

## CHROMOSOME NUMBER VARIABILITY IN CENTRAL EUROPEAN MEMBERS OF THE *FESTUCA OVINA* AND *F. PALLENS* GROUPS (SECT. *FESTUCA*)

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**Abstract:** Chromosome numbers for 98 plants of *F. pallens*, 19 of *F. psammophila*, *F. belensis* and *F. vaginata*, and 44 of *F. ovina* (originating from Austria, the Czech Republic, Germany, Slovakia and Latvia) are given. In addition to the *F. ovina* and *F. pallens* groups, chromosome counts for the following taxa are also reported: *F. alpestris* (2n=14) reported for the first time in this work, *F. amethystina* subsp. *amethystina* (2n=28), *F. brevipila* (2n=42), *F. cinerea* (2n=28), *F. rupicola* subsp. *rupicola* (2n=42) and *F. versicolor* subsp. *versicolor* (2n=14).

In *F. pallens*, two ploidy levels (2n=2x=14+0-1B, 2n=4x=28+0-1B) as well as two natural triploid plants (2n=21+0-1B), were found. In addition to the four *F. pallens* types that have been distinguished in Austria, one new tetraploid type (*F. pallens* “*scabrifolia*”) from the Czech Republic and Germany is reported and its taxonomy is discussed. The distributions of the Oberösterreich-Niederösterreich and Pannonisches-Hügelland *F. pallens* types outside of Austria are documented.

Only the diploid chromosome number (2n=14) was found in *F. psammophila* and *F. vaginata*. Chromosome numbers for *F. psammophila* subsp. *muellerstollii* and *F. belensis* (both 2n=14) were determined here for the first time. Two ploidy levels, 2n=14+0-5B corresponding to *F. ovina* subsp. *ovina* and 2n=28 corresponding to *F. ovina* subsp. *guestphalica* and *F. cf. duernsteinensis* were confirmed in *F. ovina*. Differences in chromosome structure (simple and multiple secondary constrictions) between *F. pallens* as opposed to *F. psammophila* and *F. vaginata* are discussed. A complete survey of published chromosome counts for Central European species from the *F. ovina* and *F. pallens* groups is included.

**Keywords:** Fescue, Karyology, Ploidy level distribution, *Poaceae*, Taxonomy

### INTRODUCTION

Species of the genus *Festuca* are morphologically very similar and often represent young taxa. Speciation is believed to be strongly influenced by hybridization and polyploidization (JENKIN 1955a,b,c, MALIK & THOMAS 1966, MALIK 1967, MÁJOVSKÝ 1962). This results in extreme taxonomical difficulties being associated with most of the taxa. The absence of strong differential morphological characters and character variability led to a broad species concept in the past. It was soon shown that these broad species contained miscellaneous polyploid complexes. Different ploidy levels correlated with some morphological characters and usually showed some kind of geographic coherence. This consequently led to the designation of plants of newly reported ploidy levels as separate species or subspecies. Classic examples of this practice are the works of AUQUIER & KERGUÉLEN (1977),

KERGUÉLEN (1983) and more recently, the species checklists and conspects of MARKGRAF-DANNENBERG (1980), WILKINSON & STACE (1991), FUENTE GARCIA & ORTÚÑEZ RUBIO (1998) and PORTAL (1999). In the current species concept and in *Festuca* taxonomy as a whole, ploidy level plays a very important role and is often the main classification criterion. This is especially manifested in larger and taxonomically problematic groups. Both the *F. ovina* and *F. pallens* groups belong to this category.

The concept of the *Festuca pallens* and *F. ovina* groups is not always uniform and, depending on the author and study area, various taxa are included in them. In this work, we followed the group concept of TRACEY (1980) that corresponds to the series divisions of PAWLUS (1985). This work addresses the following Central European species and infraspecific taxa:

*F. ovina* group (*Festuca* L. sect. *Festuca* ser. *Festuca*)

*F. ovina* L. subsp. *ovina*

subsp. *bigoudenensis* KERGUÉLEN et PLONKA

subsp. *hirtula* (HACK. ex TRAVIS) M.J. WILK.

subsp. *guestfalica* (RCHB.) K. RICHT.

subsp. *ophiolicola* (KERGUÉLEN) M.J. WILK.

*F. filiformis* POURR.

*F. supina* SCHUR

*F. airoides* LAM.

*F. eggleri* R. TRACEY

?*F.* “×”*duernsteinensis* J. VETTER (“= *F. ovina* × *F. pallens*”)

*F. pallens* group (*Festuca* sect. *Festuca* ser. *Psammophila* PAWLUS)

*F. pallens* HOST

Oberösterreich-Niederösterreich type

Weizklamm type

Pannonisches-Hügelland type

Steiermark-Kärnten type

“*scabrifolia*” type (newly reported in this work)

*F. psammophila* (HACK. ex ČELAK.) FRITSCH subsp. *psammophila*

subsp. *muellerstollii* M. TOMAN

*F.* “×”*belensis* M. TOMAN (“= *F. pallens* × *F. psammophila*”)

*F. vaginata* WALDST. et KIT. ex WILLD. subsp. *vaginata*

subsp. *dominii* (KRAJINA) SOÓ

From the other groups, the following taxa were investigated:

*Festuca* L. sect. *Festuca*

*F. alpestris* ROEM. et SCHULT.

*F. brevipila* R. TRACEY

*F. cinerea* VILL.

*F. rupicola* subsp. *rupicola* HEUFF.

*F. versicolor* TAUSCH subsp. *versicolor*

*Festuca* sect. *Aulaxyper* DUMORT.

*F. amethystina* L. subsp. *amethystina*

The first chromosome counts for *F. ovina* can be found in the works of LITARDIÈRE (1923) and LEWITSKY & KUZMINA (1927). These data are of only limited use in current systematic studies. The main problems are an especially broad species concept and insufficient or missing localization, in most cases preventing unambiguous assignment of the data to species in the current concept. The broad species concept of *F. ovina* (according to HACKEL 1882) led to obscurity in the beginning and all chromosome numbers ranging from  $2n=14$ ,  $21\dots$  to  $2n=70$  have been reported. In the current, narrow *F. ovina* species concept, only two main ploidy levels are documented: diploid  $2n=14$  and tetraploid  $2n=28$  (see Appendix 2).

Plants of the diploid type are commonly distributed in northern, Central and eastern Europe and are classified as the nominate subspecies *F. ovina* subsp. *ovina*. Plants of the tetraploid cytotype comprise a morphologically heterogeneous group in western Europe. Most of them were described at the subspecific (*F. ovina* subsp. *hirtula*, *F. ovina* subsp. *bigoudenensis*, *F. ovina* subsp. *ophiolitica*) or the specific level (e.g. *F. armoricana* KERGUÉLEN) during the last 30 years. Detailed karyological investigation of tetraploid plants from Central Europe and the Pannonian region have been carried out only in Austria (TRACEY 1974, 1980, PILS 1980, 1981). Also in this region *F. ovina* tetraploids are very difficult taxonomically and probably represent several different taxa (cf. ENGLMAIER 1995, EHRENBERGEROVÁ 2001). In this work we unite them under the provisional name *F. ovina* subsp. *guestphalica*.

Two ploidy levels ( $2n=2x=14$  and  $2n=4x=28$ ) are also known in *F. eggleri* (TRACEY 1980), an endemic species of Austria. Different ploidy levels were also published for a group of mountain species from the *F. airoides*-*F. supina* complex, usually comprising *F. supina*, *F. airoides* and *F. niphobia* (ST.-YVES) KERGUÉLEN from the Pyrenees. *Festuca filiformis* is known to be only diploid.

A situation similar to that in *F. ovina* is also found in *F. pallens*. Two main ploidy levels are known ( $2n=14$ ,  $2n=28$ ), reports of  $2n=21$  are rare, and those of  $2n=42$  probably refer to other taxa. More detailed karyological information is known from Austria, less is available from Hungary and Belgium (see Appendix 2). Based on morphological characters and karyological data, TRACEY (1980) and PILS (1981) divided *F. pallens* in Austria into 4 main types: diploid Oberösterreich-Niederösterreich and Weizklamm types and tetraploid Pannonisches-Hügelland and Steiermark-Kärnten types. All these groups show some geographic coherence, however their distribution outside of Austria has not yet been sufficiently explored. A wider distribution of one diploid type (Oberösterreich-Niederösterreich type, ŠMARDÁ in prep.) is indicated for example, by karyological data from Belgium and France (AUQUIER & RAMELOO 1973, KERGUÉLEN 1975), Slovakia and Hungary (UHRÍKOVÁ & MÁJOVSKÝ 1978, BAKSAY 1956, HORÁNSZKY et al. 1972, GALLI et al. 2001). The data by HOLUB (1970) and part of those in BAKSAY (1956) from Hungary and Slovakia refer to the Pannonisches Hügelland type. In *F. psammophila* and *F. vaginata*, only diploids are known (SCHWARZOVÁ 1967, BAKSAY 1956).

This work presents the preliminary results of a chromosome number study undertaken within a more extensive taxonomical study of both the *F. ovina* and *F. pallens* groups. In addition to original chromosome counts from these groups (Appendix 1), a survey of the previously published karyological data of the above-mentioned taxa in Europe (Appendix 2) and some original counts from other groups are included (Appendix 1).

## MATERIALS AND METHODS

Chromosome numbers were determined in plants cultivated in the Botanical Garden of Masaryk University in Brno, beginning in 1997. Plants originated mostly from the Czech Republic and its wider surroundings. A full list of localities is given in Appendix 1. One to six samples were investigated from the same locality. Herbarium specimens of all plants studied are stored in the Herbarium of the Department of Botany of Masaryk University, Brno (BRNU). For the karyological study of the *F. ovina* group, the rapid squash aceto-orcein method was used. Root tips from plants cultivated *in vitro* in water were pre-treated in para-dichlorobenzene, then fixed for 2 hours in a mixture of ethanol and acetic acid (3 : 1). They were then macerated in a mixture of 96% ethanol and concentrated hydrochloric acid (1 : 1) for about 1 minute at room temperature.

For *F. pallens*, the following modification of the same method was used. The meristem of root tips sampled directly from plants cultivated outdoors in pots was used for chromosome counts. The best results were achieved by sampling on sunny mornings with high air and soil humidity, between 8–10 a.m., about 3 months after transplanting. Fully developed, thick root tips with yellowish ends were most useful. Most root tips were pre-treated for 2–3 hours in para-dichlorobenzene, sample F21 was pre-treated in 8-hydroxyquinoline, samples F3 and F6 were pre-treated in ice cold water, and sometimes pre-treatment was eliminated. Then they were fixed for 2 hours in a mixture of ethanol and acetic acid (3 : 1). Maceration proceeded in a mixture of 96% ethanol and concentrated hydrochloric acid (1 : 1) at 31–32 °C for about 50–60 sec. (depending on root thickness). The whole milk-coloured or about 1–2 mm of the top part of the root was cut off and suspended on a microscope slide in a small amount of water using fine preparation needles. The root fragment was mashed onto the slide and the larger debris were brushed away. Lacto-propionic orcein dye was added, the slide was covered with a cover slip and immediately examined.

## RESULTS AND DISCUSSION

### *Festuca ovina* group

In concordance with the results of previous studies, we found two ploidy levels in 44 investigated *F. ovina* plants ( $2n=14+0-5B$ ,  $2n=28$ ). This improved our knowledge about their distribution in Central Europe. Taking previously published data into consideration, we can conclude that the different ploidy levels have different geographical ranges in Europe (Fig. 1). Diploid plants seem to be common throughout the entire European species range. They dominate especially in northern Europe and in Scandinavian countries. Tetraploid plants occupy mainly western and Central Europe. The present karyological data and routine field observation indicate that in Central Europe tetraploids are concentrated mainly in the

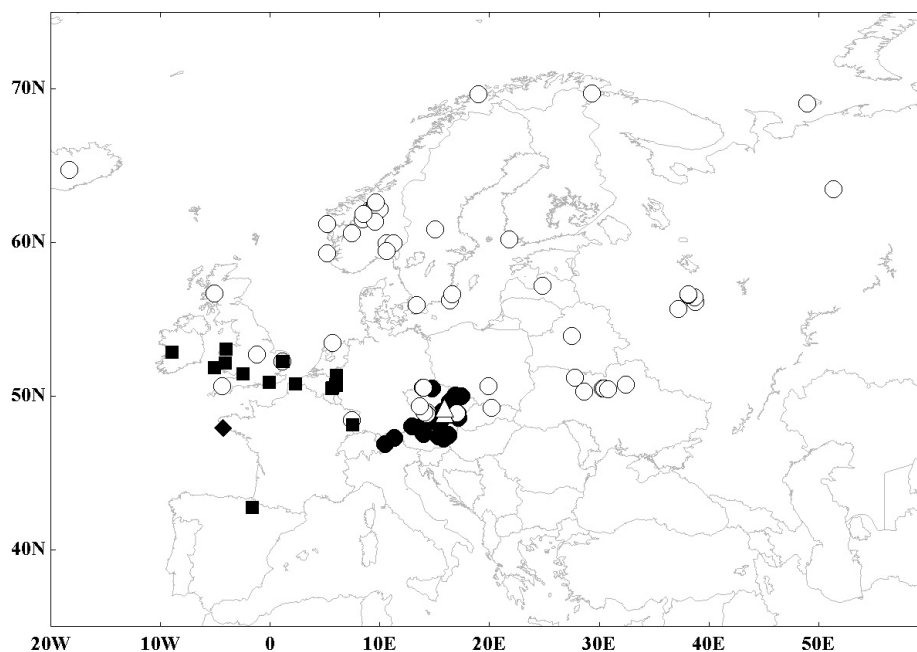


Fig. 1. Map of the localities of karyologically investigated plants and the localities of previously published chromosome number literature data of *F. ovina*: empty circles – *F. ovina* subsp. *ovina* ( $2n=14$ ); dark circles – *F. ovina* subsp. *guestfalica* ( $2n=28$ ); empty triangles – *F. ovina* “cf. *F. ×duernsteinensis*” ( $2n=28$ ); dark squares – *F. ovina* subsp. *hirtula* + *F. ovina* subsp. *ophiolithicola* ( $2n=28$ ); dark diamond – *F. ovina* subsp. *bigoudenensis* ( $2n=28$ ); altogether 135 chromosome number records are shown.

