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Chromosome numbers and reproductive systems in selected species of *Hieracium* and *Pilosella* (Asteraceae) from Romania

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Chromosome numbers are given for 17 taxa of the genus *Hieracium* and 4 taxa of the genus *Pilosella* originating from Romanian Eastern and Southern Carpathians: *Hieracium alpinum* (2n = 18), *H. atratiforme s. lato* (2n = 36), *H. bifidum s. lato* (2n = 27, 36), *H. inuloides* (2n = 27), *H. jankae* (2n = 27), *H. lachenalii s. lato* (2n = 27), *H. lubricicaule* (2n = 27), *H. kotschyanum* (2n = 27), *H. magocsyanum* (2n = 27), *H. ostii-bucurae* (2n = 27), *H. praecurrens s. lato* (2n = 27), *H. ratezaticum* (2n = 36), *H. sabaudum s. lato* (2n = 27), *H. telekianum* (2n = 27), *H. tomiasae* (2n = 27), *H. tubulare* (2n = 27), *H. transylvanicum* (2n = 18), *Pilosella aurantiaca* (2n = 36, 45), *P. bauhinii* (2n = 45), *P. cymosa* (2n = 36) and *P. pavichii* (2n = 18). For the first time the chromosome numbers are reported for the following taxa: *H. atratiforme s. lato*, *H. jankae*, *H. lubricicaule*, *H. kotschyanum*, *H. magocsyanum*, *H. ostii-bucurae*, *H. telekianum*, *H. tomiasae* and *H. tubulare*. Apomictic mode of reproduction was proved in triploids *H. jankae*, *H. lubricicaule*, *H. kotschyanum, H. magocsyanum*, *H. ostii-bucurae*, *H. telekianum*, *H. tomiasae* and *H. tubulare* by emasculation experiments. Diploid populations of *Hieracium alpinum* were confirmed in the Southern and Romanian Eastern Carpathians. Because diploid *H. alpinum* occurs just in the Eastern and Southern Carpathians and nowhere else, these parts of its area of distribution may be considered as glacial refugia for this species. The Skhidni Beskidi Mts. (the most western part of the Eastern Carpathians) probably represented a strong barrier of postglacial migrations of some diploid *Hieracium* taxa from the Eastern Carpathians towards the Western Carpathians.

Key words: apomixis, breeding system, cytotaxonomy, glacial refugia, *Hieracium*, *Pilosella*, ploidy level

Introduction

Hieracium and *Pilosella* are among the most taxonomically complicated genera in the plant kingdom. Although it is a much debated point, in this paper the two entities will be treated as distinct genera. It seems that their complexity is caused by a reticulate pattern of morphological and molecular variation. Probably, in the past, immense hybridization events, including introgression, were the most powerful mechanism of speciation resulting in thousands of taxa in the genus *Hieracium*. This history contrasts with the present situation, when hybridization is very rare (Mráz *et al*. 2003). The situation in *Pilosella* is different; its taxa are usually highly outcrossing under current natural conditions (Krahulcová *et al*. 2000). Polyploidy connected with an apomictic mode of reproduction is another typical feature of both genera. In *Hieracium* sexual diploids are very rare, while apomictically reproducing polyploids (diplospory of *Antennaria* type) are much more common (Merxmüller 1977). Conversely, facultative apomixis (apospory of *Hieracium* type) and even full sexuality in polyploids are known in the genus *Pilosella* (Krahulcová *et al*. 2000). In *Hieracium* triploids and tetraploids (2n = 27, resp. 36; pentaploids are very rare, cf. Stace *et al*. 1995, Chrtek 1996) are believed to reproduce by obligate apomictic formation of the seeds. However, some irregularities observed in the development of the apomictic megaspore mother sac led us to suggest that at least some traces of residual sexuality could exist in *Hieracium* polyploids. Skawińska (1963) observed that ca. 50% of ovules in the triploid *Hieracium alpinum* were early degenerated probably due to true meiotic division leading to an unviable macrospore tetrad.

Knowledge of ploidy level is one of the most important sources of information indicating the mode of reproduction and forms the basis for taxonomic evaluation. Although many chromosome counts for many taxa were published in both genera (for review *see* Schuhwerk 1996), some regions are still poorly investigated and represent *terra incognita* from the karyological point of view. Romania is a country with a very high diversity of these two genera. Nyárády (1965) reported 55 species in *Pilosella* and 165 species in *Hieracium*. In each genus there are several hundreds (if not thousands) of infraspecific taxa (subspecies, varieties and forms). Moreover, the Munţii Retezatului (Retezat Mts.) in the Southern Carpathians are considered to be one of the most important centres of evolution of the genus *Hieracium*, with many endemic taxa described from the area (Nyárády 1930).

