitschii*). Fl. Polon. Exs. no. 194. In convalle alpina Velka (Felka) montium Tatra, na skalach granitowych i łyszczakowych, 1700 m (Scherfel 19. VIII 1893; WU 1465; W 1927-3414; LW; CL 27078; LWS; B; ut *H. alpicola* var. *rhodopeum*, rev. Zahn ut *H. alpicola* subsp. *ullepitschii*).

Herb. Hieraciorum ed. ab Otto Behr no. 361. In lapidosis sub cacumine Vöröstrony [Priečne sedlo saddle], 2000 m (Lengyel 20. VIII 1935; BP 400179, 66477, 353592, 353593; W 1950-7763; B s.n.; det. Zahn ut *H. alpicola* subsp. *ullepitschii* Błocki).

Fl. Exs. Distr. Bacov. no. 61. Comm. Dărmăneşti: in pascuis saxosis montis Ţiganca [Mt Nemira Mica?] intra ass. *Festucetum supinae* Domin 33., ca 1600 m (Mititelu & Barabaş 16. VII 1970; SO 80560; KRAM 099 373; CL 596119; BRNU 202643; ut *H. alpicola*).

Slovakia: Western Carpathians – Západné Tatry Mts: Mt Brestová (1902.6 m), mountain ridge Predný Salatín, rocks near the marked tourist path, 6.8 km SE of the village of Zuberec, 1860 m alt., 19°41'15"E, 49°13'23"N (Chrtek 10. VII 2003 PRA). – Trnovecká dolina, 1870 m (Zlatník 24. VIII 1976 SAV). – Trnovecká dolina, 1880 m (Zlatník 20. VIII 1977 SAV). – Trnovecká dolina, 1850 m (Zlatník 26. VIII 1976 SAV). – Trnovecká dolina, 1880 m (Zlatník 6. VIII 1977 SAV). – Trnovecká dolina, 2010 m (Zlatník 9. VIII 1977 SAV). – Trnovecká dolina, 1890 m (Zlatník 17. VIII 1977 SAV). – Trnovecká dolina, 1880 m (Zlatník 20. VIII 1977 SAV). – Trnovecká dolina, 1885 m (Zlatník 25. VIII 1977 SAV). – Trnovecká dolina, 1850 m (Zlatník 25. VIII 1977 SAV). – Trnovecká dolina valley, N 49°09'46.5", E 19°44'04", 1885 m (Šingliarová & Lakoštík 27. VII 2007 SAV). – Ľaliové sedlo saddle, N 49°13'35", E 19°59'30", 1952 m (Šingliarová 25. VIII 2005 SAV).

Vysoké Tatry Mts: Vyšný Príslop, vrcholová časť, exp. SE, 1500 m (Paclová 15. IX 1966 TANAP 7898). – In Krivani montis orientali quam du cunt „Nad ?Gaolwa" e regione mughi superiore incipiens fere usque as cacumen Krivani pro cedi?, locis apricis et meridici obversis copiossisime (Ilse s.d. G s.n., ut *H. alpicolum*). – Dol. Niewcerka pod Krzywaniem (s.coll. 28. VII 1883 KRAM 146131). – Ex alpe Krivan (Kitaibel s.d. BP Herb. Kitaibel XXVI/130, ut *H. alpinum*, rev. Jávorka ut *H. alpicola* subsp. *ullepitschii*). – In valle alpina Handel-Thal

