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SAMOBORSKO GORJE, A REFUGE OF VARIOUS FLORAL ELEMENTS BETWEEN THE ALPS AND THE DINARIC MOUNTAINS

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Because of its characteristic position between the South-east Alps and the North-west part of the Dinaric Mountains, Samoborsko gorje presents phytogeographically a bridge between the Alps and the Dinarids. For this reason we can find here Illyric-Dinaric, West-European, Balkan -Apennine and Pannonian species. A certain number of species are endemic to Samoborsko gorje, and a very significant number of species has their solitary localities in Samoborsko gorje isolated from the main part of the area. A separate, very well represented group of relicts consists of species designated as Illyricoid elements.

All these elements in Samoborsko gorje grow close to one another, and they give this territory a specific phytogeographical feature – that of an important refuge, owing in the first place to the dolomite as the lithological ground.

Introduction

The mountain chain of Samoborsko gorje, together with Žumberačko gorje (Gorjanci), by its geographical position, is wedged between the south-east Alps and the north-west Dinaric Alps (Fig. 1), while its eastern border closes the western part of the Pannonian region. As for its configuration, Samoborsko

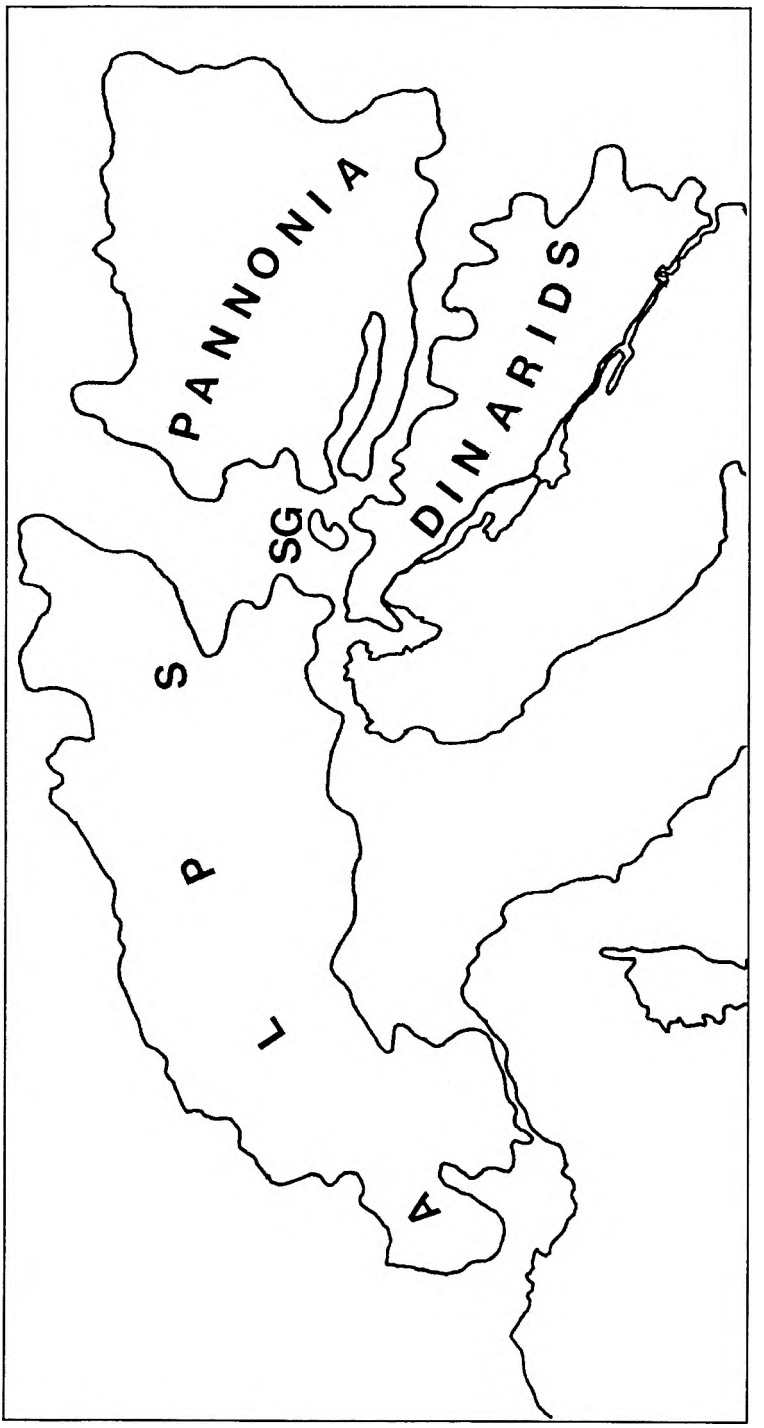

Fig. 1. Geographical position of Samoborsko gorje (SG)

gorje is very similar to the carbonate Alps in which steep slopes alternate with deep valleys. Such orography is caused in the first place by the dolomitic lithologic strata which due to their easy weathering facilitate the formation of peculiar geomorphological shapes. Since in some parts of both Samoborsko gorje and Žumberačko gorje various silicate rocks can also be found, this was the reason for the development not only of their very rich flora, but also of their characteristic vegetation.

