Lynx, n. s. (Praha), **42**: 133–143 (2011). ISSN 0024-7774 (print), 1804-6460 (online)

Vegetation of *Spermophilus citellus* localities in the Czech Republic (Rodentia: Sciuridae)

Vegetace na lokalitách sysla obecného (*Spermophilus citellus*) v České republice (Rodentia: Sciuridae)

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received on 6 December 2011

Abstract. The European ground squirrel (*Spermophilus citellus*) is a typical inhabitant of the steppe but it also occurs in a variety of man-made habitats such as pastures, lawns or sports fields. In our study we attempt to present a complete survey of vegetation types and environmental conditions on recent ground squirrel localities in the Czech Republic. We carried out vegetation research of 42 localities and recorded 110 phytocoenological relevés at the sites recently occupied by ground squirrels. The relevés were classified using the TWINSPAN classification and general patterns of vegetation were analysed using the principal component analysis (PCA). Environmental factors were assessed using the Ellenberg indicator values. The classification analysis showed six distant groups of relevés/vegetation types (in descending order according to group size): (i) *Cynosurus* pastures, (ii) Undifferentiated grasslands, (iii) Xerophilous ruderal vegetation with biennial and perennial species, (iv) Xerophilous natural grasslands, (v) Annual vegetation of arable land, and (vi) Acidophilous grasslands on shallow soils. The PCA showed relation, although limited, of the ground squirrel occurrence to three groups of plant species characterized by (i) *Lolium perenne*, (ii) *Festuca rupicola*, and (iii) *Poa angustifolia* and *Festuca rubra* agg. The Ellenberg indicator values characterized vegetation present at ground squirrel localities as hemi-heliophilous, sub-atlantic and adapted to average temperature and lower humidity conditions. The soil productivity and soil reaction values were considerably variable. Occurrence of the European ground squirrel in the Czech Republic thus seems to be related rather to low vegetation cover than to habitats possessing some specific plant species or vegetation types.

Key words. Habitat, distribution, vegetation, European ground squirrel, environmental conditions, endangered species.

INTRODUCTION

Geographical distribution of an animal species is not limited only by physical factors like temperature or precipitation, but also by the distribution of other species representing its food, predators, competitors, or prey etc. (Lomolino et al. 2006 and references therein). In analyses of species distribution or environmental requirements is thus necessary to consider its relation to the biological components of occupied habitat.

Ground squirrels (tribe Marmotini) are usually referred to occur in open short grass habitats such as steppe, prairie, semi-desert or alpine meadows (e.g. Nowak 1999, Van Horne 2007 and references therein). These habitats may be crucial for ground squirrel survival and their preference is frequently reported in these species (e.g. Van Horne 2007). Their anti-predator function seems to be the most likely explanation. Being diurnal and visually oriented species, ground squirrels suffer lower predation rate in a habitat with short or sparse vegetation cover where they have a better chance to notice the predator at longer distance (e.g. Carey 1985, Schooley et al. 1996). However, occurrence of ground squirrels may also be related to a specific habitat or specific plant species, not only to low vegetation cover. For instance, Hafner et al. (1998) mentioned that the typical habitat of *Spermophilus bruneus endemicus* was originally dominated by *Artemisia tridentata* (Asteraceae) and *Purshia tridentata* (Rosaceae) with perennial bunchgrasses and forbs. Invasion of exotic annual grasses to the original plant community changed intensity of primary productivity and possibly also demographical trends in populations of this ground squirrel. Hafner et al. (1998) also described that during drought years, summer fat accumulation of adults of *S. mohavensis* appears to depend on two perennial species of the family Chenopodiaceae: *Grayia spinosa* and *Eurotia lanata*.