Pannonian area (Fig. 1). Although the Central European tetraploids in Pannonia have been designated as *F. ovina* subsp. *guestfalica*, they do not represent a homogeneous group. Remarkably different are some tetraploid *F. ovina*-like plants from siliceous river canyons in southern Moravia (Czech Republic). These plants mainly occupy slope edges; they are robust (with large spikelets and lemmas) and in appearance resemble *F. pallens*, which always occurs nearby and which in contrast has completely smooth leaves. These plants can probably be associated with the name *F. ×duernsteinensis* (= *F. ovina* × *F. pallens*), according to the original description (type material not seen). Besides the type locality near the village of Dürnstein (Austria, Danube valley), other localities of this taxon in the Austrian part of the Dyje river valley were presented in the original work (VETTER 1922). These localities are close to those from the Czech part of the Dyje valley presented in this paper (Appendix 1). Discovering to what extent these plants are the result of hybridization processes, habitat conditions or other mechanisms is the subject of further study by the authors.

Only previously published data for the other taxa from the *F. ovina* group are shown in Fig. 2. The *F. airoides*-*F. supina* complex, which is united as the single species *F. airoides* in Flora Europea (MARKGRAF-DANNENBERG 1980) is especially interesting. Conversely KERGUÉLEN (1983) and EHRENBERGEROVÁ (2001) argue for the distinguishing of two

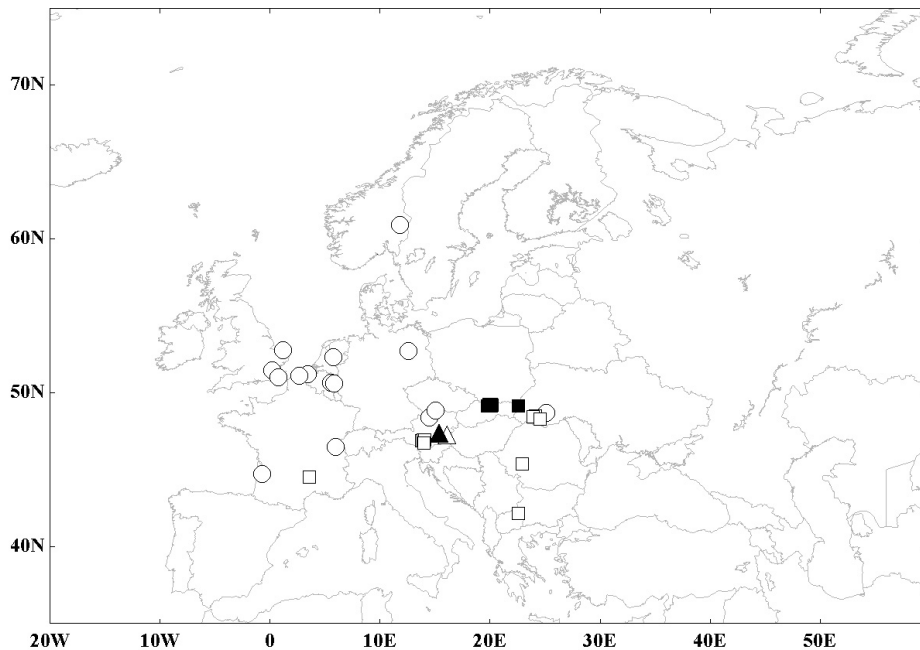


Fig. 2. Map of the localities of previously published chromosome number literature data from the *F. ovina* group: empty circles – *F. filiformis* ( $2n=14$ ); empty triangles – *F. eggleri* ( $2n=14$ ); dark triangles – *F. eggleri* ( $2n=28$ ); empty squares – *F. airoides*/*F. supina* complex ( $2n=14$ ); dark squares – *F. airoides*/*F. supina* complex ( $2n=28, 35$ ); altogether 44 chromosome number records are shown.

species, mainly based on different ploidy levels and geographic distributions. While diploids should be associated with *F. airoides*, described from the Massif Central Mts. (France), tetraploids probably refer to *F. supina*. The lectotype of the name *F. supina* SCHUR Enum. Pl. Transs.: 784, 1866, has not been selected yet. Because of this, it is not clear whether *F. supina* refers to the tetraploid or pentaploid populations of the Western Carpathians or to some of the diploid ones from Romania (EHRENBERGEROVÁ 2001).

### ***Festuca pallens* group**

In *F. pallens*, 98 plants were karyologically investigated. Two main ploidy levels, diploid with  $2n=14+0-1B$  and tetraploid with  $2n=28+0-1B$  were observed. In addition, two natural triploid plants ( $2n=21+0-1B$ ) from two different localities were found (Appendix 1). Diploid plants corresponded to the Oberösterreich-Niederösterreich morphological type and seem to be distributed throughout most of the studied region. Tetraploid plants corresponded to one of four other morphological variants, each with a more restricted geographical distribution (Fig. 3). A tetraploid chromosome count for the Pannonian type (Pannonisches-Hügelland type) was recorded for the first time in the Czech Republic. The other types (Steiermark-Kärnten and Weizklamm types) represent local types for Austria and were not observed in this study. In addition to these, one new tetraploid type was found. This type is

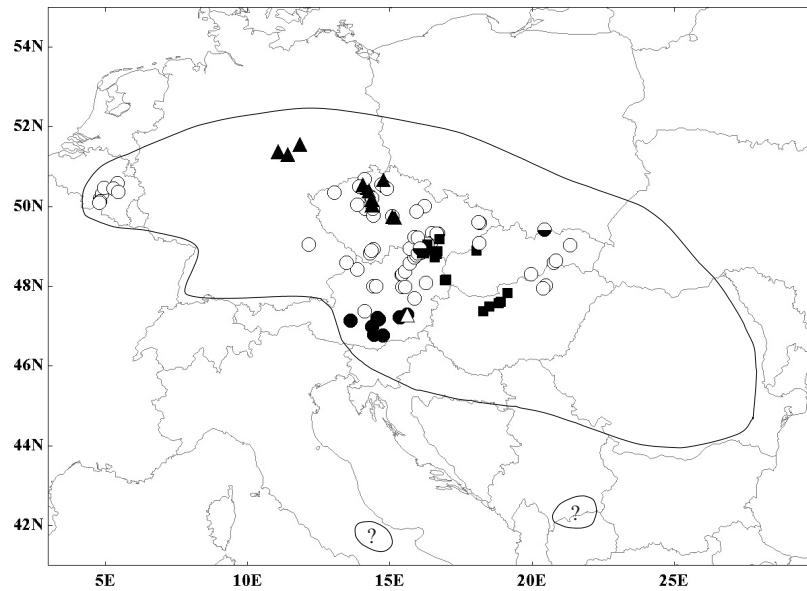


Fig. 3. Map of the localities of karyologically investigated plants and the localities of previously published chromosome number literature data of the *F. pallens* group: empty circles – *F. pallens* Oberösterreich-Niederösterreich type ( $2n=14$ ); empty/dark circles – *F. pallens* triploid plants ( $2n=21$ ); dark circles – *F. pallens* Steiermark-Kärnten type ( $2n=28$ ); dark triangles – *F. pallens* “*scabrifolia*” type ( $2n=28$ ); empty triangles – *F. pallens* Weizklamm type ( $2n=14$ ); dark squares – *F. pallens* Pannonisches-Hügelland type ( $2n=28$ ); continuous line defines the supposed *F. pallens* natural range; altogether 147 chromosome number records are shown.

distributed mainly in Bohemia (Czech Republic) and Thüringen (Germany). Distribution in Bohemia corresponds with the localities of *F. cinerea* VILL. subsp. *cinerea* given by TOMAN (1974). In this paper it is designated as the *F. pallens* “*scabrifolia*” type. This tetraploid type fully corresponds to *F. glauca* var. *scabrifolia* HACK. ex ROHLENA (type material seen, PRC) described from the surroundings of the village of Libčice nad Vltavou (Czech Republic, Vltava river canyon). The name *F. glauca* var. *scabrifolia* HACK. ex ROHLENA Věstn. Král. Čes. Spol. Nauk, cl. math.-natur, 24: 3, 1899 was combined as *F. pallens* var. *scabrifolia* (HACK. ex ROHLENA) MARKGR.-DANN. in JANCHEN Catal. Fl. Austr., Ergänzungsheft 1: 109, 1963 and *F. pallens* subsp. *scabrifolia* (HACK. ex ROHLENA) ZIELONK. Hoppea 31: 177, 1973 (nom. inval., Art. 33.3). The invalidly published name *F. pallens* subsp. *scabrifolia* was subsequently also used in Flora Europaea (MARKGRAF-DANNENBERG 1980). There are significant differences between the conception of this taxon in our work and that found in the Flora Europaea (MARKGRAF-DANNENBERG 1980) and ZIELONKOWSKI (1973). Both MARKGRAF-DANNENBERG (1980) and ZIELONKOWSKI (1973) primarily mentioned Bavarian populations under the var./subsp. *scabrifolia*, but our results show (Appendix 1, ŠMARDÁ & KOČÍ, in prep.) that these Bavarian populations are exclusively diploid and also morphologically different from the tetraploids of Bohemia and Thüringen and therefore can

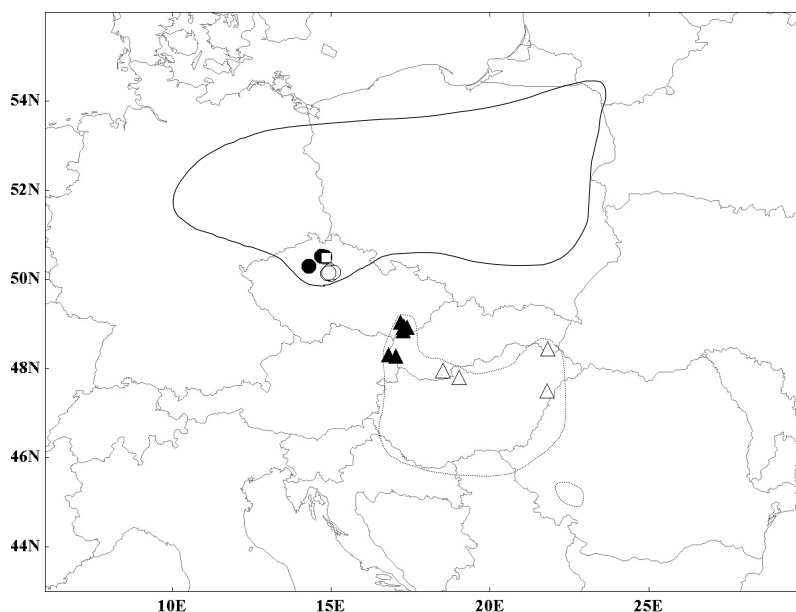


Fig. 4. Map of the localities of karyologically investigated plants and the localities of previously published chromosome number literature data from the *F. pallens* group: empty circles – *F. psammophila* subsp. *psammophila* ( $2n=14$ ); dark circles – *F. psammophila* subsp. *muellerstollii* ( $2n=14$ ); empty triangles – *F. vaginata* subsp. *vaginata* ( $2n=14$ ); dark triangles – *F. vaginata* subsp. *dominii* ( $2n=14$ ); empty square – *F. “x”belensis* ( $2n=14$ ); the continuous line defines the *F. psammophila* natural range, the dotted line the range of *F. vaginata*; altogether 28 chromosome number records are shown.

not be combined with them. In this work, diploid Bavarian plants are presented together with the Oberösterreich-Niederösterreich type.

Another interesting variant is represented by tetraploid plants from sands in the wider surroundings of the village of Oleško (Czech Republic, near Roudnice nad Labem). These plants are sometimes classified as *F. duvalii* (ST.-YVES) STOHR (TOMAN 1990), but this tetraploid species is found on andesite rocks in western Germany and eastern France and evidently cannot be associated with the plants from Oleško. The plants from Oleško are most similar to the *F. pallens* “*scabrifolia*” type and are included within the “*scabrifolia*” type in Appendix 1.

*Festuca psammophila* and *F. vaginata* were found in all cases to be only diploid (altogether 19 plants were investigated, Appendix 1, Fig. 4). Diploid chromosome numbers recorded here for *F. psammophila* subsp. *muellerstollii* and *F. “x”belensis* ( $2n=14$ ) represent the first published data for these two taxa. The conceptions of *F. psammophila* subsp. *muellerstollii* and *F. “x”belensis* are still confusing and have yet to be explained. Both taxa occur practically together in the only existing locality of *F. “x”belensis* (Bělá pod Bezdězem, Czech Republic) and their descriptions are based on relatively variable quantitative morphological characters. Other localities of these taxa given in the original works (TOMAN 1974, 1990) refer mainly to *F. pallens*.



### Mixed ploidy populations

During the study, the existence of mixed ploidy populations of the same species has been demonstrated. This is the case for *F. ovina* near Hodonín (FO01, FO02, FO05, FO08) and for *F. pallens* near Zruč nad Sázavou (samples F84, F85, F86) and Moravský Krumlov (samples F24, F25, F26, F62) (Appendix 1). In Moravský Krumlov, for example, tetraploid plants form a small colony on a ruderal terrace above the slopes of “Pod Floriánkem” Nature Reserve, while diploid plants occupy the relict conglomerate rocky slopes of the Reserve itself. While no reliable morphological differences were found between the diploid and the tetraploid *F. ovina* plants from Hodonín, in the case of *F. pallens*, both from Zruč nad Sázavou and Moravský Krumlov, different ploidy levels are relatively well distinguished from each other. The origin of the tetraploid *F. pallens* plants in these localities can be explained in several ways. One is the autotetraploid origin hypothesis, supported by the occurrence of triploid plants in some natural populations as is documented this work. On the other hand, some ecological and morphological differences support the hypothesis that their origin was connected to a hybridization event. Lastly, due to the similarity of these tetraploids to the tetraploid plants of the Pannonisches-Hügelland type, we can consider this situation to be the simple co-occurrence of two independent taxa. However, an unambiguous solution would require using more precise taxonomic methods. In any case, this relatively common phenomenon must be considered in further taxonomic studies of these groups.