To the best of our knowledge, chromosome numbers for *Hieracium* and *Pilosella* species from Romania have been presented in four sources only. Christoff and Popoff (1933) published chromosome counts for several taxa from the seed collection of the Botanical Garden in Cluj, but with no indications of localities, thus the origin of plant material is unkown. Ştefureac and Tăcină (1979) reported the relict diploid species *Hieracium pojoritense*, endemic of calcareous moutains in NE Romania. Later, Mráz (2003b) confirmed the diploid counts for this species. The diploid level of *H. transylvanicum* and *H. alpinum* was reported for the first time from the Romanian Carpathians by Mráz (2003b). The triploid level (2n = 27) was reported for *H. borsanum*, *H. brevipiliferum* and an unnamed taxon from *Hieracium* sect. *Alpina*; the tetraploid level (2n = 36) for *H. ratezaticum* and *H. pietroszense* (Mráz 2001, 2003a, 2003b). *Pilosella bauhinii* was counted as tetra- and hexaploid in one Romanian population (Rotreklová 2002).

Material and methods

Chromosome counts were made in pot-grown plants by P. Mráz. Root tip cuttings were pretreated with 0.5% solution of colchicine for 1.5–3 hours at room temperature. Subsequently fixative (absolute ethanol and glacial acetic acid, 3:1) replaced colchicine. Roots were stored in 70% ethanol and hydrolysed for 10 minutes in 1 N HCl at 60 °C. The squash and smear method with cellophane replacing the glass covers followed Murín (1960). Giemsa solution in phosphate buffer was used as a stain. Voucher specimens of the analysed plants or gatherings from the field are deposited in Herbarium P. Mráz and Herbarium Z. Szeląg. The number given in

parentheses after each locality is the cultivation number of plants cultivated in the Botanical Garden of the P. J. Šafárik University.

The mode of reproduction for polyploid species from *Hieracium* sect. *Cernua* and *H. jankae* (cultivated by the second author) was determined by emasculation experiments. The emasculation was carried out by cutting off the whole upper half of the capitulum together with the styles (five flower heads per species). Those flower heads producing fully developed seeds after emasculation were recognized as apomictic.

The chromosome counts published here are the results of several expeditions of the first author in Romania (in 2000 with V. Jurkovičová *et al*., in 2001 with Ph. Choler, and in 2002 with Z. Szeląg).

Taxonomic concept

The analysed taxa of the genus *Hieracium s. stricto* are arranged into sections recognized by Stace (1998), whereas the species of *Pilosella* are given in alphabetical order.

For polyploid taxa, i.e. triploids and tetraploids, we have usually adopted a narrow concept of species. However, in several cases the taxa are treated as *s. lato*, because we are not sure of the application of correct names (lack of knowledge of whole range of variability, type material and locality, etc.).

Results

Genus *Hieracium*

Hieracium sect. *Alpina*

Hieracium alpinum L. — 2n = 18

Localities: **1**. Munţii Retezatului [Retezat Mts.] on the ridge between Mt. Bărlea and Mt. Seşele Mari, ca. 2300 m, 8.VII.2001 *P. Mráz* (1 plant, no. 1018). **2**. Munţii Retezatului [Retezat Mts.], on the ridge Culmea Lolaia, Saua Ciurila saddle, ca. 1800 m, 7.VII.2001 *P. Mráz* (2 plants, nos. 1054, 1055). **3**. Munţii Retezatului [Retezat Mts.], Valea Pietrele, ca. 1950 m, 8.VII.2001 *P. Mráz* (1 plant, no. 1028). **4**. Munţii Rodnei [Rodna Mts.], on the path from Borşa to Staţia Meteo below Mt. Pietrosul Mare, 1500–1700 m, 5.VII.2001 *P. Mráz* (1 plant, no. 1061). **5**. Munţii Bistriţei Mts., the Massif Ceahlău, northern slopes of Mt. Toaca, 1545 m, 18.VII.2000 *P. Mráz & V. Jurkovičová* (1 plant, no. 807). **6**. Munţii Bistriţei Mts., Mt. Pietrosul Bogolin, in the Massif of Mt. Pietrosul Broşteni lor, 1650–1700 m, 20.VII.2000 *P. Mráz* (1 plant, no. 828).