(Thaisz 12. VIII 1912 BP 193993, det. Jávorka ut *H. alpicola* subsp. *ullepitschii*). – Das grosse Krivan (Ilse 28. VII 1868 B s.n., LW, ut *H. alpicola*). – In cacumine montis Kriván, 2000–2200 m (Nyárády 20. VIII 1910 SB 117673). – In monte Kriwán (Filarzsky 3. VIII 1915 BP 191044, det. Zahn ut *H. alpicola* subsp. *ullepitschii*). – Krywań, 1800 m (Trela 20. VIII 1925 KRAM s.n.). – Kriván (s.coll. 1868 SLO s.n.). – Na svahu Kriváne k JZ, 1850 m (Weber 3. VIII 1947 PR P4S 417/5330, ut *H. alpinum* L., rev. Chrtek ut *H. alpicola*). – Hängen der Krivan gegen den Zelené pleso, 5500' (Fritze VIII 1868 PR P4S 417/5621). – Kriwan, 5560´ (Fritze VIII 1868 WU 771, ut *H. alpicolum*, rev. Zahn ut *H. alpicola* subsp. *ullepitschii*). – In alpibus Kriván, 1800 m (Margittai 12. VIII 1928 BP 653523, 664286, det. Zahn ut *H. alpicola* subsp. *ullepitschii*). – In alp. Kriván, 1900 m (Margittai VIII 1928 BP 353509, B 109009350). – In alp. Kriván (Margittai VIII 1928 BRNU 175834, ut *H. ullepitschii*). – In Alpe Patria (Krivan), 1700–1800 m (Bornmüller 25. VII 1912 B s.n., BRNU 164862, W 1927-3414, ut *H. alpicola* var. *rhodopeum*, det. Zahn ut *H. alpicola* subsp. *ullepitschii*). – Wiesen des Kriwan (Sagorski VII 1888 W 1949-5443, ut *H. alpicolum* var. *rhodopeum*). – Krivan, 1400 m (Sagorski VII 188? B s.n., ut *H. alpicola* var. *rhodopeum*). – Kriwan, 2250 m (Sagorski 5. VIII 1887 W 1926-27341, ut *H. alpicola β rhodopeum*). – In monte Krivan, 1600 m (Sagorski VII 1888 SO 80557, WU 1604, W ?-13488, ut *H. rhodopaeum*). – Krivan, 1300 m (Sagorski VII 1884 BP 353597, ut *H. rhodopeum*). – Kriwan (Piasecki VIII 1891 W 1926-18322, det. Wołoszczak ut *H. alpicola* f. *rhodopeum*). – In alpe Krzyvań (Piasecki IX 1891 LW, det. Błocki ut *H. alpicola*). – Ostrá (Eggers 8. VII 1904 PR P4S 417/5471, LW, ut *H. alpinum* L. v. *genuinum* Wimm.). – SW slope of Mt Kriváň, meadow above *Pinus mugo* communities, green-marked tourist path, N 49°09'27", E 19°59'25", 1900 m (Šingliarová 27. VIII 2005 SAV). – SE slope of Mt Kriváň, above blue-marked tourist path, N 49°09'05", E 19°59'55", 1900 m (Šingliarová 27. VIII 2005 SAV). – Mt Kriváň, SE ridge, above blue-marked tourist path, N 49°09'02", E 19°59'55", 1890 m (Mráz & Mrázová 16. VIII 2001 SAV). – Mt Sedielková kopa, around the summit, W of the Furkotská dolina valley, 2050 m (Somogyi 8. VIII 2000 Herb. Mráz, det. Mráz ut *P. alpicola* subsp. *ullepitschii*). – In graminosis alpinis inter Csorbam et vallem Furkota, ca 1400 m (11. VIII 1904 Degen WU-1950-7764, det. Zahn ut *H. alpicola* subsp. *furcotae*). – Furkotská dolina, 1700 m (Kavka 22. VII 1952 BRA). – Furkotská dolina, pri výstupe po neznačenom chodníku do sedla medzi Furkotskou dolinou a dolinou Suchej vody (Somogyi 8. VIII 2000 Herb. Mráz, det. Mráz ut *P. alpicola* subsp. *ullepitschii*). – Dol. Furkotna, murawy zesp. *Trifidi-Distichetum*, 1750 m (Jasiewicz 17. VIII 1955 KRAM 366148). – Furkotská dolina, 1850–1930 m (Mráz & Jurkovičová 7. VIII 2000 Herb. Mráz). – Furkotská dolina valley, near the tourist path, 1858 m (Mráz 3. VIII 2004 SAV). – In valle alpini Furkota ad lac. Hor. Wahlenbergovo, 2400 m (Weber VIII 1925 PR P4S 417/6578). – Furkota pataktól a Kriván alatti Zöldcig (Handelvölgy) (Nyárády 22. VII 1908 SB 117675, det. Zahn ut *H. alpicola* subsp. *furcotae*). – Initio vallis Furkota in pinetis montanae, 1850 m (Hulják 15. VIII 1930 BP 664732, det. Zahn ut *H. alpicola* subsp. *furcotae*). – Furkotská dolina valley, below the Nižné Wahlenbergovo pleso tarn, N 49°09'12", E 20°01'43", 1910 m (Mráz P. & Mráz J. 11. IX 2002 SAV). – Furkotská dolina valley, along the tourist path, below the Nižné Wahlenbergovo pleso tarn, N 49°09'10", E 20°01'40", 1900 m (Šingliarová & Lakoštík 18. VIII 2005 SAV). – Solisko, okolie chaty, 1849 m (Šoltésová 1. VIII 1975 TANAP 5638, 5639, ut *H. alpinum* subsp. *pseudofritzei*, rev. Chrtek ut *P. alpicola*). – Montis Veľ. Solisko, 2400 m (Weber VIII 1925 PR P4S 417/6579, BRA). – In alpe Młynica (Sokołowski 1904 LW, det. Błocki ut *H. alpicola*). – Mlynská dolina, 2150 m (Paclová 15. X 1990 SLO). – Mlynická dolina, v kosodrevine pod vodop. Skok (Marhold 22. VII 1986 SAV, det. Mráz ut *P. alpicola* subsp. *ullepitschii*). – A Mlinica völgyben a tuscitaúl[?] jobloldala menti, gránit türmelénes, lejtü (Hulják VII 1915 CL 159321, ut *H. rhodopeum*). – Mliniczathal in der Höhe der Schleierwasserfallen (Brancsik 18. VIII 1902 BRA, ut *H. alpicola* Schleich var. *rhodopaeum*). – In pratis alpinis supra vodopád Skok (Weber VII 1925 PR N 1371). – In graminosis vallis Mlinica, 1600 m (Margittai 29. VII 1932 PR P4S 417/9352, ut *H. alpicola* subsp. *rhodopeum* = *ullepitschii* Błocki). – Mlinica, Liptó Csorbató (Hulják VII 1915 BP 664770, det. Zahn ut *H. alpicola* subsp. *ullepitschii*). – Cottus Liptó Hungariae: in valle Mlynica, circa catharactam veli (Schleierwasserfall), 1600 m (Hulják VII 1916 BP 375424). – In graniticus vallis Mlinica, pr. Csorbató, 1700 m (Hulják VIII 1917 BRNU 90462, ut *H. rhodopeum*). – Mlynická dolina valley, below Capie pleso tarn, N 49°09'56", E 20°02'14", 2017 m (Mráz P. & Mráz J. 11. IX 2002 SAV). – Mlynická dolina valley, meadows below vodopád Skok waterfall, N 49°09'00", E 20°02'48", 1675 m (Šingliarová & Lakoštík 18. VIII 2005 and 26. VII 2007 SAV). – Montis Predná Bašta, 2360 m (Weber VIII 1925 PR P4S 417/6577, P4S 417/6574, BRA). – Koprovské sedlo, solo granitico, 2100–2200 m (Pénzes 15. VIII 1960 BP 360918). – Mengusovská dolina valley, "Satania dolinka valley", grassy site in semi-open dwarf-pine (*Pinus mugo*) canopies, 1783 m (Mráz & Jurkovičová 12. VIII 2001 SAV). – Mengusovská dolina valley, Satanov žľab, N 49°10'00", E 20°03'27.8", 1875 m (Mráz & Mrázová 12. VIII 2001 SAV). – Mengusovská dolina valley, Satania dolinka valley, N 49°09'57", E 20°03'40", 1800 m (Šingliarová 29. VIII 2005 SAV). – Ad lacum Hincovo (Weber s.d. BRA). – Sub jugo Koprova hágó supra lacum Hinszkó tó [Hincovo pleso], 2100 m (Jávorka & Timkó 17. VIII 1915 BP 191043, 191043, det. Zahn ut *H. alpicola* subsp. *ullepitschii*). – Beim Poprader See (Wołoszczak 26. VII 1897 W 1926-18327, det. Schuhwerk ut *H. alpicola* subsp. *ullepitschii*). – Montis Ostrva, 1890 m (Weber VIII 1925 BRA 40, ut *H. alpicola*

