

Contributions to the distribution and ecology of *Carex hordeistichos* Vill. in the Czech Republic and Slovakia

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Abstract: Current and historical occurrence as well as habitat requirements of *Carex hordeistichos* in the Czech Republic and Slovakia are presented. The study is based on the revision of herbarium specimens from 25 herbaria and a field survey carried out during 2004-2009. Altogether, 195 sites were documented in the Czech Republic, exclusively in the Moravia region. Recent occurrence was confirmed at only four localities (2% of sites), therefore the status of threat was confirmed – the species is critically endangered. In Slovakia, 184 localities of the species were recorded in total; 34 sites were found in period 1975-1999 and 35 sites were confirmed recently (19% of sites recorded), but only 6 in the Pannonia (3% of sites). The number of localities was stable over the last 35 years, therefore, we re-evaluated the IUCN status of *C. hordeistichos* in Slovakia. The species is now assessed in the category vulnerable – VU. Results of the study are summarised in the maps of historical and actual species distribution. *C. hordeistichos* usually occurred in various wet grassland communities and it had no well-defined coenotic relationships. On the basis of our knowledge, we consider *C. hordeistichos* as a facultative halophyte.

Key words: facultative halophytes, occurrence, IUCN criteria, rare species

1. Introduction

Carex hordeistichos Vill. is a species with the European Centre of range. It occurs in Spain, France, Italy, Germany, Central and Eastern Europe (the Czech Republic, Slovakia, Hungary, Romania, Bulgaria) and in the countries of former Yugoslavia. The range extends south into northern Africa and eastward to southern Russia, the Caucasus, in Asia Minor, Iraq and Iran (Meusel *et al.* 1965; Schulze-Motel 1980).

Occurrence of *C. hordeistichos* in Europe is characterized by Chater (1980) as “in most of the territory is very rare”. The species is absent in Scandinavia, the British Isles, the Benelux and also in some Mediterranean countries such as Portugal or Greece (Muller 1999). In Spain, it occurs only very rarely (Luceño 1994); in France, it is included in Red Book (Olivier *et al.* 1995) and is protected by law (Danton & Baffray 1995). In Germany, the species is considered one of the most endangered plant species (Korneck *et al.* 1996). Muller (1999) believes that in central Europe, the species probably occurs more commonly but current data are missing. In fact, the species is also relatively rare in this area.

In Austria, the species grows only in the Burgenland Region, the Lower Austria and in Vienna, while in the Carinthia Region, it is now extinct (Fischer *et al.* 2005); it belongs to the critically endangered species of Austrian flora (Niklfeld & Schrott-Ehrendorfer 1999). Similarly, it is rare in Ukraine (Krečetovič 1940), but it is not included in the protected plants (Shelyag-Sosonko 1996). In Hungary, *C. hordeistichos* occurs scattered all over the territory (Soó 1973), but it was included in the latest version of Red list in the category NT (near threatened) (Király 2007). The species is evaluated as critically endangered (C1) in the Czech Republic (Procházka 2001), in Slovakia, it is included in IUCN category EN – endangered (Feráková *et al.* 2001); the species is also protected by law in both countries.

In view of the foregoing contributions, the paper is aimed to obtain historical and current occurrence and ecology of *Carex hordeistichos* in the Czech Republic and Slovakia.

2. Material and methods

Carex hordeistichos is a perennial tussock sedge up to 10-30 cm high. The stems are prostrate to ascending,

thick, smooth, and blunt triangular. The basal leaf sheaths are yellow-brown to black and fibrous. The leaves are 3 to 5 mm wide, stiff, leathery. Male spikelets usually two or three, are close together, but away from female ones. Female spikelets three to four. Utricles are ovoid to oblong, 8-12 mm long, in distinct rows, surface is sparsely pubescent (Chater 1980; Schulze-Motel 1980). The species is very often confused with *Carex secalina* Wahlenb. *C. secalina* is characteristic especially for glabrous utricles 5-7 mm long, not in distinct rows (Grulich & Řepka 2002).

The research was undertaken in years 2004-2009. We designed the distribution by studying the herbarium specimens from the herbaria BP, BBZ, BRA, BRNM, BRNU, CB, KO, LTM, MMI, MZ, NI, NJM, OL, OLM, PMK, PR, PRC, ROZ, SAS, SLO, TM, TMM, VM, VYM, ZV, data from the Central Database of phytosociological relevés (CDF) deposited in Institute of Botany (Hegedúšová 2007), literature data as well as our field research. Data published from South Moravia can be used only in a limited extent, as we found in the herbaria frequent confusions with a very similar species *C. secalina*, both species grow here sympatrically. Some unpublished data from the territory of Slovakia were

also obtained from database of vascular plants stored at the Department of taxonomy of vascular plants, Institute of Botany, Bratislava. Older literature is cited in abbreviated form following Futák & Domin (1960). Nomenclature of taxa according to Marhold & Hindák (1998), syntaxa nomenclature is not according to a single source, thus the name of each syntaxonomic unit includes the name of the author. Phytogeographical division of the Czech Republic is according to Skalický (1988), in Slovakia, it followed Futák (1984). Herbarium abbreviations are according to Holmgren *et al.* (1990) and Vozárová & Sutorý (2001). Categories of threat were determined according to the methodology of IUCN (2001).

3. Results and discussion

3.1. Distribution of *Carex hordeistichos* in the Czech Republic

In the Czech Republic, *C. hordeistichos* was recorded at 195 sites in total (Fig. 1, Appendix 1, see <http://www.brc.amu.edu.pl>). 37 locations were found in period 1975-1999 and the species was recently confirmed at