We confirm the presence of diploid populations in the Ukrainian (Chrtek 1997, Mráz 2001) and Romanian Eastern and Southern Carpathians (Mráz 2003b).

Because in the rest of the area of distribution (including the Western Carpathians) *H. alpinum* is represented by triploids (e.g. Schuhwerk 1996, Chrtek 1997) we suppose that glacial refugia of diploid *H. alpinum* have been in the territory of the Eastern and Southern Carpathians or very close to these mountain ranges. The diploid state is usually assumed to be ancestral to higher ploidy levels. It seems that triploid populations of *H. alpinum* have arisen outside the Eastern and Southern Carpathians. The glacial refugia of this species in the territory of the Eastern Carpathians (at that time no counts were available from the Southern Carpathians) were deduced also by Štorchová *et al*. (2002). The tetraploid level for *H. alpinum* was reported only once (Szeląg & Jankun 1997) from the Polish part of the Tatra Mts.

Hieracium sect. *Vulgata*

Hieracium lachenalii s. lato — 2n = 27

Locality: **1**. Munţii Apuseni [Bihor Mts.], Pietroasa, SE slopes of Mt. Cornul Munţilor, 46°38´17.0´´N, 22°40´19.2´´E, 1453 m, 3.VIII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1284).

Hieracium lachenalii s. lato is a very complex taxonomic entity. For most of the distribution area *H. lachenalii s. lato* has been found to be triploid (cf. Schuhwerk 1996, Schuhwerk & Lippert 1998). In Central Europe the chromosome number 2n = 27 was also reported by Májovský *et al*. (1974) from the Slovak part of the Western Carpathians, and by Krahulcová (1990) from the Bohemian Karst. The tetraploid level (2n = 36) was reported by Lavrenko and Serditov (1987), and a hypertriploid level (2n = 28) by Rostovtseva (1979) (as *H. tilingii*).

Hieracium transylvanicum Heuff. — 2n = 18

Localities: **1**. Munţii Hargithei [Hargitha Mts.], Băile Tuşnad, Mt. Piatra Şoimului, beech-fir forest below the top, 46°08´55.1´´N, 25°50´57.9´´E, 750 m, 29.VII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1240/T). **2**. Munţii Apuseni [Bihor Mts.], Pietroasa, ridge of Dl. Pălţinetu, 46°37´37.1´´N, 22°39´42.7´´N, 1266 m, 3.VIII.2002 *P. Mráz & Z. Szeląg* (2 plants, nos. 1279, 1282). **3**. Munţii Hăghimaşului [Hăghimaş Mts.], Bălan, spruce forest by the path from Bălan to Mt. Ecem, ca. 1200–1300 m, 16.VII.2000 *P. Mráz & V. Jurkovičová* (1 plant, no. 783).

This diploid species is distributed across the Eastern and Southern Carpathians to the mountains in the Balkan Peninsula. The western-most localities are situated in Steier in Austria (Zahn 1922–1939). Some localities were given also from the Western Carpathians, but these data are highly doubtful. For the first time the diploid chromosome number for *H. transylvanicum* was reported by Rosenberg (1927), but without indication of the exact locality of the studied material. Later, Chrtek (1996) reported the diploid level for plants from the Ukrainian Eastern Carpathians and Vladimirov (2000) for plants coming from the Stara Planina Mts. in Bulgaria. Mráz (2003b) confirmed diploid counts in plants from the Romanian Eastern Carpathians.

Hieracium sect. ***Subalpina***

Hieracium atratiforme s. lato — 2n = 36

Locality: **1**. Munţii Godeanului [Godeanu Mts.], Mt. Tomeasa, spruce forest by the path from Gura Apei, 45°21´15.7´´N, 22°42´35.4´´E, 1480 m, 2.VIII.2002 *P. Mráz & Z. Szeląg* (2 plants, nos. 1248, 1249).

This is the first chromosome number report for this taxon, which is morphologically between *H. transylvanicum* and *H. kotschyanum*.

Hieracium ratezaticum (Nyár. & Zahn) Mráz — 2n = 36

Locality: **1**. Munţii Retezatului [Retezat Mts.], the slopes 0.2 km W of the Zănoaga lake, exp. S–SE, 45°20´30´´N, 22°20´E, 1850–1980 m, 8.VII.2001 *P. Mráz* (1 plant, no. 1045).

