

***Jovibarba globifera* (L.) J. PARN. (Crassulaceae, Sempervivoideae) in Bratislava (Slovakia): notes on taxonomy, nomenclature, distribution, ecology and conservation status**

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Evaluation of the name *Jovibarba hirta* subsp. *glabrescens* (SABR.) HOLUB, which has been usually applied for the majority of the populations of the genus *Jovibarba* from Slovakia, shows that its basionym is based on plants from granite localities in Bratislava. The only recent locality of *Jovibarba* in Bratislava is on the rock slopes of the Bratislava Castle hill, which represents an important refuge for the native flora just in the centre of the city. The population from this locality belongs to the variant intermediate between *J. globifera* subsp. *globifera* and *J. globifera* subsp. *hirta*, which also occurs on other localities in the lower altitudes in Slovakia (e.g. Malé Karpaty Mts), the Czech Republic (Pavlovské vrchy Hills) and NE Austria. The occurrence of such intermediate variants supports a wide species concept within the genus *Jovibarba*, where *J. hirta* and *J. globifera* (syn. *J. sobolifera*) are treated as two subspecies within *J. globifera*. These intermediate populations are provisionally classified as *J. globifera*, without indication of subspecific name. *J. globifera* belongs to the category V (vulnerable) in the Red list of Bratislava.

Key words: *Jovibarba globifera*, Crassulaceae, Bratislava, Slovakia, threatened plants, taxonomy, distribution.

Introduction

The number of threatened and extinct plant species increases in areas under intensive anthropic influence, such as in the territory of Bratislava where 43.73% of the flora is threatened (FERÁKOVÁ et al., 1994). Because of large anthropic threats, more research attention should be paid to threatened taxa. The aims of the present study were to evaluate the contemporary state of the distribution of *Jovibarba globifera* in the territory of

Bratislava and its vicinity, to explain some taxonomic, nomenclatural and ecological aspects of this species, and to characterize the actual degree of threat in the study area.

Material and methods

The area studied was in a radius of 15 kms from the historical centre of Bratislava. This includes the city of Bratislava, the Malé Karpaty Mts from Bratislava to the towns of Stupava and Svätý Jur, the Devínska Kobyla Hill and the Hundsheimer Berge Hills.

Data about the distribution of *Jovibarba globifera* were obtained from the literature and from herbaria (BP, BRA, BRNU, LI, PR, SAV, SLO, WU; see HOLMGREN et al., 1990; and the private herbarium of Dr. GUTERMANN, Wien). They are arranged according to localities. Old names of localities were located and replaced according to HORVÁTH (1990). The reported distribution of this species was verified in the field, and searches for its occurrence in other potential habitats were conducted. The extent of anthropogenic threat was evaluated according to categories given in the second draft of the Red List of the Slovak flora (MAGLOCKÝ et FERÁKOVÁ, 1993). Samples for taxonomic study were cultivated during a 24 month study, along with material from other localities, for comparison under common-garden conditions (experimental field, Department of Botany, Comenius University, Bratislava).

Taxonomy and nomenclature

The division of the genus *Sempervivum* L. s. l. (Sp. Pl. 1753: 464) into more narrowly circumscribed *Sempervivum* and the genus *Jovibarba* OPIZ (Seznam 1852: 54) is widely accepted on the basis of clear morphological, chorological, cytological (ZÉSIGER, 1961), pollen (PARNELL, 1991) and seed-coat morphological (KNAPP, 1994) differences. Infrageneric classification of *Jovibarba*, however, is still controversial because of different species concepts and insufficient knowledge of variability and distribution of constituent taxa. The present author believes that a wide species concept within the genus *Jovibarba* is convincingly supported by morphological, karyotaxonomical and chorological arguments (PARNELL 1988a, 1988b; PARNELL et FAVARGER, 1990); there is insufficient morphological, geographic, and cytological evidence to support more than two (or three) species. The results of morphometric analysis (SMITH, 1971) correspond with the broader species concepts of HUBER (1961). However, nomenclatural combinations of the species of *Jovibarba*, published by HUBER (1961) in the genus *Diopogon* JORD. et FOURR. are invalid. The account of the genus in the second edition of *Flora Europaea* (PARNELL et FAVARGER, 1993) follows this concept, contrary to that given in the first edition of the flora (FAVARGER et ZÉSIGER, 1964). The second edition distinguishes two species with different modes of vegetative propagation: *Jovibarba heuffelii* (SCHOTT) Á. LÖVE et D. LÖVE and *Jovibarba globifera* (L.) J. PARN. The distribution area of the first species covers the mountains of the Balkan peninsula and the South Carpathians; the area of the second species ranges from the Alpes Maritimes to the East Carpathians and to the north-