### Chromosome constrictions

Although we do not present the complete karyotype of the investigated taxa, some additional karyological data are worth mentioning. Secondary chromosome constrictions were observed in several taxa (Fig. 5A–U). Based on these observations, distinguishing *F. pallens* from the other psammophilous taxa (*F. psammophila* and *F. vaginata*) seems to be possible. Diploid *F. pallens* usually contains one or two pairs of chromosomes with a single secondary constriction (Fig. 5A, F); tetraploid plants usually have only one pair, and the triploid plant from South Moravia has two (Fig. 5C, K). An interesting exception is a tetraploid *F. pallens* (sample F73, Fig. 5M) from Kleneč, whose karyotype contains about six pairs of chromosomes with secondary constrictions, some of which are multiple. This chromosome structure more closely resembles that of some psammophilous taxa.

The karyotype of psammophilous taxa of the *F. pallens* group also shows chromosomes with multiple secondary constrictions. In *F. psammophila*, all four chromosome pairs that have secondary constrictions have multiple constrictions (Fig. 5Q). In *F. vaginata* multiple constriction was usually observed only on a single chromosome (Fig. 5E, I). These results do not agree with those obtained by SCHWARZOVÁ (1967), who reported three pairs of chromosomes with a single secondary constriction in both *F. psammophila* and *F. vaginata*.

In addition to the normal chromosome number, some accessory chromosomes (B chromosomes) were observed in one *F. ovina* (sample FO29) and four *F. pallens* plants (samples F1, F36, F38, F1025) (Appendix 1).

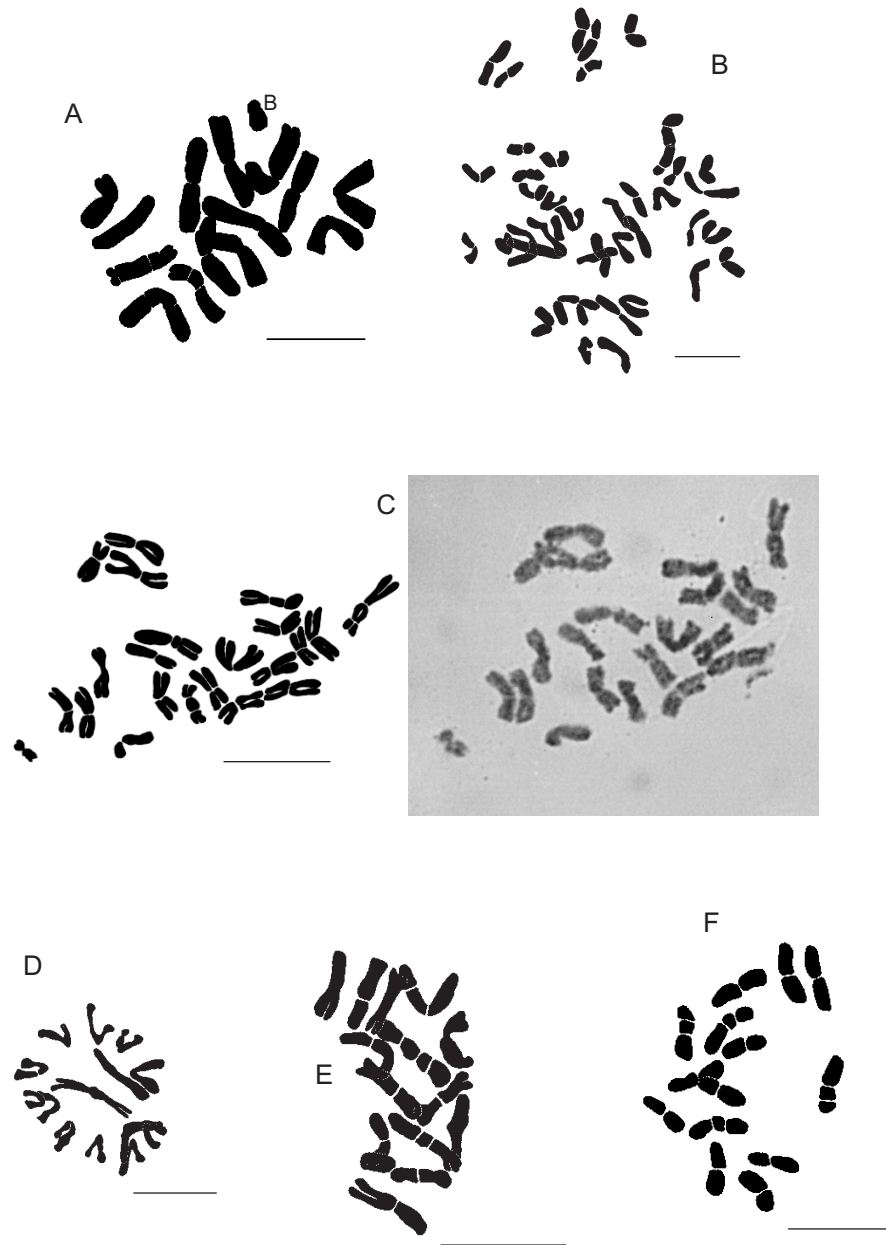


Fig. 5. Selected somatic metaphases of karyologically investigated plants. Species name, reported chromosome number and plant cultivation number are given. Photos and drawings made by Petr Šmarda are indicated by an "s" after the plant cultivation number, those by Kateřina Kočí by a "k". Scale bars 10  $\mu\text{m}$ . A – *F. pallens* 2n=14+1B (F1)s; B – *F. rupicola* 2n=42 (F4)s; C – *F. pallens* 2n=21+1B (F1025)s; D – *F. pallens* 2n=14 (F6)s; E – *F. vaginata* subsp. *dominii* 2n=14 (F18)s; F – *F. pallens* 2n=14 (F1032)s.

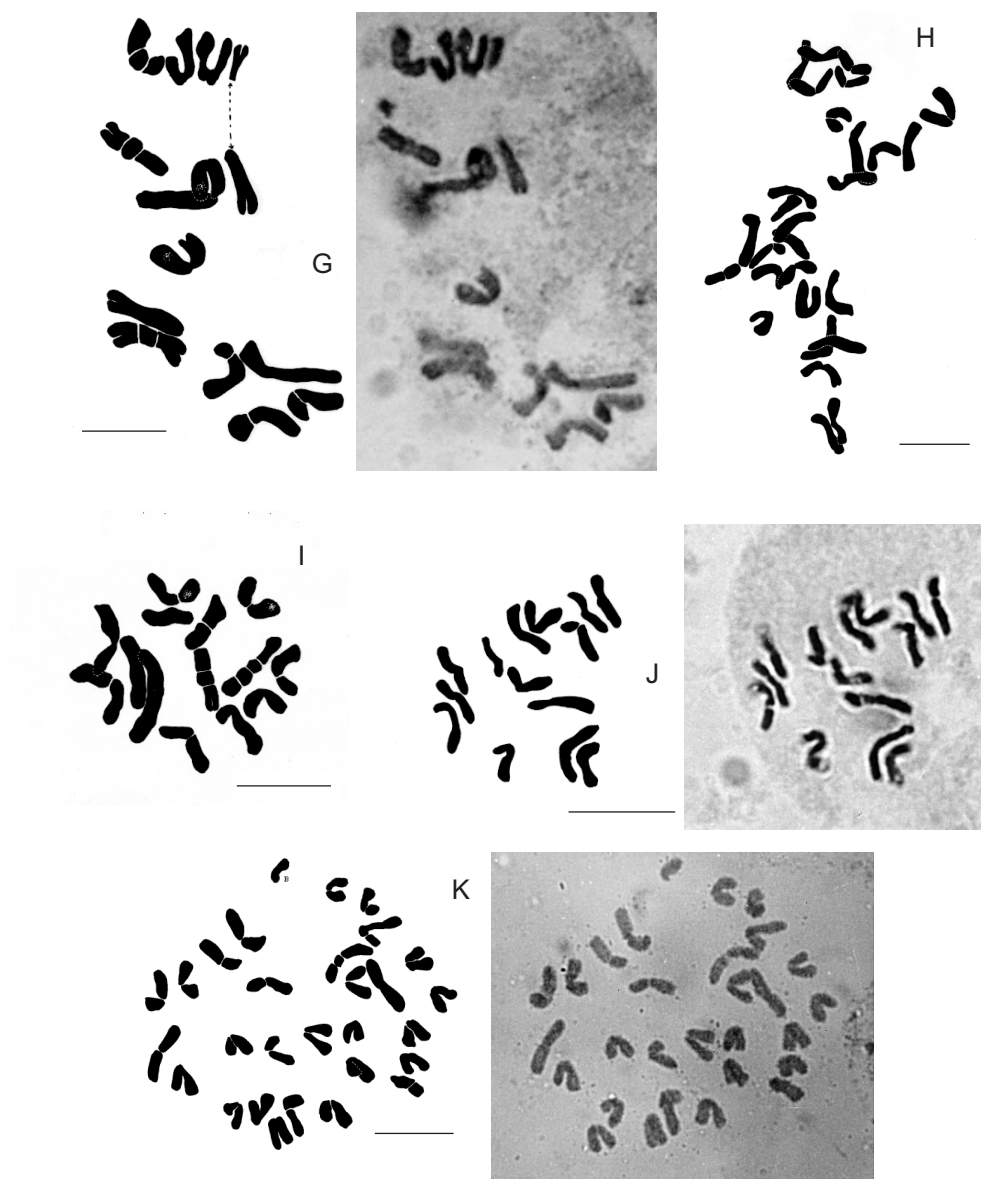


Fig. 5. Selected somatic metaphases of karyologically investigated plants. Species name, reported chromosome number and plant cultivation number are given. Photos and drawings made by Petr Šmarda are indicated by an "s" after the plant cultivation number, those by Kateřina Kočí by a "k". Scale bars 10  $\mu$ m. G – *F. vaginata* subsp. *dominii* 2n=14 (F13)s; H – *F. pallens* 2n=28 (F22)s; I – *F. vaginata* subsp. *dominii* 2n=14 (F19)s; J – *F. pallens* 2n=14 (F25)s; K – *F. pallens* 2n=28+1B (F36)s.