Mráz (2001) reported the same chromosome number from other specimens collected in 1998 from the same locality.

Hieracium sect. ***Hieracium***

Hieracium bifidum s. lato — 2n = 27, 36

Localities: **1**. Munţii Hăghimaşului [Hăghimaş Mts.] Bălan, spruce forest by the path from Bălan to Mt. Ecem, ca. 1200 m, 16.VII.2000 *P. Mráz & V. Jurkovičová* (2 plants, nos. 784, 785, 2n = 27). **2**. Munţii Godeanului [Godeanu Mts.], Mt. Tomeasa, SE rocky slope, by the path from Gura Apei, 45°21´16.7´´N, 22°42´08.3´´E, 1796 m, 2.VIII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1254, 2n = 36). **3**. Munţii Banatului [Banat Mts.], summit area of the Mt. Treskovać, rock crevices and rocky ground, 44°33´43´´N, 22°03´08´´E, 680 m, 31.VII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1265, 2n = 36).

The *Hieracium bifidum* group represents a morphologically very polymorphic complex and is in need of a thorough taxonomic and nomenclatural revision (Mráz & Marhold 2002). Up to now, the diploid, triploid and tetraploid levels have been reported (cf. Schuhwerk 1996). From the Western Carpathians (Mt. Pilsko) the triploid number for *H. bifidum* was published by Májovský *et al*. (1970), although this count most probably refers to a taxon of the *H. lachenalii* group, not to *H. bifidum s. lato*.

The taxon counted here from the Munţii Hăghimaşului is probably related to *H. pseudobifidum* (morphological position: *bifidum–transylvanicum*). It has a similar indumentum in the basal part of its stem and partially on the leaves, and smaller capitula with scattered to numerous glandular trichomes as in *H. transylvanicum*. On the other hand, there are numerous stellate trichomes on the peduncles and involucres.

Hieracium praecurrens s. lato — 2n = 27

Locality: **1**. Munţii Hargithei [Hargitha Mts.], Băile Tuşnad, Mt. Piatra Şoimului, beach-fir forest below the top, 46°08´55.1´´N, 25°50´57.9´´E, 750 m, 29.VII.2002 *P. Mráz & Z. Szeląg* (2 plants, nos. 1239, 1240/P).

The triploid chromosome number for this

taxon with intermediate morphology between diploid *H. transylvanicum* and usually triploid *H. murorum s. lato* was found by Mráz (Chrtek *et al.* 2004). The area of distribution is more or less the same as that of *H. transylvanicum* except in the Western Carpathians (cf. Sell & West 1976), where the occurrence of *H. transylvanicum* is strongly doubtful.

Hieracium sect. ***Foliosa***

Hieracium inuloides Tausch — 2n = 27

LOCALITY: **1**. Munţii Apuseni [Bihor Mts.], Pietroasa, SE slopes of Mt. Cornul Munţilor, 46°38´17.0´´N, 22°40´19.2´´E, 1453 m, 3.VIII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1285).

This taxon is very rare not only in the Romanian Carpathians (Nyárády 1965), but also in the whole Carpathian arc (Zahn 1922–1938), and the locality given above is new. According to the first author of this contribution, the Romanian plants from the Bihor Mts. are morphologically similar to those from the Western Carpathians and the Sudeten Mts., from where the taxon was originally described.

The triploid number presented here agrees with that of Morton (1974) for *H. subcrocatum* and with two counts from the Western Carpathians (Mráz in Chrtek *et al.* 2004). Finch (in Moore 1982) also published 2n = 27 for *H. latobrigorum*.

Hieracium sect. ***Pilosissima***

Hieracium jankae R. Uechtr. — 2n = 27 (apomictic mode of reproduction)

LOCALITY: **1**. Munţii Banatului [Banat Mts.], summit area of the Mt. Treskovać, scattered *Caprinus orientalis* forest on quartzite, 44°33´35.3´´N, 22°03´36.3´´E, 680 m, 31.VII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1266).

This is the first chromosome report for this species that is based on a plant from the type locality. The triploid chromosome number was previously given for *H. jankae s. lato* from the Pirin Mts. in Bulgaria (Vladimirov & Szeląg 2001b) and for "*H. jankae* Uechtr. *cf.* subsp. *patentiramum* Rech. f. & Zahn" (Schuhwerk & Lippert 1998).