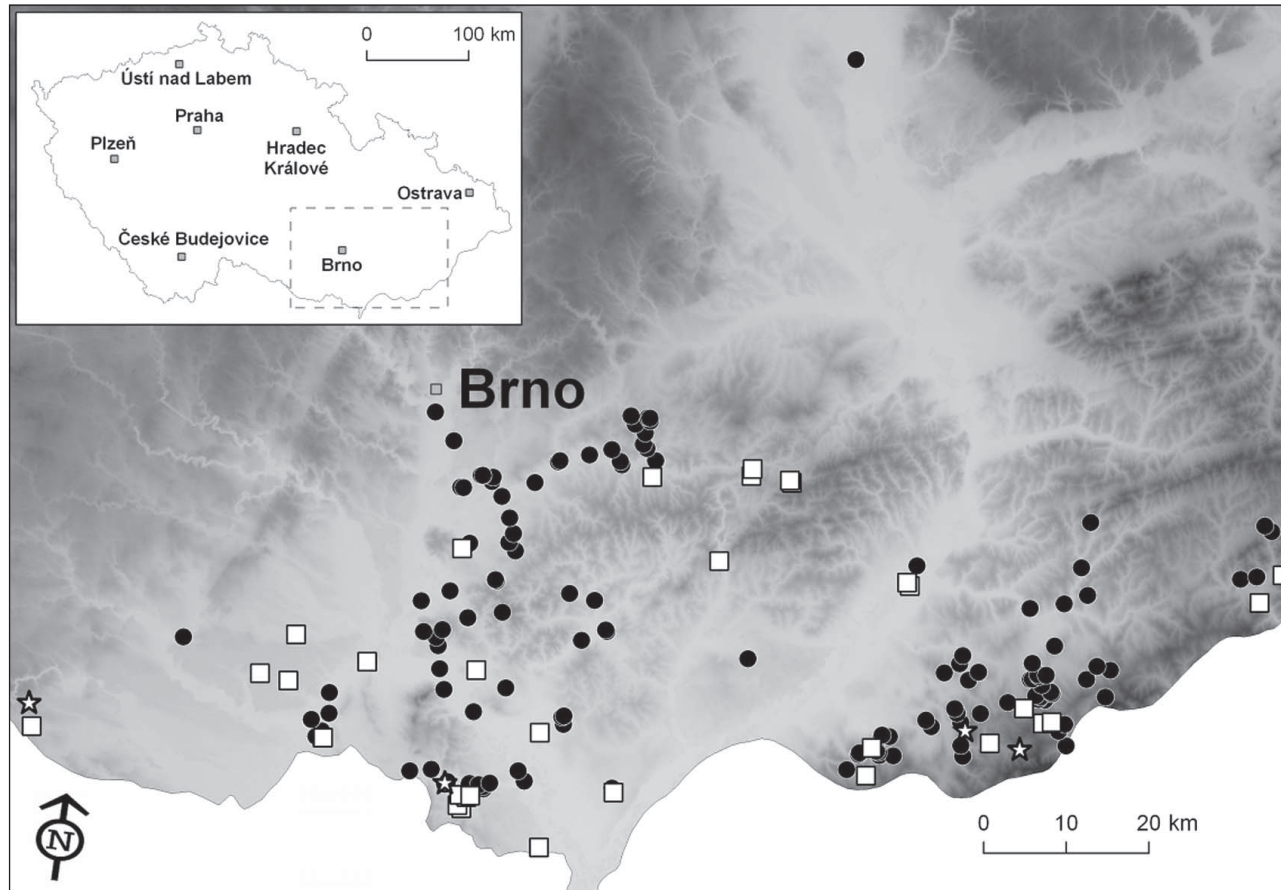


Fig. 1. Historical and current distribution of *Carex hordeistichos* in the Czech Republic
 Explanations: ● – until 1975, □ – 1975-1999, ☆ – 2000 onwards

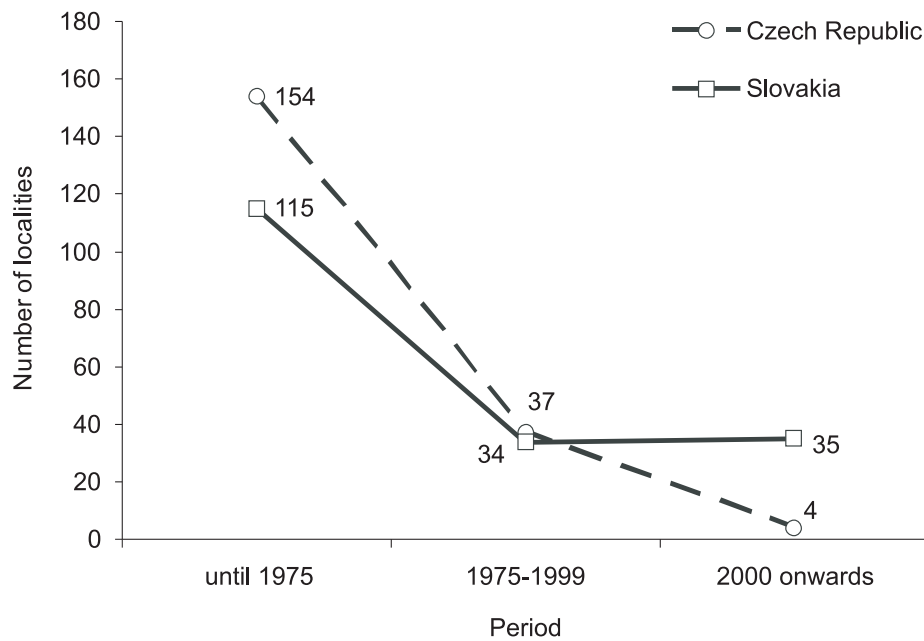


Fig. 2. Trend in reduction of *Carex hordeistichos* localities in the Czech Republic and Slovakia

four sites only (2% of sites recorded). A marked decrease in numbers of localities was found during our study due to massive land reclamation (Fig. 2). The occurrence of the species is limited to the Pannonian Thermophyticum and Carpathian Mesophyticum in the Southeast and southern Moravia, the isolated site was located near Olomouc in Central Moravia. The species is very rare in south-west Moravia (the Znojensko-brněnská pahorkatina Hills); only six sites are known here. Most sites were recorded in the central part of South Moravia in the territory between settlements of Drnholec, Brno, Bučovice and Břeclav; these sites are located in the Dyjsko-svratecký úval Region, the Bučovická a Hustopečská pahorkatina Hills, Pavlovské kopce Area and Milovicko-valtická pahorkatina Hills. The second isolated distribution area is located in south-east Moravia in the territory between settlements of Uherské Hradiště, Luhačovice, Valašské Klobouky and Strážnice. The center of species occurrence lies there in forest and steppe areas of the Bílé Karpaty Mts, where the species spread to the Dolnomoravský úval Region and Zlínské vrchy Mts. It is documented from lowland to submountain areas (cf. Skalický 1988). The minimum altitude site is located between villages of Lednice and Charvátská Nová Ves (157 m above sea level); maximum altitude was recorded in 650 m a. s. l. at the Lesná Hill near the village Horní Němčí.

Distribution of *C. hordeistichos* was summarized for the first time by Podpěra (1930) in Moravia. A detailed grid map for Bílé Karpaty Mts. was published much later by Jongepier & Pechanec (2006). Čelakovský (1867) mentioned *C. hordeistichos* occurrence also from

Bohemia (Budyně nad Ohří), but the information was confused with *C. secalina* and was somewhat later corrected by himself (Čelakovský 1871). In addition, several Bohemian vouchers come from a culture in botanical gardens: Prague, Botanic Garden, leg. Vogl 1852 PR; a specimen located in Prague [no exact location], leg. Gintl 1856 PRC is probably of the same origin.

3.2. Distribution of *Carex hordeistichos* in Slovakia

The species occurs scattered and rarely only in some parts of the territory of Slovakia from the foothills to lowlands. Overall, 184 sites were found in our study. 34 locations were recorded in period 1975-1999 and the species was confirmed at 35 sites recently (Fig. 3, Appendix 2, see <http://www.brc.amu.edu.pl>). The number of localities was stable during last 35 years (Fig. 2). Most data in the Pannonia are from the Danube Lowland and the Ipeľsko-Rimavská brázda Region. However, a large reduction of localities influenced by agricultural land use was recorded – from 58 sites known in the past only six are found presently (9% of sites). Overall, in the Carpathian region 126 sites were documented, of which 30 are current (23% of sites). The sites are located especially in the Turčianska Basin and basins under the Tatras. Populations are often small in number of individuals (see e.g. Bernátová *et al.* 2006), micro-populations contain only one or two plants in extreme cases (e.g. in the Turčická Valley at 710 m a.s.l.). The minimum altitude of *C. hordeistichos* occurrence was found in Tvrdošovce (109 m a.s.l.), maximum altitude was recorded near Fačkov (Strážovské vrchy Mts.) approximately in 1000 m a.s.l.