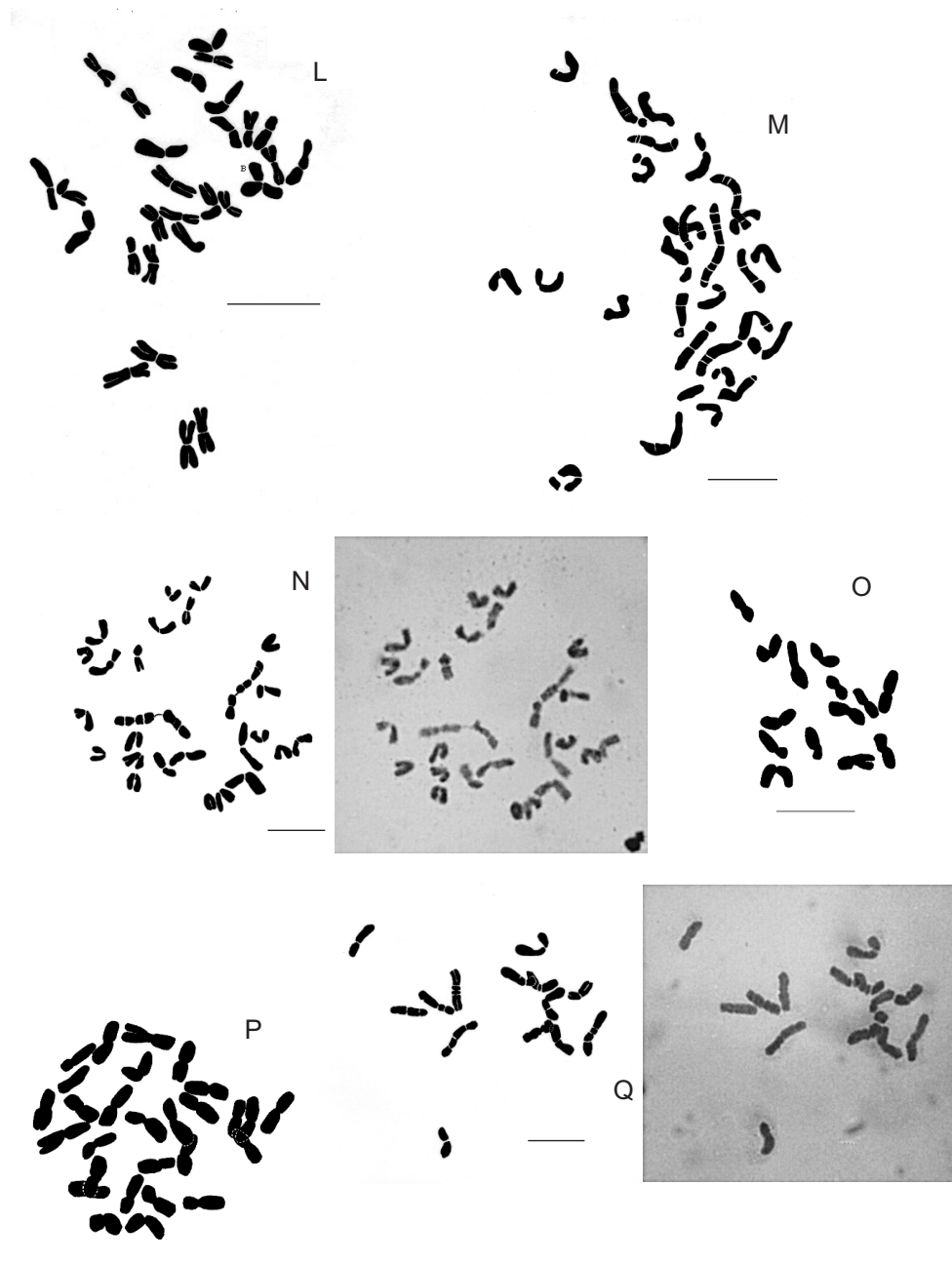


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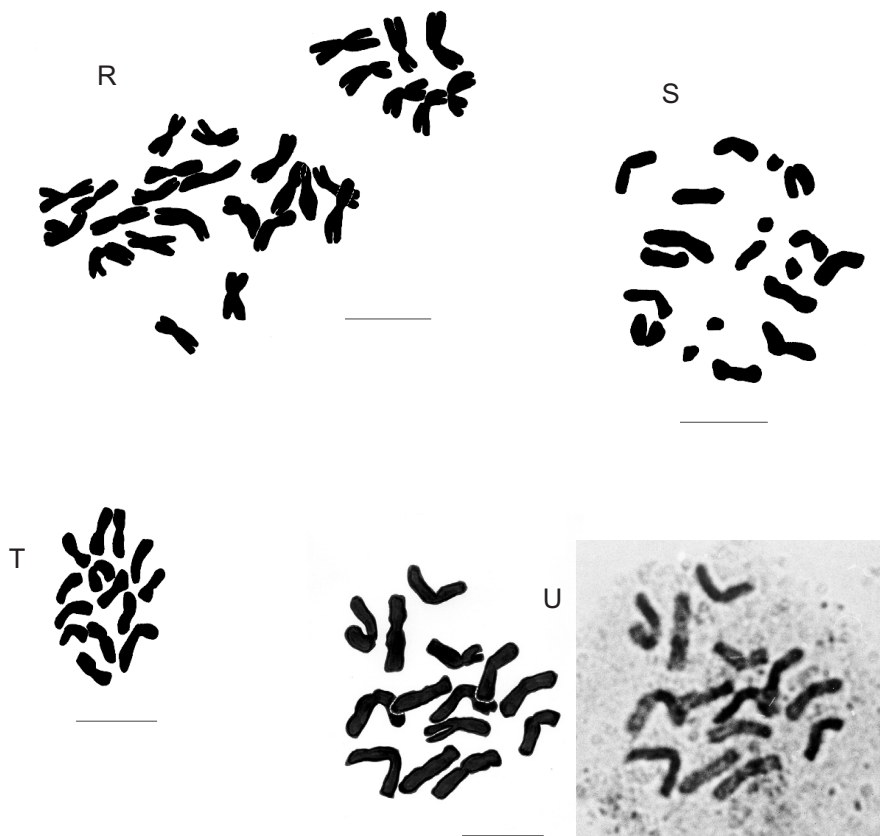


Fig. 5. Selected somatic metaphases of karyologically investigated plants. Species name, reported chromosome number and plant cultivation number are given. Photos and drawings made by Petr Šmarda are indicated by an "s" after the plant cultivation number, those by Kateřina Kočí by a "k". Scale bars 10  $\mu$ m. R – *F. ovina* 2n=28 (FO08)k; S – *F. ovina* 2n=28+5B (FO29)k; T – *F. ovina* 2n=14 (FO26)k; U – *F. ovina* 2n=14 (FO02)k.

### Other taxa

Altogether 15 chromosome records of taxa, out of the *F. ovina* and *F. pallens* groups, are documented (Appendix 1). For the first time, chromosome number for *F. alpestris* (2n=14) was estimated. Diploid chromosome number was also found in *F. versicolor* subsp. *versicolor*. Tetraploid chromosome numbers (2n=28) are documented for three *F. cinerea* and three *F. amethystina* subsp. *amethystina* plants. In *F. rupicola* and *F. brevipila* the hexaploid number (2n=42) was proved (Fig. F). These data are in concordance with the previously published chromosome numbers for these species in the regions studied (BRANDENBERG 1948, PÓLYA 1949, BAKSAY 1956, KERGUÉLEN 1975, MURÍN & MÁJOVSKÝ 1978, TRACEY 1980, MIZIANTY & PAWLUS 1984).

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## APPENDIX 1

List of localities of the karyologically investigated plants. Country of sample origin is indicated at the beginning of the locality description by the following abbreviations: (A – Austria, Cz – Czech Republic, Fr – France, Ge – Germany, It – Italy, Lt – Latvia, Sk – Slovakia). The name just before the colon represents the nearest town/village. The cultivation numbers of plants are given after the collector's name. Observed chromosome number is presented in the right column.

***F. ovina* group (*Festuca* L. ser. *Festuca*)****2n*****Festuca ovina* L. (cf. *Festuca* × *duernsteinensis* J. VETTER)**

- Cz; Podyjí National Park, Čížov: Hardeggská vyhlídka view, 2.8 km SSW of the village – cleft on the gneiss rock edge, small colony, 360 m a.s.l., 48°51'22"N, 15°51'36"E, 26.5.1999, coll. P. ŠMARDÁ (F58) 28
- Cz; Podyjí National Park, Hnanice: above the Dyje river, Nad papírnou elevation point, 2 km NNW of the church in the village – W exp. rocky slope (composed of rocky blocks), common, 285 m a.s.l., 48°48'58"N, 15°58'58"E, 27.5.1999, coll. P. ŠMARDÁ (F64/2) 28
- Cz; Lukov (near Znojmo): Sloní hřbet elevation point, 1.5 km E of Lukovská horka (420.7 m) elevation point – rockeries on the S exp. siliceous slope edge, small colony, 340 m a.s.l., 48°51'39"N, 15°52'40"E, 26.5.1999, coll. P. ŠMARDÁ (F60) 28
- Cz; Třebíč-Hrádek: 40 m NE of the footbridge from the town centre (blue marked hiking trail) – sunny SSW exp. siliceous slopes above the Jihlava river, this type only in scattered tufts (compared to the diploid *F. pallens*, which dominates), 405 m a.s.l., 49°13'01"N, 15°53'02"E, 26.6.1999, coll. P. ŠMARDÁ (F1021, F1022, F1023) 28

***Festuca ovina* subsp. *guestphalica* (RCHB.) K. RICHT.**

- Cz; Dešov: 3.0 km SW of the church in the village, above the road and the Želetavka river, near Koberův mlýn mill – rocky siliceous slopes with pine, abundant, 400 m a.s.l., 48°57'44"N, 15°40'52"E, 10.9.1999 coll. P. ŠMARDÁ (F1033) 28
- Cz; Horní Kounice: 1 km N of the church in the village, on the right bank of the Rokytá river, above Valův mlýn mill – rocky outcrop in oak forest, near the edge of the slope, abundant, 300 m a.s.l., 49°02'24"N, 16°09'02"E, 29.8.1999, coll. P. ŠMARDÁ (F1026) 28
- Cz; Plužná (near Mladá Boleslav): Na borovém elevation point, 800 m SW of Panská horka (294.4 m) elevation point, near an electric pole – sunny pine wood margin, on the edge of a small slope on sandstone, scattered, 280 m a.s.l., 50°29'01"N, 14°48'28"E, 15.6.1999, coll. P. ŠMARDÁ (F99, F1000) 28
- Cz; Tavikovice: 600 m SW of "386.2 m" elevation point, edge of the road through the wood to Vilímův mlýn mill (on the right bank of the Rokytá river) – siliceous rocky slope, in places, 315 m a.s.l., 49°01'49"N, 16°05'32"E, 29.8.1999, coll. P. ŠMARDÁ (F1028) 28
- Cz; Podyjí National Park, Čížov: Hardeggská vyhlídka view, 2.8 km SSW of the village – cleft on the gneiss rock edge, small colony, 360 m a.s.l., 48°51'22"N, 15°51'36"E, 26.5.1999, coll. P. ŠMARDÁ (F59) 28
- Cz; Brno-Kohoutovice: 1.5 km NE of Kamenný kopec (378.6 m) hill, behind the Myslivna hotel – acidophilous oak forest on NE exp. siliceous slope, common, 350 m a.s.l., 49°11'22"N, 16°33'15"E, 1997, coll. K. KOČÍ (FO39) 28
- Cz; Bruntál: 650 m NE of Uhlířský vrch hill – in linden avenue on the way to a church, small colony, 560 m a.s.l., 49°58'38"N, 17°26'43"E, 1997, coll. K. KOČÍ (FO38) 28
- Cz; Dukovany: 300 m SW from Dukovanská přehrada dam, 2.4 km NNW of the centre of the village – NW exp. granulite slope, common, 320 m a.s.l., 49°05'47"N, 16°11'52"E, 1996, coll. V. ŘEHOREK (FO22) 28
- Cz; Dukovany: Dukovanský mlýn Nature Reserve, 2.4 km NNW of the church in the village – acidophilous oak forest on N exp. serpentine slope over the dam, abundant, 350 m a.s.l., 49°05'57"N, 16°10'38"E, 1995 coll. V. GRULICH (FO12) 28
- Cz; Dukovany: Dukovanský mlýn Nature Reserve, 2.5 km NNW of the church in the village – acidophilous oak forest edge on NW exp. granulite slope over the dam, abundant, 350 m a.s.l., 49°05'46"N, 16°10'15"E, 1995, coll. V. GRULICH (FO21) 28

- Cz; Dukovany: Dukovanský mlýn Nature Reserve, 2.6 km NNW of the church in the village – serpentine pine forest (*Thlaspio montani-Pinetum*) in a stand of *Sesleria albicans*, abundant, 360 m a.s.l., 49°05'54"N, 16°10'25"E, 1995, coll. M. CHYTRÝ (FO13, FO14) 28
- Cz; Hodonín: Hovoranská cesta forest track, "191.2" elevation point, 4.3 km NNW of the railway station in the town – thermophilous oak forest on sand, abundant, 190 m a.s.l., 48°53'28"N, 17°06'03"E, 1995 coll. K. KOČÍ & V. GRULICH (FO04) 28
- Cz; Hodonín: Červené domky crossing, 1.9 km NW of the railway station in the town – thermophilous oak forest on sand, abundant, 175 m a.s.l., 48°51'59"N, 17°06'05"E, 1995, coll. K. KOČÍ & V. GRULICH (FO08) 28
- Cz; Hodonín: between Černé blato and Svatý Jan elevation points, on Holanova alej forest track, 2.6 km NW of the railway station in the town – thermophilous oak forest on sand, abundant, 175 m a.s.l., 48°52'14"N, 17°05'40"E, 1995, coll. K. KOČÍ & V. GRULICH (FO05) 28
- Cz; Hodonín: crossroad by the small cross, Svatý Jan, 3.5 km NW of the railway station in the town – thermophilous oak forest on sand, abundant, 170 m a.s.l., 48°52'18"N, 17°04'48"E, 1995, coll. K. KOČÍ & V. GRULICH (FO01) 28
- Cz; Jamolice: above Jihlava river, near the forest track to the Templštejn ruin, 2.7 km NNW of the church in the village – ENE exp. granulite slope, pine forest, abundant, 340 m a.s.l., 49°05'45"N, 16°14'29"E, 1996, coll. K. KOČÍ & V. GRULICH (FO34) 28
- Cz; Jamolice: Templštejn ruin, 2 km NNW of the church in the village – pine forest on serpentine, abundant, 385 m a.s.l., 49°05'26"N, 16°14'47"E, 1996, coll. K. KOČÍ & V. GRULICH (FO33) 28
- Cz; Lhánice (near Mohelno): 1 km SSW of the centre of the village, near Mohelnička Nature Reserve – pine forest on serpentine rocky slope, abundant, 290 m a.s.l., 49°06'00"N, 16°12'58"E, 1996, coll. M. CHYTRÝ (FO30) 28
- Cz; Mohelno: slopes near the road on the right bank of the Jihlava river, near Mohelenský most bridge, 1.7 km S of the church in the village – NE exp. granulite slope, pine forest, abundant, 295 m a.s.l., 49°05'56"N, 16°11'37"E, 1996, coll. K. KOČÍ & V. GRULICH (FO31, FO32) 28
- Cz; Podyjí National Park, Popice (near Znojmo): Sealsfieldův kámen view point, 2.2 km NW of the church in the village – NW exp. siliceous slope above Dyje river, acidophilous oak forest, abundant, 370 m a.s.l., 48°50'12"N, 15°59'40"E, 1995, coll. K. KOČÍ (FO09) 28
- Cz; Raškov: Modřínový vrch Nature Reserve, on the crest of Modřínový vrch (625.3 m) hill, 1.3 km NW of the church in the village – W exp. serpentine rocks, abundant, 620 m a.s.l., 50°02'37"N, 16°53'26"E, 1996, coll. K. KOČÍ & M. KOČÍ (FO36) 28
- Cz; Svojanov: near weekend cottages 1.3 km E of the church in the village – SE exp. grassy ridge, some tufts, 540 m a.s.l., 49°37'31"N, 16°23'33"E, 1996, coll. K. KOČÍ & M. KOČÍ (FO35) 28
- Cz; Znojmo: Kraví hora hill on the SSW town periphery – heath on N exp. granite slopes above Dyje river, abundant, 260 m a.s.l., 48°50'51"N, 16°02'16"E, 1995, coll. V. GRULICH (FO10, FO11) 28
- Sk; Záhorská nížina lowland, Šišulákovci: 1 km NE of the village – sands of sunny S exp. pine wood margin, scattered, 210 m a.s.l., 48°34'64"N, 17°08'93"E, 26.6.2000, coll. P. ŠMARDA & T. VYMYSLICKÝ (F1184) 28