east, extending to Murmansk in Russia. The four closely related species presented in the first edition of *Flora Europaea* (FAVARGER et ZÉSIGER, 1964) – *Jovibarba allionii* (JORD. et FOURR.) D. A. WEBB, *J. arenaria* (KOCH) OPIZ, *J. hirta* (L.) OPIZ and *J. sobolifera* (J. SIMS) OPIZ – are considered in its second edition as subspecies of *J. globifera* [*J. sobolifera* (J. SIMS) OPIZ is the synonym of *J. globifera* (L.) J. PARN. subsp. *globifera*]. Previously, the epithet “*globiferum*” was used incorrectly for some species of the genus *Sempervivum* L. s. str. with yellow flowers. However, the lectotype of the name *S. globiferum* L. (LETZ et MARHOLD, 1996) belongs to the genus *Jovibarba* and after unification of the above mentioned four species into one species the epithet “*globiferum*” has priority (PARNELL, FAVARGER, 1990). Subspecific names of *J. hirta* given in the first edition of *Flora Europaea* are treated in the second edition as synonyms. Among the subspecies enumerated in the first edition are *Jovibarba hirta* subsp. *glabrescens* (SABR.) HOLUB and *J. hirta* subsp. *tatrensis* (DOMIN) Á. LÖVE et D. LÖVE, names previously used to represent the populations from Slovakia (ZAHRAĐNÍKOVÁ, 1985).

The epithets “*sobolifera*”, “*hirta*”, “*arenaria*”, and “*allionii*” have been used in various nomenclatural combinations, at different ranks within different species. The poor taxonomic distinction is supported by the occurrence of intermediate forms presented also in this study. Another intermediate form has been reported by LEUTE (1966) between *J. hirta* and *J. arenaria* from Austria.

After considering the arguments of PARNELL and FAVARGER (1990, 1993), and on the basis of personal experience with the material of this genus, the present author is inclined to accept the concept of these authors as presented in *Flora Europaea* (2nd ed.). This solution, however, is not considered as definitive, as more problems of species and especially infraspecific taxonomy remain unresolved and have to be studied.

A great amount of within-population variability is common in *J. globifera*, especially in the contact zone of its different subspecies (e.g. West Carpathians). Along a possible introgression it is probably caused by great tendency towards vegetative propagation in the reproductive strategy of this species. Population variability leads to special morphological lines (clones) as a result of such reproduction. However, this pattern can vary in different subspecies. For example, *J. globifera* subsp. *globifera* only rarely produces flowers, but undergoes very intensive vegetative propagation. This

reproduction strategy leads to the relative morphological uniformity of populations. The variability of this species is also influenced by the isolation of populations growing on rocky "islands" in the country. Such topodemes can differ from one another in the prevailing morphotypes. Furthermore, it seems that a clinal pattern of variation is observable in some characters. The above mentioned situation is also complicated by the variability, manifested in the size and the extent of the opening of the rosette and in the length and the shape of the leaves, caused by different ecological conditions.

