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Occurrence of *Camphorosma annua* PALL. in Slovakia: past and present

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Abstract

Historical and current occurrence of obligate halophyte *Camphorosma annua* was studied in Slovakia during 2005-2008. The species occurred only in the Danube Lowland; 38 localities were found in total. Due to intensive land reclamation of saline habitats the species is near extinction in Slovakia presently, only eight sites has been confirmed since 2000. The results of study showed that the species belongs to group of the most endangered plants of Slovak flora.

Összefoglaló: A *Camphorosma annua* PALL. előfordulása Szlovákiában

A tanulmány az obligát halofiton *Camphorosma annua* múltbéli és aktuális előfordulási viszonyait dolgozza fel Szlovákia területén, 2005-2008 között végzett kutatások alapján. A faj csak a Kisalföld területén található meg, ahol összesen 38 lokalitásról jelezték. A szikes élőhelyek felgyorsuló átalakítása miatt a faj Szlovákiában kipusztulással veszélyeztetett, 2000 óta mindössze 8 egykori lelőhelyén erősítették meg előfordulását.

Introduction

Genus *Camphorosma* (Chenopodiaceae) has included 10 species of annual and perennial herbs or sub-shrubs. Most of the *Camphorosma* species occupy Asian range of the genus, only *Camphorosma annua* PALL. and *Camphorosma monspeliaca* L. have occurred in Europe (AELLEN 1979). The first mentioned taxon is exclusively known from Slovakia (MARHOLD – HINDÁK 1998).

C. annua belongs to the group of vanishing obligate halophytic plants in Central Europe. This species is endemic for Pontic-pannonian region. It occurs from Austria, Hungary and countries of former Yugoslavia (Croatia, Serbia, and Macedonia) to Ukraine, Romania and Bulgaria (BALL – AKEROYD 1964, AELLEN 1979). In Slovakia *C. annua* occurs only in the Danube Lowland and it is considered as a phytogeographically important species and border element of the Slovak flora (MAGLOCKÝ 1999). It was included in the Red lists of endangered taxa in Austria and Slovakia (NIKLFIELD – SCHRATT-EHRENDORFER 1999, FERÁKOVÁ et al. 2001).

The species is widespread especially in Hungary where the main part of Pannonia occurs and where alkali habitats cover nearly 400.000 ha (MOLNÁR – BORHIDI 2003). In the Duna-Tisza köze region ca 3000 ha of salt bare spots vegetation was estimated

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(MOLNÁR – VAJDA 2000). *C. annua* was found also in SE and E Hungary (SOÓ 1929, 1964). Due to this wide distribution the species was not included to the actual Red list of vascular flora of Hungary (KIRÁLY 2007).

C. annua is scattered or rare in other parts of central and south-eastern Europe. In Austria it is distributed only at suitable habitats around the Neusiedler See (FISCHER et al. 2005). According to TOPIČ et al. (2006) current distribution of *C. annua* in Croatia is not known exactly; well-known is only single locality near the town of Vukovar (E Croatia). Similar situation is in Macedonia. MIČEVSKI (1965) mentioned only two localities in the eastern part of the country. Occurrence of the species in Serbia is also very scattered. It was found only in the Banat and Bačka regions (SLAVNIĆ 1948, KNEŽEVIĆ 1994). Similarly, scattered distribution of the species is known from Romania. POPESCU (2005) pointed out its recent occurrence only from two districts in E part of the country (Muntenia and Moldova).

The species prefer especially solonetz soils and occupy mainly salt pans (called in Slovakia “salt eyes”, in Hungary “blind szik”) with highest salinity where the vegetation cover is sparse and species poor (WENDELBERGER 1943, 1950, KRIPPELOVÁ 1965). Those stands are considered as those of the most extreme habitats for existence of vegetation cover in lowland conditions. Presently, the most of still existing “salt eyes” are degraded in Slovakia. The change of water regime caused the decrease of soil salinity. Lower soil salinity allowed colonisation of other species that do not tolerate high soil salinity typical for salt pans. *C. annua* was mainly replaced by *Artemisia santonicum* subsp. *patens* and *Festuca pseudovina* (DITĚ et al. 2008). These two perennial species are more successful in the process of long term colonisation of new site as the annual, *C. annua*.

