Chromosome numbers and breeding systems in some species of *Hieracium* subgen. *Pilosella* from Central Europe

Počty chromozomů a způsoby reprodukce vybraných druhů jestřábníků (*Hieracium* subgen. *Pilosella*) ze střední Evropy

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Rotreklová O., Krahulcová A., Vaňková D., Peckert T. & Mráz P. (2002): Chromosome numbers and breeding systems in some species of *Hieracium* subgen. *Pilosella* from Central Europe. – Preslia, Praha, 74: 27–44.

Chromosome numbers are given for 16 taxa (and one interspecific hybrid) of *Hieracium* subgen. *Pilosella* originating from Central Europe: *H. apatelium* Nägeli et Peter (2n = 45), *H. aurantiacum* L. (2n = 36), *H. bauhini* Besser (2n = 36, 45, 54), *H. brachiatum* Bertol. ex DC. (2n = 45, 48, 63, 72), *H. densiflorum* Tausch (2n = 36), *H. echioides* Lumn. (2n = 18, 27, 36), *H. floribundum* Wimm. et Grab. (2n = 36, 45), *H. glomeratum* Froel. (2n = 36, 45), *H. guthnickianum* Hegetschw. (2n = 54), *H. lactucella* Wallr. (2n = 18), *H. onegense* (Norrl.) Norrl. (2n = 18), *H. pilosella* L. (2n = 36, 45, 54), *H. piloselliflorum* Nägeli et Peter (2n = 36, 45), *H. piloselloides* Vill. (2n = 36), *H. rothianum* Wallr. (2n = 36), *H. schultesii* F. W. Schultz (2n = 45), and the hybrid *H. floribundum* × *H. aurantiacum* (2n = 36). New chromosome numbers are reported for *H. brachiatum* and *H. floribundum.* The octoploid cytotype (2n = 72), recorded in *H. brachiatum*, is the highest ploidy level ever found in plants from the subgen. *Pilosella* originating from the field. Aneuploidy, rare in this subgenus in Europe, occurs in this hybridogenous species as well: it was recorded in one plant (2n = 48) collected in a hybrid swarm *H. pilosella* × *H. bauhini*. The breeding system in *H. bauhini*, *H. brachiatum*, *H. densiflorum, H. echioides, H. pilosella, H. piloselloides,* and *H. rothianum* was studied. The sexual reproduction of pentaploid *H. pilosella* is a new observation: it means an increase of diversity in possible reproduction modes of those cytotypes having odd chromosome numbers.

K e y w o r d s : *Compositae*, karyology, ploidy level, reproduction mode, Czech Republic, Slovakia, Poland, Slovenia, Germany, Hungary, Austria, Ukraine

Introduction

The genus *Hieracium* subgen. *Pilosella* is a typical example of a taxonomically intricate agamic complex (basic chromosome number x = 9). Seven ploidy levels (diploids to octoploids) have been recorded in nature (see e.g. Schuhwerk 1996, Krahulcová et al. 2000). In approximately half of examined species, more than one ploidy level was found

even in plants growing together at one locality. Aneuploids are extremely rare in European populations: a few records concern *H. aurantiacum* L. (2n = 30, Pashuk 1987), *H. stoloniflorum* Waldst. et Kit. (2n = 46, Finch ined. in Moore 1982), *H. piloselliflorum* Nägeli et Peter (2n = 44, Krahulcová & Krahulec 1999), and a plant originating from a hybrid swarm between *H. pilosella* and *H. bauhini* (2n = 48, Krahulcová et al. 2000). On the other hand, aneuploids are relatively common in populations of *H. pilosella* in New Zealand (Chapman & Lambie 1999).

It was shown that diploid plants are sexual and self-incompatible (e.g. Skalińska 1967, Skalińska & Kubień 1972, Gadella 1982, 1984, Krahulcová & Krahulec 1999). Nevertheless, the self-incompatibility can be broken under the influence of pollen from another species (Krahulcová et al. 1999). Naturally occurring triploids examined hitherto are either sterile or apomictic (Skalińska 1967, 1968, Gadella 1984). The mode of reproduction in cytotypes with higher ploidy levels seems to vary among specific polyploid complexes (species groups). Both sexuals and (facultative) apomicts were discovered among tetraploids and hexaploids; the apomictic mode of reproduction seems to prevail in pentaploids and heptaploids (published data reviewed by Krahulcová et al. 2000).

Spontaneous hybridization between either all sexual or sexual and apomictic types (apomicts usually serve as pollen donors, but the facultative apomicts might act as seed parents as well; see e.g. Skalińska 1968, 1971a, b, c), is a widespread phenomenon in this subgenus. Hybridization, together with polyploidy and facultative apomixis, is the most important source of the complex pattern of morphological variation.

Materials and methods

The plants were collected in 1996–2000 from natural habitats and cultivated in pots in the Botanical Garden of Masaryk University, Brno, in the experimental garden of the Institute of Botany, Průhonice, and in the Botanical Garden of the P. J. Šafárik University, Košice. Root tip cuttings of mature plants were used for chromosome counts. The material was pretreated at room temperature with a saturated water solution of p-dichlorbenzene for 2 hours (procedure used by O. Rotreklová, D. Vaňková, and T. Peckert), with a saturated water solution of α-bromonaphtalene for 3 hours (procedure used by A. Krahulcová), or with a 0.1% solution of colchicine for 1.5 hour (procedure used by P. Mráz), and then fixed in a cold mixture of ethanol and acetic acid (3 : 1) for 24 hours. The fixed material was treated immediately or it was stored in 70% ethanol at 4 °C until required. The root tips were macerated in a mixture of ethanol and hydrochloric acid (1 : 1) for 2 min at room temperature (procedure used by O. R., D. V., and T. P.) or in 1N HCl at 60 °C for 7–10 min (procedure used by A. K. and P. M.). Temporary slides were made by squashing the cut and macerated meristems in lacto-propionic orcein (chromosome counts by O. R., A. K., D. V., and T. P.). The squash and smear method with cellophane replacing the glass covers (Murín 1960) and with Giemsa solution in phosphate buffer as a stain was used by P. M.

The occurrence of a long marker chromosome was studied by A. Krahulcová in karyotypes of all specimens, which she examined. The other co-authors did not search for this karyotype peculiarity, which has already been frequently recorded in several species of the Krkonoše Mts (Krahulcová & Krahulec 1999, Krahulcová et al. 2001). Therefore, the presence (absence) of this marker chromosome is here explicitly given for those particular

specimens belonging to *H. bauhini*, *H. brachiatum*, *H. floribundum,* and *H. glomeratum*, studied by A. K. Within the whole group of species presented in this paper, the marker chromosome was recorded in the four above-mentioned species only. The remark "the presence of a long marker chromosome not studied" is given for those specimens of *H. bauhini*, *H. brachiatum, H. floribundum*, and *H. glomeratum* examined by the other co-authors.

Voucher specimens (plants from natural habitats or cultivation) are deposited in the herbarium of the Department of Botany of Masaryk University, Brno (BRNU, plants counted by O. R. and D. V.), in the herbarium of Institute of Botany, Průhonice (PRA, plants counted by A. K. and T. P.), and in the herbarium of Patrik Mráz (plants counted by P. M.). The permanent squashes and smears done by P. M. are stored in the Department of Experimental Botany and Genetics, Faculty of Science, P. J. Šafárik University, Košice.

The breeding system (i.e. the sexual vs. apomictic mode of reproduction) was examined in selected species, following a procedure based on comparisons between the seed set in open-pollinated and emasculated capitula. This procedure is described elsewhere in detail (e.g. Gadella 1987, Krahulcová & Krahulec 1999). While the sexual plants produce no seeds in emasculated capitula, the apomictic ones have good seed-set in both emasculated and open-pollinated capitula. However, all types having well developed seeds in emasculated capitula are here called apomictic, although the apomixis may be facultative: the generation of a part of the progeny of such seed parents by a sexual process is not excluded.

The localities within each country are ordered from north to south and from west to east. The coordinates of some localities (especially those visited by F. Krahulec and A. Krahulcová as collectors) are determined to an accuracy of ten seconds.

Results and discussion

Hieracium apatelium Nägeli et Peter

Die Hieracien Mittel-Europas 1: 706, 1885.

H. floribundum – H. pilosella

2n = 45

L o c a l i t y : **1**. Czech Republic, distr. Svitavy: along the forest road 1.1 km SE of the church in the village of Modřec, 620 m a.s.l., 49°40'46"N, 16°18'37"E, coll. O. Rotreklová, 18 June 1999, 2n = 45 (2 plants), counted by O. Rotreklová.

Tetraploid and hexaploid cytotypes are known from the Krkonoše Mts in the Czech Republic (Krahulcová & Krahulec 1999). Recently, rare occurrences of the pentaploid cytotype were recorded in this mountain range as well (Krahulcová et al. 2001). Here, a pentaploid *H. apatelium* is reported from a highland area in the Czech-Moravian borderland.