SABRANSKY (1882) described two formae of *Sempervivum hirtum* L.: f. *vulgaris* SABR. and f. *glabrescens* SABR. The first of these taxa, according to the original description, is the synonym of the nominal subspecies *Jovibarba hirta* (L.) OPIZ subsp. *hirta*. This forma was said to be localized on the limestone area of the Malé Karpaty Mts. (SABRANSKY, 1882). The name of the second forma, later combined as *Jovibarba hirta* subsp. *glabrescens* (SABR.) HOLUB, was applied to nearly all the West Carpathians populations of *J. globifera*. This forma was given as confined to habitats in Bratislava and its vicinity, on granite (SABRANSKY, 1882). There is no original material of these two formae in the herbarium W, where SABRANSKY's herbarium is deposited. Present study of populations from this area, from both types of localities, reveal that there is no taxonomic distinction between them. The name *Sempervivum hirtum* f. *glabrescens* SABR. is, according to the original description (SABRANSKY, 1882), based on plants with leaves \pm glabrous on the abaxial surface. BOLLA (1856: 12) considered such plants from Bratislava as *S. arenarium* KOCH [= *J. globifera* subsp. *arenaria* (KOCH) J. PARN.]. In addition, WIESBAUER (1867: 969) noted that: "Das bei Presburg (auf kalklosem Bodem) vorkommende sogenannte *arenarium* K. ist nach NEILREICH's Ansicht nur ein schwach behaartes *hirtum*." NEILREICH (1866: 227) wrote in his "Aufzählung" at *S. arenarium* KOCH: "Im Steinschutt der Weingärten bei Presburg und St. Georgen (BOLLA PV.1.12), was insofern unwahrscheinlich ist, als diese Art sonst nur auf schattigen Felsen der Voralpen gefunden wurde." (NEILREICH, 1866: 227). WIESBAUER also stated that he had found specimens with glabrous leaves on the limestone area of Malé Karpaty Mts (Vysoká Mt). The population from the locality above Žižkova street (probably the "locus classicus" in a wide sense - referring to the SABRANSKY's original localities on granite hills in Bratislava and its vicinity among vineyards) has mostly glabrous leaves. However,

in other Slovak populations some individuals with extremely hairy abaxial leaf surfaces are found, and considerable variation in the indumentum within populations is common. Taxonomic distinction at a level higher than forma, made only on the basis of presence or absence of hairs on abaxial leaf surfaces (e.g. as *Jovibarba hirta* subsp. *glabrescens* (SABR.) HOLUB and *J. hirta* (L.) OPIZ subsp. *hirta*) should thus be considered as doubtful. PARNELL (1988b) expressed a similar opinion based on examination of herbarium material.

In Flora Europaea, 1st and 2nd eds. (FAVARGER et ZÉSIGER, 1964; PARNELL et FAVARGER, 1993), the following differences are given [for the subspecies of *Jovibarba globifera* (L.) J. PARN.]: *J. globifera* (L.) J. PARN. subsp. *globifera* [syn. *J. sobolifera* (J. SIMS) OPIZ] has rosette-leaves which are widest above the middle and incurved, giving a closed, globose rosette. The sepal surfaces are glabrous. *J. globifera* subsp. *hirta* (L.) J. PARN. [syn. *J. hirta* (L.) OPIZ] has rosette-leaves which are widest at or below the middle, patent or erect, forming an open rosette. The sepal surfaces are usually \pm hairy. Apart from these characters *J. globifera* subsp. *hirta* is distinguished from *J. globifera* subsp. *globifera* by a grey pruina and longer marginal cilia of the leaves.

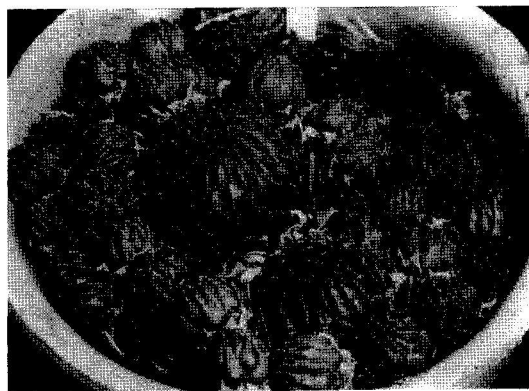


Fig. 1. *Jovibarba globifera* (L.) J. PARN. from the locality above Žižkova street in cultivation. (Photo M. ŠKULTÉTYOVÁ).