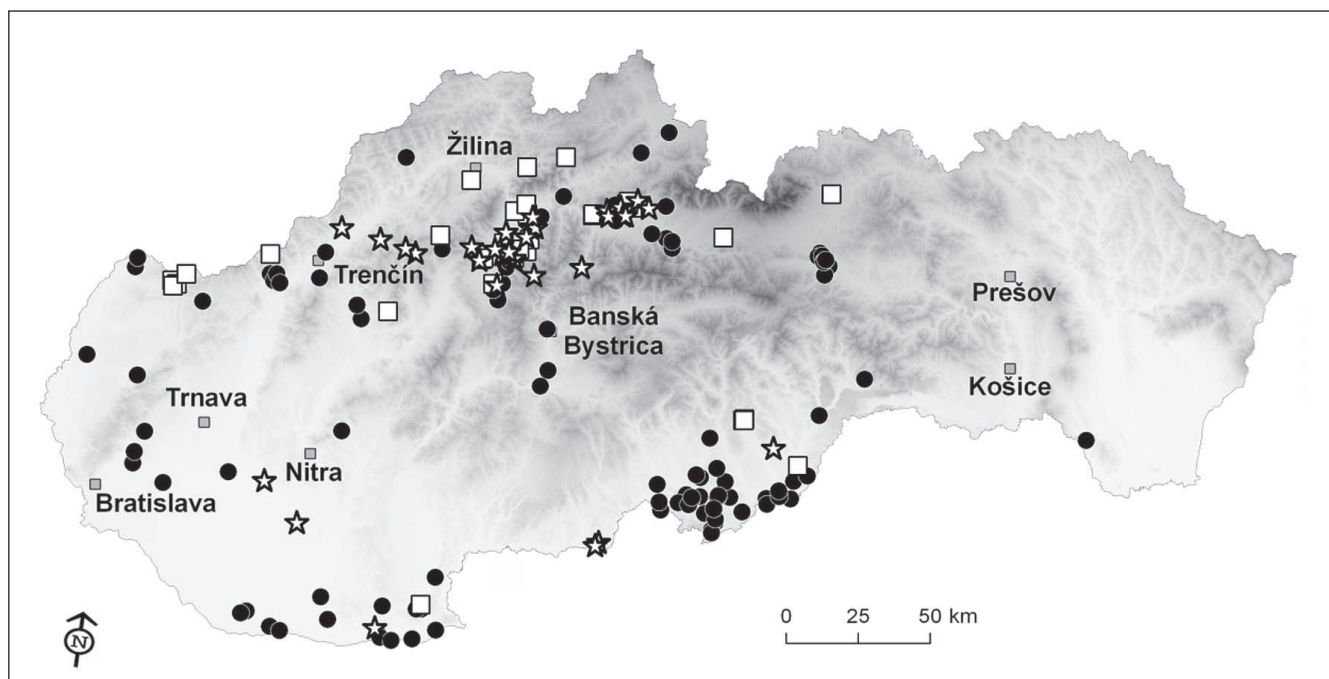


Fig. 3. Historical and current distribution of *Carex hordeistichos* in Slovakia

Explanations: ● – until 1975, □ – 1975-1999, ☆ – 2000 onwards

Most detailed data on the occurrence of *C. hordeistichos* in Slovakia was published by Dostál & Červenka (1992): lowlands, middle and lower Považie Basin, Bánovce nad Bebravou, Ponitrie Region, middle and lower Pohronie Region, Hostice (Rimavská Sobota district), around town of Rožňava, as well as rarely in Liptov, Turiec and Spiš regions. Based on our data, we can conclude that the extension of the above is inaccurate and incomplete.

3.3. Ecology and coenotic relationships

Very little information is available about *Carex hordeistichos* habitat (Muller 1999). The species occurs in the salt marshes, in salinised edges of pastures and fields, field roads (Schulze-Motel 1980; Muller 1999; Řepka 2007), it also grows in wet grasslands, in ditches, (Dostál & Červenka 1992) and along watercourses (also regulated). Several authors considered the species as obligate halophyte (Krist 1940; Šmarda 1961), respectively, for species preferring saline habitats (Wendelberger 1950; Schulze-Motel 1980; Oberdorfer 1990). Some authors (Guinochet & de Vilmorin 1973; Oberdorfer 1990) regarded it as characteristic species of halophytic association *Juncion gerardii* Wendelberger 1943 [pseudonym *Agropyro-Rumicion crispi* Nordhagen 1940; syn. *Scorzonero-Juncion gerardii* (Wendelberger 1943) Vicherek 1973] which includes halophytic and sub-halophytic communities physiognomic close to moist ruderal vegetation, pasture and meadows (Šumberová *et al.* 2007). Other authors (Mucina 1993; Šumberová *et al.* 2007) included it not to a dis-

tinctive taxa of association of *Juncion gerardii* Wendelberger 1943.

From Western Europe, the association *Carici hordeistichi-Trifolietum fragiferi* is known from this alliance, which has been described in Spain (Rivas-Goday & Borja-Carbonell 1961) and was recorded also in France (Mony & Muller 2005). From this alliance, the species was still referred in association *Dactylo-Festucetum* Tx. 50 (syn. *Potentillo-Festucetum* Nordh. 1940) (Muller 1999). Mucina (1993) included it among the diagnostic species of the *Scorzonero-Juncetalia gerardii* Vicherek 1973 and *Potentillo-Polygonetalia* R. Tx. 1947. Oberdorfer (1983) mentioned it in the association *Junco compressi-Trifolietum repentis* Egger 1933 (the alliance *Plantagini-Prunellion* Eliáš 1980).

The analysis of occurrence in recent sites showed that the species had no well-defined coenotic affinities. Only a small proportion of sites was related to halophilic or sub-halophilic communities of the alliance of *Juncion gerardii* Wendelberger 1943 in the Czech Republic and Slovakia. Except for the above mentioned alliance of *Plantagini-Prunellion* Eliáš 1980, we recorded the species, for example, in vegetation of *Cynosurion cristati* Tüxen 1947 and *Deschampsion cespitosae* Horvatić 1930. It was also found in communities of *Caricion davallianae* Klika 1934 alliance and, occasionally, on forest roads in contact with vegetation of the alliance of *Cirsio-Brachypodion pinnati* Hadač et Klika ex Klika 1951.

The results of our study showed that *C. hordeistichos* cannot be considered as obligate halophyte. Most of

historical and current sites were found outside the salted soil. Plants of *C. hordeistichos* found in saline habitats occupied here less salted sites and they avoided excessively highly salted soils. Most sites were recorded on rural roads and sites often strongly affected by anthropic disturbances; however, it also grew in fens with a high content of bases (Watzka 1997; Hájek 1998). The same conclusion was also reached by Mony & Muller (2005); the authors studied the relationship of *C. hordeistichos* and halophytic communities in Lorraine, France. Species was absent in typical halophilic community with the dominance of *Juncus gerardii* and *Salicornia europaea*, and it was most often recorded in grassland communities (18 out of 21 analysed sites). They also found a negative correlation between the occurrence of the species and increasing soil salinity. Therefore, the authors considered the species as a plant only slightly tolerating increased salt content in soil.