#### *Festuca ovina* L. subsp. *ovina*

- Cz; Hodonínská doubrava woodland, Mutěnice: 3.8 km SE of the railway station in the village, 100 m SE of the crossroad of Topolová alej country road and the road – open thermophilous oak forest on sand, abundant, 170 m a.s.l., 48°53'05"N, 17°05'01"E, 1995, coll. K. KOČÍ & V. GRULICH (FO02) 14
- Cz; Holubov: Holubovské hadce Nature Reserve, 1.2 km E of the railway station in the village – S exp. serpentine pine forest (*Asplenio cuneifolii-Pinetum*) slope dominated by *Festuca ovina* and *Brachypodium pinnatum*, abundant, 480 m a.s.l., 48°55'34"N, 14°20'27"E, 1996, coll. M. CHYTRÝ (FO25) 14
- Cz; Lovosice: Lovoš (569.7 m) hill, WNW of the town – thermophilous oak forest edge on S exp. basalt rocky slope, abundant, 520 m a.s.l., 50°31'37"N, 14°01'01"E, 1995, coll. V. GRULICH (FO16) 14
- Cz; Milešov: S slope of Milešovka (836.6 m) hill, 1.5 km N of the church in the village – acidophilous oak forest on phonolite, abundant, 750 m a.s.l., 50°33'08"N, 13°55'51"E, 1995, coll. M. CHYTRÝ (FO15) 14

- Cz; Miletínky (SE of Prachatic): Borek hill on the W village periphery – N exp. gentle slope of serpentine pine forest (*Asplenio cuneifolii-Pinetum*) in stand dominated by *Molinia coerulea*, abundant, 710 m a.s.l., 48°55'22"N, 14°05'00"E, 1996, coll. M. CHYTRÝ (FO24) 14
- Cz; Prácheň (near Hora d'ovice): Prácheň Nature Reserve, 400 m W of the centre of the village – W exp. slope above the Otava river, siliceous rocky outcrops in a mixed oak-linden forest, in places, 480 m a.s.l., 49°19'00"N, 13°40'53"E, 1996, coll. M. CHYTRÝ (FO27) 14
- Cz; Re ný Újezd (near Lovosice): Boreč Nature Reserve on SW village periphery – NW exp. phonolite slope, acidophilous oak forest edge, abundant, 420 m a.s.l., 50°30'52"N, 13°59'14"E, 1995, coll. V. GRULICH (FO17) 14
- Cz; the protected landscape area Blanský les, Lazec (NW of Český Krumlov): Lazecký vrch hill, 300 m NE of the centre of the village – W exp. marble slope, secondary pine forest dominated by *Brachypodium pinnatum*, scattered, 650 m a.s.l., 48°50'16"N, 14°16'17"E, 1996, coll. M. CHYTRÝ (FO26) 14
- Cz; Holubov: Bořinka Nature Reserve, 1.05 km WNW of the railway station in the village – serpentine flat with pine forest (*Asplenio cuneifolii-Pinetum*), very abundant, dominating in the vegetation, 500 m a.s.l., 48°53'42"N, 14°18'37"E, 1996, coll. M. CHYTRÝ (FO29) 14+5B
- Lt; Gaujas National Park, Sigulda: 2 km NW of the centre of the village, Gauja river valley – acidophilous oak forest on SE exp. sandstone rocky slope, abundant, 150 m a.s.l., 57°10'02"N, 24°51'00"E, 1995, coll. V. GRULICH (FO20) 14

#### ***F. pallens* group (*Festuca* ser. *Psammophilae* PAWLUS)**

##### ***Festuca* "×" *belensis* M. TOMAN ("F. pallens × F. psammophila")**

- Cz; Bělá pod Bezdězem-Páterov: 650 m NE of the railway station Bělá pod Bezdězem, between houses number 817 and 818 or 1008, above the local road (type locality) – small sandstone steppe slope, small colony, 260 m a.s.l., 50°29'31"N, 14°50'36"E, 14.6.1999, coll. P. ŠMARDÁ (F96, F97) 14

##### ***Festuca pallens* HOST Oberösterreich-Niederösterreich type**

- A; Retz: Paraplueberg elevation point, NW of the town – rocky outcrops on the top of the steppe hillock, common, 370 m a.s.l., 48°45'36"N, 15°56'02"E, 27.5.1999, coll. K. KOČÍ (F1032) 14
- A; Retz: top crest of Gotllisch hill, SW of the town, common, 310 m a.s.l., 48°45'64"N, 15°56'33"E, 27.5.1999, coll. K. KOČÍ (F1031) 14
- Cz; Bělá pod Bezdězem: 650 m SW of Panská horka (294.4 m) elevation point, above the road from Bělá pod Bezdězem to Plužná, 280 m from the railroad crossing – small bare sandstone slope, small colony, 285 m a.s.l., 50°29'11"N, 14°48'24"E, 15.6.1999, coll. P. ŠMARDÁ (F1001) 14
- Cz; Bezděz: 50 m SE of Bezděz (603.5 m) castle, near the red marked hiking trail to the castle – basalt rocky slope, small colony, 560 m a.s.l., 50°32'18"N, 14°43'17"E, 16.6.1999, coll. P. ŠMARDÁ (F1005) 14
- Cz; Bítov: 1.1 km WSW of the church in the village, below the Cornštejn ruin – S exp. siliceous rockeries on the slope above the road, small colony, 390 m a.s.l., 48°56'02"N, 15°42'54"E, 10.9.1999, coll. P. ŠMARDÁ (F1034) 14
- Cz; Boč (near Karlovy Vary): Čedičová žíla Boč Nature Reserve – small basalt rocky terraces in the lower part of the reserve, common, 400 m a.s.l., 50°20'07"N, 13°03'56"E, 24.10.1999, coll. J. VOZANKA (F1056) 14
- Cz; Boršov nad Vltavou: 0.6 km WSW of the church in the village – siliceous rockeries on the edge of the quarry in the Vltava river valley, common, 430 m a.s.l., 48°55'07"N, 14°25'36"E, 20.7.1999 coll. V. GRULICH (F1051) 14
- Cz; České Středohoří hills, Povrly: Kozi vrch Nature Reserve – SW exp. slopes of an andesite hill, common, 200 m a.s.l., 50°40'35"N, 14°07'56"E, 22.6.1999, coll. O. ROTREKLOVÁ (F1019) 14
- Cz; Český Krumlov: 500 m SSE of the railway station, above the urban clearway to České Budějovice – limestone rock in the town, common, 500 m a.s.l., 48°49'05"N, 14°19'13"E, 22.7.1999, coll. V. GRULICH (F1052) 14
- Cz; Davle: 400 m NE of the railway station, directly beside the railway in front of the railway tunnel – siliceous rocky slope, abundant, 210 m a.s.l., 49°53'26"N, 14°24'15"E, 20.6.1999, coll. P. ŠMARDÁ (F1014) 14

- Cz; Děkovka: 700 m E of the chapel in the village, E part of Plešivec (477.2 m) hill – basalt rocky terraces, abundant, 450 m a.s.l., 50°29'26"N, 13°56'24"E, 10.10.1999, coll. P. ŠMARDA (F1046) 14
- Cz; Dyje (near Znojmo): Dyjské svahy Nature Reserve, 1.1 km SSE of the church in the village, above the dirt track along the Dyje river – siliceous rocky outcrops, abundant, 210 m a.s.l., 48°50'17"N, 16°07'21"E, 25.5.1999, coll. P. ŠMARDA (F51) 14
- Cz; Podyjí National Park, Havraníky: Havranické vřesoviště Nature Reserve, 0.5 km NNE of Staré vinice elevation point – S exp. small rise on the heath, on deeper gravel soil together with *Pinus sylvestris*, *Cerasus avium*, small colony, 325 m a.s.l., 48°48'49"N, 15°59'33"E, 27.5.1999, coll. P. ŠMARDA (F63) 14
- Cz; Podyjí National Park, Havraníky: Havranické vřesoviště Nature Reserve, Staré vinice elevation point, 0.9 km W of the church in the village – rocky bank of a footpath on the heathland, rare tufts, 325 m a.s.l., 48°48'42"N, 15°59'45"E, 26.5.1999, coll. M. KOČÍ & P. ŠMARDA (F61) 14
- Cz; Podyjí National Park, Hnanice: above the Dyje river, Nad papírnou elevation point, 2 km NNW of the church in the village – W exp. rocky slope (rocky blocks), common, 285 m a.s.l., 48°48'58"N, 15°58'58"E, 27.5.1999, coll. P. ŠMARDA (F64) 14
- Cz; Horní Kounice: 1.1 km N of the church in the village, on the left bank of Rokytá river, opposite the Valův mlýn mill – siliceous rocks, common, 305 m a.s.l., 49°02'28"N, 16°09'05"E, 29.8.1999 coll. P. ŠMARDA (F1027) 14
- Cz; Hradištko-Brunšov (opposite Štěchovice): 400 m E of the bridge over the Vltava river, in the quarry near the road – rocky slope on SE exp. siliceous rock, cover 60%–70%, 210 m a.s.l., 49°51'15"N, 14°24'25"E, 20.6.1999, coll. P. ŠMARDA (F1015) 14
- Cz; the protected landscape area Český Kras, Srbsko: 1.3 km SE of the church in the village – steep limestone slopes above the road, abundant, 230 m a.s.l., 49°55'57"N, 14°09'03"E, 21.6.1999, coll. O. ROTREKLOVÁ (F1018) 14
- Cz; the protected landscape area Český Kras, Srbsko: 900 m SSE of the church in the village – steep limestone slopes above the road, abundant, 230 m a.s.l., 49°55'55"N, 14°08'37"E, 21.6.1999, coll. O. ROTREKLOVÁ (F1017) 14
- Cz; Choceň: Peliny Nature Reserve, 1.35 km NE of the railway station in the town, W part of the reserve – at the top of argillite rocks, in places (on chimenies), 330 m a.s.l., 50°00'13"N, 16°14'04"E, 14.10.1999 coll. P. FILIPPOV (F1053) 14
- Cz; Chvatčubry (near Kralupy nad Vltavou): 450 m SE of the church in the village, quarry edge on the Vltava river bank – siliceous rocky slope, common, 210 m a.s.l., 50°14'14"N, 14°20'33"E, 19.6.1999, coll. P. ŠMARDA (F1008) 14
- Cz; Ivančice: 450 m SSE of Réna elevation point – siliceous outcrop above the railway, common, 230 m a.s.l., 49°05'12"N, 16°23'35"E, 24.5.1999, coll. P. ŠMARDA (F50) 14
- Cz; Josefův: Býčí skála elevation point – S exp. slope on top of a vertical limestone cliff, rich colony, 350 m a.s.l., 49°18'30"N, 16°41'45"E, 23.4.1998, coll. P. ŠMARDA (F3, F2) 14
- Cz; Josefův: Křkavčí skála elevation point – limestone rocky outcrop, dense colony, 360 m a.s.l., 49°18'33"N, 16°41'32"E, 23.4.1998, coll. P. ŠMARDA (F5, F6) 14
- Cz; Koprivnice: Raškův kámen elevation point – limestone rock, common, 480 m a.s.l., 49°34'58"N, 18°09'43"E, 20.6.1999, coll. J. DANIHELKA (F1006) 14
- Cz; Libčice nad Vltavou: NW edge of the Větrušická rokle Nature Reserve, 600 m SE of the research institute – overgrown rocky (spilite, schist) slopes, common, 220 m a.s.l., 50°11'48"N, 14°22'36"E, 19.6.1999, coll. P. ŠMARDA (F1010) 14
- Cz; Malhostovice (near Brno): Malhostovická pecka Nature Reserve – cleft of limestone boulder ( $\pm$  2 m high), in front of a cave at the foot of the slope in S part of the reserve, totally in *Aesculus hippocastanum* shadow, some individuals, 310 m a.s.l., 49°19'31"N, 16°29'42"E, 19.5.1999, coll. P. ŠMARDA (F41) 14
- Cz; Malhostovice (near Brno): Malhostovická pecka Nature Reserve – S exp. limestone rocky faces, abundant, 320 m a.s.l., 49°19'32"N, 16°29'42"E, 19.5.1999, coll. P. ŠMARDA (F42 – foot of the slopes, at anthesis before all the others, F43 – steep part of the slopes) 14
- Cz; Mladá Boleslav-Debrž: Radouč Nature Reserve, 1.15 km SSE of the church in the town part, S part of the reserve – argillite outcrops, small colony, 250 m a.s.l., 50°25'57"N, 14°53'53"E, 14.6.1999, coll. P. ŠMARDA (F95) 14