On his scheme of the world floristic wealth Mališev (1975) indicated the Alps and the central part of' the Balkan Peninsula as floristically the richest part of Europe. According to his estimations in those regions about 3,000 or 4,000 plant species would grow per a surface unit of 100,000 sq.km. On the basis of Webb's (1978) estimations the flora of the Alpine countries, for instance, Switzerland (41,288 sq.km) would comprise about 2,600-2,700, and Austria (83,849 sq.km.) about 2,900-3,100 species. Here we could mention also the flora of Slovenia (20,226 sq.km.) which, with about 3,000 species according to the data of Martinčič and Sušnik (1985), also belongs to the regions having a relatively high concentration of plant species.

On the other hand, the flora of the Dinaric Alps is very rich, too. Thus, according to Rossi (1930), the flora of the Croatian Littoral comprises about 2,700 taxa, and that of Velebit, Lika and Plješivica about 3,700 taxa according to Degen (1936-37).

As already mentioned, Samoborsko gorje, situated between the Alps and the Dinarids as well as on the very border of the Pannonian region could be suitable for the development of a rich flora in this region. Early data (Rossi 1924) are relatively poor, but more recently Šugar (1972) made a list of the entire Samoborsko gorje flora comprising, according to that list approx. 890 species which grow on a surface area of about 100 sq.km.

Phytogeographical characteristics of Samoborsko gorje

If we consider the flora of Samoborsko gorje in a wider phytogeographical context by following the early investigations by A. Kerner (1863), Beck (1907, 1908, 1913) and Hayek (1923), as well as those more recent ones by I. Horvat (1929) or Niklfeld (1973), we can note a great number of its peculiarities. In addition to the species which in general are characteristic of this part of Europe, such as *Fagus sylvatica*, *Carpinus betulus*, *Corylus avellana*, *Acer pseudoplatanus*, *A. platanoides*, *A. campestre*, *Alnus glutinosa*, *Crataegus monogyna*, *Anemone nemorosa*, *Galanthus nivalis*, *Bromus,erectus*, *Salvia pratensis* etc., we find here, on this relatively small space, many species also of a very limited distribution or such as have in Samoborsko gorje their solitary or even only localities in this part of Europe.

Because of its characteristic position, Samoborsko gorje presents phytogeographically a bridge between the Alps and the Dinarids and the boundary

