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Ruscus hypoglossum L. in Slovakia

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ABSTRACT: *Ruscus hypoglossum* L., a rare plant species of the Slovak flora, is distributed in SE, part of the Malé Karpaty Mts. (SW Slovakia). Data on taxonomy, syntaxonomy, morphology, phenology, chorology, endangerment and conservation of *Ruscus hypoglossum* are presented in this paper. Geological, pedological and climatic characteristics of its habitat are given, as well, on the basis of the author's observations, particularly from 1983 to 1985, and on data obtained from the literature.

KEYWORDS: *Ruscus hypoglossum*, *Liliaceae*, Morphology, Distribution, Site conditions

Introduction

The localities of *Ruscus hypoglossum* L. on the territory of Slovakia represent the northernmost, isolated occurence, of the whole distribution area. The species grows only in the southeastern part of Malé Karpaty Mts. at a very limited number of localities. It also belongs to the critically endangered species of the Slovak flora (MAGLOCKÝ 1983).

The paper represents a review of biology of *Ruscus hypoglossum*, based on our own observation results, particularly from 1983 to 1985 and the knowledge from literature.

Taxonomy

Ruscus hypoglossum L., Sp. Pl. 1041 (1753).

Typus: Herb. Linneanum in H. Kewensi ex Hortus Cliffortianus (BM, lectotypus)
Syn.: *R. hypophyllum* L. subsp. *hypoglossum* (L.) DOMIN - Pl. Čechosl. Enum. 20 (1935); in Preslia 13-15:20 (1936)
R. alexandrinus MOTTE - Bull. Soc. Bot. France 86: 162 (1939), pro parte, nom. illegit.
R. troadensis E. D. CLARKE - Travels 2(1): 146 (1812)
R. hypophyllum L. var. *hypoglossum* (L.) BAKER - Journ. Linn. Soc. London (Bot.) 14: 630 (1875)
R. humilis SALISB. - Prodr. 255 (1796), nom. illegit.

The genus *Ruscus* L. is very often classified to the *Liliaceae,* or to *Asparagaceae,* when the family is understood more narrowly (eg. TAKHTAJAN 1969). HUTCHINSON recommended to use a separate family *Ruscaceae* (sec. HEGNAUER 1963), involving the genera *Ruscus, Danaë* and *Semele.* The same classification is adopted by TACHTADŽJAN (1987). YEO (1968) divided the genus *Ruscus* into 2 sections: *Ramosae* and *Simplices,* and suggests *R. hypoglossum* to belong to the section *Simplices.*

MURÍN and MÁJOVSKÝ (1974) estimated the karyotype of *R. hypoglossum* on the plants from the Malé Karpaty as follows: 2n=40=2x (Vs, J, J, J, J, J, Js, J, V, V, V, V, V, V, V, V, V, V, V). The same chromosome number was also found by MARTINOLI (1951), POPOVA and ČESCHMEDJIEV (1978) and YEO (1980).

Morphology

1. Description

Ruscus hypoglossum is a perennial, evergreen dioecious rhizomatous geophyte. Rhizomes are irregularly thickened with remnants of died shoots, horizontal, 1-5 cm under the soil surface. From the rhizomes 6-25 simple straight roots directed downwards originate. Stem is simple, straight or crooked, up to 40 cm long (in Slovak populations preferably to 20 cm). Leaves alternate in the axils of tiny (max. 0.5 cm) bracts of a red-brownish colour, two terminal leaves nearly opposite. When leaves more numerous the lower ones are mostly arranged in a whorl. Leaves are oblanceolate, the lower ones often ovate or broadly ovate, gradually narrowing. In the centre of the above surface of the adult shoot leaves is an inflorescence bract. It never occurs on the most terminal leaf, sometimes it is lacking from the lower leaves, either. The bract is herbaceous, 13-15 mm long and 4-16 mm wide, on the basis coalesced with the leaf. In the axil of the bract, 1-5 tiny, unisexual flowers originate. Male flowers have normally developed stamens and the ovary is reduced; in the female flowers the situation is opposite. Flowers with 5-8 mm long flower petioles have 6 light green tepals in two circles. The tube of coalesced filaments is cylindrical, slightly narrowing towards the base. On the apical end of the cylinder well developed blue anthers are present. The cylindrical tube of the female flowers is narrow, of a dark violet colour and tapering upwards. Anthers are indistinctly developed, rudimentary. Simple ovary has two ovules. The fruit is a berry (2 cm in diameter) with one or two seeds. The mature berry is red.