Plants from Bratislava and its vicinity (see Fig. 1), examined and cultivated under uniform conditions, have closed or subclosed rosettes due to arched incurving of the leaves. However, the rosette leaves are not widest above the middle, but below or at the middle and are thus more acuminate than *J. globifera* subsp. *globifera*. The epidermis of the leaves is only slightly pruinose. The abaxial surfaces of cauline leaves and sepals are

only seldom as glabrous as they should be for *J. globifera* subsp. *globifera*; isolated hairs are usually found on sepals. However, these plants are never as hairy as *J. globifera* subsp. *hirta*. It is assumed that they represent intermediates between *J. globifera* subsp. *globifera* and probably *J. globifera* subsp. *hirta*.

Names (e.g. *S. soboliferum* and *S. hirtum*) used by some botanists, for plants of *J. globifera* from Bratislava and its vicinity, also show an intermediarity between these taxa in this region. It is indicated for example by determinations and notes quoted on WIESBAUER's specimens (LI) of *J. globifera* from Bratislava and adjacent part of Malé Karpaty Mts: "*Sempervivum soboliferum* SIMS", "*Sempervivum hirtum* L.? (nahe *soboliferum* SIMS)", "*Sempervivum hirtum* L.?", "*Sempervivum hirtum* L.". These intermediate variants occur at lower altitudes in Slovakia (e.g. Malé Karpaty Mts, Považský Inovec Mts, Tríbeč Mts). Plants examined from the Pavlovské vrchy Hills (SE Moravia, Czech republic) probably represent the same intermediate variant.

Intermediarity of plants seems to be very variable among and also within populations. Some plants are closer to *J. globifera* subsp. *hirta* (e.g. from Hundsheimer Berge Hills, Austria), another ones to *J. globifera* subsp. *globifera* (e.g. from Pavlovské vrchy Hills). The solution of this problem requires more detailed morphometric analysis of populations from a wider area.

The aforementioned facts confirm JÁVORKA's (1924) opinion that the frequent intermediate forms tending to *Sempervivum soboliferum* J. SIMS should be classified as *Sempervivum hirtum* f. *glabrescens* SABR.

Based on the information given above the present author uses the name *Jovibarba globifera* (L.) J. PARN (s.l.) for populations from Bratislava and its vicinity. At the present time, no taxonomic units are recognized at the subspecific level. A new Slovak name – skalničník guľkovitý – is proposed here.

Distribution, native status and ecology

A. Habitats on granite substratum

1. Data from Bratislava without precise localities: Bratislava (SCHNELLER, S. A. BP; as *S. hirtum*). [In the herbarium WU the specimen labelled "*S. hirtum* L., Presburg, WIESBAUER" is deposited. But this plant belongs to *J. globifera* subsp. *arenaria* (KOCH) J. PARN. and certainly does not come from Bratislava. (This subspecies occurs in the Alps only.)]

Bratislava, granit (WIESBAUER, 1865 LI; as *S. soboliferum* and WIESBAUER 1867: 969; as *S. hirtum*). Stone heaps among vineyards at Bratislava (BOLLA 1844, SLO; BOLLA, 1856: 12; as *S. arenarium*). Bratislava, gneiss and granit (BOLLA, 1865 LI [ex Herb. WIESBAUER]; as *S. arenarium*).

[These data are probably connected with published data of WIESBAUER (1871: 40) and SABRANSKY (1882: 378); see data No. 3 and 4.]