The European ground squirrel *Spermophilus citellus* (Linnaeus, 1766) occurs in central and south-eastern Europe and is commonly referred to as a typical inhabitant of the short-grass steppe and similar man-made habitats (Kryštufek 1999, Spitzenberger 2001). According to Grulich (1960) and Ružić (1978), man-made habitats are represented by field balks, mowed meadows, grassy edges of pathways, pastures and perennial fodder crops – clovers, lucernes. However, Matějů et al. (2008) recorded *S. citellus* occurrence mostly at grassy airfields, vineyards, orchards and meadows as well as in campsites and sport areas. This variability in habitats occupied by *S. citellus* led us to a principal question. Which types of vegetation occur at its localities? Hence the main aim of our study is to describe vegetation of recent ground squirrel localities and eventually, using the knowledge of plant species ecology, also assess other environmental conditions at *S. citellus* localities.

METHODS

During the years 2003–2009, a study of vegetation cover was performed at 42 localities with recent *S. citellus* occurrence in the Czech Republic. This number represents all existing localities with ground squirrel occurrence during the above mentioned period (37 localities) and five recently extinct localities. The latter five localities, also included in our study, were regularly managed. The time lapse between the last observation of *S. citellus* and data collection was usually 2 or 3 years, the longest being six years.

Composition of vegetation cover (plant species and their abundance) was recorded at each locality using one to eight phytocoenological relevés following a standard methodology (Moravec et al. 1994). Number of relevés depended on locality size and visually assessed variability of vegetation – relevés should cover the complete vegetation diversity of each locality. In total, 110 phytocoenological relevés were recorded. The relatively small relevé size (2×2 m) and the higher number of relevés reflected very heterogeneous and patchy character of the vegetation. Relevés were always situated in a close vicinity of occupied or at least

abandoned ground squirrel burrows, respecting the areas with management typical for the locality. Plant species were identified using the Field Guide to the Czech Flora (Kubát et al. 2002) and nomenclature of the taxa follows this source. Taxa with complicated taxonomy such as *Achillea millefolium* agg. or *Festuca rubra* agg. were determined only to the aggregate level. Regarding considerable differences in the type and frequency of management on particular localities and differences in the period of data collection, we were not able to record comparable data on the height of vegetation cover.

The TWINSPAN classification was performed in the Juice environment using the modified TWINSPAN algorithm (Roleček et al. 2009). This method allows keeping the internal heterogeneity of resulting groups on similar levels. We used pseudospecies cut levels 0 and 5% and the dissimilarity threshold was set to 0.7 (Sørensen dissimilarity index). Three of the resulting groups were joined together as they lacked any diagnostic species. The diagnostic species were tested using the Fisher's exact test with standardisation to the equal size of all groups. The P-value threshold was set to 0.001.

General patterns of vegetation cover variability were assessed using the indirect ordination (principal component analysis, PCA) performed in CANOCO for Windows 4.56 (Lepš & Šmilauer 2003). We included only species with more than four occurrences in the whole dataset to reduce the influence of the outliers on the ordination. The percentage cover data were square-root transformed. The other settings were set to default.

Environmental conditions of each locality were inferred from the vegetation data using the Ellenberg indicator values (Ellenberg et al. 1992). The Ellenberg indicator values are a 9 point scale for soil reaction, productivity/nutrients, humidity, continentality, temperature and light conditions of the locality. The final value for each environmental factor is calculated as an arithmetic mean from values of all species identified in the relevé regardless their abundance, it means by a qualitative method. This method eliminates the effect of indifferent species, which are usually present in high abundance and would shift the results towards mean values if the quantitative method was used. All graphs and calculations of data set characteristics and distribution fitting were processed in STATISTICA 8.0 (StatSoft Inc. 2007).

RESULTS

Classification analysis

The TWINSPAN classification identified six groups of relevés (vegetation types; see Fig. 1a) that were interpreted as:

(i) "*Cynosurus* pastures" is the largest group of relevés comprising vegetation typical for intensively mowed areas such as airfields, campsites or grassy stripes in vineyards, rarely also intensive pastures. This group covers most of *Cynosurus* pastures sensu Chytrý et al. (2010).