2. Notes on the morphological peculiarities of the species

A number of authors dealt with morphological pecularities of the genus *Ruscus.* LINNÉ and the botanists in that period considered the assimilation organs to be the true leaves, and LINNÉ named the species with flowers and fruits on the bottom part of the leaves as *Ruscus hypophyllum,* and species which has them on the upper part of the leaf under the ligule (lat. glossa) as *Ruscus hypoglossum.* Turpin's opinion (1820) was that the assimilation organs are of stem origin, that they are flattened lateral stems - phylokladia (sec. SCHLITTER 1953). For this opinion stood up DE CANDOLLE, ASKENASY (sec. ČELAKOVSKÝ 1893), ČELAKOVSKÝ (1893), KAUSMANN (sec. SCHLITTER 1960). Other authors preferred the leaf origin of assimilation organs - eg. KOCH, VAN

TIEGHEM, DUVAL-JOUVE (sec. ČELAKOVSKÝ 1893). Another theory says that the assimilation organs are widened, winged stems coalesced with the enlarged bract (VELENOVSKÝ, DANĚK - sec. KOMAR 1961). The latest results of SCHLITTER (1953, 1960) show they are coalesced leaves and inflorescence, with the predominant presence of the leaves. This is in agreement with the opinions of MARKGRAF (1974) that has been respected also in this paper. In our literature an opinion is accepted on the rotation of the *Ruscus* leaves. In DOSTÁL (1950: 1785) writes: "the leafy phyloclady rotates during the flowering and the berry (2 cm in diameter) is then on the bottom of it". Such description does not agree with the reality. The leaves do not rotate and the fruits are on the above side of the leaf.

Phenology

Young shoots start to grow in the second half of April. From one rhizome 1-3 new shoots originate. Within one month, the shoots reach the lenght of perennial shoots, differing only by a little lighter colour. This difference disappears at the end of May. The flower buds appear on the shoots by the second half of June, some of them flower in autumn. My observations in 1982: It seems, that those flowers are retarded, both the stamens and the ovaries are rudimentary in flowers collected at 5.12.1982. Most of buds flower at spring time - April and May (rarely by the end of March). By the second half of May the first green berries can be seen. They ripen in summer, by September they are completely red. Most often the fruits stay on the plants till next spring.

Chorology

1. General geographical distribution

MEUSEL, JÄGER et WEINERT (1965) characterize the area where *Ruscus hypoglossum* occurs as "disjunctive westmediterran-eastsubmediterran-colchical". This characterization is in contradiction with the data of YEO (1980), postulating the western boundary of area in northwest Italy ("southeast Europe, the east part of central Europe, in west the area reaches to the north-west of Italy"). The occurence of *Ruscus* is put by him to Italy, Austria, former Czechoslovakia, Hungary, Jugoslavia, Rumania, Bulgaria, Greece, Turkey, former USSR - Crimea (YEO 1968, 1980). The data proves that the assertion about the occurence of *Ruscus hypoglossum* in the west Mediterranean area is not true.

The eastern border of *Ruscus hypoglossum* occurence is represented by the findings in Turkey - Eastern Paphlagonia between Ünye and Niksar (YEO 1968), the northernmost point of its occurence is in Slovakia: the Malé Karpaty Mts., approximately 48°24′ N (HALADA 1985). There is a record from Polish part of the Pieniny Mts. by BOSNIAKOVSKI (1877), but it was never proved, and KULCZYNSKI stated that it represents *Polygonatum odoratum* (MILL.) DRUCE (sec. PTAČOVSKÝ 1959). The nearest localities to our territory are those in Austria - Wiener Wald (YEO 1968) and Hungary - Dunántúli középhegység, Dél-Dunántúl (SOÓ 1973).

More detailed data on the occurence of the species is in the paper of YEO (1968). The area of distribution of *Ruscus hypoglossum* is on Fig. 1.