Hieracium sect. ***Sabauda***

Hieracium sabaudum s. lato — 2n = 27

LOCALITIES: **1**. Munţii Banatului [Banat Mts.], ca. 0.5 km SE from Mt. Treskovać, oak forest margin, 44°33´35.3´´N, 22°03´36.3´´E, 481 m, 31.VII.2002 *P. Mráz & Z. Szeląg* (no. 1269). **2**. Munţii Hargithei [Hargitha Mts.], Băile Tuşnad, Mt. Piatra Şoimului, beech forest margin by the andesit rocks, 46°08´55.1´´N, 25°50´57.9´´E, 850 m, 29.VII.2002 *P. Mráz & Z. Szeląg* (no. 1237).

Triploid chromosome numbers greatly prevail in the literature. However, diploid and tetraploid levels have also been reported (cf. Schuhwerk 1996). Both diploid (Feráková 1971, Májovský *et al.* 1974, Uhríková & Feráková 1977, Hrušovská-Osuská 1988) and triploid chromosome numbers (Májovský *et al.* 1970, 1974, 2000) were given for populations from the Western Carpathians. However, with high probability all diploid numbers refer to *H. umbellatum* rather than to *H. sabaudum s. lato* (cf. Chrtek *et al.* 2004).

Hieracium sect. ***Cernua***

Hieracium kotschyanum Heuff. — 2n = 27 (apomictic mode of reproduction)

LOCALITIES: **1**. Munţii Godeanului [Godeanu Mts.], Mt. Tomeasa, SE rocky slope, by the path from Gura Apei, 45°21´16.7´´N, 22°42´08.3´´E, 1796 m, 2.VIII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1253). **2**. Munţii Godeanului [Godeanu Mts.], rocky slopes above the dam Gura Apei, 45°20´21.5´´N, 22°42´49.0´´E, 1085 m, 1.VIII.2002 *P. Mráz & Z. Szeląg* (2 plants, nos. 1259, 1260).

Hieracium lubricicaule (Nyár.) Borza — 2n = 27 (apomictic mode of reproduction)

LOCALITY: **1**. Munţii Godeanului [Godeanu Mts.], Mt. Tomeasa, SE rocky slope, by the path from Gura Apei, 45°21´16.7´´N, 22°42´08.3´´E, 1796 m, 2.VIII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1258).

H. magocsyanum Jáv. — 2n = 27 (apomictic mode of reproduction)

LOCALITIES: **1**. Munţii Retezatului [Retezat Mts.], on the ridge Culmea Lolaia, Saua Ciurila saddle, ca. 1800 m, 7.VII.2001 *P. Mráz* (3 plants, nos. 1034, 1037, 1058). **2**. Munţii Godeanului [Godeanu Mts.], Mt. Tomeasa, SE rocky slope, by the path from Gura Apei, 45°21´16.7´´N, 22°42´08.3´´E, 1796 m, 2.VIII.2002 *P. Mráz & Z. Szeląg* (2 plants, nos. 1256, 1257).

Hieracium ostii-bucurae Nyár. *ex* Szeląg* — 2n = 27 (apomictic mode of reproduction)

LOCALITY: **1**. Munţii Godeanului [Godeanu Mts.], rocky slopes above the dam Gura Apei, 45°20´21.5´´N, 22°42´49.0´´E, 1085 m, 1.VIII.2002 *P. Mráz & Z. Szeląg* (1 plant, nos. 1264).

Hieracium telekianum Boros & Lengyel — 2n = 27 (apomictic mode of reproduction)

LOCALITY: **1**. Munţii Hargithei [Hargitha Mts.], Băile Tuşnad, Mt. Piatra Şoimului, andesit rocks, 46°08´55.1´´N, 25°50´57.9´´E, 850 m, 29.VII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1241).

Hieracium tomiasae (Nyár. & Zahn) Nyár. — 2n = 27 (apomictic mode of reproduction)

LOCALITY: **1**. Munţii Godeanului [Godeanu Mts.], Mt. Tomeasa, SE rocky slope, by the path from Gura Apei, 45°21´16.7´´N, 22°42´08.3´´E, 1796 m, 2.VIII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1251).

Hieracium tubulare (Nyár.) Zahn — 2n = 27 (apomictic mode of reproduction)

LOCALITY: **1**. Munţii Hargithei [Hargitha Mts.], Băile Tuşnad, Mt. Piatra Şoimului, andesit rocks, 46°08´55.1´´N, 25°50´57.9´´E, 850 m, 29.VII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1243).