(ii) "Undifferentiated grasslands" is the second largest, heterogeneous group of relevés covering undifferentiated vegetation types often with a higher number of ruderal species, but also some natural vegetation types sensu Chytrý et al. (2010) such as *Festuca* sand grasslands, Acidophilous and Broad-leaved dry grassland, Mesic *Arrhenateherum* meadows and also some indefinite *Cynosurus* pastures. Intensity of management or disturbances is highly variable from no to intensive management. This vegetation type usually occurs at rarely mowed parts of airfields, golf ranges, former fields or meadows.

(iii) "Xerophilous ruderal vegetation with biennial and perennial species". This group includes vegetation types typical for initial phases of plant succession with dominance of ruderal short-lifespan herb species. This vegetation type is usual in mowed or disturbed areas (former airfields and fields) of southern Moravia.

(iv) "Xerophilous natural grasslands" is a relatively homogenous group of relevés covering vegetation of dry and warm localities of Raná, Mohelno, Vinařická hora, Radouč. This type of vegetation has longer continuity under extensive management – usually grazing.

(v) “Annual vegetation of arable land” is represented by a small group of relevés comprising vegetation of ruderal weeds of vineyards and fields, which is under intensive agricultural management. This type of vegetation was recorded only in southern Moravia.
(vi) “Acidophilous grasslands on shallow soils”. This type of vegetation is represented by only two relevés recorded on extensively mowed steep slopes on the margin of a golf range at the locality Karlovy Vary – golf range. However, due to its minor presence, importance of this vegetation type is low.