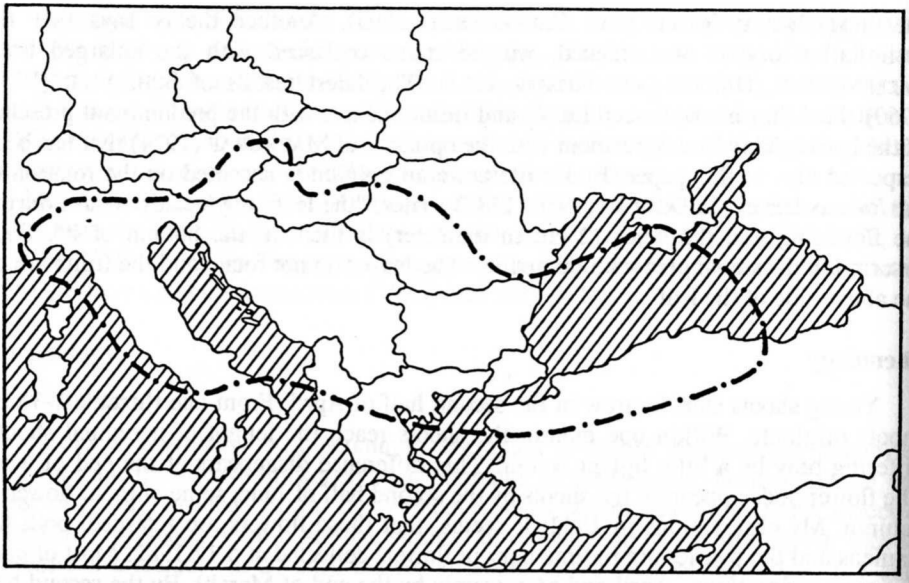


Fig. 1 - Geographical distribution area of *Ruscus hypoglossum* L. (according to YEO 1968)

2. Distribution in Slovakia

The first reports on occurence of *Ruscus hypoglossum* in Slovakia are from 1791 - in "Flora Posoniensis" (LUMNITZER 1791). In this flora and also in a later one with the same title (ENDLICHER 1830) a few sites are listed around Bratislava: Jur and Pezinok. KRZISCH (1856) found *Ruscus hypoglossum* also at Čierna skala at Lošonec in the Malé Karpaty Mts. The locality was sometimes wrongly interpreted as Lučenec (Losoncz) by POLÍVKA, DOMIN, PODPĚRA (1928) and YEO (1968). Neither the locality at Čierna skala was proved, in spite of effort of NEVOLE (ex DOMIN ms.) and PTAČOVSKÝ (DOMIN 1925). Unsuccessful were my attempts in 1984 and 1986 as well, but the occurence of the species there is still possible.

The existing data on distribution of the species in territory of Slovakia are as follows (the herbarium collection of Bratislava herbaria, with the name of the author, year of collection and the abbrevation of the herbarium: BRA, SLO, SAV; literature data are quoted with author names and year of publication):

Pannonicum - 5. Devínska Kobyla

Bratislava - Patrónka, Zoological garden (Májovský 1981 SLO; lit.: HALADA 1985) - Bratislava, in forest at Patrónka (Schidlay 1936 BRA, SLO)

Carpaticum - 10. Malé Karpaty

Bratislava - Krasňany, Chlmec hill (Murín 1967 SLO; Murín 1971 SLO; lit.: MURÍN, MÁJOVSKÝ 1974; HALADA 1985) - Bratislava, Šínweg - Pekná cesta (Ptačovský 1918 SAV; lit.: PTAČOVSKÝ 1959) - Bratislava, Rača, Veľká Baňa hill (lit.: PTAČOVSKÝ 1959; HALADA 1985) - Jur, Fajčokrova búda (lit.: HALADA 1985) - Jur, Fanglovské údolie, Fangl (lit.: PTAČOVSKÝ 1959; HALADA 1985) - Jur, chestnut garden (lit.: HALADA 1985) - Jur, Biely Kameň castle (Ptačovský 1930 SAV; Schidlay 1941 SLO, BRA; lit.: HALADA 1985) - Jur, hillfort Neštich (Schidlay 1930