Hieracium sect. *Cernua* is the correct section name for the taxa of the *H. sparsum* group (Szeląg 2003b). The centre of distribution of *Hieracium* sect. *Cernua* in Europe is concentrated in the central part of the Balkan Peninsula and the Southern Carpathians. In addition, only scattered, relict stations are in the Eastern Alps, Eastern Sudeten and Western and Eastern Carpathians. In *H.* sect. *Cernua* a diploid (only *H. sparsum*), triploids and tetraploids have so far been detected (Christoff 1942, Chrtek 1996, Schuhwerk & Lippert 1998, 1999, Vladimirov & Szeląg 2001b, Chrtek *et al.* 2004). All the taxa included in our analyses are Romanian endemics and their chromosome numbers are here reported for the first time.

Genus *Pilosella*

Pilosella aurantiaca (L.) F. W. Schultz & Schultz Bip. — 2n = 36, 45

LOCALITIES: **1**. Munţii Apuseni [Bihor Mts.], Pietroasa, SE slopes of Mt. Cornul Munţilor, 46°38´17.0´´N, 22°40´19.2´´E, 1453 m, 3.VIII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1283, 2n = 36). **2**. Munţii Hargithei [Hargitha Mts.], Mt. Hargitha Ciceu, 46°23´53.5´´N, 25°37´51.0´´E, 1566 m, 28.VII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1278, 2n = ca. 36). **3**. Munţii Rodnei [Rodna Mts.], Prislop saddle, ca. 1380 m, 22.VII.2000 *P. Mráz & V. Jurkovičová* (1 plant, no. 801, 2n = 36). **4**. Munţii Godeanului [Godeanu Mts.], Mt. Tomeasa, SE slope, by the path from Gura Apei, 45°21´16.7´´N, 22°42´08.3´´E, 1796 m, 2.VII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1255, 2n = 45).

Triploid (2n = 27) to heptaploid (2n = 63) numbers have so far been published for this species. In the Polish and Slovak part of the Carpathians the tetraploid, pentaploid, hexaploid and heptaploid levels were given by Skalińska (1967, 1970), Skalińska *et al.* (1968, 1974) and Uhríková (1970). Mráz (in Rotreklová *et al.* 2002) published a tetraploid chromosome number for a plant from the Ukrainian Eastern Carpathians. Pashuk (1987) reported an aneuploid cytotype (2n = 30) from the same territory.

Pilosella bauhinii (F. W. Schultz ex Besser) Arv.-Touv. — 2n = 45

LOCALITY: **1**. Munţii Hargithei [Hargitha Mts.], Băile Tuşnad, Mt. Piatra Şoimului, andesite rocks, 46°08´55.1´´N, 25°50´57.9´´E, 850 m, 29.VII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1238).

Several ploidy levels have so far been reported in the literature (cf. Schuhwerk 1996). From the Carpathians, tetraploid, pentaploid

* This species name was recently validated by Szeląg (2003a).

and hexaploid numbers (2n = 36, 2n = 45, 2n = 54) were given from Slovakia (Uhríková 1970, Rotreklová 2002, Rotreklová *et al*. 2002). Rotreklová (2002) reported tetraploids and hexaploids from one population from Romania. Some cytogeographical trends within this species in the territory of Central and Eastern Europe are noteworthy (cf. Rotreklová 2002). The pentaploid cytotype seems to be the most common in Western Europe and in the western part of Central Europe, while in the southeastern part of the area (e.g. Slovakia, Hungary, Greece) tetraploids prevail (Gadella 1984, Papanicolaou 1984, Schuhwerk & Lippert 1997, 1998, 2002, Bräutigam & Bräutigam 1996, Krahulcová *et al*. 2001, Rotreklová 2002, Rotreklová *et al*. 2002).

Pilosella cymosa (L.) F. W. Schultz & Sch. Bip. — 2n = 36

Locality: 1. Munţii Banatului [Banat Mts.], summit area of the Mt. Treskovać, scattered *Caprinus orientalis* forest on quartzite, 44°33´35.3´´N, 22°03´36.3´´E, 680 m, 31.VII.2002 *P. Mráz & Z. Szeląg* (1 plant, no. 1265).