2. Bratislava, above "Schlossberg" [Podhradie] (HATTLER 1865, BRNU [ex Herb. WIESBAUER]; as *S. hirtum*).

Bratislava, on the rock slopes of the Bratislava Castle hill, above Žižkova street (above former "Zuckermandel" [part of Podhradie]), altitude 170–200 m, south exposition (LETZ 1993, SLO).

3. Bratislava, "Schüllergrund" [the area approximately delimited by Mudroňova, Drotárska cesta and Na Hrebienku streets], at the way from "Friedlichen Hütte" [Mierová buda, probably between Drotárska cesta and Búdkova cesta streets] to Mlynská dolina (WIESBAUER, 1871: 40; as *S. hirtum*).

Bratislava, "Schüllergrund", on stone heaps (DEGEN s. a., BP; as *S. hirtum*).

Bratislava, at the way from "Friedlichen Hütte" to Mlynská dolina (SABRANSKY, 1882: 378; as *S. hirtum* f. *glabrescens*).

Bratislava, Mlynská dolina, sunny slopes (BÄUMLER s. a., BP; as *S. hirtum*).

[These data have not been confirmed during the present study.]

4. Bratislava, stone heaps along vineyards on so-called "Timlersberg" [Bôrik Hill] (SABRANSKY, 1882: 378; as *S. hirtum* f. *glabrescens*).

[This data has not been confirmed during the present study.]

5. Svätý Jur, on stone heaps among vineyards (BOLLA 1844, SLO; BOLLA, 1856: 12; as *S. arenarium*).

Svätý Jur, in vineyards (PTAČOVSKÝ 1939, SAV; as *S. hirtum*).

Malé Karpaty Mts, Svätý Jur, on stones among vineyards under Hájna hora Hill, altitude 200 m, south exposition, rare occurrence (LETZ 1993, SLO).

B. Habitats on limestone substratum

6. Malé Karpaty Mts, Borinka, rocks towards the west of the castle Pajštún, altitude 400 m, south exposition, rare occurrence (LETZ 1993, SLO).

7. Hainburg an d. Donau in Lower Austria (AUST 1888, PR; as *S. hirtum*).

Hundsheimer Berge Hills, Hundsheimer Berg hill at the town Hainburg, Lower Austria, rock parts (the north-west wing), altitude 350–380 m (NIKLFIELD, 1964: 162; GUTERMANN 1981, private herbarium; as *S. hirtum*).

Same locality, very abundant occurrence (found in 1994 by LETZ, unpubl.).

It is interesting that LUMNITZER (1791) only recognized *Sempervivum tectorum* L. from Bra-

tišlava. However, the specimen designated as *S. tectorum* in his herbarium (deposited in BP) is *Jovibarba globifera*. In HEUFFEL's own copy of LUMNITZER's Flora Posoniensis (deposited in BP) there is handwritten addition "S. hirtum fol. caul. petalorumque apicibus hirtis". It means also HEUFFEL (1800–1857) knew about an occurrence of *J. globifera* in Bratislava. Unconfirmed records from Devínska Kobyla Hill (MIKEŠ, 1938: 61; FERÁKOVÁ et al., 1989) probably belong to *S. tectorum* which is naturalized there in some places.

Data record number 2 is the only recent record of occurrence for *J. globifera* in the territory of Bratislava on a refugial, rock habitat (collected there already in 1856 by I. HATTLER, S. J. – WIESBAUER's order brother). Its autochthonous character is highly probable due to the longlasting existence of the rock scarp above the river Danube (on the south-west foot of the Castle hill, as it is seen on some historical panoramas of Bratislava with the castle). However, evaluation of the native status of this species needs careful consideration, because of the proximity of this locality to the center of Bratislava. Apart from suitable ecological conditions, native status of this species at this locality is supported by a spectrum of accompanying species: *Allium flavum*, *A. rotundum*, *Anthemis tinctoria*, *Asperula cynanchica*, *Bupleurum falcatum*, *Cerasus mahaleb* subsp. *simonkaii*, *Erysimum diffusum*, *Geranium rotundifolium*, *Lactuca viminea*, *Potentilla pedata*, *Hylotelephium maximum*, *Seseli elatum* and others which usually occur on natural habitats. The occurrence of *J. globifera* is situated only in the western area of open rocks, where vegetation is only weakly ruderalized. In the neighbouring area under the building of Parliament there is considerable ruderalization. The theory of an indigenous occurrence of *J. globifera* is also supported by the geographical connection of this locality with other historical distribution data (enumerated above), by the character of distribution of the population, and by morphological data – the plants from this locality are morphologically similar to other populations of *J. globifera* from the Malé Karpaty Mts and localities at lower altitude.