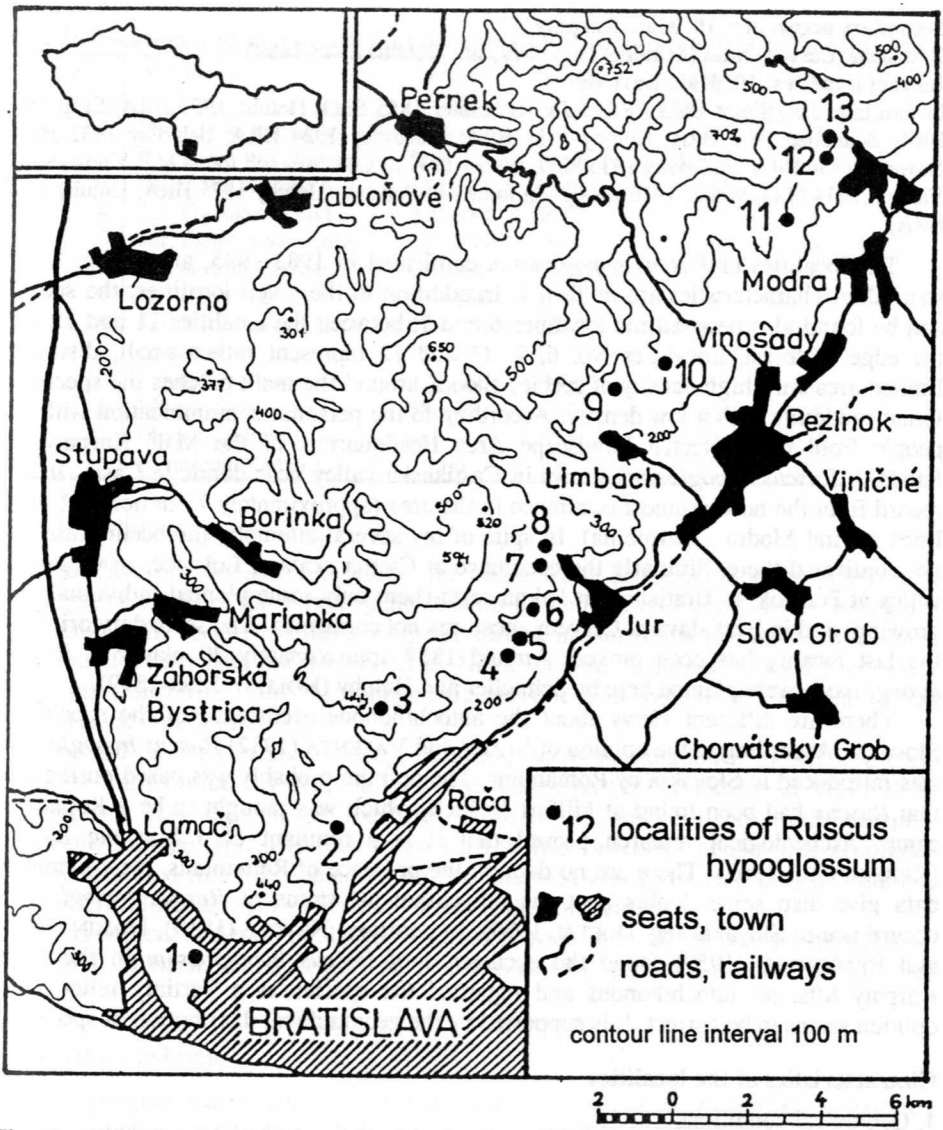


Fig. 2 - Distribution of *Ruscus hypoglossum* L. in the Malé Karpaty Mts. (SW Slovakia)

BRA; Valenta 1933 BRA; Dočolomanský 1963 BRA; lit.: STARÝ, VALENTA 1932; FUTÁK 1941; PTAČOVSKÝ 1959; NEUHÄUSLOVÁ - NOVOTNÁ 1970; HALADA 1985) - Limbach (Zigmundík 1915 BRA; lit.: DOMIN 1925; HALADA 1985) - Pezinok, calvary (lit.: HOLUBY 1916; PTAČOVSKÝ 1959; HALADA 1985) - Pezinok, Cajlanská dolina (lit.: HOLUBY 1916; PTAČOVSKÝ 1959) Modra, Široké (lit.: HALADA 1985) - Modra, Harmónia (lit.: HALADA 1985) - Modra, Harmónia, Zámčisko (lit.: HALADA 1985) - Lošonec, Čierna skala (lit.: KRZISCH 1856)

Secondary occurence: 10. Malé Karpaty
Bratislava, Červený most (Schidlay 1955 SAV; lit.: HOLUBY 1898-1899)
Inexact localities: 10. Malé Karpaty
In forests at Jur (Simor 1865 BRA) - Jur (Schneller 1855 SLO; Holuby 1957 BRA; Szép 1895 BRA; Schneller 1906 BRA; Holuby 1911 BRA; Ptačovský 1924 BRA; Schidlay 1932 BRA; Novacký 1934 BRA; Ptačovský 1936 SLO; Weber 1937 SLO) - In beech forest at Pezinok (Starý, Valenta 1933 SLO; Weber 1936 BRA) - In forests of Pezinok (Holuby 1875 BRA; Holuby 1917 BRA)

The localities of *Ruscus hypoglossum* confirmed in 1983-1985, are in Fig. 2 and their short characteristics are in Tab. 1. In addition to the given localities, the species can be found also between the localities 6 and 7, between the localities 11 and 12 and the edge of forest. Localities No. 6, 7, 11 and 12 represent rather small, distinctly limited area with high density of species shoots, around the main patches the species is found randomly with a low density. According to the personal communication with the people from the Protected Landscape Area Headquarters of the Malé Karpaty (P. Fandák), *Ruscus hypoglossum* grows in Častianska valley near domicile Častá. It is a record from the northernmost occurence in the area (approximately 7 km north of localities around Modra - Harmónia). In spite of my several attempts, the occurrence was not confirmed there. Similarly the occurence at Čierna skala at Lošonec, in Cajlanská valley at Pezinok, in Bratislava at Pekná cesta (here only some planted individuals are growing) and in Bratislava at Červený most was not confirmed. The secondary origin of the last locality has been proved. Around 1857 approximately 20 plants of *Ruscus hypoglossum* were planted here by Schneller and Holuby (HOLUBY 1898-1899).