C. annua participates as a dominant or subdominant species in several plant communities, but only *Camphorosmetum annuae* RAPAICS ex SOÓ 1933 occurs in Slovakia (VICHEREK 1973, VALACHOVIČ 2002). Historical and recent occurrence of the community in Slovakia as well as some remarks to syn-ecology of *C. annua* was published by DITĚ et al. (2008).

Detail historical and recent distribution of *Camphorosma annua* in Slovakia is still not known. Therefore, the paper is aimed to fill up this whitespace in Slovak botany.

Material and Methods

The study was carried out during the years 2005-2008 in the Danube Lowland. The data concerning the distribution of the species was achieved from herbariums BP, BRA, BRNU, BRNM, KO, LTM, MMI, MP, MZ, NI, OLM, OSM, PMK, PR, PRC, SAV, SLO and ZV. Herbarium abbreviations are according to HOLMGREN et al. (1990) and VOZÁROVÁ – SUTORÝ (2001). Nomenclature of flowering plants follows MARHOLD – HINDÁK (1998). Result of this study is presented on the point map. The maps were designed by program ArcGIC, version 9.2. Coordinates of historical localities were taken from Google Earth. Coordinates of recent localities were obtained during field research using GPS equipment Garmin CS 60; the numbers of grid squares follow one that was described by NIKLFELD (1971).

The abbreviations of works published before 1956 cited follows FUTÁK – DOMIN (1960). Phytogeographical divisions of FUTÁK (1980) are used.

Results

Camphorosma annua occurred in 38 localities in Slovakia before 1975 (Tab. 1., Fig. 1). Three main areas of the species distribution existed: area among the towns of Nitra and Nové Zámky, area among the village of Tôň and the settlement of Iža and area north of Štúrovo among villages of Nána and Biňa. Subsequently, the number of localities decreased year by year due to intensive land reclamation (drain away, ploughing, and afforestation) in seventies of 20th century. So that 15 localities were documented in period of 1975-2000. Recently, the species have been found on eight sites only. We point out short description of those still existing populations:

Veľké Kosihy, Mostová Nature Reserve [8273/2]: the species was persisting only in three small salt pans in NE part of area. Whereas relative dense cover of *C. annua* was recorded here between years 2003-2006 (total area ca 6 m²), in 2008 approximately 200-300 individuals of the species have been found only in one salt pan (area up to 2 m²).

Močenok, Siky farmstead [7773/4]: three separate micro-populations were confirmed during field research in 2008, all covered salt pans areas. The first one was situated on saline pasture near residential building. Despite the fact that more relatively well-preserved salt pans occurred here, the species was found only in single of them. Population included ca 100-200 individuals (total area ca 0.5 m²). The reason why *C. annua* was not very abundant was intensive sheep grazing. The second micro-population was located in small degraded salt pan approximately 1 km SW from the farmstead and it included ca 500 individuals covering area circa 2 m². The third one was the largest; it was situated ca 1.4 km SW from the farmstead and covered area about 10 m² (markedly degraded salt pan).

Tvrdošovce, salt pastures NW from the village [7974/1]: a few hundred of *C. annua* individuals were growing on two micro-sites in SE part of this area. The first one was the rest of degraded salt pan very close to private fields (area ca 3 m²), the micro-population included a few hundred individuals and the main threat represented ploughing up. The second one was vegetation of the species on the margin of rural road and adjacent degraded salt pan.

Tvrdošovce, the Ráczove jazierko pool [7974/1]: only several individuals have been found in dense vegetation of *Festucion pseudovinae* SOÓ 1933 in NE part of the locality in 2008, the area was not bigger then 1 m². Surviving of *C. annua* here will be depending on rate of succession.

Šurany, Okomán farmstead [7975/1]: several ten of *C. annua* individuals occupied margin of rural road in W part of the area in 2004 (rutted salt pan), but no plants have been found in 2008. Therefore, occurrence of the species depends on favourable year and habitat condition (existence of open sites).

Iža, the Bokrošské slanisko Nature Reserve [8275/2]: the second largest population in Slovakia; three secondary salt pans established by removing of vegetation cover and soil mining were found in 2007 in W part of the reserve in front of fence of rubbish

heap built in nineties of last century. We estimate the total area circa 15 m². Must be mentioned, that at least one other salt pan with *Camphorosma annua* was in the area of this rubbish heap too, but it was destroyed in 2008.