- Cz; Moravské Bránice: above the chapel in the village, 1.5 km NNW of Šibeniční vrch (296.6 m) elevation point – siliceous SSW exp. rockery, robust tufts in competition with a dense stand of *Bromus sterilis* (90% cover E<sub>1</sub>) and *Robinia pseudacacia* (30% cover E<sub>3</sub>), small colony, 215 m a.s.l., 49°04'45"N, 16°26'27"E, 24.5.1999, coll. P. ŠMARDÁ (F48) 14
- Cz; Moravský Krumlov: Pod Floriánkem Nature Reserve – NW exp. basic conglomerate rocky slopes, abundant, 290 m a.s.l., 49°02'50"N, 16°19'16"E, 24.5.1998, coll. P. ŠMARDÁ (F25) 14
- Cz; Moravský Krumlov: Pod Floriánkem Nature Reserve, under st. Florián's chapel – SW exp. basic conglomerate rocky slopes, abundant, 285 m a.s.l., 49°03'00"N, 16°19'10"E, 24.5.1998, coll. P. ŠMARDÁ (F26) 14
- Cz; Neveklov-Nebřich: 650 m ESE of the beginning of the bridge to the village, on the right bank of the Vltava river (by green trail mark) – at the top of a massive siliceous rocky slopes, abundant, 350 m a.s.l., 49°45'60"N, 14°25'20"E, 21.6.1999, coll. P. ŠMARDÁ (F1016) 14
- Cz; Nové Bránice: 300 m NW of Šibeniční vrch (296.6 m) elevation point, above the road opposite the quarry – siliceous rocky promontory, small colony, 215 m a.s.l., 49°04'10"N, 16°27'04"E, 24.5.1999, coll. P. ŠMARDÁ (F49) 14
- Cz; Rokytňá (near Moravský Krumlov): Tábor Nature Reserve – slope on the top of a basic conglomerate rocky face, small colony, 290 m a.s.l., 49°03'43"N, 16°19'57"E, 24.5.1998, coll. P. ŠMARDÁ (F27) 14
- Cz; Roztoky u Křivoklátu: Na Babě Nature Reserve, 300 m NE of the railway bridge over the Berounka river – NW exp. rocky edge of the reservation margin, common, 310 m a.s.l., 50°01'50"N, 13°52'15"E, 8.10.1999, coll. P. ŠMARDÁ (F1041) 14
- Cz; Skála u Chrudimi: NNW village periphery, on the left bank of Žejbro brook – sunny wood edge on an argillite rock, common, 330 m a.s.l., 49°52'13"N, 15°56'49"E, 19.6.1999, coll. J. VOZANKA (F1030) 14
- Cz; Štramberk: 0.6 km SSW of Babí hora (557 m) elevation point – limestone rocks in the larger of two quarries, common, 450 m a.s.l., 49°35'25"N, 18°07'25"E, 3.10.1999, coll. M. HORSÁK (F1038) 14
- Cz; Třebíč: 400 m up the river from the central bridge, above the Jihlava river in the park below the castle – S exp. siliceous rockery, small colony, 395 m a.s.l., 49°12'57"N, 15°52'16"E, 26.6.1999, coll. P. ŠMARDÁ (F1020) 14
- Cz; Třisov (near České Budějovice): 0.9 km NE of the railway station in the village – on the walls of the Dívčí kámen ruin, common, 500 m a.s.l., 48°53'22"N, 14°21'26"E, 20.7.1999, coll. V. GRULICH (F1050) 14
- Cz; Třisov (near České Budějovice): 1.05 km NE of the railway station in the village, 350 m NNW of the Dívčí kámen ruin – siliceous E exp. rocks in the Vltava river valley, common, 480 m a.s.l., 48°53'30"N, 14°21'16"E, 20.7.1999, coll. V. GRULICH (F1049) 14
- Cz; Vladislav u Třebíče: 600 m ESE of the church in the village, above the road and the Jihlava river – SW exp. siliceous slopes, abundant, 400 m a.s.l., 49°12'31"N, 15°59'40"E, 26.6.1999, coll. P. ŠMARDÁ (F1024) 14
- Cz; Vrané nad Vltavou: Zvolská homole Nature Reserve, 600 m E of the church in the village – NW exp. siliceous rocky slopes of an open pine and oak grove, common, 310 m a.s.l., 49°56'24"N, 14°23'47"E, 20.6.1999, coll. P. ŠMARDÁ (F1013) 14
- Cz; Zruč nad Sázavou: 1.1 km NW of the castle in the town, in Sázava river bend, above the railway to Čerčany – in pine wood, top of siliceous rocky outcrop, common, 370 m a.s.l., 49°44'58"N, 15°05'22"E, 5.6.1999, coll. P. ŠMARDÁ (F84) 14
- Cz; Adamov: NE town periphery, road to the village Josefův – road ditch on deep sandy soil, 4 individuals, 270 m a.s.l., 49°18'20"N, 16°39'26"E, 23.4.1998, coll. P. ŠMARDÁ (F1) 14+1B
- Cz; Plaveč: 1.7 km NW of the church in the village, left bank of the Jevišovka river, opposite the mouth of Plenkovický potok brook – overgrown siliceous rocky outcrop, small colony, 245 m a.s.l., 48°56'17"N, 16°03'46"E, 29.8.1999, coll. P. ŠMARDÁ (F1025) 21+1B
- Ge; Bayern, Regensburg region, Schwabelweis: Fellingnerberg Nature Reserve, N of the village – S exp. limestone slope, scattered, 360 m a.s.l., 49°01'50"N, 12°09'28"E, 11.7.2000, coll. O. ROTREKLOVÁ & P. ŠMARDÁ (F1198) 14
- Ge; Niederbayern, Passau-Ilstätt: on Klosterberg hill – siliceous S exp. rocky slopes near the Dunaj river, abundant, 320 m a.s.l., 48°34'37"N, 13°29'06"E, 11.7.2000, coll. O. ROTREKLOVÁ & P. ŠMARDÁ (F1195) 14

- Sk; the protected landscape area Slovenský kras, Zádiel: 200 m from Zádielsky kameň (600.6 m) elevation point, 900 m NE of the church in the village – edge of limestone canyon, common, 580 m a.s.l., 48°37'38"N, 20°50'19"E, 8.8.2000, coll. P. ŠMARDA (F1229) 14
- Sk; Pieniny National Park, Lesnica: 2.5 km WNW of the church in the village, Dunajec river canyon, near the footpath to the Sedem mníchov rocks – limestone, common, 500 m a.s.l., 49°24'24"N, 20°26'13"E, 30.10.1999, coll. K. KOČÍ (F1059) 21

***Festuca pallens* HOST Pannonisches-Hügelland type**

- Cz; Brno-Bedřichovice: Horky Nature Reserve, 650 m E of the church in the town – edge of conglomerate rocky terrace, abundant, 260 m a.s.l., 49°10'52"N, 16°43'45"E, 20.5.1999, coll. P. ŠMARDA (F45 – middle part of the terrace, F46 – N part and F47 – NW part of the terrace) 28
- Cz; Hodonice (near Znojmo): Vraní vrch (232.4 m) elevation point, 2.5 km SE of the railway station in the village, 600 m SE of the sandpit – completely grass-covered flatt siliceous hill, on shallow soil without ocky outcrops, rare scattered tufts, 230 m a.s.l., 48°49'28"N, 16°11'17"E, 25.5.1999, coll. P. ŠMARDA (F55) 28
- Cz; the protected landscape area Pálava, Mikulov: Svatý kopeček Nature Reserve – limestone rocky steppe above the town, abundant, 340 m a.s.l., 48°48'24"N, 16°38'52"E, 7.5.1999, coll. T. VYMYSLICKÝ (F39, F40) 28
- Cz; the protected landscape area Pálava, Pavlov: surrounding of the Dívčí hrad ruin – steppe on limestone rocky slope, abundant, 405 m a.s.l., 48°52'34"N, 16°39'47"E, 22.5.1998, coll. T. VYMYSLICKÝ (F37) 28
- Cz; the protected landscape area Pálava, Pavlov: Děvín Nature Reserve, 650 m SW of Děvín (548.7 m) elevation point – SW exp. limestone cliffs, abundant, 480 m a.s.l., 48°51'58"N, 16°38'31"E, 22.5.1998 coll. P. ŠMARDA (F22) 28
- Cz; the protected landscape area Pálava, Pavlov: Děvín Nature Reserve, 700 m SSW of Děvín (548.7 m) elevation point – cleft in S exp. limestone cliffs, abundant, 440 m a.s.l., 48°51'48"N, 16°38'35"E, 22.5.1998, coll. P. ŠMARDA (F21) 28
- Cz; the protected landscape area Pálava, Pavlov: Děvín Nature Reserve, on the top of the hill near the transmitter – elevation with deeper sandy soil on bunker ruin, a single tuft isolated here, 530 m a.s.l., 48°52'10"N, 16°39'00"E, 22.5.1998, coll. P. ŠMARDA (F23) 28
- Cz; the protected landscape area Pálava, Pavlov: Dívčí hrad ruin – edge of the ruin wall, clay substrate on limestone, 405 m a.s.l., 48°52'39"N, 16°39'45"E, 22.5.1998, coll. P. ŠMARDA (F20) 28
- Cz; Miroslav: Miroslavské kopečky Nature Reserve, 500 m SE of Markův kopec (303.0 m) elevation point – steppe hill with dense grass stand on rough basic conglomerate, in places, 285 m a.s.l., 48°56'10"N, 16°18'41"E, 25.5.1999, coll. P. ŠMARDA (F57) 28
- Cz; Moravský Krumlov: Pod Floriánkem Nature Reserve, on Křepelčín vrch hill, near "312" elevation point – platform near the edge of the NW exp. basic conglomerate slope, scattered, 310 m a.s.l., 49°02'48"N, 16°19'08"E, 24.5.1999, coll. O. ROTREKLOVÁ (F62) 28
- Cz; Moravský Krumlov: Pod Floriánkem Nature Reserve, platform near the edge of the NW exp. slope of the reservation (near "312" elevation point), on Křepelčín vrch hill – deeper sandy soil on basic conglomerate rock, scattered here, 310 m a.s.l., 49°02'48"N, 16°19'17"E, 24.5.1998, coll. P. ŠMARDA (F24) 28
- Cz; Oleksovice: Oleksovické vřesovište Nature Reserve, 0.8 km SSE of the church in the village – in a dense stand of *Calluna vulgaris*, on deep sand bank, small colony, 240 m a.s.l., 48°53'51"N, 16°15'05"E, 25.5.1999, coll. P. ŠMARDA (F56) 28
- Cz; Tasovice: Nad Splavem Nature Reserve, 1.4 km W of the bridge in the village – S exp. siliceous rocky promontory above the Dyje river, soil composed exclusively of stony debris, scattered, 210 m a.s.l., 48°49'51"N, 16°08'04"E, 25.5.1999, coll. P. ŠMARDA (F54) 28
- Cz; the protected landscape area Pálava, Pavlov: surrounding of the Dívčí hrad ruin – steppe on limestone rocky slope, abundant, 405 m a.s.l., 48°52'34"N, 16°39'47"E, 22.5.1998, coll. T. VYMYSLICKÝ (F38) 28+1B



***Festuca pallens* HOST “*scabrifolia*” type**

- Cz; Budčice: 600 m NNW of railway station, above the railway above the Sázava river – siliceous rocky slopes, abundant, 350 m a.s.l., 49°43'41"N, 15°10'58"E, 5.6.1999, coll. P. ŠMARDÁ (F83) 28
- Cz; Kleneč: Klenečská stráň Nature Reserve – dry sandy slope (*Plantagini-Festucetum ovinae*), on the edge of the S part of the reserve shaded by trees, rare, 220 m a.s.l., 50°23'20"N, 14°15'24"E, 2.6.1999, coll. M. CHYTRÝ & P. ŠMARDÁ (F73) 28
- Cz; Mimoň: below the top of Ralsko hill, 4 km ENE of the railway station in the town, along the red marked trail – E exp. basalt rocky outcrops, in places, 650 m a.s.l., 50°40'28"N, 14°46'06"E, 17.6.1999, coll. K. KOČÍ (F1037) 28
- Cz; Oleško (near Roudnice nad Labem): 1.1 km E of the chapel in the village – sands along the dirt track on S exp. pine wood margin, together with *Jurinea cyanoides*, *Gypsophila fastigiata*, common, 180 m a.s.l., 50°28'50"N, 14°12'48"E, 2.6.1999, coll. M. CHYTRÝ & P. ŠMARDÁ (F72) 28
- Cz; Oleško (near Roudnice nad Labem): NE village periphery, 200 m NE of the chapel in the village – sands on S exp. pine wood margin, common, 170 m a.s.l., 50°28'55"N, 14°11'53"E, 2.6.1999, coll. M. CHYTRÝ & P. ŠMARDÁ (F70, F71) 28
- Cz; Podmoráň: 250 m NW of the nearest railway station – schist rocky promontory above the village, abundant, 250 m a.s.l., 50°10'18"N, 14°20'55"E, 19.6.1999, coll. P. ŠMARDÁ (F1011) 28
- Cz; Praha-Hlubočepy: Dalejský mlýn mill in the Dalejský potok valley – S exp. limestone rocky slope, common, 275 m a.s.l., 50°02'35"N, 14°22'30"E, 3.11.1998, coll. P. ŠMARDÁ & M. HORSÁK (F35) 28
- Cz; Praha-Hlubočepy: Děvín Nature Reserve in the Dalejský potok valley, S of Jezírko reservoir – top of the limestone rocky faces, abundant, 260 m a.s.l., 50°02'30"N, 14°22'55"E, 3.11.1998, coll. P. ŠMARDÁ & M. HORSÁK (F29, F30, F31) 28
- Cz; Praha-Hlubočepy: Prokopské údolí Nature Reserve, Dalejský potok valley – top of the S exp. limestone rocky slopes, abundant, 250 m a.s.l., 50°02'30"N, 14°22'05"E, 3.11.1998, coll. P. ŠMARDÁ & M. HORSÁK (F28, F32, F33) 28
- Cz; Praha-Hlubočepy: Prokopské údolí Nature Reserve, Dalejský potok valley – top of the S exp. limestone rocky slope, abundant, 280 m a.s.l., 50°02'30"N, 14°22'15"E, 3.11.1998, coll. P. ŠMARDÁ & M. HORSÁK (F34) 28
- Cz; Praha-Hlubočepy: Dalejský mlýn mill in the Dalejský potok valley - S exp. limestone rocky slope, common, 275 m a.s.l., 50°02'35"N, 14°22'31"E, 3.11.1998, coll. P. ŠMARDÁ & M. HORSÁK (F36) 28+1B
- Cz; Roztoky-Žalov: 100 m N of the church in the village – grassy siliceous rockeries below the cemetery, small colony, 230 m a.s.l., 50°10'11"N, 14°22'27"E, 19.6.1999, coll. P. ŠMARDÁ (F1012) 28
- Cz; Velké Žernoseky: 850 m NNW of the church in the village, near the dirt track (green marked hiking trail) between the railway and Labe river – gneiss rock block, small colony, 150 m a.s.l., 50°32'44"N, 14°03'13"E, 10.10.1999, coll. P. ŠMARDÁ (F1047) 28
- Cz; Zruč nad Sázavou: 1.25 km NW of the castle in the town, in a wood on the edge of the slope, where the road meets the red marked hiking trail leading from the wood (10 m from the road), highest point in the slope surrounding – siliceous rocky, small wooded flat, together with *Festuca cf. filiformis* and *F. pallens* 2n=14, scattered, 400 m a.s.l., 49°45'03"N, 15°05'14"E, 5.6.1999, coll. P. ŠMARDÁ (F85, F86) 28
- Ge; Sachsen-Anhalt, district Halle, Friedrichsschwerz: 1.0 km NW of the village – steppe hillocks on bare porphyrite, abundant, 150 m a.s.l., 51°33'25"N, 11°50'03"E, 11.6.1999, coll. P. ŠMARDÁ (F92) 28
- Ge; Sachsen-Anhalt, district Halle, Friedrichsschwerz: 1.2 km NW of the village – steppe hillocks on bare porphyrite, abundant, 150 m a.s.l., 51°33'30"N, 11°49'56"E, 11.6.1999, coll. P. ŠMARDÁ (F93) 28
- Ge; Thüringen, Bottendorfer Hügel hills, Bottendorf: NE village periphery – stoney steppe slopes with a high amount of copper, abundant, 190 m a.s.l., 51°18'32"N, 11°24'35"E, 7.6.1999, coll. P. ŠMARDÁ (F87, F88) 28
- Ge; Thüringen, Kyffhäuser Gebirge, Bad Frankenhausen: 3.0 km NW of the church in the village – S exp. gypsum slope, abundant, 210 m a.s.l., 51°22'34"N, 11°03'41"E, 7.6.1999, coll. P. ŠMARDÁ (F91) 28
- Ge; Thüringen, Kyffhäuser Gebirge, Bad Frankenhausen: Kaffenburg Nature Reserve, 2.3 km NW of the church in the town – S exp. gypsum slope, abundant, 210 m a.s.l., 51°22'30"N, 11°04'45"E, 7.6.1999, coll. P. ŠMARDÁ (F89, F90) 28