The tetraploid chromosome number (2n = 36) is most frequent for this taxon (Schuhwerk & Lippert 1997, 2002, Vladimirov & Szeląg 2001a), but diploids, hexaploids and heptaploids are given in the literature too (e.g. Měsíček & Javůrková-Jarolímová 1992, Schuhwerk & Lippert 1997, 1998, Šimek 2000).

Pilosella pavichii (Heuff.) Holub — 2n = 18

Locality: 1. Munţii Banatului [Banat Mts.], summit area of the Mt. Treskovać, rock crevices and rocky ground, 44°33´35.3´´N, 22°03´36.3´´E, 680 m, 31.VII.2002 *Mráz & Z. Szeląg* (1 plant, no. 1268).

This subendemic species of the Balkan Peninsula occurs in the Carpathians just in southern Romania (Zahn 1922–1939), although Nyárády (1965) reported also some localities from the surroundings of Cluj-Napoca. Previously diploid (Christoff & Popoff 1933, Strid & Franzén 1981, Vladimirov 2000) and tetraploid (Vladimirov 2003) levels are reported in the literature.

Discussion

The proportion of the three ploidy levels of the investigated taxa within the genus *Hieracium* from Romania analyzed in this paper and given in the cited literature is as follows: 67% triploids, 19% tetraploids and 14% diploids.

The distribution of the ploidy levels in the genus *Hieracium* overall is noteworthy. Schuhwerk and Lippert (1998, 1999) stated that while the triploids and tetraploids each represent about 35%–40% among the investigated taxa (the diploid level is very rare, ca. 5%) in the Balkan Peninsula, only triploids and diploids occur in the Iberian Peninsula (about 80% and 20% respectively). For Central Europe the proportion of triploids is much higher (ca. 70%) than that of tetraploids (ca. 20%), diploids are, as in the above cases, rare (8%). In the Western Carpathians the proportions of triploids and tetraploids are more or less equal, 53% and 45%, and the diploids are represented just by *H. umbellatum* (ca. 3%). It seems, however, that the tetraploid species are much more common at higher altitudes than at lower ones in the territory of Western Carpathians (Chrtek *et al*. 2004).

Up to now three diploid species have been found in Romania: *H. alpinum*, *H. pojoritense* and *H. transylvanicum*. However, also *H. umbellatum* and *H. hryniawiense* can be considered as diploid in Romania, although never counted from Romanian plants. *Hieracium umbellatum* is a diploid species in most of its range and, moreover, in Central Europe only diploid populations have been found so far (cf. Schuhwerk 1996). The second taxon is probably endemic to the Eastern Carpathians occurring in the montane and subalpine meadows. Diploid populations of *H. hryniawiense* were reported from adjacent parts of the Ukrainian Carpathians (Chrtek 1996, as *H. conicum*; Mráz 2003b). One analyzed population is situated in the Ukrainian part of the Marmarosh Mts., ca. 100 m from the state boundary with Romania (Chrtek 1996). While four diploid species are present in the Ukrainian Eastern Carpathians (*H. pojoritense* does not occur there), the widely distributed *H. umbellatum* is the single, certainly diploid taxon in the territory of the Western Carpathians (most of Slovakia, Moravian parts of Czech Republic, the

south-eastern part of Poland, northern Hungary and a very small part of north-eastern Austria) (Chrtek *et al*. 2004).

We suppose that the Skhidni Beskidi Mts. (in the literature often given as "Waldkarpaten"; the most western part of the Ukrainian Eastern Carpathians, slightly overlapping in Poland and Slovakia) represented in the past a strong barrier to the postglacial migrations of many montane and (sub-)alpine plant species from the Eastern Carpathians towards the Western Carpathians (Wołoszczak 1896, Pax 1898, Jasiewicz 1965, Malinovskiĭ 1991). The diploid taxa *H. alpinum*, *H. hryniawiense* and *H. transylvanicum* did not reach the territory of the Western Carpathians, perhaps due to the very low altitude of the Skhidni Beskidi Mts. (the highest peak is Mt. Pikuĭ, 1408 m a.s.l.), where the suitable habitats, treeless in the case of *H. alpinum* and *H. hryniawiense*, or spruce forests in the case of *H. transylvanicum*, were missing during most of the last post-glacial (with the exception of Mt. Pikuĭ). The detailed distributions of apomictic polyploid taxa of the genus *Hieracium* have recently been successfully used as phylogeographic markers to determine the migration routes and barriers in the Nordic countries (Tyler 2000).

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