Kamenín, the Kamenínske slanisko Nature Reserve [8177/2]: the largest population of the species in Slovakia, a few thousand of individuals occupied not more than ten more or less degraded salt pans in NW part of the reserve including total area circa 35-45 m².

Kamenný Most, the Čistiny Nature Reserve [8177/2]: two local populations of *C. annua* have been found. The first one was situated in SW part of the reserve; the species covered ca 15 m² of degraded salt pan. The second was in rutted bare spot in SE part of the reserve. A few ten individuals covered the area of approximately 3 m² in 2008.

Three doubtful sites were found too. Presence of the species on those sites is improbable, because no suitable habitat occurs there. We supposed that all data mentioned above has arisen by herbarium labels change. Very sporadically we found determination mistakes, where *Camphorosma annua* exchanged for *Bassia laniflora*.

Tab. 1. List of historical and present localities of *Camphorosma annua* PALL. in Slovakia (localities were arranged in direction west-east)

1. táblázat. A *Camphorosma annua* PALL. szlovákiai lelőhelyei (az adatok felsorolása nyugatról kelet felé történik)

Distr. 6., Danube Lowland:

- Tõň, saline pastures SE from the village (MÁJOVSKÝ 1951 SLO).
- Zemianska Olča, E (ŠMARDÁ 1952; VICHÉREK 1973).
- Veľké Kosihy, W (MÁJOVSKÝ 1963 SLO).
- Veľké Kosihy, the Mostová Nature Reserve (SVOBODOVÁ – ŘEHOŘEK 1992; GRULICH 1986 MMI; ELIÁŠ jun. 2003 NI; ZLINSKÁ 2003; DÍTĚ et al. 2008).
- Veľké Kosihy, saline site near railway station (ZÁBORSKÝ 1962 SLO; MÁJOVSKÝ 1963 SLO). = Okoličná na Ostrove, S from the railway station (KRIST 1940; ŠMARDÁ 1951 BRNM; ŠMARDÁ 1952; VICHÉREK 1973).
- Zlatná na Ostrove (VALENTA 1936 BRA, PRC; WEBER 1936 PR; SKŘIVÁNEK 1950 BRA).
- Zlatná na Ostrove, saline site around the Pavel farmstead (VALENTA 1936 BRA; KRIST 1936 BRNU; KRIST 1940; ŠOUREK 1950 PR; ŠMARDÁ 1952; KRIPPELOVÁ 1965; KRIPPELOVÁ 1967; VICHÉREK 1973).
- Komárno, part Hadovce (WEBER 1936 PR).
- Komárno, part Nová Stráž (FUTÁK 1949 SLO; SKŘIVÁNEK 1950 BRA).
- Komárno W (KRIST 1936 BRNU; KRIST 1940; KRIPPELOVÁ 1965, 1967).
- Komárno, railway station (WEBER 1932 PR; KRIST 1938 BRNU; KRIPPEL 1951 SLO, ŠMARDÁ 1952 BRNM; HEJNÝ 1953 PR; KLOKNER 1955 SLO; KRIPPELOVÁ 1965).
- Hájske, S and SW from the village (SCHEFFER 1924 BP, BRA, SLO; VALENTA 1937 BRA; KRIST 1936 BRNU, 1937 BRNU; KRIST 1940; ŠMARDÁ 1952; VICHÉREK 1973; GRULICH 1988 MMI).
- Hájske, Mešterik farmstead (WEBER 1970 PR).
- Šaľa, N from the town (HAJDÚK 1971 BRA – the site is probably identical with the next one).
- Močenok, Siky farmstead (VLACH 1935 BRNM, PRC; WEBER 1936 PR, 1970 PR; KRIST 1936 BRNU, 1937 BRNU; KRIST 1940; ŠOUREK 1950 PR; SVOBODOVÁ 1992; SVOBODOVÁ – ŘEHOŘEK 1992; MATUŠINCOVÁ – ČERNUŠÁKOVÁ 2005; ELIÁŠ jun. 2008 NI).
- Veľká Dolina, Bačala farmstead (WEBER 1932 PR, 1936 BRA; KRIST 1940).