Hieracium aurantiacum L.

Sp. Pl. 801, 1753.

2n = 36

L o c a l i t i e s : **1**. Czech Republic, Šumava Mts, distr. Klatovy: woodland edge 4 km E of the crossroad near the former settlement of Gerlova Huť, ca. 8 km NE of the town of Železná Ruda, 920 m a.s.l., 49°10'00"N, 13°20'00"E, coll. F. Krahulec, 10 August 1999, 2n = 36 (1 plant), counted by A. Krahulcová. **2**. Czech Republic, Šumava Mts, distr. Klatovy: ruderal place N of the branch road to the village of Hartmanice in the former settle-

ment of Gerlova Huť, ca. 4 km NE of the town of Železná Ruda, 250 m ESE of the survey stake 979.8 m, 950 m a.s.l., 49°09'54"N, 13°16'44"E, coll. F. Procházka, 27 June 1999, 2n = 36 (1 plant), counted by A. Krahulcová. **3**. Czech Republic, Šumava Mts, distr. Prachatice: meadow at the woodland edge 1.5 km SW of the village of Kvilda, 1075 m a.s.l., 49°00'30"N, 13°34'10"E, coll. F. Krahulec, 10 August 1999, 2n = 36 (1 plant), counted by A. Krahulcová. **4**. Czech Republic, distr. Žďár nad Sázavou: road margin in the NW part of the village of Cikháj, 650 m a.s.l., 49°38'46"N, 15°57'49"E, coll. O. Rotreklová, 7 June 2000, 2n = 36 (1 plant), counted by O. Rotreklová. **5**. Ukraine, Svydovets' Mts: saddle ca. 0.5 km S of Mt Mala Blyznytsya, 1500 m a.s.l., 48°13'N, 24°14'E, coll. P. Mráz and V. Jurkovičová, 10 August 1999, 2n = 36 (1 plant, no. 714), counted by P. Mráz.

Triploid (2n = 27) to heptaploid (2n = 63) counts have been published for this species so far. Triploids occurring in natural populations have been recorded in Poland (Skalińska 1967) and New Zealand (Bicknell 1997) only. Tetraploids have been reported by Rosenberg (1917) and Christoff (1942) in plants cultivated in botanical gardens, but the origin of these plants is unknown. Since then, tetraploids have been found in Poland (Skalińska 1967, 1970, Skalińska et al. 1974), the Czech Republic (Krahulcová & Krahulec 1999), the Ural Mts, Russia (Lavrenko et al. 1990), Germany (Bräutigam & Bräutigam 1996, Schuhwerk & Lippert 1997), France (Delcourt 1977), Sakhalin in the Far East (Skalińska 1970), Canada (Mulligan 1957, alien plant), and New Zealand (Jenkins & Jong 1997, alien plant). The pentaploid level has been recorded in plants from Poland (Skalińska & Pogan 1966, Skalińska 1967, 1970), Slovakia (Skalińska & Pogan 1966, Májovský et al. 1970, Uhríková 1970), France (Delcourt 1977), and the Krkonoše Mts in the Czech Republic (Krahulcová et al. 2001). Hexaploids are reported from Poland (Skalińska 1967, 1968), Steiermark in Austria (Dobeš et al. 1997), and France (Delcourt 1977). The heptaploid cytotype has been found in Poland only (Skalińska 1967). The occurrence of aneuploid cytotypes is reported in three cases: 2n = 31 from New Zealand (Koltunow et al. 1998), 2n = 30 from the botanical garden in Helsinki (Zhukova 1964), and 2n = 30 from the subalpine belt of the Chornohora Mts, Ukrainian Carpathians, for which no site was specified (Pashuk 1987).

There are also three records of experimentally derived diploid cytotypes: Skalińska (1971a) and Krahulcová & Krahulec (2001) have recorded a diploid plant (assumed to be a dihaploid) among the progeny of a tetraploid seed parent used in experimental crossing; Bicknell (1997) identified a diploid (dihaploid) plant among the progeny of triploid apomictic *H. aurantiacum*, which rarely produced reduced embryo sacs. Several higher ploidy levels (2n = 72, 90, 108) are reported by Skalińska (1973, 1976) in plants originating from crossing experiments.

Hieracium bauhini Besser

Prim. Fl. Galic. 2: 149, 1809.

2n = 36; 2n = 45 (with a long marker chromosome), apomictic; 2n = 54, apomictic.

Localities: **1**. Czech Republic, distr. Louny: at the W edge of Vroutecký les wood near the village of Valov, 2.2 km S of the church in the town of Podbořany, 350 m a.s.l., 50°12'50"N, 13°25'00"E, coll. F. Krahulec, 2 June 1998, 2n = 54 (without a long marker chromosome, 2 plants), apomictic (1 plant), counted by A. Krahulcová. **2**. Czech Republic, Praha: town district Vysočany, on the slope above the railway W of the railway station Praha-Vysočany, 210 m a.s.l., 50°06'45"N, 14°29'50"E, coll. F. Krahulec and J. Chrtek, 18 May 2000, 2n = 45 (with a long marker chromosome), apomictic (1 plant), counted by A. Krahulcová. **3**. Czech Republic, Brno: S part of the nature reserve Kamenný kopec in the W part of the city, 380 m a.s.l., 49°10'47"N, 16°33'18"E, coll. O. Rotreklová, 21 May 1998, 2n = 45 (the presence of a long marker chromosome not studied, 5 plants), apomictic (3 plants), counted by O. Rotreklová. **4**. Slovakia, Volovské vrchy Mts: on the E slope of Mt Sitárka (578.2 m), ca. 4 km E of the town of Rožňava, 440 m a.s.l., 48°39'39"N, 20°35'14"E, coll. P. Mráz and V. Jurkovičová, 16 May 2000, 2n = 36 (the presence of a long marker chromosome not studied, 1 plant, no. 740), counted by P. Mráz.

Three ploidy levels (tetraploid, pentaploid and hexaploid) have been previously known in this species. Pentaploids are reported from Bavaria in Germany, as are tetraploids and hexaploids (Schuhwerk & Lippert 1997). Furthermore, the pentaploid cytotype, which seems to be the most frequent one, is known from Saxony in Germany (Bräutigam & Bräutigam 1996), Belgium, the Netherlands (Gadella 1984), and Slovakia (Uhríková 1970). Tetraploids are reported from Greece (Papanicolaou sec. Löve 1984) and Montenegro [Schuhwerk & Lippert 1998, under the name *H. bauhini* grex *magyaricum* subsp. *magyaricum* (Nägeli et Peter) K. Maly], hexaploids from Macedonia [Schuhwerk & Lippert 1998, under the name *H. bauhini* grex *magyaricum* subsp. *filiferum* (Tausch) Zahn]. The pentaploid chromosome number (2n = 45, including a marker chromosome) has been recorded in one apomictic plant, which might have been introduced in the Krkonoše Mts in the Czech Republic, quite recently (Krahulcová et al. 2001).

Hieracium brachiatum Bertol. ex DC. in Lam. et DC.

Fl. Franc., Ed. 3, 5: 442, 1815.

H. pilosella > *H. bauhini/piloselloides*

2n = 45, apomictic; 2n = 48; 2n = 63 (with a long marker chromosome); 2n = 72, apomictic.

L o c a l i t i e s : **1**. Czech Republic, Praha: town district Vysočany, on the slope above the railway W of the railway station Praha-Vysočany, 210 m a.s.l., 50°06'45"N, 14°29'50"E, coll. F. Krahulec and J. Chrtek, 18 May 2000, 2n = 45 (1 plant), 2n = 48 (1 plant) (both without a long marker chromosome), 2n = 63 (with a long marker chromosome, 1 plant), 2n = 72, apomictic (without a long marker chromosome, 1 plant), counted by A. Krahulcová. The hybrids (*H. pilosella* > *H. bauhini*) occur here together with both parents, i.e. tetraploid *H. pilosella* and pentaploid *H. bauhini*. **2**. Czech Republic, Brno: S part of the nature reserve Kamenný kopec in the W part of the city, 380 m a.s.l., 49°10'47"N, 16°33'18"E, coll. O. Rotreklová, 20 May 1999, 2n = 72 (the presence of a long marker chromosome not studied, 1 plant), counted by O. Rotreklová. The hybrids (*H. pilosella* > *H. bauhini*) occur here together with both parents, i.e. *H. pilosella* and pentaploid *H. bauhini*. **3**. Czech Republic, distr. Olomouc: grassland at the W periphery of the village of Slatinice na Hané, 250 m W of the church, 250 m a.s.l., 49°33'40"N, 17°05'40"E, coll. F. Krahulec, 24 May 1999, 2n = 45 (without a long marker chromosome), apomictic (1 plant), counted by A. Krahulcová. *H. pilosella* and *H. bauhini* have been recorded at this locality as well.