subsp. *ullepitschii*, rev. Mráz ut *P. alpicola* subsp. *ullepitschii* – one plant ad mixtum with other plant belonging to *H. alpinum*). – Ostrva, Popradské pleso (Futák & Hubová 7. VIII 1962 SAV, det. Futák ut *H. alpinum* L., rev. Šingliarová ut *P. alpicola* subsp. *ullepitschii*). – SSE slope of Mt Ostrva, N 49°08'58", E 20°05'22", 1959 m (Šingliarová & Lakoštík 16. VIII 2006 SAV). – Štôlska dolina, 1900 m (Futák & Hubová 3. VIII 1962 SAV, det. Futák ut *H. alpinum* L., rev. Šingliarová ut *P. alpicola* subsp. *ullepitschii*, two plants ad mixtum with other plant belonging to *H. alpinum*). – Południowe stoki Konczystej (s.coll. 28. VIII [18]81 KRAM 146127, ut *H. furcatum* β *alpicola*). – Montis Končistá, 2480 m (Weber VIII 1925 PR P4S 417/6573, BRA). – Dol. Szeroka Jaworzyńska na prełęczu Zamki (Kotula 11. VIII 1881 W 1926-18324, KRAM 146132, ut *H. alpicola*, rev. Zahn ut *H. alpicola* subsp. *ullepitschii*). – In lapidosis herbosis sub jugo Lengyelnyereg [Poľský hrebeň] (Lengyel VII 1912 BP 353596). – In pratis alpinis prope Batizovské pleso (Skřivánek IX 1949 BRNM 0498257, ut *H. alpicola* subsp. *furcotae*). – Valle Felka [Velická dolina] (Scherfel s.d. LW, ut *H. alpicola* x *alpinum*). – Felkerthal [Velická dolina], an der Granatenwand (Scherfel 19. VIII 1893 B s.n., ut *H. alpicola* var. *rhodopeum*). – An der Granatenwand des Felkerthales, 1800 m (Scherfel 29. VIII [18]91 CL 27077, 34883, LW, PR P4S 417/3682, W 1893-2790, SO 80556, G-BU s.n., ut *H. rhodopeum*). – An der Granatenwand des Felkerthales, 1800 m (Scherfel 22. VIII [1]894 B s.n.). – In valle Felka, 1700 m (Margittai VII 1915 BRNU 151106, ut *Hieracium scepusiense* Simk.). – Im Felkathal, granit, 1700 m (Scherfel 19. VIII 1893 KRAM 145637, ut *H. alpicola* var. *rhodopaeum*). – Gräsige Abhänge an der Granatenwand in Felkerthal (Scherfel 24. VIII 1894 CL 54555, B s.n., ut *H. alpicola* var. *rhodopeum*). – A Felkai völgy [Velická dolina] baloldali résnei[?] a l. ci mentén, a granit fal alatt, füva, gnévittalajú (Hulják VIII 1916 CL 161885, ut *H. rhodopeum*). – Velická dolina, 1500 m (Odložilíková 7. VIII 1954 TANAP 2204, det. Skřivánek ut *H. alpicola* subsp. *ullepitschii*). – V sedle medzi Velickou kopou a Dvojitou vežou (Odložilíková 9. VIII 1957 TANAP 2205, det. Skřivánek ut *H. alpicola* subsp. *ullepitschii*). – Kvetnica (Velická dolina) (Domin 5. IX 1919 SAV). – In valle Felka supra Tátraszéplak, 1500 m (Kováts 9. VIII 1927 BP 353594, 664766, det. Zahn ut *H. alpicola* subsp. *ullepitschii*). – Felker Tal [Velická dolina valley]: Zwischen Blumengarten [Kvetnica] und Langem See [Dlhé pleso], 1900 m (Behr 23. VII 1931 W 1950-7762, det. Zahn ut *H. alpicola* subsp. *ullepitschii*). – Felker Tal: über dem Blumengarten, 1900 m (Behr 23. VII 1931 B s.n., det. Zahn ut *H. alpicola* subsp. *ullepitschii*). – Im Felkathale, 1600 m (Preissmann VIII 1905 W 1928-3218, ut *H. rhodopeum*). – Tatra, Kohlbachthal [Veľká Studená dolina] (Fritze VII 1875 W 1889-100627, det. Schuhwerk ut *H. alpicola* subsp. *ullepitschii*). – Kolbachthal (Engler VIII 1888 WU 302, rev. Zahn ut *H. alpicola* subsp. *ullepitschii*). – Veľká Studená dolina, pod Prostredným hrotom, W, 2100 m (Foltínová s.d. BRA). – In valle Nagy Tarpatak [Veľká Studená dolina], 2000 m (Margittai 27. VII 1938 BP 193994). – In valle Nagytarpatakivölgy [Veľká Studená dolina], 2000 m (Margittai 27. VIII 1938 BP 358505, 485493, rev. Mráz ut *P. alpicola*). – In valle Papirus [Veľká Studená dolina], Magna Tátra, granit, 1800 m (Margittai VII 1926 BP 195361, BRNU 129331, 181694, ut *H. scepusiense*). – Senná Kopa (Sychova 27. VIII 1957 KRAM 097893). – Slavkovská dolina, Senná kopa (Paclová 7. VIII 1957 TANAP 4213). – Montis Slavkovský štít, 2400 m (Weber VIII 1925 BRA 40, PR P4S 417/6580). – Mały Kolbach [Malá Studená dolina], kosodrzew (s.coll. 14. VIII 1882 KRAM 146134, ut *H. alpicola*). – Nad Kežmarským Zeleným plesem, 1700 m (Šmarda 23. VII 1961 TANAP 2162, det. Skřivánek ut *H. alpicola* subsp. *ullepitschii*). – Circa Zelené pleso (Jasnier 12. VIII 1925 SLO 784, ut *H. alpinum*, rev. Chrtek ut *P. alpicola*). – In pascuis alpinis „Zöld tó" [Zelené pleso] (Czakó 12. IX 1897 W 1950-7761, BP 353598, ut *H. ullepitschii*, *H. scepusiense*, rev. Zahn ut *H. alpicola* subsp. *ullepitschii*, *H. rhodopeum*). – Am Lomnitzer Gratz oberhalb des Steinbachsees (Wałoszczak 19. VIII 1897 WU 2502, W 1926-18328 ut *H. rhodopeum*, rev. Zahn ut *H. alpicola* subsp. *ullepitschii, syn. H. scepusiense*). – Lomnica (s.coll. 13. VIII 1882 KRAM 146126).