- Velká Dolina, Čierny Vřšok site (OSVAČILOVÁ 1953 NI, 1955 NI; DOSTÁL 1955 PRC; GRULICH 1988 MMI). = Dolný Jatov, Čierny Vřšok farmstead (DOSTÁL 1953 PR, 1955 PR).
- Horný Jatov (KRIST 1936 BRNU).
- Jatov (KNAPP 1865; KRIST 1936 BRNU; FUTÁK 1949 ined.; GRULICH 1988 MMI).
- Tvrdošovce, pastures NW from the village (KNAPP 1865; SCHEFFER 1929 BP; WEBER 1936 PR; VALENTA 1936 BRA; POSPÍŠIL 1952 BRNM; HLAVAČEK 1957 SAV; MANICA 1960 ZV; HEJKAL 1984 MMI; GRULICH 1986 MMI, 1987 MMI, 1988 MMI; VOZÁROVÁ 1994 BRA; ELIÁŠ jun., DÍTĚ et SÁDOVSKÝ 2003 NI; DUCHÁČEK 2007 PR).
- Tvrdošovce, near railway station (KRIST 1936 BRNU; PLUHAŘ 1986 BRNU).
- Tvrdošovce, the Ráczoze jazierko pool (GRULICH 1985 MMI; SVOBODOVÁ – ŘEHOŘEK 1992; VALACHOVIČ 1995; SÁDOVSKÝ et al. 2004a).
- Tvrdošovce, S from the village (WEBER 1936 PR; ŠMARDA 1952; VICHEREK 1973).
- Palárikovo, saline site near the railway station (WEBER 1932 PR; MICHALCO 1951 SLO; ŠMARDA 1952; GREBENŠČIKOV 1954 SAV; FUTÁK 1951 ined.; MANICA 1960 ZV; VICHEREK 1973).
- Palárikovo, ca 1 km SW from the railway station (JIRÁSEK 1936 KO, PRC; KRIST 1940; HEJNÝ 1953 PR, ŠOUREK 1954 PR; FUTÁK 1949 SLO; GRULICH 1988 MMI).
- Palárikovo, Velké Čiky farmstead (WEBER 1932 PR; SMEJKAL 1965 BRNU; UNAR 1965 BRNU).
- Palárikovo, Malé Čiky farmstead (KRIST 1936 BRNU; WEBER 1970 PR, 1971 PR; JASENÁK 1974 LTM; GRULICH 1988 MMI). =? Palárikovo, Malé Pisky farmstead (WEBER 1935 PR).
- Palárikovo, E, Jur farmstead (FUTÁK 1949 SLO).
- Šurany, Okomáň farmstead (FUTÁK 1949 ined.; WEBER 1971 PR; GRULICH 1986 MMI, 1987 MMI, 1988 MMI; SÁDOVSKÝ et al. 2004a). = Šurany, 4 km W from the village (ŠMARDA 1952; VICHEREK 1973).
- Šurany, Čiastka gamekeeper's house (KRIST 1937 BRNU; KRIST 1940; KLOKNER 1955 SLO; WEBER 1970 PR; GRULICH 1988 MMI).
- Rastislavice, E (KLIKA – VLACH 1937; VICHEREK 1973). = Komjatice, Ružový dvor farmstead (VLACH 1934 NI, PRC, 1935 PRC; KRIST 1940).
- Komjatice, E (KLIKA – VLACH 1937; VICHEREK 1973).
- Iža, near Patkányos farmstead (FUTÁK 1949 ined.) = Iža, the Bokrošské slanisko Nature Reserve (KLOKNER 1955 SLO, 1958 PMK and 1985; VALENTA 1958 BRA, ZLÍNSKA 2005; DUCHÁČEK 2005 PR; ELIÁŠ jun., DÍTĚ et SÁDOVSKÝ 2006 NI). = Patince, salt pastures Páthpuszta (DOSTÁL 1968 PR).
- Bíňa, salt meadows (DOMIN 1933v: 246).
- Kamenín, site Álsó rétek = Kamenín, S = the Kamenínske slanisko Nature Reserve (BOROS 1917 BP; KRIST 1935 BP, BRNM, MP, MZ, NI, PR, PRC, SLO, ZV, 1936 BRNU; DOMIN et JIRÁSEK 1936 KO, PRC; NÁBĚLEK 1936 BRA; KLIKA – VLACH 1937; JÁVORKA 1939 BP; WEBER 1939 OSM; KRIST 1940; DVOŘÁK 1947 BRNM, BRNU; DOSTÁL 1947 PR; ŠMARDA 1947 PR; FUTÁK 1948 SLO; SKŘIVÁNEK 1948 BRA; ŠMARDA 1949 BRNM; HRDLÍČKA 1950 BRNU; HRABĚTOVÁ 1950 BRNU; KOMÁREK 1950 MZ, ČERNOCH 1951 BRNM; ŠMARDA 1952; ŠVEC 1953 LTM; MÁJOVSKÝ 1954 SLO, 1965 SLO; ŠOUREK 1954 PR; OSVAČILOVÁ 1955 NI; HOSTIČKA et ZELENÝ 1958 PRC, ZÁBORSKÝ 1957 SLO; SPUDILOVÁ 1958 PRC; POSPÍŠIL 1966 BRNM; SCHWARZOVÁ 1966 SLO; KUČERA et al. 1968 PR; SVOBODOVÁ 1968 NI; ČVANČARA 1971 BRNU; JASENÁK 1974 LTM; ŠTYS 1975; DVOŘÁK 1976 BRNU; DEYL 1977 OLM, GRULICH 1985 MMI; SVOBODOVÁ – ŘEHOŘEK 1985; KOCHJAROVÁ 1987 SLO; DAVID 1996; ELIÁŠ jun. 2001 NI; DÍTĚ et al. 2008).
- Kamenný Most, the Čistiny Nature Reserve, N part of Irtoványi rétek site (WEBER 1935 PR; ŠOUREK 1950 PR; ČERNOCH 1951 PRC; OSVAČILOVÁ 1955 NI; SMEJKAL 1959 BRNU; VICHEREK 1973; GRULICH 1987 MMI; SVOBODOVÁ et ŘEHOŘEK 1988; SÁDOVSKÝ et al. 2004a; ELIÁŠ jun. 2008 NI; DÍTĚ et al. 2008).
- Kamenný Most, N margin of the village, S part of Irtoványi rétek site (WEBER et KRIST 1935 BRNU; KRIST 1940; ŠOUREK 1954 PR; SMEJKAL 1959 BRNU).