Three ploidy levels have been published for *H. brachiatum* from Germany (Bavaria and Saxony): the tetraploid (2n = 36), the pentaploid (2n = 45), and the hexaploid (2n = 54) (Bräutigam & Bräutigam 1996, Schuhwerk & Lippert 1997). However, both the hexaploid and the tetraploid cytotypes recorded in one population in Saxony (Bräutigam & Bräutigam 1996) have been assigned to *H. brachiatum*, while the heptaploid hybrid (2n = 63) occurring at the same locality has been classified as *H. leptophyton* Nägeli et Peter (*H. bauhini* > *H. pilosella*). The putative parents *H. piloselloides*, *H. pilosella* (both tetraploid), and *H. bauhini* (pentaploid) have been recorded at the site (Bräutigam & Bräutigam 1996): the two latter species (and cytotypes) correspond to the assumed parental types presented here from localities 1 and 2. Pentaploid *H. brachiatum* (2n = 45) has also been recorded in Bulgaria, Pirin Mts (Vladimirov & Szeląg, unpubl.).

Octoploid cytotypes from the field are here reported for the first time: this is the highest ploidy level in *Hieracium* subgen. *Pilosella* ever recorded in the field. Two of the records reported here in detail [the octoploid (2n = 72), and the aneuploid plant (2n = 48), both recorded in a hybrid swarm at locality 1], have been already mentioned by Krahulcová et al. (2000). According to counts presented here and in the references, extensive variation in chromosome numbers can be expected among the hybrids between *H. pilosella* and *H. bauhini*.

Hieracium densiflorum Tausch

in Flora Regensburg 11, Ergänzungsbl. 1: 59, 1828.

[Syn: *H. tauschii* Zahn]

H. bauhini – H. cymosum

2n = 36, sexual.

L o c a l i t i e s : **1**. Czech Republic, distr. Hustopeče: nature reserve Pouzdřanská step, dry grassland 1.8 km NE of the church in the village of Pouzdřany, 300 m a.s.l., 48°56'41"N, 16°38'32"E, coll. O. Rotreklová, 16 May 1998, 2n = 36, sexual (3 plants), counted by O. Rotreklová. **2**. Czech Republic, distr. Hustopeče: along the road 2 km N of the church in the village of Kurdějov, 250 m a.s.l., 48°58'31"N, 16°45'31"E, coll. Z. Lososová, May 1998, 2n = 36 (1 plant), counted by O. Rotreklová. **3**. Czech Republic, distr. Hustopeče: slope called Nosperk 2.3 km NE of the church in the village of Němčičky, 280 m a.s.l., 48°56'35"N, 16°50'44"E, coll. Z. Lososová, May 1998, 2n = 36 (1 plant), counted by O. Rotreklová. **4**. Czech Republic, distr. Hustopeče: Čejkovický Špidlák Hill 1.9 km NE of the church in the village of Čejkovice, ca. 250 m a.s.l., 48°54'58"N, 16°57'46"E, coll. M. Chytrý, 5 May 1999, 2n = 36 (1 plant), counted by O. Rotreklová. **5**. Czech Republic, distr. Hodonín: slope above the railway station in the village of Velká nad Veličkou, 390 m a.s.l., 48°52'42"N, 17°30'31"E, coll. O. Rotreklová, 4 August 1998, 2n = 36, sexual (1 plant), counted by O. Rotreklová. **6**. Slovenia, Julijske Alpe Mts: village of Ukanc, on the slope above the W coast of Bohinjske jezero Lake, ca. 800 m a.s.l., 46°17'50"N, 13°49'47"E, coll. V. Grulich, 18 June 1998, 2n = 36, sexual (1 plant), counted by O. Rotreklová. **7**. Slovenia, Julijske Alpe Mts: village of Stara Fužina, karstic plateau Vogar, ca. 1000 m a.s.l., 46°17'50"N, 13°52'10"E, coll. V. Řehořek, 18 June 1998, 2n = 36 (3 plants), sexual (2 plants), counted by O. Rotreklová.

Tetraploid and pentaploid chromosome numbers have been found by Schuhwerk & Lippert (1997) in plants from Germany. The hexaploid level has been reported in plants from Greece (Schuhwerk & Lippert 1998).

Hieracium echioides Lumn.

Fl. Poson. 348, 1791.

2n = 18, sexual; 2n = 27; 2n = 36, sexual.

L o c a l i t i e s : **1**. Czech Republic, České středohoří Mts, distr. Litoměřice: Kalvárie (Tříkřížová hora) hill, rocks above the Labe river, 1.5 km NW of the village of Velké Žernoseky, ca. 200 m a.s.l., 50°32'50"N, 14°03'01"E, coll. T. Peckert, 8 July 1998, 2n = 27 (2 plants), 2n = 36, sexual (1 plant), counted by T. Peckert. **2**. Czech Republic, distr. Beroun: Trubínský vrch hill at the W margin of the village of Trubín, 350 m a.s.l., 49°56'36"N, 13°59'49"E, coll. T. Peckert, 18 June 2000, 2n = 18 (2 plants), sexual (1 plant), counted by T. Peckert. **3**. Czech Republic, Praha: town district Praha-Podbaba, rocks in the valley of the Vltava river below the ruin, ca. 300 m a.s.l., 50°07'07"N, 14°23'25"E, coll. D. Vaňková, 1996; T. Peckert, 30 June 1998 and July 2000, 2n = 36 (3 plants), sexual (1 plant), counted by D. Vaňková and T. Peckert. **4**. Czech Republic, Praha: town district Velká Chuchle, rocks below the church Sv. Jan Nepomucký N of the town district, 200 m a.s.l., 50°01'02"N, 14°23'16"E, coll. T. Peckert, 4 June 1999, 2n = 18, sexual (2 plants), counted by T. Peckert. **5**. Czech Republic, distr. Třebíč: nature reserve Mohelenská hadcová step, serpentine rocks near the village of Mohelno, 350 m a.s.l., 49°06'30"N, 16°11'10"E, coll. D. Vaňková, June 1996; T. Peckert, July 1998, 2n = 18 (4 plants), sexual (2 plants), counted by D. Vaňková and T. Peckert. **6**. Czech Republic, distr. Znojmo: hill called U Michálka at the S margin of the village of Bohutice, 270 m a.s.l., 48°59'03"N, 16°21'31"E, coll. T. Peckert, July 1998, 2n = 36, sexual (1 plant), counted by T. Peckert. **7**. Czech Republic, distr. Znojmo: hill at the NE margin of the village of Hostěradice (place called U kapličky), 240 m a.s.l., 48°57'12"N, 16°15'46"E, coll. T. Peckert, July 2000, 2n = 18 (2 plants), 2n = 27 (1 plant), counted by T. Peckert. **8**. Czech Republic, distr. Znojmo: Cínová hora hill at the NW margin of the town of Znojmo, 315 m a.s.l., 48°52'08"N, 16°00'33"E, coll. T. Peckert, 14 July 1999, 2n = 18, sexual (1 plant), counted by T. Peckert. **9**. Czech Republic, distr. Znojmo: slopes in the valley of the Dyje river SE of the village of Dyje, 240 m a.s.l., 48°50'26"N, 16°07'27"E, coll. T. Peckert, 12 July 1999, 2n = 18, sexual (1 plant), counted by T. Peckert. 10. Czech Republic, distr. Znojmo: heathland and waste places S of the village of Konice (nature reserve Popické kopečky), 300 m a.s.l., 48°49'44"N, 16°01'11"E, coll. D. Vaňková, June 1996; T. Peckert, July 1998, 2n = 27 (3 plants), 2n = 36, sexual (2 plants), counted by D. Vaňková and T. Peckert. **11**. Czech Republic, distr. Znojmo: Pustý kopec hill (also called Suchý vrch hill), ca. 2 km E of the village of Popice, 260 m a.s.l., 48°48'45"N, 16°02'08"E, coll. T. Peckert, 6 June 1998, 2n = 27 (1 plant), counted by T. Peckert. **12**. Czech Republic, distr. Znojmo:

near the chapel 0.3 km SW of the village of Popice, 300 m a.s.l., 48°49'12"N, 16°00'42"E, coll. D. Vaňková, June 1996, 2n = 18 (1 plant), 2n = 27 (1 plant), counted by D. Vaňková. **13**. Czech Republic, distr. Znojmo: Havranické vřesoviště heathland 1 km W to NW of the village of Havraníky, 300 m a.s.l., 48°49'10"N, 16°00'10"E, coll. D. Vaňková, June 1996; T. Peckert, July 1998, 2n = 18, sexual (1 plant), 2n = 27 (3 plants), 2n = 36, sexual (1 plant), counted by D. Vaňková and T. Peckert. **14**. Czech Republic, distr. Znojmo: Skalky hill 0.6 km S of the church in the village of Havraníky, 350 m a.s.l., 48°48'18"N, 16°00'31"E, coll. D. Vaňková, June 1996, 2n = 36 (1 plant), counted by D. Vaňková. **15**. Czech Republic, distr. Znojmo: above the Šobes vineyards ca. 2 km N of the village of Hnanice, 270 m a.s.l., 48°49'08"N, 15°58'26"E, coll. T. Peckert, July 1998, 2n = 36, sexual (1 plant), counted by T. Peckert. **16**. Austria, Niederösterreich: rocks above the Dyje river at the W margin of the village of Drosendorf, 390 m a.s.l., 48°52'08"N, 15°36'35"E, coll. T. Peckert, J. Chrtek and D. Hrčka, 12 June 1999, 2n = 36 (1 plant), counted by T. Peckert. **17**. Austria, Niederösterreich, distr. Gänsendorf: open sandy sites ca. 1 km N of the village of Markhof, 150 m a.s.l., 48°16'43"N, 16°50'19"E, coll. T. Peckert, J. Chrtek and D. Hrčka, 13 June 1999, 2n = 18, sexual (2 plants), 2n = 36, sexual (1 plant), counted by T. Peckert. **18**. Austria, Niederösterreich, distr. Bruck an der Leitha: Mt Braunsberg (346 m) near the village of Hainburg an der Donau, NW rocky slopes (limestone), 320 m a.s.l., 48°09'31"N, 16°57'14"E, coll. T. Peckert, J. Chrtek, and D. Hrčka, 13 June 1999, 2n = 18 (1 plant), counted by T. Peckert. **19**. Austria, Burgenland, distr. Neusiedl am See: Leithagebirge Hills, Mt Zeilerberg (302 m) ca. 2 km N of the village of Winden am See, around the limestone quarry, 260 m a.s.l., 47°58'18"N, 16°45'25"E, coll. T. Peckert, J. Chrtek, and D. Hrčka, 14 June 1999, 2n = 18 (1 plant), counted by T. Peckert. **20**. Hungary, distr. Heves, Bükk Mts: stony slopes 0.8 km NW of the village of Szarvaskö (railway station), 300 m a.s.l., 47°59'50"N, 20°19'40"E, coll. T. Peckert, J. Chrtek, and J. Škorničková, 25 June 1998, 2n = 18, sexual (3 plants), counted by T. Peckert. **21**. Germany, Brandenburg, distr. Barnim: Pimpinellenberg hill ca. 2 km W of the village of Oderberg, sandy slopes above the road, 50 m a.s.l., 52°52'13"N, 14°01'32"E, coll. T. Peckert and J. Chrtek, 15 July 2000, 2n = 18 (4 plants), counted by T. Peckert. **22**. Germany, Brandenburg, distr. Barnim: village of Niederfinow, waste sandy places and heathland along the road near the Schiffhebewerk, ca. 30 m a.s.l., 52°50'50"N, 13°56'50"E, coll. T. Peckert and J. Chrtek, 15 July 2000, 2n = 18 (2 plants), counted by T. Peckert. **23**. Germany, Brandenburg, distr. Barnim: village of Brodowin, Klein Rummelsberg hill 0.8 km W of the village of Pehlitz, 80 m a.s.l., 52°55'10"N, 13°58'00"E, coll. T. Peckert and J. Chrtek, 15 July 2000, 2n = 18 (3 plants), counted by T. Peckert. **24**. Germany, Brandenburg, distr. Barnim: Falkenberg Hills, pastures above the road from village of Amalienhof to village of Struwenberg ca 0.4 km of NW of Amalienhof, ca. 40 m a.s.l., 52°49'30"N, 13°56'10"E, coll. T. Peckert and J. Chrtek, 14 July 2000, 2n = 18, sexual (1 plant), counted by T. Peckert. **25**. Poland, distr. Szczeczin (Wojwodstwo Szczecinskie): village of Cedynia [Zehden], sandy soils near the road between villages of Bielinek [Bellinchen] and Dolny Lubiechów ca. 0.8 km of Bielinek, 50 m a.s.l., 52°55'40"N, 14°09'30"E, T. Peckert and J. Chrtek, 15 July 2000, 2n = 18 (1 plant), counted by T. Peckert.

Four ploidy levels have been reported in the past. The first tetraploid counts were reported from plants of unknown origin, cultivated in the botanical garden in Belgrade (Gentscheff 1938). Diploids have been found in southeast Poland (Skalińska et al. 1976), northeast Austria (Schuhwerk & Lippert 1997) and Krasnoyarsk, Siberia, Russia (Stepanov & Muratova 1995). Triploid plants have been found to occur in northeast Austria and adjacent S Moravia (Schuhwerk & Lippert 1997), in Krasnoyarsk, Siberia, Russia (Stepanov & Muratova 1995), and in Bulgaria (Vladimirov & Szeląg, unpubl.). Tetraploids have been reported from northeast Austria (Schuhwerk & Lippert 1997) and Slovakia (Májovský et al. 1970, 2000). *H. echioides* has also been included in extensive studies focused on microevolutionary processes in *Hieracium* subgen. *Pilosella* at a model locality near Saratov in SW Russia (Kashin & Chernishova 1997, Kashin et al. 1999, 2000). Diploids, tetraploids, and pentaploids have been recorded there. While the sexual mode of reproduction has been detected in diploids and tetraploids, agamospermy prevails in pentaploids. Nevertheless, parallel cytoembryological studies showed some parthenogenetically developing embryo sacs (at lower than 1% frequency) in a diploid, otherwise sexual population (Kashin & Chernishova 1997, Kashin et al. 1999).

Previously reported counts together with our first results shed new light on geographical patterns of karyological differentiation. Some preliminary conclusions can be drawn: (1) The co-occurrence of two or three cytotypes was detected at some localities in southwest Moravia and in the adjacent region of Austria (vicinity of the town of Retz, Schuhwerk & Lippert 1997). More than one ploidy level was also encountered at some localities in central

and northwest Bohemia. Both diploids and tetraploids have been proven to be sexual and allogamous; consequently gene flow between these cytotypes would be expected. Nevertheless, it has not yet been confirmed because the occurrence of a triploid plant is not evidence of hybridization. (2) Diploids and tetraploids were found in northern parts of the Pannonian Basin in Hungary, Austria and Slovakia. Our studies revealed the occurrence of a diploid cytotype in plant communities on limestone in Eastern Austria (Mt Braunsberg near the town of Hainburg an der Donau, Mt Zeilerberg near the town of Winden am See); both diploids and tetraploids were identified on neighbouring sandy sites near the village of Marchegg. Only diploids were found in northern Hungary. (3) All hitherto examined plants from northeast Germany (distr. Barnim) and the adjacent region of Poland (11 plants from 5 localities) were diploid. With regard to their appearance, nearly all plants from this area have dense, long patent hairs on the upper part of stem and on the peduncles. On the other hand, plants from the Czech Republic, Slovakia, Austria, and Hungary usually have only scattered hairs (or without them) on the upper part of the stem and on the peduncles.

Hieracium floribundum Wimm. et Grab.

Fl. Siles. 2/2: 204, 1829.

H. caespitosum > *H. lactucella*

2n = 36; 2n = 45 (both cytotypes with a long marker chromosome).