***F. pallens* × *Festuca cf. valesiaca* SCHLEICH. ex GAUDIN**

Cz; Chvatěruby (near Kralupy nad Vltavou): 50 m NW of the church in the village – rocky place above the road, only 1 tuft in a stand dominated by *Festuca valesiaca*, 195 m a.s.l., 50°13'59"N, 14°20'29"E, 19.6.1999, coll. P. ŠMARDA (F1009) 14

***Festuca psammophila* subsp. *psammophila* (HACK. ex ČELAK.) FRITSCH**

Cz; Hradištko (near Nymburk): S village periphery, 400 m WNW of the dairy barns – sunny, sandy pine wood margin, small colony, 185 m a.s.l., 50°09'46"N, 14°56'19"E, 3.6.1999, coll. P. ŠMARDA (F78, F79 – 2n=14 + ?B) 14

Cz; Písty u Nymburku: S part of Písečný přesyp Nature Reserve – on sands in an open pine wood, in closed vegetation with *Avenella flexuosa*, small colony, 185 m a.s.l., 50°09'44"N, 14°59'54"E, 3.6.1999 coll. P. ŠMARDA (F75) 14

Cz; Písty u Nymburku: S part of Písečný přesyp Nature Reserve – edge of bare sand-dune with open vegetation, small colony, 185 m a.s.l., 50°09'48"N, 14°59'55"E, 3.6.1999, coll. P. ŠMARDA (F76) 14

***Festuca psammophila* subsp. *muellerstollii* M. TOMAN**

Cz; Bělá pod Bezdězem: 1.1 km SE of Šibeniční vrch (336.8 m) elevation point, 100 m W of the westernmost edge of the road from Bělá p. B. to Krupá, under birches and street lights near the dirt track to the house number 587 – sandstone rockery, small colony, 296 m a.s.l., 50°30'16"N, 14°48'23"E, 15.6.1999, coll. P. ŠMARDA (F1004) 14

Cz; Bělá pod Bezdězem: 1.2 km NNE of Panská horka (294.4 m) elevation point, 1.7 km NW of the Bělá pod Bezdězem railway station – SW exp. sandstone slope of a pine-birch grove with dense herb layer, common, 275 m a.s.l., 50°29'54"N, 14°49'09"E, 15.6.1999, coll. P. ŠMARDA (F1003) 14

Cz; Bělá pod Bezdězem: 100 m S of Šibeniční vrch (336.8 m) elevation point – edge of the small sandstone quarry on a sunny pine grove margin, small dense colony, 310 m a.s.l., 50°30'44"N, 14°47'50"E, 15.6.1999, coll. P. ŠMARDA (F1002) 14

Cz; Nové Ouholice (near Kralupy nad Vltavou): 1.2 km SSW of the railway station in the village, 0.5 km SE of Na horách (253.7 m) elevation point – ESE exp. edge of sandstone slope in an open stand birch-pine-oak grove with dense *Avenella flexuosa* cover, 1 tuft, (locality of *F. pallens* cf. subsp. *muellerstollii* sensu TOMAN 1990) 200 m a.s.l., 50°17'38"N, 14°18'32"E, 19.6.1999, coll. P. ŠMARDA (F1007) 14

***Festuca vaginata* subsp. *dominii* (KRAJINA) SOÓ**

Cz; Bzenec: Cvičiště u Bzence Nature Reserve – sands in SW part of the reserve, about 40 tufts, 190 m a.s.l., 48°57'25"N, 17°17'24"E, 16.7.1998, coll. P. ŠMARDA (F12) 14

Cz; Bzenec: Cvičiště u Bzence Nature Reserve – sand steppe in the E part of the reserve, small colony, 195 m a.s.l., 48°57'33"N, 17°17'30"E, 16.7.1998, coll. P. ŠMARDA (F9, F10, F11) 14

Cz; Bzenec: Váté písky Nature Reserve – sand steppe along railway line, abundant, 185 m a.s.l., ±48°55'45"N, ±17°16'30"E, 16.7.1998, coll. P. ŠMARDA (F13, F14, F15, F16, F17, F18) 14

Cz; Bzenec: Váté písky Nature Reserve – dense growth of grass on sand steppe along railway line, rare, 185 m a.s.l., 48°56'10"N, 17°17'15"E, 16.7.1998, coll. P. ŠMARDA (F19) 14

**OTHER TAXA*****Festuca alpestris* ROEM. et SCHULT.**

It; Riva del Garda (near Lago di Garda lake): Bocca Sperone saddle, 2.5 km SW of the town – glade in brush on W exp. limestone rocky slope, common, 950 m a.s.l., 45°52'39"N, 10°49'21"E, 10.6.2000, coll. P. ŠMARDA (F1122) 14

***Festuca amethystina* L. subsp. *amethystina***

- Cz; Hodonínská doubrava wood, Mutěnice: 3.8 km SE of the railway station in the village, 100 m SE of the crossroad of Topolová alej forest track and the road (also railway) – open stand thermophilous oak forest, edge of a wetter depression on sand, small colony, 180 m a.s.l., 48°53'04"N, 17°05'02"E, 20.5.1995, coll. V. GRULICH & K. KOČÍ (F111) 28
- Sk; Velká Fatra National Park, Blatnica: top part of Tlstá (1373 m) elevation point – limestone rockeries, common, 1350 m a.s.l., 48°56'01"N, 18°58'28"E, 29.10.2000, coll. K. KOČÍ & M. KOČÍ (F147, F151) 28

***Festuca brevipila* R. TRACEY**

- Cz; Brno-Slatina: road toward Bedřichovice, 0.6 km E of the last crossroad, 2.1 km SE of Stránská skála (310.0 m) elevation point – loamy road edge (under the tuft of an anthill of cf. *Lasius flavus*), scattered, 255 m a.s.l., 49°10'55"N, 16°42'05"E, 20.5.1999, coll. P. ŠMARDÁ (F44) 42
- Cz; Brno-Kohoutovice: between Stamicova and Voříškova trolleybus stations (N of road) – dry anthropic grassy area, large dense community, 370 m a.s.l., 49°11'47"N, 16°32'13"E, 18.5.1998 coll. P. ŠMARDÁ (F8) 42
- Cz; Brno-Kohoutovice: Bellova trolleybus station – anthropic grassy road edge, rare, 384 m a.s.l., 49°11'20"N, 16°32'05"E, 18.5.1998, coll. P. ŠMARDÁ (F7) 42
- Ge; Niedersachsen, Döhle: 500 m E of Wilseder Berg elevation point – on sandy soil on the edge of the footpath across the heathland, scattered, 120 m a.s.l., 53°09'29"N, 9°58'08"E, 10.6.1999 coll. P. ŠMARDÁ (F94) 42

***Festuca cinerea* VILL.**

- Fr; Alpes Maritimes, Tende: ±7 km NNW of the village, below the Col de Tende elevation point – local road border on S exp. stony partly limestone slopes, common, 1300–1600 m a.s.l., 44°08'43"N, 7°44'15"E, 9.6.2000, coll. P. ŠMARDÁ (F1129, F1130, F1132) 28

***Festuca rupicola* HEUFF. subsp. *rupicola***

- Cz; Děkovka: 700 m E of the chapel in the village, at the foot of Plešivec (477.2 m) hill – S exp. basalt rocky and scree slopes, abundant, 430 m a.s.l., 50°29'25"N, 13°56'23"E, 10.10.1999, coll. P. ŠMARDÁ (F1045) 42
- Cz; Josefov: between Býčí skála and Krkavčí skála elevation points – wood footpath fringe on limestone slope, 350 m a.s.l., 49°18'34"N, 16°41'32"E, 23.4.1998, coll. P. ŠMARDÁ (F4) 42

***Festuca versicolor* TAUSCH subsp. *versicolor***

- Sk; Vysoké Tatry National Park, Starý Smokovec: 1 km E of Slavkovský štít peak – alpine grassland on siliceous rocks, common, 2100 m a.s.l., 49°10'60"N, 20°09'02"E, 12.5.2000, coll. P. ŠMARDÁ (F1077) 14
- Sk; Velká Fatra National Park, Liptovské Revúce: Suchý vrch (1549 m) elevation point – top of limestone rockeries, common, 1540 m a.s.l., 48°54'34"N, 19°05'42"E, 29.10.2000, coll. K. KOČÍ & M. KOČÍ (F153) 14
- Sk; Velká Fatra National Park, Liptovské Revúce: Čierny-kameň Nature Reserve, rockeries below Čierny-kameň (1479 m) elevation point – limestone outcrops, common, 1450 m a.s.l., 48°56'14"N, 19°09'09"E, 29.10.2000, coll. K. KOČÍ & M. KOČÍ (F152) 14

## APPENDIX 2

Previously published data on chromosome numbers of the Central European species of the *Festuca ovina* and *Festuca pallens* groups, in which only plants originating from Europe (according to the Flora Europaea) are indicated. If possible, the locality and number of investigated plants are given.

### *F. ovina* group

#### *F. ovina* L. subsp. *ovina*

ALEXEEV 1974	2n=14	Russia, European part, 5 plants
ALEXEEV et al. 1990	2n=14	former USSR, 25 plants
AROHONKA 1982	2n=14	Finland, Ab Nauvo, Seili, originally identified as <i>F. ovina</i> s.l.
BORGEN & ELVEN 1983	2n=14	Norway, Finnmark region, Neiden
DMITRIEVA 1985	2n=14	Belarus, Minsk region, 1 locality
FLOVIK 1938	2n=14	Norway, Tromsø
FREDERIKSEN 1981	2n=14	5 populations from Norway, 2 from Great Britain (Wales and Scotland)
GADELLA & KLIPHUIS 1973	2n=14	Netherlands, Friesland Province, Ameland island, Hollum, 1 plant
GAGNIEU & BRAUN 1961	2n=14	France, Alsace region
HARBERD 1961	2n=14	Great Britain, 1 population
HORÁNSZKY et al. 1971	2n=14	Hungary, mentioned to be a typical Hungarian diploid species
KNABEN & ENGELSKJON 1967	2n=14	Norway, Dovre Mts., Knutshø and Grimsdalen
KNABEN & ENGELSKJON 1979	2n=14	Norway, 19 plants from 4 localities
LEWITSKY & KUZMINA 1927	2n=14	Ukraine, Kiev
LIPTÁKOVÁ 1963	2n=14	Slovakia, Belanské Tatry Mts., near Šalviové pramene elevation point
LÖVE & LÖVE 1956	2n=14	Iceland, mentioned to grow together with tetraploid <i>F. vivipara</i> (L.) SM.
MALIK & THOMAS 1966	2n=14	material from the Welsh Plant Breeding Station
MIZIANTY & PAWLUS 1984	2n=14	Poland, Czeszochowa province, Dzierzgow near Moskorzew
PILS 1980	2n=14	Austria, Oberösterreich, Kempfendorfer Berg hill (N of Pregarten village)
SALVESEN 1986	2n=14	S Norway, 24 plants without further localization
SALVESEN 1979	2n=14	Norway and Sweden, altogether 35 plants from 13 localities
SOKOLOVSKAYA 1970	2n=14	Russia, Usa river basin, Yun"-Yaga
TURESSON 1930	2n=14	2 types from Öland island (Sweden) and 1 from Norway
TURESSON 1938	2n=14	S Sweden, Stehag
TVERETINOVA 1977	2n=14	Ukraine, 4 plants from Kiev and Zhitomirsk regions
UHRÍKOVÁ & DÚBRAVCOVÁ 1997	2n=14	Slovakia, Vysoké Tatry Mts., Mt. Štrba
WILKINSON & STACE 1991	2n=14+0-1B	Great Britain, 11 plants; Norway 1 plant

#### *Festuca ovina* subsp. *hirtula* (HACK. ex TRAVIS) M.J. WILK. + *Festuca ovina* subsp. *ophiolicola* (KERGUÉLEN) M.J. WILK.