Belianske Tatry Mts: Jatki w Bielskich Alpach (Kotula 27. VIII 1883 W 1926-18329).

Geographically vague / poorly localized samples: Alpes scepusienses, Hungariae borealis (Ullepitsch s.d. W 1926-18323, det. Błocki ut *H. alpicola*). – (Tatrae hungar.). Cultum e semine tatrensi, a d. Ullepitsch accepto (Błocki 1888 G-BOISS s.n., LW 100221, WU 1888-5779, ut *H. Ullepitschii* mihi). – In monte Sucha, Tatra (Wołoszczak 23. VIII 1881 W 1926-18325).

Poland: Western Carpathians – Tatry Zachodnie Mts: Wołowiec (Hruby) nad doliną Chocholowską, skalne upłazy od północy (Pawłowski 13. VIII 1922 KRA 0121250, ut *H. rhodopeum*). – Wolowiec (Hruby), nad dol. Chochołowską, stok upłazy skalne, 1700 m (Pawłowski 13. VIII 1922 KRAM 336757). – Dol. Staroleśna, górny kosodrzew (s.coll. 16. VIII 1882 KRAM 146130). – On the main ridge between Mt Beskid and the Liliowa Prełęcz saddle, Polish part, 1960 m (Mráz 2. IX 2004, SAV s.n.). – Gładkie obok Zaworów (s.coll. 1885 KRAM 146133). – Zavory pas, supra lacus Polnische Fünf Seen, 2000 m (Nyárády 16. VIII 1910 SB 117678, 117677, 117671, ut *H. alpicola,* det. Zahn ut *H. alpicola* subsp. *ullepitschii*).