The enumerated survey of localities shows that most of the data related to the city area of contemporary Bratislava come from the second half of the last century. It is assumed that plants of *J. globifera* occurred on rock places and successively settled vineyard stone heaps. All these localities are similar in their ecological conditions, and are geographically connected (see map of distribution – Fig. 2). The area including all these lo-

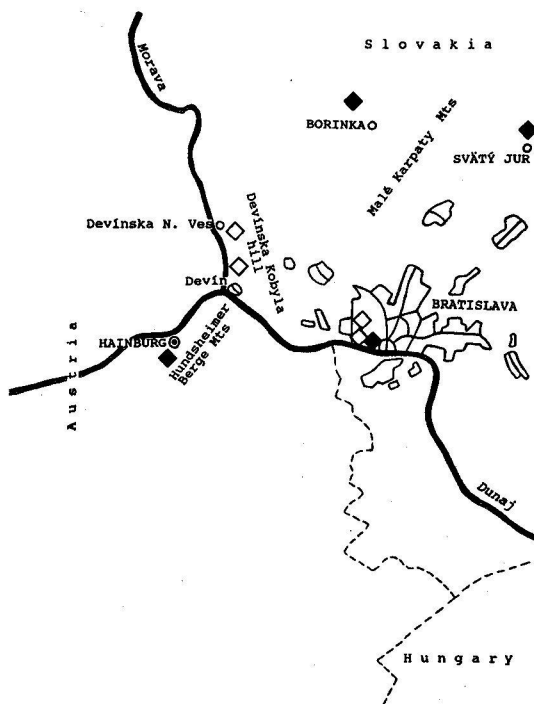


Fig. 2. The distribution map of *Jovibarba globifera* (L.) J. PARN. in the territory studied. ◆ – confirmed data, ◇ – unconfirmed data. (Orig.)

calities can be circumscribed by the streets of Štefánikova, Brnianska, Mlynská dolina and Nábrežie a. g. Svobodu. This is the beginning of the so-called Bratislava massif of the Malé Karpaty crystallinicum created by granodiorites and granites. Phytogeographically this area is intermediate between the regions Pannonicum and Carpathicum occidentale (the district of the Malé Karpaty Mts). For a long time this territory was used for viniculture, but recently, however, radical antropogenic changes have taken place in this area. Construction works, gardening, and quarrying, have been particularly important factors in changing the flora and vegetation (cf. BRTEKOVÁ, 1976). Therefore, it is not surprising that only one item of historical data (No. 2) has been confirmed. The locality above Svätý Jur (No. 5), which is to this date preserved, may provide a good example of a very similar habitat on granite rocks and stones in a grape-growing area.