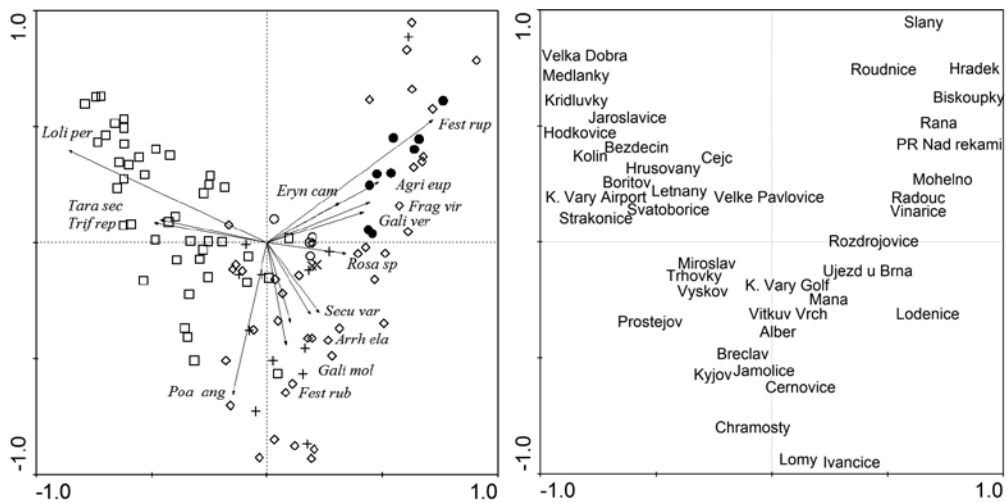

Fig. 1. A – Composition of the vegetation cover at European ground squirrel localities in the Czech Republic. Three species groups identified using PCA are: lawns strongly managed by man (group of *Lolium perenne*); natural dry grasslands and xerophilous ruderal plant formations, both with extensive management (group of *Festuca rupicola*); and undifferentiated intensively managed grasslands (group of *Poa angustifola*, *Festuca rubra* agg.). Only 14 plant species best fitting the PCA model are shown. Six vegetation types were identified based on the classification analysis of phytocoenological relevés: □ *Cynosusur* pastures, ◊ undifferentiated grasslands, + xerophilous ruderal vegetation with biennial and perennial species, ● xerophilous natural grasslands, ○ annual vegetation of arable land, × acidophilous grasslands on shallow soils. B – centroids for localities are shown in the same ordination space as in Fig. 1A).
Obr. 1. A – Složení vegetace na lokalitách sysla obecného v ČR. Identifikovány byly tři druhové formace: intenzivně kosené trávníky s jílkem vytrvalým (*Lolium perenne*), sušší trávníky s extenzivním managementem s kostřavou žlábkatou (*Festuca rupicola*) a nerozlišené intenzivně obhospodařované trávníky s lipnicí úzkolistou a kostřavou červenou (*Poa angustifola*, *Festuca rubra* agg.). V grafu je zobrazeno pouze 14 druhů, které nejlépe vyhovují modelu PCA. Dle klasifikační analýzy fytocenologických snímků bylo rozlišeno šest typů vegetace: □ poháňkové pastviny, ◊ vegetace nerozlišených trávníků, + teplomilná ruderální vegetace s dvouletými a vytrvalými bylinami, ● přirozené suchomilné trávníky, ○ jednoletá vegetace zemědělských kultur a × acidofilní trávníky mělkých půd. B – Rozdělení lokalit zobrazené ve stejném měřítku jako obr. 1A (blíže viz text).
Legend / vysvětlivky: Agri eup – *Agrimonia eupatoria*, Arrh ela – *Arrhenatherum elatius*, Eryn cam - *Eryngium campestre*, Fest rub – *Festuca rubra agg.*, Fest rup – *Festuca rupicola*, Frag vir – *Fragaria viridis*, Gali mol – *Galium mollugo*, Gali ver – *Galium vernum*, Loli per – *Lolium perenne*, Poa ang – *Poa angustifolia*, Rosa sp. – *Rosa* sp., Secu var – *Securigera varia*, Trif rep. – *Trifolium repens*.

Table 1. List of vegetation types identified by the classification analysis of phytocoenological relevés
Tab. 1. Přehled vegetačních typů identifikovaných pomocí klasifikační analýzy fytocenologických snímků

vegetation formations / rostlinná formace	no. of relevés / počet snímků	diagnostic species / diagnostické druhy
Cynosurus pastures / poháňkové pastviny	43	*Lolium perenne*, *Trifolium repens*, *Taraxacum* sect. *Ruderalia*, *Poa annua*
undifferentiated grasslands / vegetace nerozlišených trávníků	40	*Trifolium dubium*, *Arrhenatherum elatius*, *Festuca rubra* agg., *F. rupicola*, *Securigera varia*
Xerophilous ruderal vegetation with biennial and perennial species / teplomilná ruderální vegetace s dvouletými a vytrvalými bylinami	12	*Picris hieracioides*, *Daucus carota*, *Trifolium campestre*, *Anagallis arvensis*
Xerophilous natural grasslands / přirozené suchomilné trávníky	9	*Fragaria viridis*, *Galium verum*, *Carex humilis*, *Crataegus* sp., *Euphorbia cyparissias*, *Teucrium chamaedrys*, *Stipa* sp., *Medicago falcata*
Annual vegetation of arable land / jednoletá vegetace zemědělských kultur	4	*Vitis vinifera*, *Geranium columbinum*, *Stellaria media*
Acidophilous grasslands on shallow soils / acidofilní trávníky mělkých půd	2	*Carex pilulifera*, *Teesdalia nudicaulis*, *Cytisus nigricans*, *Calluna vulgaris*

For diagnostic species and the number of relevés associated with the particular group of relevés/vegetation type see Table 1. Representation and dominance of vegetation types at the particular localities are given in Table 2.

Principal component analysis

Three groups of plant species representing *S. citellus* localities were identified using PCA, where the first axis of PCA explained 17.1% of variability in vegetation and the second axis 9.7% (Fig. 1a). The first group of species is characterized by *Lolium perenne*, often accompanied by *Taraxacum* sect. *Ruderalia* and *Trifolium repens* – these species are typical for lawns strongly managed by man ("artificial *Cynosurus* pastures") and occur in most of the localities – mostly airfields (Fig. 1b). The second group is characterized by *Festuca rupicola* together with *Agrimonia eupatoria*, *Eryngium campestre*, *Galium vernum* and *Fragaria viridis* – species representing natural dry grasslands and xerophilous ruderal plant formations, both with extensive management. This species group is typical for warm and dry localities of central Bohemia and southern Moravia. The third group is formed by *Poa angustifolia* and *Festuca rubra* agg. along with *Arrhenatherum elatius*, *Galium mollugo* agg. and *Securigera varia*. This group represents vegetation of undifferentiated regularly managed grasslands, which well corresponds with the undifferentiated group of localities (Fig. 1b) ranging from a golf range and campsites to a pasture.