There are different views about the autochthonous occurrence of the species in Slovakia. According to the opinion of STARÝ and VALENTA (1932) *Ruscus hypoglossum* was introduced to Slovakia by Romanians. The opinion probably was based on the fact that *Ruscus* had been found at hillfort Neštich, which was thought to be a Romanian camp. Archeological research proved that it is a remnant of a Slavonic hillfort (KRASKOVSKÁ 1963). There are no data on the presence of Romanians. New literature data give also some doubts abut the autochthonous status of *Ruscus hypoglossum* occurrence in Slovakia (eg. DOSTÁL 1989). In contrary, NEVOLE (1910), DOMIN (1924) and PTAČOVSKÝ (1959) found the occurrence of *Ruscus hypoglossum* in the Malé Karpaty Mts. as autochthonous and regarded the species as a Tertiary relict. This opinion seems to be correct. It is supported by the geographical distribution of species.

Characteristics of the localities

1. Geological conditions

The Malé Karpaty Mts. is a core mountain range, of crystalline core, sedimentary crust and nappe units. *Ruscus hypoglossum* occurs only in the flaces of crystalline rocks (SOÓ 1973 mentions that *Ruscus hypoglossum* avoids the lime substrates, growing on mid acidic or neutral substrate), in all crystalline units to be found in the area of occurence of the species in the Malé Karpaty Mts. Most of the localities are situated on granites, some are at the connection of granites with biotitic mica schists gneisses and paragneisses, rarely also with amphibolites. The locality at Pezinok is in territory of Pezinok - Pernek crystalline slates, geological substate is composed of pegmatits. Localities near Harmonia are lying on crystalline slates of Harmonia seria.

Tab. 1: Location and size of the sites occupied by Ruscus hypoglossum in Slovakia

Site no.	Site name	Altitude [m]	Slope	Slope inclination	Size [ha]
1	Bratislava, Patrónka	170-180	NE	5-20°	0,47
2	Krasňany, hill Chlmec	220-300	NE-E	5-20°	2,2
3	Rača, Veľká Baňa	310-360	ENE	15°	2,1
4	Jur, Fajčokrová búda	330-380	ENE	15°	0,6
5	Jur, Fanglovské údolie	340-380	NE	20°	1,8
6	Jur, chestnut garden	270-330	NE	15°	3,0
7	Jur, Biely Kameň	310-350	ENE	5°	2,2
8	Jur, hillfort Neštich	250-350	NE-E	0-30°	7,9
9	Limbach	250-280	ENE	15°	0,5
10	Pezinok, calvary	320-350	NE	5°	3,4
11	Modra, Široké	380-400	ESE	10°	0,4
12	Modra, Harmónia	340-380	ESE	10°	0,6
13	Harmónia, Zámčisko	400	S	15°	0,02

2. Soil conditions

The data on the soil conditions are taken from documentation of pedological investigation a part of forest management plans of the Forestry Headquarters, Bratislava - Petržalka. The locality in the Zoological garden in Bratislava lies outside the forest land, therefore the data are not available. Nomenclature of the soil types and of lower units was transferred into "Morphogenetic classification system of Czechoslovakian soils" (HRAŠKO et ŠURINA 1985).

The soil on each locality is deep, according to its granulation it mostly is a clay-sand soil. Only on locality Pezinok - calvary and the part of the locality at Veľká Baňa the soil is a clay soil. On all localities, there is the same soil type and subtype - cambisoil, subtype typical (brown forest soil) in two varieties - acidic (oligotrophous) and the saturated (mezothrophous) one. The saturated variety prevail, only at localities (part of it) Chlmec and Jur - chestnut garden is the soil acidic.

Soils without skeleton, or slightly skeleted prevail, at localities near Modra (Široké, Harmónia, Zámčisko) and at part of localities at Chlmec and Limbach the soils are skeleted.

3. Climatic conditions

The geographical distribution area of *Ruscus hypoglossum* in Slovakia, according to the climatic classification, belongs to the temperate warm region, district with temperate warm, temperate moist, temperate climate (ANONYMUS 1979). The climadiagrams (fig. 3) show annual courses of the temperature and the precipitation measured at three stations in the south-east part of the Malé Karpaty Mts.. The seasonal variation of precipitation and temperature is very even. The lowest temperature was measured in January (the month average ranging from -1.4 to +2.6°C), the highest temperature was found in July and August (19.1 - 20.9°C). There are two dry periods, one in April and a one more evident in September. The average duration of the vegetation period (t>10°C) for years 1960-1980 is 184-192 days, for more wider vegetation period (t>5°C) it is 241-247 days.