AUQUIER 1977	2n=28	Belgium, Liège and Aix-la-Chapelle regions, more localities
AUQUIER & RAMELOO 1973	2n=28	Belgium, Liège region, 5 plants
CATALÁN RODRIGUÉS & GARCÍA HERRAN 1990	2n=28	Spain, Navarra region, Baztán, Puerto de Otxondo, 1 locality
GADELLA & KLIPHUIS 1971	2n=28	Netherlands, Limburg province, Cottessen
GAGNIEU & BRAUN 1961	2n=28	France, Alsace region
HARBERD 1961	2n=28	Great Britain, 9 population
HUFF & PALAZO 1998	2n=28	material from Rutgers University, New Brunswick: cultivar Quatro
HUON 1968	2n=28	France, SE part
SETHI 1931	2n=28	locality and plant number not indicated
SETHI 1931	2n=28	Great Britain, Wales region, plants from 3 localities
WATSON 1958	2n=28	Great Britain, 95 populations, mainly S and W part of the country, localities not indicated
WILKINSON & STACE 1991	2n=28	Great Britain, 14 localities; 4 others from Belgium, without further localization

***Festuca ovina* subsp. *bigoudenensis* KERGUÉLEN et PLONKA**

HUON 1970	2n=28	France, Finistère region, Pouldreuzic and Peumerit, at least 3 plants originally presented as "tetraploid", later determined by KERGUÉLEN et al. 1989
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***Festuca ovina* subsp. *guestfalica* (RCHB.) K. RICHT.**

PILS 1980	2n=28+0-1B	Austria, 10 populations from the whole country
TRACEY 1980	2n=28	Austria, 9 populations from the whole country
WATSON 1958	2n=28	Germany, Bavaria, 1 sample without further localization

***Festuca eggleri* R. TRACEY**

PILS 1980	2n=14	Austria, Steiermark: Lauffnitz Bach Graben (N of Frohnleiten)
TRACEY 1980	2n=28	Austria, Steiermark-Kärnten: Pernegg, 4 plants

***Festuca filiformis* POURR.**

AUQUIER & RAMELOO 1973	2n=14	Belgium; Liège, Limbourg and East Flanders regions, altogether 4 localities
BRANDENBERG 1948	2n=14	material from the Hohenheim botanical garden (originated from Germany)
CHURCH 1936	2n=14	cultivated plant
GADELLA & KLIPHUIS 1968	2n=14	Netherlands, Gelderland province, the surroundings of Speuld, 1 plant, originally presented as <i>F. ovina</i> L., determination corrected by GADELLA & KLIPHUIS 1971
GAGNIEU & BRAUN 1961	2n=14	France, probably Alsace region
HORÁNSZKY et al. 1971	2n=14	Hungary, referred to as a typical diploid Hungarian species
HUFF & PALAZO 1998	2n=14	material from Rutgers University, New Brunswick: cultivars Barok, duellacc4, duellacc5 and psuacc2
HUON 1970	2n=14	France, Gironde region, Caudos, Villecartier forest
JENKIN 1955a	2n=14	locality and number of plants not indicated
JENKIN 1955b	2n=14	locality and number of plants not indicated
JENKIN 1955c	2n=14	locality and number of plants not indicated
KERGUÉLEN 1975	2n=14	locality not indicated
LEWITSKY & KUZMINA 1927	2n=14	?Germany, Haage u. Schmidt
LITARDIÈRE 1923	2n=14	?France, without localization in the original work
NAKAJIMA 1930	n=7, 2n=14	cultivated plant
PARREAUX 1971	2n=14	France, Central Jura Mts.
PILS 1980	2n=14	Austria, Oberösterreich: Kepfendorfer Berg hill (N of Pregarten village)
SALVESEN 1986	2n=14	S Norway, 1 plant without further localization
SALVESEN 1979	2n=14	Norway, Oslo region, Romsas
THOMAS 1939	2n=14	locality and number of plants not indicated
TRACEY 1980	2n=14	Austria, Niederösterreich: Amaliendorf/Schrems village
TVERETINOVA 1977	2n=14	Ukraine, Ivano-Frankivsk region, Vorokhty
WATSON 1958	2n=14	Germany, Bavaria, 2 samples without further localization
WILKINSON & STACE 1991	2n=14	Great Britain, 6 populations

***Festuca airoides* LAM. - *F. supina* SCHUR complex**

EHRENBERGEROVÁ 2001	2n=14	Romania; Retzat Mts.
KOZHUHAROV & PETROVA 1991	2n=14	Bulgaria: West Frontier Mts., Osogovska planina, 1 locality
KERGUÉLEN 1975	2n=14	France, Col de Finiels region, Mt. Lozère, ?1 plant
PASHUK 1987	2n=14	Ukraine, Ukrainian Carpathian Mts., 1 plant
PILS 1980	2n=14	Austria; Kärnten, Gurktaler Alpen Mts., 2 localities
PILS 1985	2n=14	Austria, Kärnten, Gurktaler Alpen Mts., 3 plants
STEFANIK et al. 1989	2n=14	Ukraine, Ukrainian Carpathian Mts., Mt. Shpitsa
TVERETINOVA 1977	2n=14	Ukraine, Ivano-Frankivsk region, Polonina Pozhyzhvetskaya, 1 plant
HADAČ & HAŠKOVÁ 1956	2n=28	Slovakia, Vysoké Tatry Mts., 2 localities

MÁJOVSKÝ & UHRÍKOVÁ 1985	2n=28	Slovakia, Vysoké Tatry Mts., Zlomisková dolina valley, ? published first in UHRÍKOVÁ et al. 1983
MIZIANTY & PAWLUS 1984	2n=28	Poland; Krosno province, Bieszczady Mts., Szeroki Wierch mountain, 1 plant
UHRÍKOVÁ et al. 1983	2n=28	Slovakia, Vysoké Tatry Mts., Zlomisková dolina valley, 1 plant
PIOTROWICZ 1954	2n=28, 35	Slovakia and Poland, Vysoké Tatry Mts., altogether 37 plants
PIOTROWICZ 1950	2n=28, 35	Poland, Vysoké Tatry Mts., Czorny Staw lake, 6 clones
MURÍN & PACLOVÁ 1979	2n=35	Slovakia, Vysoké Tatry Mts., Nefcerka and Veľká Svišťovka elevation points

#### Problematically interpretable data with relation to the *F. ovina* group

ALEXEEV et al. 1990	2n=14	Ukraine, 30 km SW of Kiev, determined as the newly described taxon <i>Festuca ovina</i> subsp. <i>firmulacea</i> (MARKGR.-DANN.) PROB.
FREDERIKSEN 1981	2n=21	4 localities from Sweden, 8 from Norway and 1 from the Faroe Islands, mentioned to be hybrids of <i>F. ovina</i> and <i>F. vivipara</i> (L.) SM.
HUON 1970	2n=28, 29, 31, 32, 34	France, between Mauves and le Cellier, determined originally as <i>F. ovina</i> var. <i>vulgaris</i>
HUON 1970	2n=28	France, Gironde region, Caudos, presented as <i>F. filiformis</i>
NAKAJIMA 1931	2n=28	origin unknown, determined originally as <i>F. ovina</i>
ÖNDER & JONG 1977	2n=14, 28+0-2B	Great Britain, Scotland, 60 plants from 11 localities, without distinguishing <i>F. ovina</i> and <i>F. filiformis</i>
ROHWEDER 1937	n= 7, 2n=14, 21	Germany, Schleswig-Holstein region, 4 populations, used <i>F. ovina</i> s.l. concept
TRACEY 1980	2n=28	Austria, Niederösterreich, Unterloiben village, determined as <i>F. guestphalica</i> RCHB. > <i>F. pallens</i> HOST
TRACEY 1980	2n=14	Austria, Niederösterreich, W of Pulkau village, determined as <i>F. guestphalica</i> RCHB. > <i>F. valesiaca</i> GAUDIN
WATSON 1954	2n=14, 28	Great Britain and from seeds originating from Scandinavian countries, Netherlands and France, according to the author diploids should represent <i>F. filiformis</i> , tetraploids <i>F. ovina</i> (diploid <i>F. ovina</i> was not taken into account), preliminary results, published fully in WATSON 1958
WATSON 1958	2n=14	Great Britain, 87 populations, mainly N and E part of the country, localities not indicated, without distinguishing <i>F. ovina</i> and <i>F. filiformis</i>
WATSON 1958	2n=14, 28	Great Britain, 25 mixed ploidy populations, further localities not indicated, without distinguishing diploid <i>F. ovina</i> and <i>F. filiformis</i>

#### *F. pallens* group

##### *Festuca pallens* HOST

AUQUIER & KERGUÉLEN 1977	2n=14	1 plant from Belgium and 2 plants from France, Ardennes region
AUQUIER & RAMELOO 1973	2n=14	Belgium, 4 plants from Liège and Namur regions
BAKSAY 1956	2n=14	Hungary, Bükk Mts., 3 plants
GALLI et al. 2001	2n=2x	Hungary: Szarvasko
HORÁNSZKY et al. 1972	2n=14	Hungary, Mts. Bükk and Torna regions
HORÁNSZKY et al. 1972	2n=14	Hungary, plants used for artificial crossing with diploid <i>F. vaginata</i>
KERGUÉLEN 1975	2n=14	Belgium, population from the Meuse river valley
MÁJOVSKÝ & VÁCHOVÁ 1986	2n=14	Slovakia, Slovenský kras hills, Gemerské Teplice
PILS 1981	2n=14	Austria, 7 plants of the Oberösterreich-Niederösterreich type, 1 plant of the Weizklamm type
TRACEY 1974, TRACEY 1980	2n=14	Austria, 5 plants of the Oberösterreich-Niederösterreich type
UHRÍKOVÁ & MÁJOVSKÝ 1978	2n=14	Slovakia, Slanské vrchy Mts., Podhradík
UHRÍKOVÁ 1974	2n=14	Slovakia, Biele Karpaty Mts., Vršatecké Podhradie, Vršatec hill
AUQUIER 1976	2n=28	Austria, Steiermark, Deutschfeistritz
BAKSAY 1956	2n=28	Hungary, 4 plants
BAKSAY 1961: 364	2n=28	Hungary, without further specification

GALLI et al. 2001	2n=4x	Hungary, Buda-Hills
HOLUB 1970	2n=28	Slovakia, Strážovská hornatina highland, Trenčín
PILS 1981	2n=28	Austria, 1 plant of Pannonisches-Hügelland type, 5 plants of Steiermark-Kärnten type
TRACEY 1974, TRACEY 1980	2n=28	Austria, 3 plants of Pannonisches-Hügelland type, 3 plants of Steiermark-Kärnten type
DAWE 1989	2n=14	Austria, Voralpen and Wurklamm
DAWE 1989	2n=28	Austria, Graz-Schlossberg and Metnitz Tal

***Festuca psammophila* (HACK. ex ČELAK) FRITSCH**

SCHWARZOVÁ 1967	2n=14	Czech Republic, Sadská
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***F. vaginata* subsp. *vaginata* WALDST. et KIT. ex WILLD.**

BAKSAY 1956	2n=14	Hungary, Szentendre river island
HORÁNSZKY et al. 1972	2n=14	Hungary, plants used for artificial crossing with diploid <i>F. pallens</i>
PÓLYA 1949	2n=14	Hungary, Debrecen region, Haláp
SCHWARZOVÁ 1967	2n=14	Slovakia, Sv. Mária and Čenkov

***F. vaginata* subsp. *dominii* (KRAJINA) SOÓ**

SCHWARZOVÁ 1967	2n=14	Slovakia, Stupava
TRACEY 1980	2n=14	Austria, Niederösterreich, Marchfeld

**Problematically interpretable data with relation to the *F. pallens* group**

AUQUIER 1976	2n=21	artificial hybrid plant obtained from cross-fertilization of a diploid <i>F. pallens</i> plant from Belgium and a tetraploid one from Austria
BRANDENBERG 1948	2n=14	?Hungary, material from the Debrecen botanical garden, originally described as <i>Festuca polesica</i> ZAPAL.
BRANDENBERG 1948	2n=28	material from the Lausanne botanical garden (Switzerland), originally described as <i>F. glauca</i> LAM.
GAGNIEU & BRAUN 1961	2n=28	France, Alsace, Hoheneck hill, do not correspond with the distribution area of <i>F. pallens</i> presented in the recent France floras (cf. PORTAL 1999)
LEWITSKY & KUZMINA 1927	2n=28	without further localization, originally described as <i>Festuca glauca</i> subvar. <i>eu-glauca</i> LAM.
TRACEY 1980	2n=14	Austria, Niederösterreich, Loiben, determined as <i>F. pallens</i> > <i>F. guestphalica</i> RCHB.
TRACEY 1980	2n=14	Austria, Niederösterreich, Marchfeld, determined as <i>F. vaginata</i> × <i>F. valesiaca</i>
TRACEY 1980	2n=14	Austria, Niederösterreich, Mödling – Kalenderberg hill, determined as <i>F. valesiaca</i> subsp. <i>valesiaca</i> > <i>F. pallens</i>
TRACEY 1980	2n=28	Austria, Niederösterreich, Unterloiben, determined as <i>F. guestphalica</i> > <i>F. pallens</i> )

The following data, often cited in common karyological reviews under the name *F. pallens* or under its synonymic names, probably refer to other taxa: BIDAULT 1963, 1964a, b, 1968, 2n=14, 28; FELFÖLDY ex SOÓ 1963, 2n=42; GHORAI & SHARMA 1981, 2n=30; LITARDIÈRE 1923, 2n=14; SOKOLOVSKAYA & STRELKOVA 1940, 1948, 2n=14.