It should be mentioned that the results of both analyses are relatively similar and could be combined. The most frequent vegetation type "*Cynosurus* pastures" well corresponds with the

Lolium perenne group identified by PCA (see Fig. 1a). Similarly, "Undifferentiated grasslands" cover the formation *Poa angustifolia – Festuca rubra* agg., but also a not negligible part of the *Festuca rupicola* formation identified by PCA. "Xerophilous ruderal vegetation with biennial and perennial species" differs in the classification analysis, but in PCA it overlaps with "Undifferentiated ruderal grasslands". "Xerophilous natural grasslands" differ strongly from the others and make a well-defined group of relevés that well correspond with the *Festuca rupicola* group identified by PCA. The last two formations identified in the classification analysis were present rather marginally (6 relevés), which was insufficient to be manifested in PCA.

Environmental conditions

The obtained Ellenberg indicator values characterize vegetation occurring at *S. citellus* localities in the Czech Republic as strictly hemi-heliophilous (i.e. vegetation that needs or tolerates higher level of direct sunlight) and adapted to average temperature and lower humidity conditions. Ranges of values of all three factors are very narrow (see Fig. 2), hence indicating strong relation of the observed types of vegetation to these factors. In relation to climate conditions,

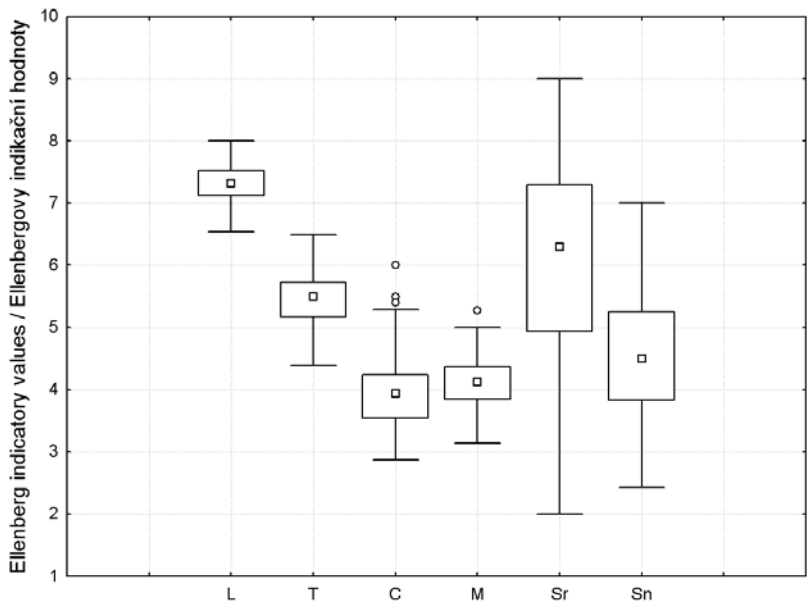

Fig. 2. Distribution of Ellenberg indicator values recorded for phytocoenological relevés from the European ground squirrel localities in the Czech Republic. The narrow range of values in light, temperature and moisture indicates importance of these factors for *S. citellus* occurrence.
Obr. 2. Rozložení Ellenbergových indikačních hodnot zaznamenaných fytocenologických snímků zhotovených na lokalitách sysla obecného (*Scotophilus citellus*) v ČR. Úzké rozmezí hodnot faktorů světlo, teplota a vlhkost dokládá jejich zvýšený význam pro výskyt.
Legend / vysvětlivky: L – light / světlo, T – temperature / teplota, C – continentality / kontinentalita, M – moisture / vlhkost, Sr – soil reaction / půdní reakce, Sn – soil nitrogen / půdní dusík.