4. Final remarks

The results of the study showed that the inclusion of the species in the critically endangered (CR A2a, c) category is justified in the Czech Republic. The occurrence of the species was strongly reduced, approxi-

mately 98% of the sites disappeared or were not recently verified (Fig. 1, 2, Appendix 1). On the other hand, in Slovakia, the inclusion of *C. hordeistichos* in IUCN category EN is overestimated. Although the occurrence of the species was significantly reduced in the Pannonia (91% of sites were not confirmed recently), the species is still present and relatively abundant in the Carpathians (23% of sites still exist or new sites were found) and the reduction of occurrence was not found since 1975 (Fig. 2, 3, Appendix 2). Therefore, we evaluated the species in the IUCN category vulnerable – VU A2c+B2b(iii, iv).

We found that *C. hordeistichos* had no well-defined coenotic relationships; the species usually occurred in various wet grassland communities, often disturbed by human activities and ruderalised (rural roads, field edges, pastures). The species does not prefer the saline habitats and could be regarded only as a facultative halophyte.

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Appendix 1. List of localities of *Carex hordeistichos* in the Czech Republic

16. Šatov, orchard near the small fortification in south edge of the village (Grulich 1996). – Havraníky, small pond in north-west edge of the village (Rydlo *et al.* 1992 ROZ; Grulich 1994 BRNU). – Oleksovice, marsh in the village (Drlík 1954 MZ). – Břežany, marshy place in field near stream 0.5 km east from the village (Řepka 1986 BRNM). – Litobratřice, bank of the Litobratřický dolní rybník Pond 2.5 km south-east from the village (Řepka 1991 BRNM). – Troskotovice, grass path near Miroslavka under the share of Troskotovický horní rybník in north edge of the village (Řepka 1991 BRNM). **17b.** Mikulov, ditches near town (E. Müller 1892 BRNM). **17c.** Sedlec, road from Mikulov (Fröhlich 1937 BRNM). – Valtice, 0.9 km west-north-west from the railway station (Daníhelka *et al.* 1995). – Valtice, 2 km west-north-west from the railway station, near the rail (Daníhelka 1994 MMI). **18a.** Jevišovka (Wildt 1911 BRNM). – Nový Přerov, north edge of the village (Řepka 1983 BRNM; Grulich 1984 MMI). – Nový Přerov, pasture to Jevišovka (Staněk 1923 BRNM). – Nový Přerov, pasture to Novosedly (Staněk 1923 BRNM). – Novosedly, pasture near the village (Staněk in Podpěra 1930). – Drnholec, meadows near the Dyje River (Fröhlich 1938 BRNM). – Pasohlávky, reservoir bank about 1 km from the village (Řepka 1981 BRNM, MMI). – Brno (Makowsky s. a. PR; J. Šmarda s. a. PRC). – Brno-Komárov (Rohrer s. a. PRC). – Brno-Brněnské Ivanovice (Schwöder 1881 BRNM). – Otmarov (Makowsky 1857 BRNU; Oborny 1867 PRC; s.leg. 1895 BRNU; Rothe 1897 BRNU; Niessl 1901 BRNU; Wildt 1901, 1911 BRNM; J. Bílý 1914 BRNU, 1914, 1920 BRNM, 1948 PRC; Weber 1931 BRNM; Šourek 1956 PR). – Sokolnice (Podpěra 1913 BRNU; Krist 1939 BRNU). – Sokolnice – Těšany (Suza 1912 BRNU). – Měnin, pheasant farm (Oborny 1867 PRC). – Moutnice, Římská bažantnice pheasant farm 3.5 km southwest from the village (Řepka 1989 BRNM). – Těšany, canal 1 km north from the village (Vicherek 1962 BRNU). – Těšany, salt site in south edge of the village (Vicherek 1962 BRNU). – Velké Němčice (Podpěra 1930). – Vranovice, salt habitat 1.5 km east from the village, near the road to Velké Němčice (Vicherek 1965 BRNU). – Starovice, salt habitat near football field (J. Dvořák 1959 BRNM). – Pavlov (Schwöder in Podpěra 1930). – Šakvice, grasslands on the eastern side of the lake between the village and Strachotín (J. Dvořák 1960 kart.). – Šakvice, salt habitat east-north-east from the village (Husák 1977 PR). – Nové Mlýny (Oborny 1876 MZ). – Terezín, road to the village (Staněk in Podpěra 1930). – Kobyly, the Kobylské jezero lake (Tkany 1834 BRNU). – Podivín, field 0.5 km from the railway station to the Rakvice village (Řepka 1981 BRNM). – Velké Bílovice (J. Šmarda 1921 BRNU). – Velké Bílovice, ditches toward to the Hradištko village (Podpěra 1921 BRNU, PRC; J. Šmarda 1921 PRC, PR). – Sedlec (J. Šmarda 1950 BRNM). – Sedlec, abandoned site 0.3 km east-south-east from the church in the village (Ducháček 2002 PR). – Sedlec, the Nesyt Pond coast (Wildt 1914 BRNM; Zimmermann 1914 BRNU; Fröhlich 1924, 1957 BRNU; Zapletálek 1930 BRNU; Duda 1948 BRNU; Smejkal 1948 BRNU; J. Dvořák 1959 BRNM; M. Deyl 1960 PR). – Sedlec, the U černých borovic Creek (Daníhelka *et al.* 1995). – Valtice, the Nesyt Pond coast (Podpěra 1921 BRNU; Řepka 1981 BRNM). – Hlohovec, the Výtopa Pond (Daníhelka 1994 MMI, 2004 BRNU; Daníhelka *et al.* 1995). – Hlohovec (Zapletálek 1938 BRNU; Husák 1971 PR). – Hlohovec, 1 km northwest from the village (Vicherek 1969 BRNU). – Lednice, the Nesyt Pond coast (J. Šmarda 1950 BRNM). – Lednice, the Hlohovecký rybník Pond (M. Deyl 1957 PR). – Lednice, meadow conduit near the road from the Hraniční zámek Castle to the Nesyt Pond (Soják 1957 PR). – Lednice (Zimmermann 1910 BRNU, PRC, PR). – Lednice – Charvátská Nová Ves (M. Deyl 1962 PR). – Hrušky, near the village (J. Šmarda 1960 BRNU). – Hrušky, marsh near a train 0.3 km from the railway station Hrušky zastávka (Řepka 1981 BRNM). – Břeclav, the Františkův rybník Pond 2.3 km south from the Boří les railway station (Daníhelka *et al.* 1995). **18b.** Uherské Hradiště (Schlögl in Podpěra 1930). – Kostelany nad Moravou, ditch in a forest 1.2 km east from the village (Řepka 1987 BRNM). – Kunovice, meadows west from the LET factory (Grulich 1989). – Vacenovice, fallow (J. Šmarda 1946 BRNM).