- Kamenný Most (FEICHTINGER 1848 BP, 1853 BP, 1862 PRC; 1871 BP and 1898: 230; BOROS 1917 BP; JÁVORKA 1939 BP; WEBER 1934 PR, PRC; 1935 PR; WEBER et WEBEROVÁ 1936 PRC; DOSTÁL 1968 PR).
- Nána (DOMIN 1933v: 247).

Doubtful data (not mapped):

Distr. 1., Burda Mts.:

- Kamenica nad Hronom, Kováčovské kopce hills (NÁBĚLEK 1942 SAV).

Distr. 5., Devínska kobyła Mts.:

- Devínska Nová Ves (PTAČOVSKÝ 1923 SAV).

Distr. 6., Danube Lowland:

- Hurbanovo (MENCL 1951 PRC).

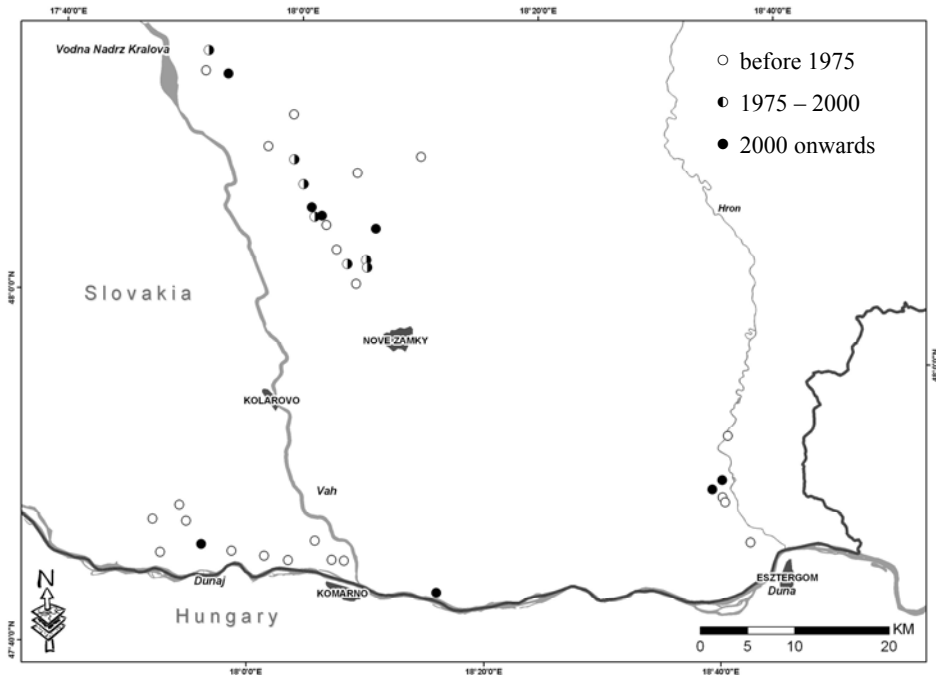


Fig. 1. Distribution of *Camphorosma annua* PALL. in Slovakia (original).