L o c a l i t i e s : **1**. Czech Republic, Krušné hory Mts, distr. Sokolov: grassy place in the former tin mine 3.5 km NNE of the village of Přebuz, 890 m a.s.l., 50°24'00"N, 12°30'00"E, coll. F. Krahulec, 8 June 2000, 2n = 36 with a long marker chromosome (2 plants), counted by A. Krahulcová. **2**. Czech Republic, Krušné hory Mts, distr. Sokolov: beside the road W of the settlement of Rolava, ca. 3 km NW of the village of Přebuz, 880 m a.s.l., 50°23'15"N, 12°35'45"E, coll. F. Krahulec, 8 June 2000, 2n = 36 with a long marker chromosome (1 plant), counted by A. Krahulcová. **3**. Czech Republic, Krušné hory Mts, distr. Sokolov: meadow beside the road in the NW periphery of the village of Jelení, 860 m a.s.l., 50°23'45"N, 12°40'00"E, coll. F. Krahulec, 8 June 2000, 2n = 36 with a long marker chromosome (1 plant), counted by A. Krahulcová. **4**. Czech Republic, Šumava Mts, distr. Klatovy: in the former settlement of Gerlova Huť ca. 4 km NE of the town of Železná Ruda, a ruderal place N of the branch road to the village of Hartmanice, 250 m ESE of the survey point 979.8 m, 950 m a.s.l., 49°09'54"N, 13°16'44"E, coll. F. Procházka, 27 June 1999, 2n = 36 with a long marker chromosome (1 plant), counted by A. Krahulcová. **5**. Czech Republic, Šumava Mts, distr. Klatovy: meadow in the former settlement of Stará Hůrka, 0.3 km SW of the church ruin, above the path leading to Laka lake, 1005 m a.s.l., 49°07'30"N, 13°19'48"E, coll. F. Procházka, 1 July 1999, 2n = 36 with a long marker chromosome (1 plant), counted by A. Krahulcová. **6**. Czech Republic, distr. Ústí nad Orlicí, Králický Sněžník Mts: grassy place at U Marcelky chalet in the NNE periphery of the village of Dolní Morava, ca. 3 km NNE of the church, 770 m a.s.l., 50°09'10"N, 16°49'10"E, coll. F. Krahulec and A. Krahulcová, 6 June 1999, 2n = 36 with a long marker chromosome (2 plants), counted by A. Krahulcová. **7**. Czech Republic, Hrubý Jeseník Mts, distr. Bruntál: near Kurzovní chata chalet, 1330 m a.s.l., 50°04'08"N, 17°12'28"E, coll. M. Kočí, July 1998, 2n = 36 with a long marker chromosome (1 plant), counted by A. Krahulcová. **8**. Czech Republic, distr. Žďár nad Sázavou: disturbed place in the NW part of the village of Cikháj, 650 m a.s.l., 49°38'46"N, 15°57'49"E, coll. O. Rotreklová, 3 June 1999, 2n = 36 (4 plants), and 5 June 2000, 2n = 36 (the presence of a long marker chromosome not studied, 1 plant), counted by O. Rotreklová. **9**. Czech Republic, distr. Žďár nad Sázavou: railway station in the town of Žďár nad Sázavou, 560 m a.s.l., 49°33'14"N, 15°56'20"E, coll. O. Rotreklová, 3 June 1998, 2n = 36 with a long marker chromosome (1 plant), counted by A. Krahulcová. **10**. Czech Republic, distr. Havlíčkův Brod: meadow 1 km E of the railway station in the town of Chotěboř, 540 m a.s.l., 49°42'43"N, 15°41'59"E, coll. O. Rotreklová, 29 June 1999, 2n = 36 with a long marker chromosome (1 plant), counted by A. Krahulcová. **11**. Czech Republic, distr. Blansko: meadow in a garden in the village of Kořenec, 650 m a.s.l., 49°31'52"N, 16°45'27"E, coll. V. Řehořek, September 2000, 2n = 36 (the presence of a long marker chromosome not studied, 1 plant), counted by O. Rotreklová. **12**. Poland, Jizerské hory Mts: along the path 1 km E of the Velká Jizerská louka meadow in the area of the former settlement of Izera, 7.5 km SSE of the village of Świeradów Zdrój, 850 m a.s.l., 50°50'50"N, 15°22'30"E, coll. F. Krahulec, 4 June 2000, 2n = 36 with a long marker chromosome (1 plant), counted by A. Krahulcová. **13**. Poland, Kudowa Zdrój, Lewin Klodzki: 300 m NW of the square, 50°24'30"N, 16°16'50"E,

ca 450 m a.s.l., coll. R. Šimek, 10 July 2000, 2n = 36 with a long marker chromosome (1 plant), counted by A. Krahulcová. **14**. Slovakia, Velká Fatra Mts: Mt Králova studňa 7 km W of the village of Staré Hory, the meadow at the hiking path 150 m NW of the chalet, 1270 m a.s.l., 48°52'40"N, 19°02'30"E, coll. F. Krahulec and A. Krahulcová, 24 July 1999, 2n = 45 with a long marker chromosome (2 plants), counted by A. Krahulcová.

Diploid, triploid and tetraploid cytotypes have been previously found in this species. Triploid plants have been reported from Poland (Skalińska 1967) and Sweden (Turesson & Turesson 1963, under the name *H. suecicum* Fr.; see also Schuhwerk 1996). The tetraploid level is more commonly encountered; there have been reports from Germany (Schuhwerk & Lippert 1997), the Kuril Islands (Probatova et al. 1989), and the Czech Republic (Krahulcová & Krahulec 1999). The diploid *H. floribundum* was recorded rarely (as a wholly new ploidy level in this species) in the Krkonoše Mts in the Czech Republic (Krahulcová et al. 2001).

The tetraploid chromosome number prevails among counts presented here. According to the literature data as well, the tetraploid level seems to be the most common one in this species. In addition, the pentaploid plants reported here from the Carpathians are a new ploidy level in *H. floribundum*. The examination of chromosome size confirmed the characteristic presence of a long marker chromosome in the karyotype of this species, except of the diploid cytotype (Krahulcová & Krahulec 1999, Krahulcová et al. 2001).

Hieracium floribundum × *H. aurantiacum*

2n = 36

Locality: **1**. Czech Republic, Šumava Mts, distr. Klatovy: the meadow in the former settlement of Stará Hůrka 0.3 km SW of the church ruin, above the path to Laka lake, 1005 m a.s.l., 49°07'30"N, 13°19'48"E, coll. F. Procházka, 1 July 1999, 2n = 36 (1 plant), counted by A. Krahulcová. The plant was revised by S. Bräutigam and G. Gottschlich in June 2000.

The morphological characters of this plant suggest its hybrid origin. Both the presumed parents, the tetraploid *H. floribundum* and *H. aurantiacum* occur at the locality as well. *H. aurantiacum* is probably also tetraploid, as no other cytotypes are known in this species from the Šumava Mts in the Czech Republic.

Hieracium glomeratum Froel. in DC.

Prodr. 7, 1: 207, 1838.

[Syn.: *H. ambiguum* Ehrh., nom. nud.]

H. caespitosum – H. cymosum

2n = 36; 2n = 45 (both cytotypes with a long marker chromosome).

Localities: **1**. Czech Republic, distr. Česká Lípa: railway station Mimoň, 310 m a.s.l., 50°39'27"N, 14°42'55"E, coll. J. Danihelka, 6 July 1998, 2n = 45 (the presence of a long marker chromosome not studied, 2 plants), counted by O. Rotreklová. **2**. Czech Republic, distr. Náchod: grassland in the N periphery of the village of Vršovka, 330 m a.s.l., 50°19'30"N, 16°07'00"E, coll. F. Krahulec, 21 May 1999, 2n = 45 with a long marker chromosome (1 plant), counted by A. Krahulcová. **3**. Czech Republic, distr. Olomouc: grassland on the E slope of Malý Kosíř Hill 0.6 km SW of the church in the village of Slatinice na Hané, 270 m a.s.l., 49°33'30"N, 17°05'40"E, coll. F. Krahulec, 25 May 1998, 2n = 36 with a long marker chromosome (1 plant), counted by A. Krahulcová.

The tetraploid chromosome number is reported by Schuhwerk & Lippert (1997) from the Czech Republic and from Bavaria in Germany. Turresson & Turreson (1963) recorded both prevailing tetraploids and rare pentaploids in Sweden. The Swedish plants were treated by Turresson & Turreson (1963) as *H. tenerescens* Norrl., *H. umbelliflorum* Nägeli

et Peter and *H. vacillans* Norrl, but here we accept their incorporation into *H. glomeratum* by Schuhwerk (1996). Both the tetraploid and the pentaploid *H. glomeratum* have been recorded at several localities in the Krkonoše Mts in the Czech Republic (Krahulcová & Krahulec 1999, Krahulcová et al. 2001). The results presented here confirm both ploidy levels (tetraploid and pentaploid) reported in *H. glomeratum*.

Hieracium guthnickianum Hegetschw.

Fl. Schweiz 4: 781, 1840.

H. aurantiacum – H. cymosum

2n = 54

L o c a l i t y : **1**. Slovakia, Veľká Fatra Mts: Mt Krížna, 1.2 km SE of the top, grassland beside the hiking path near the former ski lift station (near the survey site 1449.8 m), 4 km NW of the village of Staré Hory, 48°52'10"N, 19°05'20"E, coll. F. Krahulec and A. Krahulcová, 24 July 1999, 2n = 54 (2 plants), counted by A. Krahulcová. Identified by S. Bräutigam, G. Gottschlich and W. Gutermann.

The hexaploid *H. guthnickianum* (2n = 54) has also been recorded in Germany, Bavaria (Schuhwerk & Lippert 1997) and in Bulgaria, Pirin Mts (Vladimirov & Szeląg, unpubl.). Although the occurrence of *H. guthnickianum* was reported from this locality in earlier times (Zahn 1922–1930, 1927, Grebenščikov et al. 1956), this occurrence was later considered to be doubtful and the report to be unreliable (Soják 1971). The taxon is included in the Checklist of Slovak flora (ut *Pilosella guthnickiana*, cf. Chrtek 1998).

Hieracium lactucella Wallr.

Sched. Crit. 1: 408, 1822.

[syn.: *H. auricula* auct.]