Table 2. List of studied localities and recorded vegetation types according to the classification analysis of phytocoenological relevés. Locality names are abbreviated according to Matějů et al. (2008). Localities with former *S. citellus* occurrence included in this study are given in *italics*, the dominant type of vegetation at the particular locality is given in **bold**.
Tab. 2. Přehled studovaných lokalit a typů vegetace zjištěných na základě klasifikační analýzy fytocenologických snímků. Použité názvy lokalit zkráceny dle Matějů et al. (2008). Zaniklé lokality jsou označeny *kurzívou*, dominatní typ vegetace na lokalitě je vyznačen **tučně**.
Legend / vysvětlivky: NR – number of relevés / počet snímků; VT – vegetation types / typy vegetace; Ag – acidophilous grasslands on shallow soils/ acidofilní trávníky mělkých půd; Av – Annual vegetation of arable land / jednoletá vegetace zemědělských kultur; C – *Cynosurus* pastures/ poháňkové pastviny; U – undifferentiated grasslands/ vegetace nerozlišených trávníků; Xn – Xerophilous natural grasslands/ přirozené suchomilné trávníky; Xr – Xerophilous ruderal vegetation with biennial and perennial species/ suchomilná ruderální vegetace s dvouletými a vytrvalými bylinami)

site / lokalita	NR	VT	site / lokalita	NR	VT
Albeř	2	**C**, U	Líchovy, hotel Mana	3	**U**
Bezděčín	2	**C**	Loděnice	4	**U**
Biskoupky	2	**U**	Lomy	3	**U**
Bořitov	2	**C**	Mladá Boleslav-Radouč	3	**U**, Xn
Břeclav-Ladná	2	**U**	Medlánky	2	**C**
Čejč	2	C, **Av**	Milešov: Trhovky, Bor, Loužek	8	**C**, U
Černovice	4	**Xr**	Miroslav	3	C, **Xr**
Hodkovice n. Mohelkou	2	**C**	Mohelno	3	**U**, Xn
Hrádek	2	**U**	*Prostějov*	2	**C**
Hrubšice, PR Nad řekami	2	**U**	Raná	7	U, **Xn**
Hrušovany	4	C, **Av**	Roudnice n. Labem	1	**U**
Chramosty	2	**C**, U	Rozdrojovice, hotel Atlantis	3	C, **Xr**
Ivančice	2	**Xr**, U	*Slaný*	1	**U**
Jamolice	3	C, **U**	Strakonice	5	**C**, U
Jaroslavice	1	**C**	Svatobořice-Mistřín	2	**C**
Karlovy Vary, airport	1	**C**	Újezd u Brna	2	**Xr**
Karlovy Vary, golf range	4	Ag, **C**	Velká Dobrá	1	**C**
Kolín	1	**C**	Velké Pavlovice	3	**Av**, C
Křídlůvky	1	**C**	*Vinařice*, *Vinařická hora*	1	**Xn**
Kyjov-Milotice	4	**C**, U	*Vítkův vrch*	1	**U**
Letňany	4	**C**, U	Vyškov	3	**C**,U,Xr

the vegetation is classified as sub-atlantic which is typical for the Central European region. Concerning soil productivity and soil reaction, a wide range of values, ranging from nitrogen poor to nitrogen rich or from acid to alkaline, respectively, was recorded (Fig. 2).

DISCUSSION

Our study presents the first comprehensive description of vegetation covering *S. citellus* localities in the Czech Republic. The results show that *S. citellus* inhabits a relatively wide variety of dry non-forest habitats that are mostly under intensive human impact – mowing, trampling and disturbances. Using the Ellenberg indicator values, our study also documents that the occurrence of *S. citellus* is related to dry and warm places with direct sunlight.