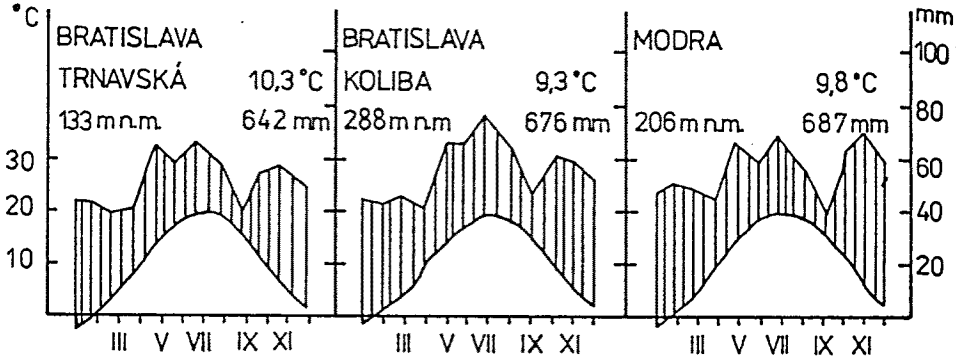


Fig. 3 - Climadiagrams of three meteorological stations in SE part of the Malé Karpaty Mts. with the data about the average year temperature (°C), Total amount of precipitation per year (mm) and site altitude.

4. Phytosociology

Data published from Slovakia about the communities in which *Ruscus hypoglossum* grows come from one single locality Jur Neštich (STARÝ et VALENTA 1932, FUTÁK 1941). NEUHÄUSLOVÁ-NOVOTNÁ (1970) ranked the community at this locality to the *Carici pilosae - Carpinetum* R. et Z. NEUHL. 1964 association.

Phytosociological relevés from six localities in the Malé Karpaty Mts., made according to the methods of Zürich-Montpellier school in 1983-1984, are shown in Tab. 2. Abundance and dominance of species was estimated by semi-quantitative seven-degree scale of Braun-Blanquet. The nomenclature is according NEUHÄUSLOVÁ and KOLBEK (1982). The first five relevés belong to the association *Carici pilosae - Carpinetum* R. et Z. NEUHL. 1964. Within the association we can distinguish a variant with *Ruscus hypoglossum* L.. The relevé number 6 belongs to the association *Dentario bulbiferae-Fagetum* (ZLATNÍK 1935) HARTMAN 1953. In the relevés number 1 and 5 also the spring short-lived species were ascertained.

Endangerment and preservation

The first mention on damaging the plants of *Ruscus hypoglossum* is in the paper of KRZISCH (1856), in which G. A. KORNHUBER add that a lot of plants of that species are brought to the market in Bratislava in great amounts for sale when the fruits are mature and red. Other authors mention the same fact as well (eg. HOLUBY 1916, DOMIN 1925, PTAČOVSKÝ 1959). On impulse of PTAČOVSKÝ *Ruscus hypoglossum* was declared as protected at the beginning of the 1920s (DOMIN 1925) but in spite of this act, it was still brought to the market for sale. Very probable this selection of female individuals caused the predominance of the male shoots in the majority of populations in the Malé Karpaty Mts. In 1958, *Ruscus hypoglossum* was declared to be highly protected (Declaration of Mandation for schools and culture No. 211/58 about the protected plants of Slovakia).

Penalty for damaging one plant of this species was fixed on 800 Kčs. However, the species does not grow at any of the protected sites. At present the locality at Zoological garden in Bratislava is endangered (water supply system has to be built there). Other localities are out of a direct danger. *Ruscus hypoglossum* is able to survive a short period of deforestation (timber harvestig). Another possible danger consists in the building activities, or excavation for cultivation and sale. About one such event informs MAGIC (1983). The most important limiting factor is grazing by animals and very low ability of the species for generative propagation. *Ruscus hypoglossum* is included in "List of extinct, endemic and threatened taxa of vascular plants of the flora of Slovakia" in the category of CI. - critically threatened plants (MAGLOCKÝ 1983). The species belongs to the group of rare plant species also in other parts of his distribution area (eg. Austria, Hungary and former USSR).