2n = 18

L o c a l i t i e s : **1**. Czech Republic, Šumava Mts, distr. Klatovy: woodland edge 4 km E of the crossroad near the settlement of Gerlova Huť, ca. 8 km NE of the town of Železná Ruda, 920 m a.s.l., 49°10'00"N, 13°20'00"E, coll. F. Krahulec, 10 August 1999, 2n = 18 (1 plant), counted by A. Krahulcová. **2**. Czech Republic, Šumava Mts, distr. Prachatice: old destroyed wall by the blue hiking path 1 km SSW of the church in the village of Kvilda, 1050 m a.s.l., 49°00'40"N, 13°34'40"E, coll. F. Krahulec, 10 August 1999, 2n = 18 (1 plant), counted by A. Krahulcová. **3**. Czech Republic, distr. Žďár nad Sázavou: meadow in the NW part of the village of Cikháj, 650 m a.s.l., 49°39'07"N, 15°57'54"E, coll. O. Rotreklová, 7 June 2000, 2n = 18 (1 plant), counted by O. Rotreklová. **4**. Slovakia, Západné Tatry Mts: grassland below the rocks on the S slope of Mt Osobitá, ca. 8 km E of the village of Zuberec, 1570 m a.s.l., 49°15'40"N, 19°43'20"E, coll. F. Krahulec and A. Krahulcová, 23 July 1999, 2n = 18 (1 plant), counted by A. Krahulcová. **5**. Slovakia, Volovské vrchy Mts: Krivé sedlo saddle between Mt Ramzová and Mt Biele skaly, 8 km SSW of Stará Voda village, 1110 m a.s.l., 48°43'50"N, 20°38'08"E, coll. P. Mráz and V. Jurkovičová, 14 June 2000, 2n = 18 (1 plant, no. 763), counted by P. Mráz.

The earliest chromosome counts in this species (n = 9) were published by Rosenberg (1907), Gentscheff (1938) and Christoff (1942) in plants of unknown origin, cultivated in botanical gardens. The diploid level has also been recorded in plants from the Veľká Fatra Mts in Slovakia (Uhríková & Bernátová in Májovský et al. 2000), Poland (Skalińska 1967, Skalińska et al. 1968), Sweden and Austria (Turesson & Turesson 1960), the French Alps (Gadella & Kliphuis 1970), Austria, Belgium, France, the Netherlands, Switzerland and Spain (Gadella 1984), the Czech Republic (Krahulcová & Krahulec 1999), and Germany (Schuhwerk & Lippert 1997). The occurrence of a triploid cytotype has been reported by Contandriopoulos (1957, 1962) who found a Corsican form with 2n = 27. Even before this

report, Zahn (1922–1930) has classified the plants from Corse as subsp. (and grex) *micranthum*. However, the relation between the triploid plants from Corse and those plants reported previously by Zahn (loc. cit.) from this area remains unclear (no comparison of herbarium material has been made). According to Krahulcová & Krahulec (1999), the triploid plants might be of hybrid origin. Except for this sporadic references to triploids, all plants examined hitherto (including those presented in this paper) were diploid.

Hieracium onegense (Norrl.) Norrl. in T. Sael., Kihlm. et Hjelt

Herb. Mus. Fenn., ed. 2, 1: 118, 1889 [cit. sec. Shljakov 1989: 351].

[Syn.: *H. caespitosum* subsp. *brevipilum* (Nägeli et Peter) P. D. Sell; *H. pratense* subsp. *silvicolum* Zahn]

2n = 18

L o c a l i t y : **1**. Slovakia, Západné Tatry Mts: meadow by the green hiking path 1.25 km NW of Zverovka chalet, ca. 6.25 km E of the village of Zuberec, 1080 m a.s.l., 49°17'00"N, 19°42'00"E, coll. F. Krahulec and A. Krahulcová, 23 July 1999, 2n = 18 (3 plants), counted by A. Krahulcová.

Most of the chromosome counts of *H. caespitosum* are reported from Poland. Diploids are distributed in the eastern part of the country; their morphological characters correspond to the subsp. *silvicolum* Zahn (Skalińska 1967, Kubień in Skalińska et al. 1968, Skalińska & Kubień 1972). The tetraploid cytotype is encountered in southern Poland both at lower altitudes in the mountains and in the lowlands. The tetraploid has been identified as subsp. *eu-pratense* (Skalińska 1967, Kubień in Skalińska et al. 1968, Skalińska & Kubień 1972). According to Skalińska & Kubień (1972), the triploid and pentaploid plants recorded in Poland (Skalińska 1967) are of hybrid origin. Recently, the pentaploid cytotype was recorded also in the Veľká Fatra Mts in Slovakia (Uhríková & Bernátová in Májovský et al. 2000). Schuhwerk & Lippert (1998) reported the diploid cytotype from Greece and Vladimirov (2000) reported it from Bulgaria [in both references under the name of *H. caespitosum* subsp. *brevipilum* (Nägeli et Peter) P. D. Sell]. Recently, this diploid taxon was recorded in the Krkonoše Mts in the Czech Republic (Krahulcová et al. 2001). The authors accept here the classification of this taxon as a separate species, according to some of the recent floras and checklists, e.g. Cherepanov (1995: 140) – presented as *Hieracium onegense* (Norrl.) Norrl., or Shljakov (1989: 351) – presented as *Pilosella onegensis* Norrl. In Germany, tetraploid (Schuhwerk & Lippert 1997) and pentaploid *H. caespitosum* (Bräutigam & Bräutigam 1996) have been detected. Gadella (1984) found tetraploid plants in Austria and in the Netherlands, as did Krahulcová & Krahulec (1999) in the Krkonoše Mts in the Czech Republic. Alien plants occurring in the USA have been found to be tetraploids (Gustafsson 1933, Van Faasen in Van Faasen & Nadeau sec. Löve 1976), those introduced to New Zealand to be tetraploids and pentaploids (Jenkins & Jong 1997).

Hieracium pilosella L.

Sp. Pl. 800, 1753.

2n = 36, sexual; 2n = 45, both sexual and apomictic; 2n = 54, apomictic.

L o c a l i t i e s : **1**. Czech Republic, distr. Louny: W edge of Vroutecký les wood near the village of Valov, 2.2 km S of the church in the town of Podbořany, 350 m a.s.l., 50°12'50"N, 13°25'00"E, coll. F. Krahulec, 2 June 1998, 2n = 36 (1 plant), counted by A. Krahulcová. **2**. Czech Republic, distr. Cheb: nature reserve Pluhův bor, serpentine rocks in the forest 1.7 km N of the church in the village of Mnichov, ca. 700 m a.s.l., 50°03'12"N, 12°47'07"E, coll. O. Rotreklová and P. Šmarda, 13 July 2000, 2n = 36 (2 plants), counted by O. Rotreklová. **3**. Czech Republic, Praha: slope above the railway W of the railway station Praha-Vysočany, 210 m a.s.l., 50°06'45"N, 14°29'50"E, coll. F. Krahulec and

J. Chrtek, 18 May 2000, 2n = 36 (5 plants), 2n = 45 (1 plant), counted by A. Krahulcová. **4**. Czech Republic, Bohemian Karst, distr. Beroun: grassland above the road N of the village of Srbsko, 1.3 km NE of the railway station, 310 m a.s.l., 49°56'40"N, 14°08'50"E, coll. F. Krahulec, 13 June 1998, 2n = 36, sexual (1 plant), counted by A. Krahulcová. **5**. Czech Republic, Šumava Mts, distr. Prachatice: slope above the railway in the centre of the village of Stožec 50 m E of the railway station, 780 m a.s.l., 48°51'30"N, 13°49'20"E, coll. F. Krahulec, 11 August 1999, 2n = 36 (1 plant), counted by A. Krahulcová. **6**. Czech Republic, distr. Náchod: grassland and the former sand pit in the N periphery of the village of Vršovka, 330 m a.s.l., 50°19'30"N, 16°07'00"E, coll. F. Krahulec, 21 May 1999, 2n = 36 (3 plants), counted by A. Krahulcová. **7**. Czech Republic, distr. Rychnov nad Kněžnou: meadow at the edge of Halín wood, 0.5 km NW of the crossroads near the village of Běstviny, 310 m a.s.l., 50°19'30"N, 16°08'40"E, coll. F. Krahulec, 21 May 1999, 2n = 54, apomictic (1 plant), counted by A. Krahulcová. **8**. Czech Republic, distr. Olomouc: grassland on the E slope of Malý Kosíř hill, 0.6 km SW of the church in the village of Slatinice na Hané, 270 m a.s.l., 49°33'30"N, 17°05'40"E, coll. F. Krahulec, 25 May 1998, 2n = 36 (3 plants), sexual (1 plant); 2n = 45, sexual (1 plant), counted by A. Krahulcová. **9**. Czech Republic, distr. Zlín: meadow 1.2 km SE of the railway station in the village of Valašské Klobouky, 510 m a.s.l., 49°08'10"N, 18°02'10"E, coll. F. Krahulec, 17 August 1999, 2n = 45 (1 plant), counted by A. Krahulcová. **10**. Slovakia, Veľká Fatra Mts: Mt Králova studňa, meadow near the hiking path 150 m NW of the chalet, 7 km W of the village of Staré Hory, 1270 m a.s.l., 48°52'40"N, 19°02'30"E, coll. F. Krahulec and A. Krahulcová, 24 July 1999, 2n = 54 (1 plant), counted by A. Krahulcová. **11**. Slovakia, Vtáčnik Mts: valley of Pokulský potok brook, in the grassy place 1 km E of the village of Ostrý Grúň, 490 m a.s.l., 48°33'50"N, 18°41'00"E, coll. F. Krahulec, 18 September 1998, 2n = 45, apomictic (1 plant), counted by A. Krahulcová. **12**. Slovakia, Vtáčnik Mts: valley of Jastrebský potok brook, ca. 2.1 km S of the church in the village of Prochoť, 500 m a.s.l., 48°35'30"N, 18°42'40"E, coll. F. Krahulec, 18 September 1998, 2n = 45, apomictic (1 plant), counted by A. Krahulcová. **13**. Slovakia, Volovské vrchy Mts: Cechy on the medieval copper heaps ca. 0.5 km N of the center of the town of Gelnica, ca. 500 m a.s.l., 48°51'28"N, 20°55'24"E, coll. P. Mráz and M. Bačkor, 26 August 1999, 2n = 45 (2 plants, no. 720 and 721), counted by P. Mráz. **14**. Slovakia, Ostrôžky Mts: ca. 0.7 km SW of the village of Ľuboreč, along the road between the villages of Ľuboreč and Závada, 250 m a.s.l., 48°18'08"N, 19°30'35"E, coll. P. Mráz and V. Jurkovičová, 23 April 2000, 2n = ca. 54 (no. 727), 2n = 54 (no. 728), counted by P. Mráz. **15**. Poland, Beskid Sląski Mts: grassland above the chalet ca. 3.8 km ESE of the railway station in the town of Ustroń, 800 m a.s.l., 49°43'20"N, 18°51'20"E, coll A. Krahulcová, 21 May 1997, 2n = 36 (1 plant), counted by A. Krahulcová. **16**. Poland, Beskid Sląski Mts: grassland along the road 0.5 km SW of the chalet ca. 3.25 km SE of the railway station in the town of Ustroń, 760 m a.s.l., 49°43'00"N, 18°50'40"E, coll. A. Krahulcová, 21 May 1997, 2n = 36 (1 plant), counted by A. Krahulcová.