Vegetation types recorded at *S. citellus* localities in our study represent a wide range from natural types of vegetation to artificial vegetation types established and managed by man. This is in agreement with previous statements by Grulich (1960) or Ružić (1978) that *S. citellus* inhabits various habitats from field balks, mowed meadows, grassy edges of pathways, pastures and also perennial fodder crops – clovers, lucernes. Our data thus confirm ecological plasticity of the European ground squirrel in relation to vegetation cover. Nevertheless almost all vegetation types recorded in our study are characterized as low and most of them are described as dependent on more or less regular management such as mowing and/or pasture. For instance the typical management of the most frequently recorded vegetation type defined as "*Cynosurus* pastures" (see Table 2) is intensive mowing or grazing, which maintain vegetation cover low during the whole season (Chytrý et al. 2010).

Comparison of our data is difficult as the available information about vegetation types at *S. citellus* localities is very scarce. Similar vegetation studies were in a limited extent (restricted to Bohemia) performed by Anděra & Hanzal (1995) and Hulová (2001), but most of their study localities are also included in our data set and that is why our results are almost congruent. From the territory of former Yugoslavia, Ružić (1978) mentioned three vegetation types/species typical for *S. citellus* localities; (i) *Poa bulbosa*, *Euphorbia seguieriana*, *Botriochloa ischaemum*, *Cynodon dactylon*, *Medicago ninima*, *M. lupulina*; (ii) *Festuca rupicola*, *Chrysopogon gryllus*, *Stipa capillata*, *Paeonia tenuifolia*; (iii) *Nardus stricta*. Although differences in environmental conditions and flora composition between the Czech Republic and Yugoslavia are not negligible, the vegetation types mentioned by Ružić (1978) show similar characteristics as those recorded in our study. In all cases it is low, intensively managed and occasionally disturbed vegetation.

It is evident that the three groups of *S. citellus* localities identified by PCA are not clustered according to location (see Fig. 1B); however the group including for instance Raná contains very dry and warm localities of central Bohemia and southern Moravia – mainly protected areas. These localities are usually under long term management supplied by nature protection institutions, which can ensure conditions suitable for *S. citellus* occurrence. The second group including e.g. Kolín consists predominantly of airfields that must be regularly mowed to ensure safety of operation. The last group, including e.g. Chramosty, covers different types of *S. citellus* localities with almost no common conditions except regular mowing or grazing. The minority of vineyard localities such as Velké Pavlovice or Újezd u Brna, even though they represent an important habitat of *S. citellus*, remained unclassified.

Regarding all the above mentioned information we suppose that *S. citellus* occurrence is probably not related to particular plant communities or species. There are two main factors that, in agreement with Hulová (2001), lead us to this conclusion. Firstly, a wide variety of plant species and their parts, ranging from leaves and seed of grasses (Poaceae), through radix of dandelion (*Taraxacum* sp.), plantain (*Plantago* sp.) seeds, yarrow (*Achillea millefolium* agg.), different species of cereals or even potatoes or fallen apricots, is known to be consumed by *S. citellus* (Grulich 1960, Herzig-Straschil 1976, Danila 1984, Leššová 2010). It implies that *S. citellus* is probably not dependent on some specific source of nourishment, i.e. presence of a particular plant species, such as in *S. mohavensis* (Hafner et al. 1998). Secondly, the range of occupied vegetation types contains markedly different plant communities with only few or even no shared plant species. Hence a specific relation between *S. citellus* and a particular plant community, as it is known for instance in *S. bruneus endemicus* (Hafner et al. 1998), probably does not exist or is still unclear. Nevertheless, our data indicate a considerable relation between *S. citellus* occurrence and low vegetation cover and thus document importance of the "anti-predator function" of habitats preferred by this rodent.

Environmental factors in *S. citellus* localities described by the Ellenberg indicator values correspond to predictions and findings of many previous authors (Jacobi 1902, Werth 1936, Grulich 1960, Kryštufek 1999, Spitzenberger 2001). The observed indicator values and especially their narrow ranges (Fig. 2) indicate strong relation of *S. citellus* to localities with lower humidity and, although this is evident prima facie, to non forest habitats – the vegetation is not tolerant towards shade. Werth (1936) and Grulich (1960) restricted the distribution range of *S. citellus* in Europe and in the area of the present Czech Republic by the July isotherm 19 °C and 17 °C, respectively. This corresponds with the observed temperature indicator values representing intermediate to warm localities. The relatively wide variety of observed soil reaction and productivity indicates tolerance of *S. citellus* to these factors and their probable insignificance for its occurrence.