19. Radějov, near Žerotín site (Staněk 1942 in Staněk *et al.* 1996). – Radějov, Horní mlýn site (Podpěra 1930). – Radějov, the Lučina water reservoir (Rydlo 1995, 1999 ROZ; Vašut 1998 OL). – Radějov, the Járkovec basin (Staněk 1924 in Staněk *et al.* 1996; Jedlička 1946 BRNU; J. Šmarda 1946 BRNM; Soják 1955 PR). – Radějov, Čertoryje site (Staněk 1925 in Staněk *et al.* 1996). – Radějov, Vojšice site (Habrovcová et Krist 1929 BRNU, PRC; Podpěra 1938 BRNU). – Kněždub, groove neat the village (Weber s.a. PR). – Kněždub, road south-south-east of the village (Podpěra 1927 BRNU). – Kněždub, Výzkum Hill (Staněk 1925, 1939 in Staněk *et al.* 1996; J. Dostál 1950 PRC). – Malá Vrbka, toward to the Vojšice village (Staněk 1925 in Staněk *et al.* 1996). – Lipov, Hájová Hill (Weber s. a. PR). – Lipov, north slope od elevation point 354 m (Vicherek 1963 BRNU). – Velká nad Veličkou (Staněk 1925 in Staněk *et al.* 1996). – Velká nad Veličkou, foothill of Háj Hill (Staněk 1924 BRNU). – Velká nad Veličkou – Blatnička (Podpěra 1930). – Blatnice, ditch near the road to Kobylí hlava (J. Šmarda 1953 BRNM). – Blatnička, Jasenová Hill (Staněk 1942 in Staněk *et al.* 1996; Weber s.a. PR). – Boršice (Staněk 1924, 1926, 1942 in Staněk *et al.* 1996). – Hluk, swamp near Kobylí hlava site (Čouka in Podpěra 1930). – Hluk (Sigmond 1928 PRC). – Hluk, Babí hory site (Rohrer s.a. PRC). – Vlčnov, Vlčnovský háj site (Staněk 1926 in Staněk *et al.* 1996). – Vlčnov, Černá hora site (Staněk 1926 in Staněk *et al.* 1996). – Uherský Brod-Havřice, on cart-road in south slope of small hill east from the village (Moravec 1948 PR). – Uherský Brod, Černé pole site (Staněk 1927 in Staněk *et al.* 1996). – Uherský Brod, cart-road in forrest near the Králov Hill (Moravec 1948 PR). – Újezdec u Luhačovic (Podpěra 1930). – Újezdec, Rajičko site (Staněk 1924 in Staněk *et al.* 1996). – Boršice – Slavkov (Staněk 1942 in Staněk *et al.* 1996). – Slavkov, meadows to Vápenky site (Staněk 1924 BRNU). – Horní Němčí, in the village (Staněk 1924, 1925, 1926 in Staněk *et al.* 1996). – Horní Němčí, Bursíkova louka Meadow near Malá obec site (Staněk 1942 in Staněk *et al.* 1996). – Horní Němčí, Drahy site (Staněk 1942 in Staněk *et al.* 1996; Staněk s.a. BRNM; M. Hájek 1995 herb.). – Nivnice (Staněk in Podpěra 1930). – Nivnice, Králov site (Staněk 1939, 1942 in Staněk *et al.* 1996). – Nivnice, lower edge of Králov site (Staněk 1925 in Staněk *et al.* 1996). – Nivnice, the Křib Hill (Staněk 1942 in Staněk *et al.* 1996; Staněk 1942 BRNM). – Nivnice, Čupy site (Staněk 1926 in Staněk *et al.* 1996). – Nivnice, Čupy site near chapel (Staněk 1942 in Staněk *et al.* 1996). – Nivnice, Lipiny site (Staněk 1924 BRNU; Staněk 1925, 1926, 1927 in Staněk *et al.* 1996; Pospíšil 1955 BRNM). – Korytná, pod Lipinami site (Staněk 1925 in Staněk *et al.* 1996). – Korytná (Staněk 1950 in Staněk *et al.* 1996). – Korytná, road to the Kadlečková forest (Staněk 1924 BRNU). – Korytná, ditches near the village (Skřivánek 1956 BRNM). – Korytná, Vaďůvky site (Staněk 1925 BRNU). – Korytná, ditch from the village to Nivnice (Černoch 1956 BRNM). – Suchá Loz, Volenov (Staněk 1924, 1925 in Staněk *et al.* 1996). – Suchá Loz (Staněk 1924 in Staněk *et al.* 1996). – Suchá Loz, Cuzeniska (Staněk 1925 in Staněk *et al.* 1996). – Suchá Loz, Dubina site (Staněk 1926 in Staněk *et al.* 1996). – Suchá Loz, ditch in pasture near Lopenický les Forest south from the Ordějov farmstead (Moravec 1948 PR). – Bánov, Ordějov farmstead (Staněk 1925, 1926 in Staněk *et al.* 1996). – Bánov – Šumice (Staněk 1924 in Staněk *et al.* 1996). – Šumice, 3 km north from the village in the Rudický potok Basin (Smejkal 1973 BRNU). – Bystřice pod Lopeníkem – Suchá Loz (Staněk 1924 in Staněk *et al.* 1996). – Bystřice pod Lopeníkem (Skřivánek 1911 BRNM, BRNU). **20a.** Slavkov, Obora site (Formánek 1880 BRNU; s. a. BRNM). – Němčany u Slavkova (Vítek 1913 BRNM). – Křižanovice (Vítek 1912 BRNM). – Dražovice, salt habitat near the village (Skřivánek 1942 KHMS; PRC, PR). – Letonice, meadow near Větrníky site (Picbauer 1921 BRNU; Krist 1940 BRNU; Dostál 1942 PRC; Lang 1942 CB, VYM; Šourek 1943 PRC, PR; Skřivánek 1940, 1942, 1962 BRNM, 1962 VYM; J. Dvořák 1962 kart.; Soják 1962 PR). – Letonice (Skřivánek 1940 CB). – Letonice, forest edge west from Šévy site (Kurka 1976 CB). – Letonice – Bučovice (Podpěra 1940 BRNU). – Bučovice (Skřivánek 1940 BRNM). – Brankovice, road edge 2 km south-west from the village (Ducháčková 1987 muz. Jičín; Grulich 1989). – Střilky, pasture 0.8 km south-west from the village (Pluhař 1986 BRNU, OL; Grulich 1989). – Střilky, east edge of the vilage (Pluhař 1990 OL). **20b.** Sokolnice, small meadow near fish pond between road Brno-Tuřany-Telnice and railway (J. Dvořák 1959 kart.). – Sokolnice, salt habitat (Skřivánek 1914 BRNM; J. Bílý 1945 BRNM; Součková et J. Šmarda 1950 BRNM; J. Šmarda 1951 BRNM; J. Dvořák 1959 BRNM; Pospíšil 1962 BRNM). – Křenovice (Formánek s. a. BRNM). – Šaratice (Novotný 1942 BRNM). – Nesvačila (J. Šmarda 1950 BRNM). – Nesvačilka, pastures (Wildt 1907 BRNM). – Nikolčice (Makowsky in Podpěra 1930; Teuber 1898 BRNM). – Kurdějov, Holý vrch Hill (Hrabětová 1973 BRNU). – Klobouky u Brna (Steiger 1869 BRNU). – Krumvř (Staněk in Podpěra 1930). – Pouzdřany (Součková 1952 BRNM). – Popice, meadows near Popický háj (Vicherek 1960 BRNU). – Popice, railway station (Picbauer