Summary

Main results of this work are:

1. 13 localities of *Ruscus hypoglossum* L. were verified in SE part of the Malé Karpaty Mts. between Bratislava and Harmónia, altitude 170-400 m, mainly in SE-E slopes, with slope inclination 0-30°. The mean year temperature in this territory is 10.5°C, precipitation about 600 mm per year, duration of vegetation period (t>10°C) 184-192 days. Crystalline bedrock occurs in all localities. Soils are deep, mainly sand-loam (at 2 sites loam), soil type is cambisol.
2. The localities of *Ruscus hypoglossum* in the Malé Karpaty Mts. represent the northernmost and isolated point in the geographical distribution area of the species (approximately 48°24'N). The nearest localities of the species are the Wiener Wald in Austria and Dunántúli középhegység and Dél-Dunántúl in Hungary.
3. *Ruscus hypoglossum* occurs in Slovakia in communities belonging to the class *Querco-Fagetea* BR.-BL. et VLIEGER in VLIEGER 1937, associations *Carici pilosae - Carpinetum* R. et Z. NEUHL. 1964 and *Dentario bulbiferae - Fagetum* (ZLATNÍK 1935) HARTMAN 1953.
4. The locality Lučenec (Loszoncz) was wrongly interpreted by POLÍVKA, DOMIN, PODPĚRA (1928) and YEO (1968). The correct locality is Čierna skala near Lošonec in Malé Karpaty Mts. (near Smolenice). The occurrence of *Ruscus hypoglossum* in Čierna skala was not confirmed in 1984-1986.

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Translation: dr. A. PREŤOVÁ, Csc.

Tab. 2. Phytosociological records of the communities with occurrence of *Ruscus hypoglossum* L. in the Malé Karpaty Mts. (SW Slovakia)

No. of relevé	1	2	3	4	5	6	S
Altitude [m]	300	330	350	340	170	300	
Exposure	NE	ENE	SSE	SE	NE	NE	
Slope [°]	20	5	10	7	7	20	
Record size [m^2]	400	400	400	200	400	200	
Coverage of E_3	70	70	80	70	80	80	
Coverage of E_2	30	40	40	10	30	20	
Coverage of E_1	60	20	50	50	80	90	
E_3							
Quercus petraea	3	3	3	4	4	1	V
Carpinus betulus	2	3	2	2	-	-	IV
Tilia cordata	1	2	2	-	+	-	IV
Fagus sylvatica	1	2	-	-	-	4	III
Acer campestre	1	1	-	-	+	-	III
A. platanoides	-	-	1	-	+	-	II
Fraxinus excelsior	-	-	2	-	1	-	II
Larix decidua	-	-	+	1	-	-	II
E_2							
Tilia cordata	2	2	2	-	1	-	IV
Carpinus betulus	2	2	1	1	-	-	IV
Acer campestre	1	-	1	-	1	-	III
Sambucus nigra	-	1	-	-	2	1	III
Quercus petraea	-	1	-	-	+	-	II
Fagus sylvatica	-	1	-	-	-	2	II
Ligustrum vulgare	-	-	-	+	+	-	II
Euonymus europaeus	-	-	-	1	+	-	II
E. verrucosa	1	-	-	-	-	+	II
Crataegus laevigata agg.	1	-	-	-	1	-	II
E_1							
Quercus petraea	+.1	+.1	1.1	1.1	+.1	+.1	V
Acer campestre	+.1	-	+.1	+.1	+.1	-	IV
Tilia cordata	+.1	2.2	2.1	-	-	1.1	IV
Carpinus betulus	1.1	1.1	-	-	-	-	II
Acer platanoides	-	-	-	+.1	+.1	-	II
Fraxinus excelsior	-	-	-	+.1	+.1	-	II
Rosa canina agg.	-	-	+.1	+.1	-	-	II
Sambucus nigra	-	-	+.1	-	+.1	-	II
Cerasus avium	-	-	+.1	-	+.1	-	II
Characteristic species of the *Carici pilosae-Carpinetum*							
Carex pilosa	1.2	1.2	2.2	1.2	-	2.2	V
Euphorbia amygdaloides	+.1	-	1.1	-	-	-	II
Variant							
Ruscus hypoglossum	2.2	2.2	2.2	1.2	1.2	1.2	V
Characteristic species of the alliance *Carpinion*							
Galium sylvaticum	1.2	-	+.1	1.2	-	1.2	IV
Dactylis polygama	-	-	1.1	-	-	2.2	II
Hedera helix	1.2	-	1.2	-	-	-	II