Extreme variation in ploidy level (ranging from 2x to 7x; triploids are unknown) is reported in this species from the field. A brief account of ploidy levels known in *H. pilosella* from localities throughout Europe has already been given elsewhere (Krahulcová & Krahulec 1999; for a distribution map of cytotypes see Gadella 1991: 458). Three ploidy levels (tetraploids prevailing, pentaploids and hexaploids) have recently been recorded in *H. pilosella* agg. in Slovakia (Pišťanský & Mičieta 2000); there plants might also include the products of spontaneous hybridization, morphologically very close to *H. pilosella* s. str.

The tetraploid *H. pilosella*, common in Europe, is usually sexual, while the less common hexaploids can be sexual or apomictic (Gadella 1984). On the contrary, the pentaploid cytotype is assumed to be almost exclusively apomictic (Gadella 1984). Nevertheless, rare sexual seed production was considered possible even in the pentaploid plants (Turesson & Turesson 1960, Turesson 1972). This was later confirmed by detailed embryological studies which revealed the possibility of facultative sexuality in otherwise apomictic pentaploid plants (Pogan & Wcisło 1995).

The fully sexual reproduction detected by us in the pentaploid H. pilosella (locality 8) is a completely new finding for the subgenus Pilosella. It is evident, that plants having odd numbers of chromosome sets need not be apomictic or sterile as had been previously assumed (e.g. Gadella 1984, 1987). The sexual mode of reproduction of the pentaploid plant concerned has been confirmed not only by standard emasculation treatment (see Methods), but also by varied chromosome numbers recorded in the progeny of this open pollinated plant cultivated with many other species.

Hieracium piloselliflorum Nägeli et Peter

Die Hieracien Mittel-Europas 1: 707, 1885.

H. floribundum < *H. pilosella*

2n = 36, 45

Localities: **1**. Czech Republic, distr. Žďár nad Sázavou: heathland S of SE coast of the water reservoir Hamerská nádrž near the village of Vortová, 600 m a.s.l., 49°44'09"N, 15°55'00"E, coll. P. Bureš, 10 September 2000, 2n = 36 (1 plant), counted by O. Rotreklová. **2**. Czech Republic, Králický Sněžník Mts, distr. Ústí nad Orlicí: gravel silt on the left bank of the Morava river in the N part of the village of Dolní Morava, 0.2 km NW of the church in the village, 620 m a.s.l., 50°07'50"N, 16°48'10"E, coll. F. Krahulec and A. Krahulcová, 5 June 1999, 2n = 45 (1 plant), counted by A. Krahulcová.

Three ploidy levels have been reported for this species from the Czech Republic: the tetraploid, the pentaploid and the hexaploid. In addition, an aneuploid chromosome number (2n = 44) was also recorded for two plants (Krahulcová & Krahulec 1999). Both the tetraploid and pentaploid level are here confirmed for this hybridogenous species.

Hieracium piloselloides Vill.

Prosp. Pl. Dauph. 34, 1779.

2n = 36, sexual.

Localities: **1**. Czech Republic, Rychlebské hory Mts: quarry in the W part of the village of Vápenná, 500 m a.s.l., 50°17'00"N, 17°05'25"E, coll. O. Rotreklová, 28 June 1999, 2n = 36 (1 plant), counted by O. Rotreklová. **2**. Czech Republic, Hrubý Jeseník Mts: quarry in the W part of the village of Branná, 650 m a.s.l., 50°09'12"N, 17°00'27"E, coll. O. Rotreklová, 28 June 1999, 2n = 36 (1 plant), counted by O. Rotreklová. **3**. Slovenia, village of Postojna: on the slope 300 m NW of the Postojnska jama cavern, 500 m a.s.l., 45°47'43"N, 14°11'36"E, coll. M. Chytrý, 17 June 1998, 2n = 36, sexual (3 plants), counted by O. Rotreklová.

Reports of tetraploid and pentaploid chromosome counts prevail in the literature. Tetraploids are reported to occur in Macedonia (Gadella 1984), Germany (Bräutigam & Bräutigam 1996, Schuhwerk & Lippert 1997), Italy (Schuhwerk & Lippert 1997), and Canada (Mulligan 1961). Pentaploid plants have been detected in Germany, the Czech Republic (Bräutigam & Bräutigam 1996), and Canada (Mulligan 1961). Diploid populations and a mixed population of prevailing diploids and tetraploids have been found in France (Favarger sec. Löve 1971, Favarger 1997); diploids are also reported by Mulligan (1984) from Canada. Furthermore, triploids have been recorded in France (Gadella 1984) and hexaploids from Mt Olympus in Greece (Strid & Franzén sec. Löve 1981).

Hieracium rothianum Wallr.

Sched. Crit. 417, 1822.

H. echioides > *H. pilosella*

2n = 36, apomictic.

Localities: **1**. Czech Republic, České středohoří Mts, distr. Litoměřice: Mt Trojhora (454 m), rocky slopes ca. 1 km N of the village of Chudoslavice, 430 m a.s.l., 50°35'24"N, 14°11'28"E, coll. T. Peckert, 14 May 2000, 2n = 36 (1 plant), apomictic (4 plants), counted by T. Peckert. **2**. Czech Republic, Praha: town district Praha-Podbaba, rock on the left bank of the Vltava River, 300 m a.s.l., 50°07'28"N, 14°23'37"E, coll. T. Peckert, 30 June 1998, 2n = 36 (1 plant), apomictic (6 plants), counted by T. Peckert. **3**. Czech Republic, distr. Kladno: nature reserve Otvovická skála 1 km ENE of the railway station in the village of Otvovice, 250 m a.s.l., 50°13'03"N, 14°16'48"E, coll. D. Vaňková, June 1996, 2n = 36 (1 plant), counted by D. Vaňková. **4**. Czech Republic, distr. Brno: Malhostovická Pecka hill 1 km SSW of the chapel in the village of Malhostovice, 330 m a.s.l., 49°19'33"N, 16°29'41"E, coll.