1921 BRNU). – Popice, pastures (Součková 1952 BRNM). – Zaječí (Uechtritz in Podpěra 1930). – Bohuslavice u Kyjova, field edge 0.8 km west-south-west from the village (Řepka 1986 BRNM). **21b.** Olomouc, military shooting place near Lazce (Čouka 1907 BRNU). **78.** Radějov, Mandátské údolí Valley (Staněk 1925 in Staněk *et al.* 1996; Podpěra 1930). – Radějov, Kútky, 4.5 km south-east from the village (Grulich 1984 MMI). – Velká, western slope of the Háj Hill 2 km south-east from the church (Grulich *et al.* 2009 BRNU). – Velká nad Veličkou, road to Buchtarky u Suchova (Podpěra 1930 BRNU). – Velká nad Veličkou, u Horáků ravine (Béňa 1914 BRNU). – Suchov (Staněk in Podpěra 1930). – Javorník (Staněk 1923, 1924 in Staněk *et al.* 1996; J. Šmarda 1953 BRNM). – Javorník, Háj forest (Ressel 1973 VM). – Javorník, swamp in the foothill of Háj Hill (Ressel 1976 VM). – Javorník, pod Paličkami site (Staněk 1942 in Staněk *et al.* 1996). – Javorník, Paličky (Staněk 1925, 1942 in Staněk *et al.* 1996). – Javorník, Machová (Staněk 1924 in Staněk *et al.* 1996). – Suchov (Staněk 1924, 1925 in Staněk *et al.* 1996). – Suchov, Přední louky (Staněk 1924, 1925 in Staněk *et al.* 1996). – Vápenky (Staněk 1924, 1942 in Staněk *et al.* 1996; Otýpková 2002 pers. com.). – Vápenky, Kamenný potok basin 0.5 km south-east from the chapel in the village (Grulich *et al.* 2009 BRNU). – Horní Němčí, Díly pod Hájem (Staněk 1926 in Staněk *et al.* 1996). – Horní Němčí, Hornoněmčický háj (Staněk 1925 in Staněk *et al.* 1996). – Horní Němčí, between the village and Přední louky site (Staněk 1942 in Staněk *et al.* 1996). – Horní Němčí, between sites Lesná and Vápenky (Staněk 1925 in Staněk *et al.* 1996). – Horní Němčí, Kadlečková (Staněk 1924 in Staněk *et al.* 1996). – Korytná, ditch in south part of the village (Moravec 1948 PR; Staněk 1948 BRNM). – Korytná, road to Dubina site (Staněk in Podpěra 1930). – Korytná - Strání, Korytenská louka meadow (Staněk 1924, 1925 in Staněk *et al.* 1996). – Korytná, Havřicko (Staněk 1926 in Staněk *et al.* 1996). – Strání, towards to Horní Němčí (Staněk 1942 in Staněk *et al.* 1996). – Strání, Hrabina Forest 1.5 km south-south-east from the crossroad in the village (Staněk 1925, 1926 in Staněk *et al.* 1996; Hájek 1993 herb.). – Strání (Staněk in Podpěra 1930). – Strání, ravine near the church (Staněk 1922 BRNM). – Strání, Štrbáň site 0.7 km west from the village (Grulich 1985 MMI). – Květná (Podpěra 1930). – Lopeník (Skřivánek 1911 BRNM). – Biskupice, ditches (M. Deyl 1954 PR). – Slavičín (Staněk 1926 in Staněk *et al.* 1996). – Rokytnice (Staněk 1926, 1927 in Staněk *et al.* 1996). – Křekov (Staněk 1924 in Staněk *et al.* 1996). – Bohuslavice nad Vlárí (Staněk 1926, 1927 in Staněk *et al.* 1996). – Bohuslavice nad Vlárí, Vrchy site (Staněk 1926 in Staněk *et al.* 1996). – Jestřabí (Staněk 1926 in Staněk *et al.* 1996). – Popov, slope above the village (Dostál 1973 PR). – Bylnice, Lazy site 1 km south-south-west from the village (Staněk 1924 in Staněk *et al.* 1996; Grüll 1987 BRNU). – Bylnice, the Bylnička Valey (Staněk 1927 in Staněk *et al.* 1996). – Brumov, along the road to the Březová Hill (Sedláčková 1973 NJM). – Brumov, road 1.3 km east from the village (Chytrý 1990 BRNM). – Návojná (Staněk 1927 in Staněk *et al.* 1996). – Nedašov (Staněk 1926 in Staněk *et al.* 1996). – Valašské Klobouky (Faltys 1973 ROZ). – Valašské Klobouky, Sokol sports ground (Podpěra 1940 BRNU). **79.** Ludkovice, near the mill in small valley to the Březůvky (Staněk 1951 BRNM). – Vlachovice (Staněk 1926 in Staněk *et al.* 1996).