Tab. 2 - continued

No. of relevé	1	2	3	4	5	6	S
Characteristic species of the order *Fagetalia*							
Galium odoratum	1.2	2.2	2.2	1.2	-	2.2	V
Polygonum odoratum	1.2	+.1	+.1	+.1	+.1	-	V
Symphytum tuberosum	2.1	+.1	-	-	1.1	-	III
Mycelis muralis	-	-	-	-	-	1.1	I
Pulmonaria officinalis	-	-	1.1	-	-	-	I
Characteristic species of the class *Querco-Fagetea*							
Melica uniflora	4.3	1.2	3.3	3.2	2.2	2.2	V
Poa nemoralis ssp. *nemoralis*	1.2	1.1	1.2	-	+.1	3.2	V
Convallaria majalis	-	+.1	1.1	3.3	1.2	-	IV
Campanula persicifolia	1.1	-	+.1	+.1	-	-	III
Geranium robertianum	1.2	-	1.1	-	+.1	-	III
Melittis melissophyllum	1.1	-	1.1	-	+.1	-	III
Lathyrus vernus	+.1	-	1.1	-	1.1	-	III
Further species							
Chaerophyllum temulum	1.2	-	1.2	-	2.2	+.1	IV
Fallopia dumetorum	1.1	-	1.2	2.2	-	1.1	IV
Impatiens parviflora	1.1	-	1.2	2.2	-	1.1	IV
Alliaria petiolata	1.2	-	1.2	-	+.1	-	III
Galium aparine	1.2	-	1.2	-	2.2	-	III
Galeobdolon luteum	2.2	-	2.2	-	-	1.1	III
Rubus sp.	1.1	-	1.1	-	1.1	-	III
Ajuga reptans	-	-	1.1	1.2	1.1	-	III
Hieracium sp.	-	-	+.1	+.1	-	+.1	III
Platanthera bifolia	-	+.1	+.1	+.1	-	-	III
Arum orientale	-	-	1.1	-	1.1	-	II
Galeopsis sp.	-	-	+.1	1.1	-	-	II
Galium album ssp. *album*	-	-	1.2	2.2	-	-	II
Galium schultesii	-	-	3.3	2.3	-	-	II
Silene nutans ssp. *nutans*	-	-	+.1	+.1	-	-	II
Veronica chamaedrys	-	-	+.1	+.1	-	-	II
Melampyrum pratense	+.1	-	+.1	-	-	-	II
Viola suavis	1.2	-	1.2	-	-	-	II
Heracleum sphondylium	+.1	-	-	-	1.1	-	II
Lamium maculatum	1.1	-	-	-	+.1	-	II
Spring geophytes							
Corydalis cava	2.2	-	-	-	2.2	-	
Ficaria bulbifera	2.2	-	-	-	2.2	-	
Gagea lutea	1.1	-	-	-	1.1	-	
Galanthus nivalis	2.2	-	-	-	1.2	-	

Species, occured only in one record:

E_3: *Betula pendula* 1 (3), *Castanea sativa* 1 (2), *Corylus avellana* + (5), *Crataegus laevigata* agg. + (1), *Picea abies* 1 (3), *Pinus sylvestris* + (4), *Robinia pseudacacia* + (5), *Sorbus torminalis* + (5), *Taxus baccata* 1 (3), *Ulmus minor* + (5)

E_2: *Castanea sativa* + (2), *Corylus avellana* + (5), *Cerasus avium* 1 (5), *Robinia pseudacacia* + (5), *Sorbus torminalis* + (6), *Taxus baccata* + (3)

(cont.)

Tab. 2 - continued

E_1: *Abies alba* +.1 (3), *Acer pseudoplatanus* +.1 (5), *Anemone ranunculoides* 1.2 (1), *Anthriscus sylvestris* 1.1 (5), *Campanula* sp. +.1 (3), *Campanula glomerata* 1.1 (6), *Chelidonium majus* +.1 (5), *Daphne mezereum* +.1 (5), *Dryopteris filix-mas* +.1 (1), *Fagus sylvatica* 2.1 (6), *Geum urbanum* +.1 (5), *Hieracium laevigatum* 1.1 (6), *Hieracium murorum* 2.1 (6), *Isopyrum thalictroides* 1.2 (1), *Ligustrum vulgare* +.1 (5), *Lilium martagon* +.1 (5), *Moehringia trinervia* +.1 (5), *Scrophularia nodosa* +.1 (5), *Sedum maximum* 1.1 (4), *Solidago virgaurea* 1.1 (4), *Vincetoxicum hirundinaria* +.2 (4)

The numbers in the table represent values of abundance (in seven-degrees scale of Braun-Blanquet) and dominance.

Localities and dates of relevés

1. Jur, hillfort Neštich - site No. 8, 24.6.1984
2. Jur, Biely Kameň - site No. 7, 24.6.1984
3. Modra, Harmónia - site No. 12, 25.6.1984
4. Modra, Harmónia - cca 400 m NE from site No. 12, 25.6.1984
5. Bratislava, Zoological garden - site No. 1, 6.5.1983
6. Jur, chestnut garden - site No. 6, 24.6.1984

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