Tatry Wysokie Mts: Krzyźne (Kulczyński 1879 KRAM 146129). – W. Krzyźne, skaly granitowe (Pawłowski 19. IX 1938 KRAM 145633). – Krzyźne, skaly granitowe, 2115 m (Pawłowski 19. IX 1938 KRAM 336820). – Swinica w Tatrach (Rehmann s.d. LW). – Swinica w Tatrach (Janota s.d. LW). – Miedziane Szpiglasowa Przełecz od Doliny za Mnichem (Zabłocky s.d. KRAM s.n., ut *H. alpinum*, rev. Chrtek ut

H. alpicola). – Mięguszowiecki Środkovy, ściana półn., 2060 m, we *Varieto-Agrostidetum alpinae* (Pawłowski, Sokołowski & Wallisch s.d. KRAM 146135). – Mięg. Wielki, ściana półn., *Varieto-Agrostietum alpinae*, 1680-1700 m (Pawłowski, Sokołowski & Wallisch 18. VII 1926 KRAM 146143). – Mięguszowiecki, ściana półn., 2060 m, we *Varieto-Agrostidetum alpinae* (Pawłowski 10. IX 1926 KRAM 336758).

Romania: Southern Carpathians – Bucegi Mts: Cabana Caraiman, 2060 m (Nyárády 2. VIII 1954 SB 117669). – Cabana Caraiman (Nyárády 28. VII 1954 B, ut *H. alpicola*). – Mtii Bucegi, Babele, Piatra Arsă (Vicol 20. IX 1967 CL 622041). – Southern Carpathians, Munţii Bucegi, Buşteni, ca 0.5 km SE of chalet Cabana Babele, towards to chalet Cabana Caraiman, N 45°24'24", E 25°28'30", 2160 m (Mráz & Chrtek jun. 13. VII 2004 SAV). – Mt Babele, eroded meadows, N 45°24'29", E 25°28'22", 2204 m (Šingliarová 5. VIII 2006 and 16. VII 2007 SAV).

Eastern Carpathians – Nemira Mts: Sandru, Slanic (Mold.) (Brândză VII 1909 CL 618426, det. Prodan ut *H. alpicola*). – Slanic (Mold.), Sandru (Brândză & Solacolu VII 1914 CL 618648, det. Prodan ut *H. alpicola* f. *romanicum* Prodan). – Slanic (Mold.), Şandru (Brândză & Solacolu VII 1914 CL 618596, det. Prodan ut *H. alpicola* f. *romanicum* Prodan, note added: "cu capituli mai mari"). – Slanic (Mold.), Stâncile de pe Ţiganca [Nemira Mica?] (Brândză & Solacolu VII 1920 CL 618629, det. Prodan ut *H. alpicola*). – Slanic (Mold.), Stâncile de pe Ţiganca [Nemira Mica?] (Brândză & Solacolu VII 1920 CL 618650, det. Prodan ut *H. alpicola* f. *magnocephala* Prod.). – Slanic (Mold.), Sandru (Brândză & Solacolu VII 1920 CL 621118**,** det. Prodan ut *H. alpicola* f. *magnocephala* Prod.). – Slanic (Mold.), pe Şandru (Brândză & Solacolu VII 1920 CL 618627, 618610, det. Prodan ut *H. alpicola* f. *macrocephala*, rev. Nyárády ut *H. alpicola* var. *ullepitschii*). – Keleti Kárpátok, Nagy Sándór teteje [Sandru Mare], 1600 m (Bányai 23. VIII 1936 SB 117670). – Mt Sandru Mare, top of the mount, clearing, N 46°11'57", E 26°20'21", 1640 m (Šingliarová 2. VIII 2006 SAV). – Mt Sandru Mare, secondary clearing in *Juniperus sibirica*, SW slope, N 46°11'59", E 26°20'29", 1590 m (Šingliarová & Lakoštík 18. VII 2007 SAV). – Mt Sandru Mare, secondary clearing in *Juniperus sibirica*, SW slope, N 46°11'59", E 26°20'29", 1590 m (Mráz & Chrtek jun. 15. VII 2004 SAV). – Mt Nemira Mare, rocks on the top of the mount, N 46°15'21.5", E 26°19'25.5", 1641 m (Šingliarová & Lakoštík 18. VII 2007 SAV). – Mt Nemira Mica, rocks on the top of the hill, N 46°13'59", E 26°19'55", 1600 m (Šingliarová & Lakoštík 18. VII 2007 SAV).