In conclusion: Recent occurrence of the European ground squirrel in the Czech Republic is related to non-forest localities usually with intensive human management of the vegetation cover. Most likely, the species occurrence is related rather to low vegetation cover than to the presence of a specific plant species or vegetation type. All *S. citellus* localities are characterized by lower humidity, direct sunlight and intermediate to warm climate.

SOUHRN

Cílem této práce je charakterizovat vegetaci na lokalitách současného rozšíření sysla obecného (*Spermophilus citellus*) v České republice a zjistit zda je výskyt sysla nějak vázán na přítomnost konkrétních rostlinných druhů či společenstev. V letech 2003 až 2009 proběhlo fytocenologické hodnocení 42 lokalit sysla obecného a bylo pořízeno celkem 110 fytocenologických snímků. Vegetace byla paralelně zhodnocena pomocí klasifikační analýzy TWINSPAN v programu Juice a analýzy komponent (PCA) v programu CANOCO. Prostředí lokalit bylo dále charakterizováno prostřednictvím Ellenbergových indikačních hodnot. Prostřednictvím klasifikační analýzy bylo identifikováno šest typů vegetace, které je možné zjednodušeně označit jako (v pořadí dle zastoupení): (1) poháňkové pastviny, (2) vegetace nerozlišených trávníků, (3) teplomilná ruderální vegetace s dvouletými a vytrvalými bylinami, (4) přirozené suchomilné trávníky, (5) jednoletá vegetace zemědělských kultur a (6) acidofilní trávníky mělkých půd. Prostřednictvím PCA byly zjištěny tři skupiny druhů, které jsou typické pro lokality výskytem sysla. Jedná se o skupinu jílku vytrvalého (*Lolium perenne*), který je doprovázen pampeliškou (*Taraxacum* sec. *Ruderalia*) a jetelem plazivým (*Trifolium repens*). Druhou skupinu tvoří kostřava žlábkatá (*Festuca rupicola*), jahodník trávnice (*Fragaria viridis*), řepík lékařský (*Agrimonia eupatoria*), máčka ladní (*Eryngium campestre*) a svízel syřišťový (*Galium verum*). Třetí skupina je tvořena lipnicí úzkolistou (*Poa angustifolia*) a kostřavou červenou (*Festuca rubra* agg.) spolu s ovsíkem vyvýšeným (*Arrhenatherum elatior*), svízelem povázkou (*Galium mollugo* agg.) a čičorkou pestrou (*Securigera varia*). Výšku vegetace na lokalitách nebylo z metodických důvodů možné přímo porovnávat, nicméně vegetaci na většině sledovaných lokalit lze charakterizovat jako nízkou, člověkem značně ovlivněnou a podléhající intenzivnímu managementu – kosení, pastva. Ellenbergovy indikační hodnoty charakterizují vegetaci na lokalitách sysla jako výrazně heliofilní, vyžadující průměrné až nadprůměrné teploty a nižší vlhkost. Vegetace byla dále charakterizována jako sub-atlantská a bez vyhraněných nároků na živiny a půdní reakci. Výsledky této práce ukazují, že sysel obecný je v našich podmínkách schopen obývat celou řadu suchých biotopů s nízkou výškou vegetace a pravděpodobně není závislý na jejím druhovém složení.

ACKNOWLEDGEMENTS

Our special thanks belong to Jiří Sádlo (Institute of Botany of the ASCR), whose critical revision and suggestions significantly improved this paper. We are also much obliged to Vladimír Vohralík, Petra Schnitzerová and Filip Kolář (Charles University, Prague) and Jiří Brabec (Cheb Museum) for their

useful comments on an earlier draft of the manuscript and Eva Cepáková for linguistic revisions. This study was supported by the Ministry of Environment of the Czech Republic (grant No. SP/2d4/61/08).

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