1. ábra. A *Camphorosma annua* PALL. előfordulása Szlovákiában (eredeti).

Discussion

Only some particular and/or inaccuracy data of historical and current distribution of the species has been published in Slovakia. Occurrence of the species was firstly documented by FEICHTINGER (herbarium voucher from 1848 and 1851 deposited in BP, see above) and KNAPP (1865) respectively. KRIST (1940) published first distribution map of *Camphorosma annua*. It included 27 localities, the most of them were situated between the towns of Nitra and Nové Zámky (19 sites). Much later MAGLOCKÝ (1999)

attempted outline of decrease of species distribution, but this data was not very precise. The author mentioned 19 localities in total; 10 of them have been put down as current. SÁDOVSKÝ et al. (2004a) confirmed four recent localities during first current survey of Slovak saline habitats. Other particular data of *Camphorosma* occurrence was given in phytosociological works of KRIPPELOVÁ (1965, 1967), VICHEREK (1973), VALACHOVIČ (1995), ZLINSKÁ (2003, 2005) and DÍTĚ et al. (2008). However, more localities were published only in two of them: VICHEREK (1973) sampled community with *Camphorosma* on 13 localities; DÍTĚ et al. (2008) mentioned alone six recent localities with dominance of the species. Both of works did not alluded localities where the species occurred only as associated species.

The results of our study showed that the species has been relatively common in saline habitats of the Danube Lowland, and it occurred in 38 localities overall (see Fig. 2). It corresponded to data of KRIST (1940) mentioned above. The saline habitats were not under massive intensification at the time and main endangerment was represented by too intensive livestock grazing and locally likewise by soil mining for brick production (e.g. Iža, Okoč). In addition, the animals (mainly pigs), markedly disturbed the soil and increased soil fertility by production of excrements what caused occurrence of some ruderal species as *Anagallis arvensis*, *Conyza canadensis*, *Datura stramonium* and *Hibiscus trionum* (KLIKA – VLACH 1937, KRIST 1940).

This number of localities was stabile, in small differences, to the 1970s of last century, because no marked changes of saline habitats were published (ŠMARDA 1952, KRIPPELOVÁ 1965, 1967, VICHEREK 1973). Afterwards the rapid decrease of *Camphorosma* sites started due to land reclamation, afforestation and transformation of saline habitats to arable land (MAGLOCKÝ 1999, SÁDOVSKÝ et al. 2004b, FEHÉR 2007). For example, GRULICH collected *Camphorosma* only in 13 localities during floristic research of Slovak saline habitats in 1985–1988 (specimens have been deposited in herbarium MMI). Similarly, adjacent inland salt marshes and saline steppes in NW Hungary near Győr have been significantly reduced in the last fifty years. *C. annua*, occurred on three sites in the past, has not been found here recently (SCHMIDT 2007).

Recent survey of saline habitats has confirmed validity of species evaluation in Slovak Red list. *C. annua* was included in category “CR – critically endangered” (FERÁKOVÁ et al. 2001). The species is near extinction – only eight localities have been found after the year 2000. That means ca 75 % reduction of distribution of *C. annua* in Slovakia. The species was still growing in more or less open salt pans only on four sites (Močenok – Siky farmstead, Bokrošské slanisko Nature Reserve, Kamenínske slanisko Nature Reserve, Mostová Nature Reserve), other four localities represented secondary habitats, usually rural roads. Furthermore, some salt pans (e.g. Mostová Nature Reserve) degraded very quickly in consequence destruction of water regime and desalination. Abundance of the species decreased dramatically year after year and DÍTĚ et al. (2008) pointed out, that surviving of the species there will depend on active human preservation.

Finally, *C. annua* is considered as typical plant for primary alkali habitats (FEHÉR 2007). Therefore, reconstruction of its distribution should give us the real picture about historical and recent occurrence of primary saline habitats in Slovakia.

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