D. Vaňková, July 1996, 2n = 36 (1 plant), counted by D. Vaňková. **5**. Czech Republic, distr. Znojmo: near the chapel 0.3 km SW of the village of Popice, 300 m a.s.l., 48°49'12"N, 16°00'42"E, coll. D. Vaňková, June 1996, 2n = 36 (1 plant), counted by D. Vaňková. **6**. Czech Republic, distr. Břeclav: Liščí vrch hill 1.3 km NNW of the church in the village of Sedlec, 250 m a.s.l., 48°47'31"N, 16°41'34"E, coll. D. Vaňková, June 1996, 2n = 36 (1 plant), counted by D. Vaňková. **7**. Czech Republic, distr. Znojmo: Pustý kopec hill (also called Suchý vrch hill), ca. 2 km E of the village of Popice, 260 m a.s.l., 48°48'45"N, 16°02'08"E, coll. T. Peckert, July 1998, 2n = 36 (1 plant), apomictic (4 plants). **8**. Czech Republic, Pavlovské kopce hills, distr. Břeclav: Mt Děvín (548 m),W slopes near the transmitter, 540 m a.s.l., 48°52'06"N, 16°38'54"E, coll. T. Peckert, 9 July 1999, 2n = 36 (1 plant), apomictic (4 plants). **9**. Czech Republic, Pavlovské kopce hills, distr. Břeclav: S slopes of Svatý kopeček hill at the town of Mikulov, ca. 330 m a.s.l., 48°48'24"N, 16°38'42"E, coll. T. Peckert, July 1998, 2n = 36 (1 plant), apomictic (2 plants). **10**. Czech Republic, distr. Břeclav: Břeclav-Poštorná, waste places near the railway station Boří les, 160 m a.s.l., 48°44'15"N, 16°51'58"E, coll. J. Danihelka, 1996; T. Peckert, J. Chrtek and J. Škorničková, 21 June 1998, 2n = 36 (4 plants), apomictic (5 plants), counted by D. Vaňková and T. Peckert. **11**. Czech Republic, distr. Hodonín: along the railway 1 km SW of the railway station Bzenec-Přívoz near the village of Bzenec, 180 m a.s.l., 48°55'47"N, 17°16'52"E, coll. D. Vaňková, July 1996; T. Peckert, 12 June 1998, 2n = 36 (3 plants), apomictic (5 plants), counted by D. Vaňková and T. Peckert. **12**. Slovakia, distr. Malacky: Zohor, 48°21'00"N, 17°01'00"E, coll. T. Peckert, 21 June 1998, 2n = 36 (1 plant), apomictic (2 plants), counted by T. Peckert.

Only the tetraploid chromosome number has been detected until now in plants originated from Austria (Schuhwerk & Lippert 1997).

Hieracium schultesii F. W. Schultz

Arch. Fl. Fr. Allem. 35, 1842.

H. lactucella – H. pilosella

2n = 45

L o c a l i t y : **1**. Slovakia, Veľká Fatra Mts: Mt Kráľova studňa, in the meadow along the hiking path 150 m NW of the chalet, 1270 m a.s.l., 48°52'40"N, 19°02'30"E, coll. F. Krahulec and A. Krahulcová, 24 July 1999, 2n = 45 (5 plants), counted by A. Krahulcová.

Three ploidy levels, i.e. triploid, tetraploid and pentaploid, have been reported in *H. schultesii.* Triploids have been recorded in Bavaria, Germany (Schuhwerk & Lippert 1997) and in Corse, France (Contandriopoulos 1957). Prevailing tetraploids (both sexual and apomictic) and one pentaploid apomictic accession have been found in the Krkonoše Mts in the Czech Republic (Krahulcová & Krahulec 1999, Krahulcová et al. 2001). The record of pentaploid plants presented here from the Carpathians might indicate a more frequent occurrence of the pentaploid cytotype. At present, very little information about chromosome number variation in *H. schultesii* is known. Therefore, more chromosome counts in this hybridogenous species are needed.

Acknowledgements

The authors are indebted to all colleagues who collected and determined plants. J. Chrtek jun., F. Krahulec and J. Danihelka made valuable remarks to the manuscript, and Sierra Dawn Holt did language corrections. An anonymous reviewer is acknowledged for supplementary comments. The authors also thank to V. Vladimirov and to Z. Szeląg, who provided their unpublished chromosome counts from Bulgaria. This study was supported by the Grant Agency of the Academy of Sciences of the Czech Republic (A. K., project no. A6005803 and AV0Z6005908), by the Ministry of Education of the Czech Republic (O. R., reasearch project MSM 143100010), by the programme "Biosféra" (A. K., research project VaV/610/3/00), and by the Grant project of the Faculty of Sciences (P. M., project no. VGS/015/2001/B).

Table 1. – List of species of *Hieracium* subgen. *Pilosella* presented in this paper, their chromosome numbers and breeding sytems. Abbreviations of countries, from which the particular cytotypes originated (the breeding systems were examined only in selected plants representing the particular cytotypes and do not relate to all countries given in the row): Cz = Czech Republic, Sk = Slovakia, Au = Austria, Hu = Hungary, Ge = Germany, Pl = Poland, Slo = Slovenia, Uk = Ukraine.

Species	Country	2n	Breeding system
H. apatelium Nägeli et Peter	Cz	45	
H. aurantiacum L.	Cz, Uk	36	
H. bauhini Besser	Sk	36	
	Cz	45	apomictic
	Cz	54	apomictic
H. brachiatum Bertol. ex DC.	Cz	45	apomictic
	Cz	48, 63	
	Cz	72	apomictic
H. densiflorum Tausch	Cz, Slo	36	sexual
H. echioides Lumn.	Cz, Au, Hu, Ge, Pl	18	sexual
	Cz	27	
	Cz, Au	36	sexual
H. floribundum Wimm. et Grab.	Cz, Pl	36	
	Sk	45	
H. floribundum × *H. aurantiacum*	Cz	36	
H. glomeratum Froel.	Cz	36, 45	
H. guthnickianum Hegetschw.	Sk	54	
H. lactucella Wallr.	Cz, Sk	18	
H. onegense (Norrl.) Norrl.	Sk	18	
H. pilosella L.	Cz, Pl	36	sexual
	Cz	45	sexual
	Cz, Sk	45	apomictic
	Cz, Sk	54	apomictic
H. piloselliflorum Nägeli et Peter	Cz	36, 45	
H. piloselloides Vill.	Cz, Slo	36	sexual
H. rothianum Wallr.	Cz, Sk	36	apomictic
H. schultesii F. W. Schultz	Sk	45	

Souhrn

V práci jsou shrnuty výsledky studia chromozomových počtů a způsobu reprodukce jestřábníků podrodu *Pilosella*, které shromáždil kolektiv autorů během posledních pěti let. Počty chromozomů jsou zde uvedeny pro rostliny pocházející převážně z České republiky, dále ze Slovenska, Polska, Slovinska, Německa, Maďarska, Rakouska a Ukrajiny. U některých druhů a cytotypů byl zjištěn i reprodukční systém. Práce zahrnuje následujících 16 taxonů a jednoho mezidruhového kříženec: *H. apatelium* Nägeli et Peter (2n = 45), *H. aurantiacum* L. (2n = 36), *H. bauhini* Besser (2n = 36; 2n = 45, 54, oba cytotypy apomiktické), *H. brachiatum* Bertol. ex DC. (2n = 45, apomiktický; 2n = 48, 63; 2n = 72, apomiktický), *H. densiflorum* Tausch (2n = 36, sexuální), *H. echioides* Lumn. (2n = 18, sexuální; 2n = 27; 2n = 36, sexuální), *H. floribundum* Wimm. et Grab. (2n = 36, 45), *H. glomeratum* Froel. (2n = 36, 45), *H. guthnickianum* Hegetschw. (2n = 54), *H. lactucella* Wallr. (2n = 18), *H. onegense* (Norrl.) Norrl. (2n = 18), *H. pilosella* L. (2n = 36, sexuální; 2n = 45, sexuální i apomiktický; 2n = 54, apomiktický), *H. piloselliflorum* Nägeli et Peter (2n = 36, 45), *H. piloselloides* Vill. (2n = 36, sexuální), *H. rothianum* Wallr. (2n = 36, apomiktický), *H. schultesii* F. W. Schultz (2n = 45), a *H. floribundum* × *H. aurantiacum* (2n = 36). V této práci nejsou zahrnuty rostliny z české části Krkonoš, jejichž karyologické a reprodukční charakteristiky již byly uveřejněny na jiném místě (Krahulcová & Krahulec 1999, Krahulcová et al. 2001).

Chromozomové počty, dosud neuváděné v literatuře, byly zjištěny u druhů *H. brachiatum* a *H. floribundum*. Oktoploidní cytotyp nalezený u hybridogenního druhu *H. brachiatum* (2n = 72) představuje dosud nejvyšší ploidní stupeň zástupců podrodu *Pilosella* objevený v přírodě. U tohoto druhu byl u rostliny pocházející z hybridního

roje *H. pilosella – H. bauhini* rovněž zaznamenán aneuploidní počet chromozomů (2n = 48), který je u evropských zástupců podrodu velmi vzácný. Dlouhý signální chromozom (Krahulcová & Krahulec 1999) byl zaznamenán v karyotypech druhů *H. bauhini*, *H. brachiatum*, *H. floribundum* a *H. glomeratum*. Obligátně sexuální způsob reprodukce pentaploidního cytotypu *H. pilosella* je dosud neznámý jev: znamená zvýšení různorodosti v možných způsobech reprodukce i u těch cytotypů, které mají lichý počet chromozomových sad. Výskyt *H. guthnickianum* na Slovensku ve Velké Fatře je zde znovu potvrzen, ač byl po prvních údajích (Zahn 1922–1930, 1927, Grebenščikov et al. 1956) později zpochybněn (Soják 1971).

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Received 6 August 2001
Revision received 20 November 2001
Accepted 24 November 2001