Appendix 2. List of localities of *Carex hordeistichos* in Slovakia

2. Zalaba, edge of a small swamp (Dvořák 1962 BRA). – Kiarov, northeast edge of the Kiarovský močiar Nature Reserve, rural road (Hrivnák *et al.* 2005). – Chrámec, in valley near the Kis farmstead south from the vilage (Hendrych 1968). – Chrámec, Močidlá; road west from the village (Hendrych 1968). – Gemerské Dechtáre [Kutas], south foothill of Dechtárske vinice Hill (Hendrych 1968). – Gemerské Dechtáre, Fušova dolina valley (Hendrych 1968). – Hodejovec, in valley south in the village (Hendrych 1968). – Gemerček, around the village (Hendrych 1968). – Svetlá (Hendrych 1968). – Hajnáčka railway station and Veľký kopec Hill, Gortva basin (Hendrych 1968). =? Hajnáčka, swamp near the Szarkó Hill (Vicherek 1965 BRNU). – Hajnáčka, near the village (Hendrych 1968). – Šurice, south-west from the village in Šurický potok basin (Hendrych 1968). – Šíd (Hendrych 1968). – Husiná, Kamenistá dolina valley (Hendrych 1968). – Veľké Dravce, in basin south from the Hôrka Hill [Kis hegy] (Hendrych 1968). – Biskupice, near the village (Hendrych 1968). – between villages of Biskupice and Fiľakovo, near railway (Hendrych 1968). – Fiľakovo, on roads south from the village (Hendrych 1968). – Fiľakovo (Hendrych 1968). – Mučín, in valley south-west of the village (Hendrych 1968). – Mikušovce, near the village (Holub & Moravec 1965). – Stará Bašta, wet meadows (Holub & Moravec 1965). – Kostolná Bašta, wet meadows (Holub & Moravec 1965). – Večelkov, wet meadows (Holub & Moravec 1965). – Ratka, wet meadows (Holub & Moravec 1965). – Lipovany, near the village (Holub & Moravec 1965). – between villages of Radzovce and Biskupice (Holub & Moravec 1965). – Blhovce, near the village (Holub & Moravec 1965). – Šťavica, near the village (Holub & Moravec 1965). – Chanava, spring near the road (Svobodová 1969 NI). – Včelince, swamp south of the village (Deyl 1975 OLM). – Vlkyňa, near roads south-west of the village (Hendrych 1968). – between villages of Vlkyňa and Janice, on cart-roads (Hendrych 1968). 3. Silická planina, moist places north-west from Borzová near road to Plešivec (Chrtek et Žertová 1956 PRC). 4. Vrádište, swamp (Holuby 1861 SLO). – Skalica, Rybník site (Knapp 1865: 20). – Skalica, pastures named Slanicko (Staněk 1947 BRNM). – Závod (Staněk 1947 BRNM). 6. Malý Šúr (Holuby 1914 BRA, PRC). – Chorvátsky Grob (Holuby 1910 PRC; Scheffer 1925 BP). – rarely on the road Pezinok – Chorvátsky Grob (Holuby 1910 PRC). – Modra (Zigmundík 1914 BRA). – Zemianska Olča (Weber 1931 BRA). – Tôň (Weber 1930 BRA). – Zlatná na Ostrove (Weber 1931 BRA). – Galanta, part Gáň, edge of salty swamp in the village (Dvořák 1961 BRA). – Močenok, Siky farmstead, salty sites in the lucerne field (Dítě 2006). = Trnovec nad Váhom, Szik farmstead (Weber 1935 BRA). – Tvrdošovce, fish pond in the village (Trávníček 1996; Eliáš jun., Dítě et Sádovský 2003 NI; Ekrt 2005 MZ). – Tvrdošovce, around the railway to Palárikovo (Manica 1960 ZV). – Zbehy (Knapp 1865: 20). – Nová Stráž, Pavel farmstead (Klokner 1972 PMK). – Hurbanovo, 117 m a. s. l. (Dostál 1966 PR). – Búč (Dvořák 1963 PR, 1975 OLM; Čvančara 1971 BRNU; Klokner 1976 PMK; Řepka 1982 BRNM; Eliáš jun., Dítě et Sádovský 2004 NI). – between villages of Búč a Kravany nad Dunajom (Čvančara 1971 PR). – Kravany nad Dunajom (Weber 1936 BRA). – Chotín (Mladý 1959 PRC). – Čenkov (Bertová 1968 BRA). – Obid (Weber 1930 BRA). – Štúrovo (Nábělek 1936 BRA). – Kamenný Most

(Feichtinger 1863, 1869 BP a 1899: 361). = Alsó rétek site (Krist 1936 BRNU). – Kamenín, the Kamenínske slanisko Nature Reserve (Svobodová 1971, Svobodová 1979 NI). **8.** Michaľany, swamp near railway (Dvořák 1960 BRA). = Michaľany, toward to Luhyňa, 130 m a. s. l. (Soják 1960 PR). **9.** Vrbovce, between Havran and Žalostiná (Staněk 1927 in Staněk *et al.* 1996). – Chvojnica, Kamenec site, the cart-road near elevation point 271 m a. s. l. (Devánová, Hájek et Perný 2010 ined.). – Chvojnica, pod Balážovcami site, road ditch (Devánová, Hájek et Perný 2010 ined.). – Chvojnica, Dolná Chvojnica, in moist cart-road edge (Devánová 1998 TMM). – Vrbovce, the Bučkova jama Nature Showplace (Devánová, Hájek et Perný 2010 ined.). – Vrbovce, south-east of the village towards to Moravia border (Staněk 1950 in Staněk *et al.* 1996). – Vrbovce, border of Moravia (Staněk 1950 in Staněk *et al.* 1996). – Vrbovce, Strana site (Staněk 1950 in Staněk *et al.* 1996). – Zemianske Podhradie (Holuby 1868 SLO; 1868, 1870, 1885, 1892, 1897 BRA; 1872, 1881 PRC; 1868, 1870, 1872, 1875, 1879, 1880, 1882 BP, 1881, 1882 PR; 1898 BRNU). – Bošáca, frequently (Holuby 1875, 1879, 1881 BP, 1875, 1876 PRC; 1887, 1892, 1896 BRA; 1898 PRC; Brancsik 1901 PRC). = Bošáca, gravel wetlands (Holuby 1989 PR). – Bošáca, Bošácke kopanice site, wet gravel road (Holuby 1868, 1896, 1881 PR; 1886 BRNU). – Nová Bošáca, Jastrabské site, cart-road (Feráková et Jongepier 1993 ined.). – Štvrtok (Holuby 1876 BRA; 1879, 1880 PRC). **12.** Jelenec (Knapp 1865: 20). **13.** Fačkovské sedlo saddleback, cca 1000 m a. s. l. (Skalický 1966 PR). – Uhrovské Podhradie, south-west from the willage (Hrouda in Ambros 1996). – Čičmany, Hanušová basin, 2.5 km south-west from the church (Grulich in Mertanová & Smatanová 2003). – Veľké Košecké Podhradie, meadows and swamps north and north-west from the Stupičie Hill (Prach in Mertanová & Smatanová 2003). – Zliechov, small springs and stream banks in the village (Koutecký in Mertanová & Smatanová 2003). – Bolešov, Bolešovská dolina valley, grassland and forest edges of the right bank of the Bolešovský potok stream, cca 1.9 – 3.2 km north-wast from the railway station (Lustyk in Mertanová & Smatanová 2003). – Strážov (Rochel s. a. BP ut *Carex secalina*). – Lietavská Lúčka, meadows near the railway station (Hallonová 1979). – Bánovce (Holuby 1888 sec. Futák 1947). – Podlužany (Holuby 1888 sec. Futák 1947). **14c.** Sliač (Heuffel 1861: 659). **14d.** Zvolen, near the Slatina River (Freyn 1924: 53). **15.** Hrušovo, wetland in livestock watering place east-south-east of the village (Kliment 1998; Kliment *et al.* 2000). – Hrušovo, Hlavina basin east from the village (Kliment 1998; Kliment *et al.* 2000). – Hrušovo, cart-road edges toward to quarry (Kliment *et al.* 2000). – Strelnice, Drienovský potok basin (Kliment 1976 SAV). – Krásnohorské Podhradie, near the mausoleum, 350 m a.s.l. (Dostál 1949 PRC). **21a.** Fačkov, neat the stream ca 1.3 km south from the village (Trávníček 1988 OL; Trávníček 1996). – Suchá dolina, small valley 100 m left from the mouth of the valley (Očka 2006 TM). – Suchá dolina, Dolinka left side, about 2100 m from the mouth of the valley Suchá near Jasenský Laz farmstead (Očka 2009). **21b.** Belá, near the stream in the Malá Bránica Valley (Trávníček 1987 OL; Trávníček 1996). **21c.** Banská Bystica, Laskomerská dolina Valley (Futák 1943: 21). – Veterné (Medovič 1979 sec. Kliment *et al.* 2008). – Liptovská Osada, south-west of the village (Kliment *et al.* 2008). – Dedošová dolina Valley, Drobkov site, the stream below the road (Kliment *et al.* 2008). – Blatnica, Gaderská dolina Valley (Kliment *et al.* 2008). – Necpaly, Necpalská dolina Valley (Škovirová 1987 TM). – Belá-Dulice, wetland at the beginning of Belianska dolina Valley (Dvořák 1951 BRA). – Belianska dolina Valley, at the beginning of the valley near stream (Dvořák & Krejčí 1953 sec. Kliment *et al.* 2008). – Turčianske Jaseno, the Jasenská dolina Valley, mrsh near the stream (Medovič 1979 sec. Kliment *et al.* 2008). – Sklabiňa, cart-road on field edges north-east fot the village (Dítě 2008 NI). – Sklabinský Podzámok, the Podzámocká dolina Valley (Kliment *et al.* 2008). – Podhradie near the Martin Town (Hruby 1931 BRNU). **21d.** Stankovany, edge of calc tuffš (Dvořák 1958 BRA). –