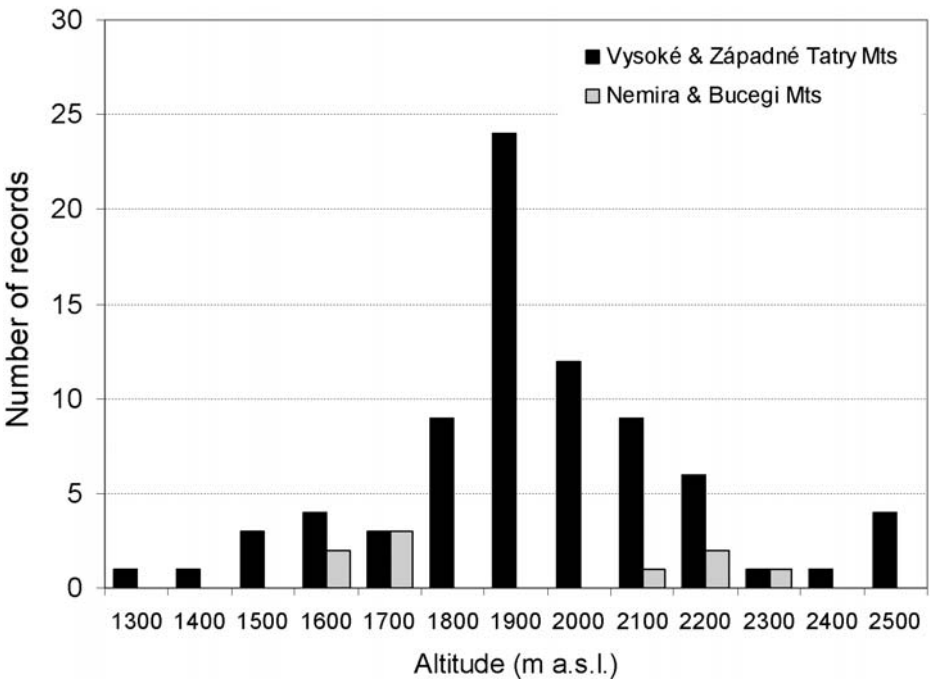

Fig. 3. – Altitudinal distribution of *P. ullepitschii* in the Western Carpathians (the Vysoké and Západné Tatry Mts) and Romania (the Nemira and Bucegi Mts) based on our field observations and herbarium specimens.

Ecology

In the Western Carpathians *P. ullepitschii* is confined to primary subalpine/alpine meadows, dwarf-shrub heaths and screes often dominated by *Avenula versicolor* (Vill.) M. Laínz [alliances of *Loiseleurio-Vaccinion* Br.-Bl. in Br.-Bl. et Jenny 1926 (Šibík et al. 2007) and *Juncion trifidi* Krajina 1933 (Krajina 1933, Dúbravcová & Jarolímek 2007)] at (1300–) 1800–2200 m a.s.l. (Fig. 3). A weak competitor, it grows in open sites with shallow and skeletal soils on acid bedrock (mostly granite, rarely mylonits). Its occurrence is patchy, and the populations are usually small. In contrast to the Western Carpathian sites, the isolated Romanian Eastern and Southern Carpathian localities are man-made habitats. In the Nemira Mts *P. ullepitschii* grows in secondary meadows and clearings dominated by the grasses *Nardus stricta* L. and *Festuca supina* Schur. There are no alpine and subalpine belts in this range. The meadows were created for pasture purposes in a spruce belt during medieval times. A large part of the main ridge was recently (ca 30–50 years ago) reforested with spruce, which grows to 6–8 m, even at these high altitudes (above 1600 m a.s.l.). In this mountain range *P. ullepitschii* is known from three summits, which reach about 1600 m (1590–1650 m a.s.l., Fig. 3). Besides disturbed places in the pastures, *P. ullepitschii* was also found growing in crevices of small flysch rocks (ca 4 m high) scattered on the summits of the mountains, which provide a competition-free habitat. Similarly, in the Bucegi Mts (Southern Carpathians) the species occurs at sites untypical for this taxon, such as large deforested plateaus (2100–2300 m a.s.l., Fig. 3) and grasslands on decalcified soils on calcium-rich conglomerates, where the original vegetation possibly consisted of *Pinus mugo* communities (Beldie 1940). The area is severaly afftected by tourism (lifts, hotels, routes) and overgrazing. In spite of human activities the population there is the largest in the whole range.

Genetic variation

A recent study using codominant allozyme markers revealed significant difference in genetic variation between the Western Carpathian populations and those from the Romanian Eastern and Southern Carpathians (Šingliarová et al. 2008). Whilst there is large panmictic and variable population in the Western Carpathian, that in the Romanian Carpathians is genetically depauperate. It is suggested that the low genetic diversity is a result of a strong founder effect, a consequence of long-distance dispersal. The unusual habitats at the Romanian localities coupled with the low genetic diversity led Šingliarová et al. (2008) to speculate that this species was unintentionally introduced into Romania.

Pilosella rhodopea (Griseb.) Szeląg

Pilosella rhodopea (Griseb.) Szeląg, Ann. Bot. Fenn. 45: 302, 2008.

≡ *Hieracium rhodopeum* Griseb., Abh. Königl. Ges. Wiss. Göttingen 5: 91, 1853. Lectotype selected by Szeląg (2008).

≡ *Hieracium alpicola* var. ["β"] *rhodopeum* (Griseb.) Nägeli et Peter, Hierac. Mitt.-Eur. I.: 283, 1885.

≡ *Hieracium alpicola* subsp. *rhodopeum* (Griseb.) Zahn in Koch, Syn. Deut. Schweiz. Fl. ed. 3: 1713, 1900.

= *Hieracium micromegas* Fr., Uppsala Univ. Årsskr. 1862: 25, 1862. Lectotype selected by Szeląg (2008).

Table 2. – Morphological characters used to differentiate *Pilosella ullepitschii* and *P. rhodopea*.

Character	*P. ullepitschii* (95 plants, 8 populations)	P. rhodopea (20 plants, 1 population)
Stem height (cm)	(5–) 7–15 (–19)	(4.5–) 5.4–11.0 (–13.0)
Stellate trichomes on the adaxial leaf surface	few	dense
Stellate trichomes on the abaxial leaf surface	few to numerous	dense
Stellate trichomes on the upper part of the stem	scattered to numerous	numerous
Simple eglandular trichomes on the stem and involucre	smoky grey with pale apex	pale white to pale grey, rarely smoky grey base (up to 1/3 of the length)
Flower length (mm)	(8.7–) 12.1–14.3 (–15.9)	(7.2–) 8.2–10.0 (–10.4)
Flower width (mm)	(1.6–) 2.2–2.6 (–2.8)	1.1–1.7
Style length (mm)	(6.0–) 7.4–10.2 (–12.0)	(5.3–) 5.5–7.1 (–7.6)

Table 3. – Proportions of mature (ripe) seeds of diploid *Pilosella ullepitschii* obtained in the different breeding experiments. See Appendix 1 for the list of plants used in the experiments.