Upon study of further Slovak localities of *Jovibarba* and *Sempervivum* the following ecological phenomena, in connection with the problem of native status, were observed. The occurrence of these plants is concentrated mostly on natu-

ral blocks of rock, outcrops and slopes. If these populations are not too severely destroyed they can be a source for recolonisation of damaged adjoining localities (e.g. abandoned quarries as at the locality at Trstín in the Malé Karpaty Mts) or other secondary habitats (e.g. the stone wall under railway track near Kralovany at the river Orava). Intensive vegetative propagation (shifting of rosettes) is the predominant mean of colonisation. The refugial character of natural rock environments provides a secure and stable long term habitat. Such habitats can serve as a reservoir for the spread of plants to nearby surroundings, either to less stable scree or to secondary habitats. Such a refugial habitat is also the larger open rock scarp above the river Danube which is probably the only remaining locality for *J. globifera* in the territory of Bratislava. The spread of this species to formerly uninhabited localities, without other than the possibility of vegetative propagation is probably only possible in the long term. This is because there is a low probability for seed distribution over long distance and natural barriers. The frequent occurrence of local, more or less isolated, topodemes of *J. globifera* and the inability of these plants to inhabit new habitats (e.g. artificial rock outcrops) also support this idea. Another important factor is probably the narrow ecological valency of the genus *Jovibarba*. The species of this genus are concentrated in places with successively settled conditions, where the interspecies competition is low. The combination of suitable soil, altitude and climate is further important factor. Most of the rock outcrops in Devínska Kobyla Hill are artificial. These are probably the reasons why *J. globifera* is absent at this locality, but, on the other hand, present in Hundsheimer Berge Hills (on the other side of the Danube) likewise as *Astragalus vesicarius* subsp. *albidus*, *Dracocephalum austriacum*, *Helictotrichon desertorum*, *Onosma visianii* (in the past stated from D. Kobyla), *Oxytropis pilosa*, *Poa badensis* (in the past stated from D. Kobyla), *Sesleria sadlerana* and others. The granite substratum and the climate of Bratislava seem to be favourable for this species. For example, at the locality above Žižkova street (data No. 2) where this species is relatively abundant – growing at its best in the half-shade of the shrub *Cerasus mahaleb*.

Conservation status and protection

In the second version of the Red List of Slovakia (MAGLOCKÝ et FERÁKOVÁ, 1993) the fol-

lowing taxa of *Jovibarba* are quoted: *J. hirta* subsp. *glabrescens* (Ed – endemic), *J. hirta* subsp. *tatrense* (Ed) and *J. sobolifera*. These taxa are placed in category I (indeterminate) – taxa potentially threatened, with uncertain status due to insufficient knowledge about their distribution. Lack of knowledge about the distribution of these taxa is caused by the unclear taxonomy of *J. globifera*, although this is under intensive study by the present author.

J. globifera is not rare in the Carpathians in Slovakia, and on suitable habitats it is often abundant. However protective measures do need to be undertaken for those easily accessible rock habitats near settlements. Populations which have recently been effected by quarrying, construction activities, alterations to terrain, and other forms of devastation, need special attention. Collection of plants for horticultural purposes is a less important factor of threat (due to the ability of these plants to multiply by vegetative propagation), except in localities where this taxon is rare.

The localities of this species in Bratislava and its vicinity are relatively few in number and they may be unambiguously placed in the group of threatened localities. These places are also valuable from the general floristic, faunistic and landscape-esthetic point of view. The locality above Žižkova street (above former "Zuckermandel") is particularly worthy of an attention, because it might be considered as the "locus classicus" of *S. hirtum* f. *glabrescens* SABR. (bearing in mind that the localities precisely specified by SABRANSKY have already been destroyed). The importance of this locality therefore increases because of the priority for the protection for the genetic resources of the flora, from a taxonomical point of view, as defined by HOLUB (1981). The locality above Žižkova street is a preserved remnant of an ecotop which has survived several destructive periods, which occurred during the history of Bratislava. This ecotop represents an important refuge of natural flora in the city, which has to be preserved and protected.

The locality among vineyards above Svätý Jur (data No. 5) is very suitable for preservation, as it is one of the last representative samples of this type of habitat in the south-west part of Malé Karpaty Mts.

After consideration of all the evidence quoted above, *Jovibarba globifera* (L.) J. PARN. is placed into the category V (vulnerable) of the Red List of Bratislava – a rare taxon with decreasing number of localities (cf. FERÁKOVÁ et al., 1994).

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