Ružomberok, mire at the eastern foot of the Čebrať Hill (Deyl et Trávníček 1989 OL; Trávníček 1996). – Likavka, marshed meadows below the Čebrať Hill (Deyl 1989 OLM). – Turícka dolina, the road in a valley about 500 m to water reservoir (Dítě 2008 NI). – Turícka dolina, the forest road in a valley above the water reservoir (Dítě 2009 NI). – Kalameny, mouth of the Kalamenská dolina Valley (Dítě 2009 NI). – Kalameny, cart-road to the Liptovský hrad Castle (Dítě 2009 NI). – Sestrč, the Sestrčská dolina Valley (Watzka 1997). – Bukovina, left side of the Sestrč stream south-south-east of the village (Watzka 1997). – Liptovská Anna, spring south of the Pravnáč Hill west of the village (Watzka 1997). – Prosiek, the Prosiecka dolina Valley (Šmarda 1965). **22.** Závažná Poruba, Opalisko site (Unar 1971 BRNU). – Jánska dolina, fens, 700 m a. s. l. (Sillinger 1931 PRC). **25.** Horná Štubňa (Fábry 1876 BRA). – Dolná Štubňa (Margittai 1916 BP). – Háj, cart-road ca 1.3 km west-north-west of the village (Bernátová *et al.* 2006). = between municipalities Háj and Rakša (Margittai 1912 BP ut *C. secalina*). – Háj (Margittai 1911 PRC, 1913 BP ut *C. secalina*; Margittai 1915 sec. Bernátová *et al.* 2006). – Rakša, the Hrádky Valley (Margittai 1914 BP ut *C. secalina*). – Turčianske Teplice, before the bridge from Martin (Medovič 1977 BRA). – between villages of Mošovce – Blatnica (Wagner 1901 sec. Bernátová *et al.* 2006). – Blatnica (Borbás 1892 BP). – Blatnica, „pod Bôrinami“ site west of the village near the Blatnický potok stream (Škovirová 1986 TM). – Sebeslavce, near the SNP road (Medovič 1976 BRA; Medovič 1979; Škovirová 1987; Bernátová *et al.* 2006). – Ondrašová – Hôrky, towards Polerieka (Škovirová 1983 TM). – Ondrašová, near the Bysterec stream (Škovirová 1987: 214). – Polerieka, cart-road near the cemetery (Bernátová 2006 TM; Bernátová *et al.* 2006: 64). – Karlová (Medovič 1976 BRA; Bernátová *et al.* 2006). – Valentová, cart-road ca 800 m southeast of the village (Bernátová *et al.* 2006). – Ďanová, the right side of the stream near the old mill (Bernátová & Kučera 2005; Bernátová *et al.* 2006). – Ležiachov, cart-road south-west of the village (Bernátová *et al.* 2006). – Necpaly, south of the village (Škovirová 1987). – Kláštor pod Znievom, Peciny site northern for the village (Očka 2009). – Príbovce, right bank of the Blatnický potok stream (Škovirová 1991 TM). – Horné Jaseno, cart-road (Bernátová 2008 BBZ). – Koštany nad Turcom, the right bank of the Turciec River (Škovirová 2000 TM; Škovirová 2003). – Turčianska Štiavnička, Hlinovisko site and za Lučinou site (Medovič 1977 BRA). – Turčianska Štiavnička, below the cementary (Očka 2005 TM; Očka 2009). – Sučany, pastures (Medovič 1976 BRA; Medovič 1979). – Vrútky, near the road to Martin (Medovič 1976 BRA; Medovič 1979). – Turčianske Kľačany, Biele brehy site easter from the village (Škovirová 1979 TM; Škovirová 1987). **26a.** Lisková, bank of the stream between meadows western from Štál Hill (Dítě 2004). – Lúčky, spa (Šmarda 1965). – Ivachnová, under the Bežan Hill near the cart-road (Magic et Májovský 1973 SLO). – Bešeňová, the Bešeňovské travertíny Nature Showplace, Kaplnka site (Futák 1951 ined.; Hájek 1999; Dítě *et al.* 2004). – Potok, road edge south of the village near crossroad to Liptovské Vlchy (Dítě 2008). – Prosiek, Jarka banks in flowing pasture about 350 m before entering the Prosiecka Valley (Dítě 2009 NI). – Beňušovce, cart-road in the southern margin of the village (Dítě 2009 ined.). – Bodice (Michiarová 1965 BRA; Urvichiarová 1966 BRA). – Jalovec, 700-800 m a. s. l. (Suza 1938 BRNU). – Liptovský Ján, the Ďumbier Hut (Hrabětová 1958 BRNU). – Východná (Rybníček 1979 CDF database). **26b.** Spišská Belá, the Belianske lúky site (Rybníček 1979 CDF database). – Hrabušice, near the Hornád River (Soják 1958 PR). – Hrabušice, wet meadow in Podlesok site (Šmarda 1965). – Švábovce (Smejkal 1964 BRNU). – Švábovce, eroded cart-road (Šmarda 1961). – Švábovce, mine colony II (Neuhäuslová-Novotná & Neuhäusl 1969). – Švábovce, an alluvium in north-east from the mine colony I (Neuhäuslová-Novotná & Neuhäusl 1969). – Spišský Štiavnik, near the railway station (Šmarda 1961). – Spišský Štiavnik, south-west from the railway station (Neuhäuslová-Novotná & Neuhäusl 1969). – Primovce,

the Spasiháj Hill (Nyárády 1911 BRNU, PR). **27a.** Skalka nad Váhom (Holuby 1861 BRA). **27b.** Papradno (Dvořák 1953 BRA). **28.** Zázrivá, near stream (Schwartzová 1979 SLO). – Trstená (Doležal 1927 BRNU). – Podbiel, banks of the Studený potok Stream toward Oravský Biely Potok, 600 m a. s. l. (Chrtek et Křísa 1971 PRC).

Questionable data: 21b. the Fatranský Kriváň Hill (Trapl 1924 PRC).

General data: the Záhorská nížina Lowland, salt habitats (Novák 1954). – Bošácka dolina Valey, stream gravel (Holuby 1878 PR). – the Trenčianska župa County (Rochel s. a. BP).