Number of plants tested	Experiment	Average proportion of mature seeds (%)
15	Open pollination	56.3
14 (7 pairs)	Controlled pollination	45.8
13	Isolation	0
8	Castration	0

D e s c r i p t i o n (based solely on plants from Mt Cozia): Phyllopodous. Underground stolons usually absent, if present then up to 3 cm long. Stem (4.5–) 5.4–11.0 (–13.0) cm tall, slender, with rare simple eglandular and glandular trichomes and numerous stellate trichomes along whole length of the stem, with towards the apex few, 3–4 mm long simple eglandular trichomes, pale white to pale grey, rarely with smoky grey bases (up to 1/3 of the length, present in ca 20% of individuals) and dense stellate trichomes, 1–2 short, single headed branches, acladium 0.8–1.3 (–2.6) cm long. Rosette leaves (6–) 10–15 (–19) at the time of flowering, greyish-green, lanceolate, without obvious petiole, (1.1–) 2.5–5.7 (–6.7) × (0.2–) 0.3–0.5 cm, at the apex rounded or slightly mucronate, entire, both adaxial and abaxial surfaces with dense stellate trichomes, abaxial with few to moderately dense eglandular trichomes, glandular trichomes absent or very rare and light brown. Cauline leaves 0–1, narrowly lanceolate, with numerous stellate and eglandular trichomes. Heads 1–2. Involucral bracts linear lanceolate, (3.6–) 4.1–5.4 (–5.8) × (0.35–) 0.40–0.50 (–0.60) mm, white-greyish, with very dense pale grey, (1.0–) 1.1–2.4 (–3.6) mm long eglandular trichomes, stellate and glandular trichomes are usually invisible due to the high density of simple eglandular trichomes. Ligules yellow, (7.2–) 8.2–10.0 (–10.4) × 1.1–1.7 mm. Styles pure yellow, (5.3–) 5.5–7.1 (–7.6) mm long. Achenes not studied. Flowers produced from the end of June to the end of July.

P l o i d y l e v e l: Fourteen plants from Mt Cozia were diploid (2n ~ 2x). The only triploids (2n = 3x = 27) previously reported for this taxon are from the Bulgarian Pirin Mts (Vladimirov & Szeląg 2001, as *H. alpicola*). A diploid ploidy level is therefore new for this species. Our yet unpublished detailed study revealed four ploidy levels (2x, 3x, 4x, 5x) and a complex cytogeographic pattern with diploid and ploidy-mixed populations at the

centre of its distribution in the Balkan Peninsula (Šingliarová & Mráz 2008, B. Šingliarová et al., unpublished).

B r e e d i n g s y s t e m: We did not test the mode of reproduction of the diploid plants from Mt Cozia. However, these plants are likely to reproduce sexually, like all diploids of *Pilosella* so far tested (Krahulcová et al. 2000).

Distribution

Like *P. ullepitschii*, *P. rhodopea* has a disjunct distribution. The core of the range is situated in the mountains of the Balkan Peninsula (e.g., Stara planina Mts, Rila Mts, Pirin Mts, Shar planina Mts, Korab Mts), where it occurs in the alpine (subalpine) belt (1800–2600 m a.s.l.), in alpine communities such as *Seslerion comosae* Horvat 1935, or in open clearings amongst *Pinus mugo* growing on acid bedrock (V. Roussakova 2000, personal observations). Two isolated localities were confirmed for the Southern Carpathians (Romania): Mt Zmeuretu in the Capaţini Mts and Mt Cozia (Fig. 2C).

S p e c i m i n a v i s a :

Romania: S o u t h e r n C a r p a t h i a n s : C a p a ţ i n i , M t s: Mt Zmeuretu – Muntii Capaţini, In păşuni alpine, Reg. Argeş R-Vilcea, alt. ca 2000 m (Ciurchea 20.VII 1950 CL 444641, ut *H. alpicola* subsp. *rhodopeum*).

C o z i a M t s: Muntenia, distr. Argeş, Cozia, partea superior, 1400–1600 m (E. I. Nyárády 20. VI. 1950 SB 117668, ut *H. alpicola* var. *rhodopeum*). – Mt Cozia, secondary meadows in the summit area, N 45°19'04", E 24°20'17", 1592 m (Šingliarová & Lakoštík 14. VII. 2007 SAV).

Ecology

On Mt Cozia, *P. rhodopea* grows in secondary pastures near the tourist chalet at a relatively low altitude (1592 m a.s.l.) in the supramontane belt originally colonized by spruce forests. The bedrock consists of crystalline schists. At present, the meadows with *P. rhodopea* are surrounded by areas re-forested with spruce. This locality currently resembles those of *P. ullepitschii* in the Nemira Mts. However, at the summit of Mt Cozia, close to this locality, there are several very steep, high rocky slopes with open forest and herbaceous vegetation, and *P. rhodopea* may be present in these relict sites. On the other hand, the second documented locality of *P. rhodopea* in the Capaţini Mts, according to the herbarium specimen, seems to be more typical, i.e. alpine meadow on acid bedrock. Unfortunately, we were not able to find this population in 2006 and 2007.

Note on Hieracium ×amphibolum Rehm., nom. illeg.

Rehmann (1894) described *H. amphibolum* from the Vysoké Tatry Mts, pointing out its probable hybrid origin [*Hieracium lactucella* (originally *H. auricula*) × *Hieracium alpinum*]. This name is, however, illegitimate because of the prior existence of the name *H. amphibolum* Boreau (Boreau 1857). For this reason Zahn (1906) published a new name, *H. alpicola* subsp. *furcotae* Degen et Zahn, with the name *H. amphibolum* Rehm. as a synonym. At the same time Zahn stated that the taxon could be a hybrid between *H. alpicola* subsp. *ullepitschii* and *H. auricula*. According to our field observations and study of original material, *P. alpicola* subsp. *furcotae* is conspecific with *P. ullepitschii*. The herbarium material originally used for the description of *H. amphibolum* Rehm. nom. illegit. appears to be missing and the protologue does not contain a detailed morphological description. Rehmann

(1894) published an illustration of *H. amphibolum*, but it is not clear, if the plant illustrated is really *P. ullepitschii* (cf. Szeląg 2008), or a hybrid with *P. lactucella*. *Hieracium amphibolum* Rehm. nom. illegit. was collected at a relatively low altitude, where both taxa might co-occur, as on Mt Sandru Mare in the Nemira Mts (P. Mráz & J. Chrtek jun., personal observation, 2004), where interspecific hybridization may have occured.

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Súhrn

Štúdium skupiny *Pilosella alpicola* v Karpatoch potvrdilo prítomnosť dvoch morfologicky odlišných taxónov – *P. ullepitschii* (Błocki) Szeląg a *P. rhodopea* (Griseb.) Szeląg. Zatiaľčo *P. ullepitschii* je endemitom Karpatského oblúka, balkánsky subendemit *P. rhodopea* má v Karpatoch len dve izolované lokality v Južných Karpatoch (pohoria Cozia a Capaţini). Areál *P. ullepitschii* je taktiež disjunktný s centrom výskytu na prirodzených subalpínskych a alpínskych lúkach Vysokých a vzácne aj Západných Tatier (Západné Karpaty, Slovensko a Poľsko). Len tri izolované lokality sú známe z pohoria Nemira (Východné rumunské Karpaty) a jedna z pohoria Bucegi (Južné rumunské Karpaty). Rumunské populácie rastú na biotopoch pozmenených človekom (sekundárne pasienky). Karyologicky a cytometricky sme stanovili chromozómový počet resp. ploidnú úroveň pre 305 rastlín pochádzajúcich z 13 populácii z oboch arel. Výsledky ukázali, že *P. ullepitschii* je výhradne diploidný (2n = 2x = 18), sexuálne sa rozmnožujúci taxón. Jediná analyzovaná karpatská populácia *P. rhodopea* z pohoria Cozia je tiež diploidná, avšak populácie z hlavného areálu *P. rhodopea* v horách Balkánu zahŕňajú aj iné cytotypy. Uvádzame detailný morfologický opis a podrobné rozšírenie týchto dvoch taxónov skupiny *P. alpicola* v Karpatoch.

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Appendix 1. – List of plants of *Pilosella ullepitschii* used for inferring of the mode of reproduction. The code (consisting of locality code and cultivation number) of each particular plant is given for each kind of experiment. Numbers in parantheses after each plant or pair of plants mean the percentage of ripe achenes. Some flower heads aborted after crossing in controlled pollination experiments, and therefore it was not possible to determine the proportion of ripe achenes in these cases.

Open pollination:
U-MLY-11 (19.8), U-FUR-28 (89.5), U-LAL-52 (65.9), U-KR55-91 (27.9), U-MEN-121 (45.3), U-MEN-125 (55.4), U-OST-1 (42.2), U-SMA-1690 (58.2), U-SMA-1710 (78.6), U-SMA-1701 (88.2), U-SMA-1691 (65.3), U-SMA-1694 (81.3), U-SMA-1693 (31.2), U-SMA-1699 (69.7), U-SMA-1692 (25.6).

Controlled pollination:
U-FUR-41×U-MLY-11 (26.6 / 89.5), U-LAL61×U-MLY-13 (75.4 / flower head aborted), U-FUR-35×U-FUR-37 (52.4 / 75.4), U-MLY-12×U-MLY-10 (65 / 76.2), U-MLY-3×U-MLY-19 (37.2 / 56.2), U-MEN-130×U-FUR-25 (32.1 / flower head aborted), U-SMA-1710×MLY5 (73.1 / flower head aborted).

Isolation (none of treated plant produced ripe achenes):
U-MLY-2, U-MLY-6, U-MLY-13, U-MLY-18, U-MLY-21, U-FUR-30, U-FUR-31, U-FUR-39, U-LAL-59, U-MEN-116; U-SMA-1688, U-SMA-1689, U-SMA-1690.

Castration (none of treated plant produced ripe achenes):
U-MLY-2, U-MLY-4, U-MLY-13, U-MLY-18, U-FUR-32, U-FUR-35, U-FUR-36, U-FUR-43.