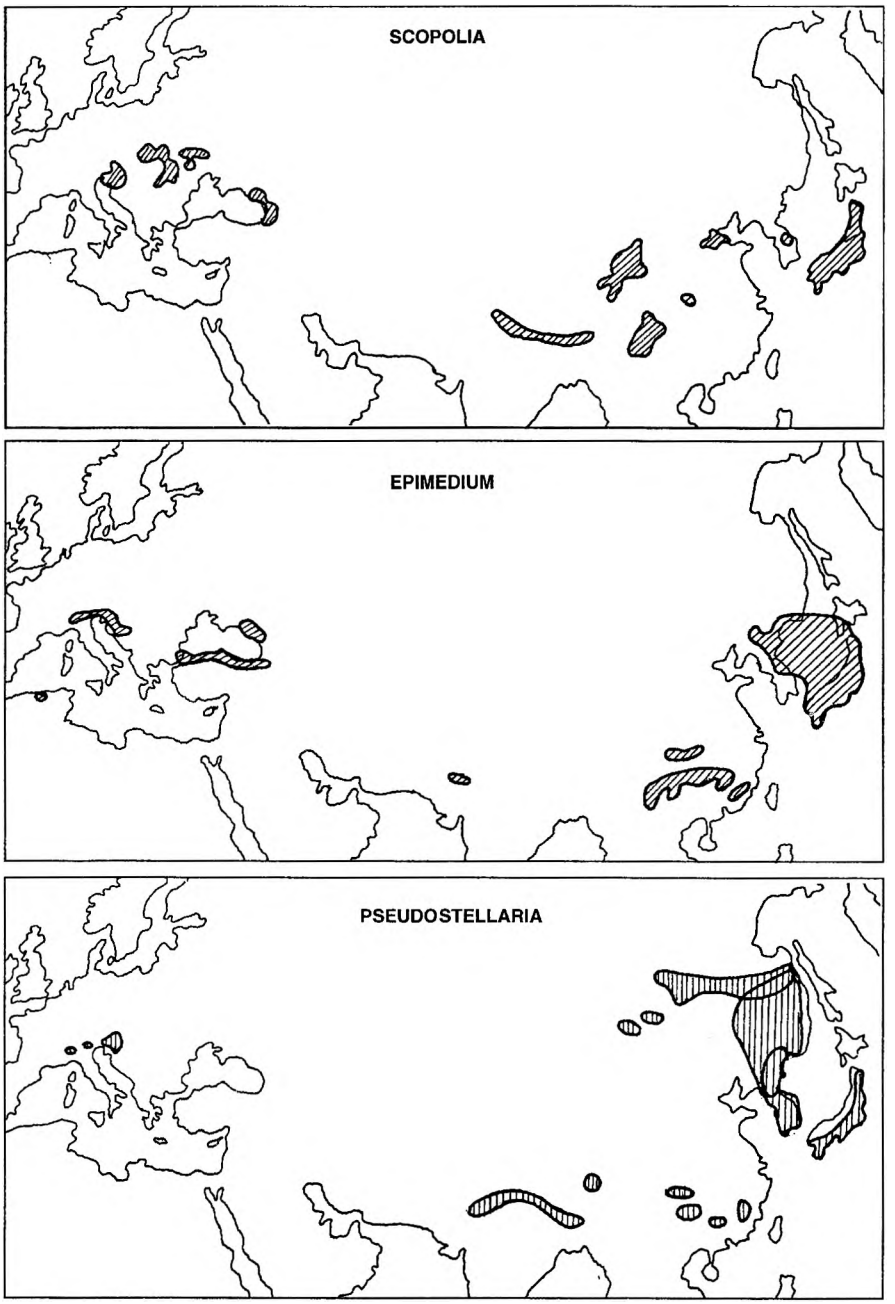

Fig. 2. Distribution of the genus *Scopolia* (*Meusel* et al. 1978); *Epimedium* and *Pseudostellaria* (Meusel et al. 1965)

region between West and South-East Europe; therefore, we can find here not only Illyric-Dinaric species but also West-European species, (such as *Calluna vulgaris, Ilex aquifolium*), together with the Balkan - Apennine ones, *Acer obtusatum* for instance. A certain number of species are endemic in Samoborsko gorje and a relatively small, but very significant number of species have in Samoborsko gorje their solitary localities isolated from the main parts of their areas. A separate, very well represented group of relicts of species has only recently (Trinajstić 1992) been designated as Illyricoid elements.

As all the above mentioned elements in Samoborsko gorje grow close to one another, they give to this area a specific phytogeographical feature, i.e. the feature of an important refuge (cf. Petkovšek 1954, Niklfeld 1970, Šercelj 1970) but also, partly, that of a relatively limited genetic centre in this part of Europe, owing in the first place to the dolomite as the lithological ground. In this connection, we could define several important phytogeographical groups, on the presumption that the areas of particular phytogeographically characteristic species did not form accidentally, but that by their form they reflect a certain sequence of ecological conditions during the near geological past. These are:

Illyricoid elements
Mountain species in the lowland refuge
Boreal species in the lowland refuge
Illyrian species on the N-W border
Alpine species on the S-E border
West Pannonian endemic species
Samobor stenoendems
Isolated Samobor localities of species with different distribution
Sarmatian elements

Illyricoid elements

As pointed out recently (Trinajstić 1992), this group of elements of mesophilous forest vegetation so far has been limited in its distribution to the N-W part of the Illyrian phytogeographical province, giving a false impression of belonging to the Illyrian floral element. In Samoborsko gorje, practically all species indicated by us as Illyricoid floral element are represented. Among them, several characteristic sub-groups predominate. Thus, the species

Epimedium alpinum
Pseudostellaria europaea
Scopolia carniolica

are the only representatives of the genera whose centre of distribution nowadays is in East Asia (Fig. 2; 3 F).

The other, markedly relict group of species is represented by the species of monotypic genera. These are (Fig. 5 A)

Aposeris foetida
Aremonia agrimonoides
Hacquetia epipactis

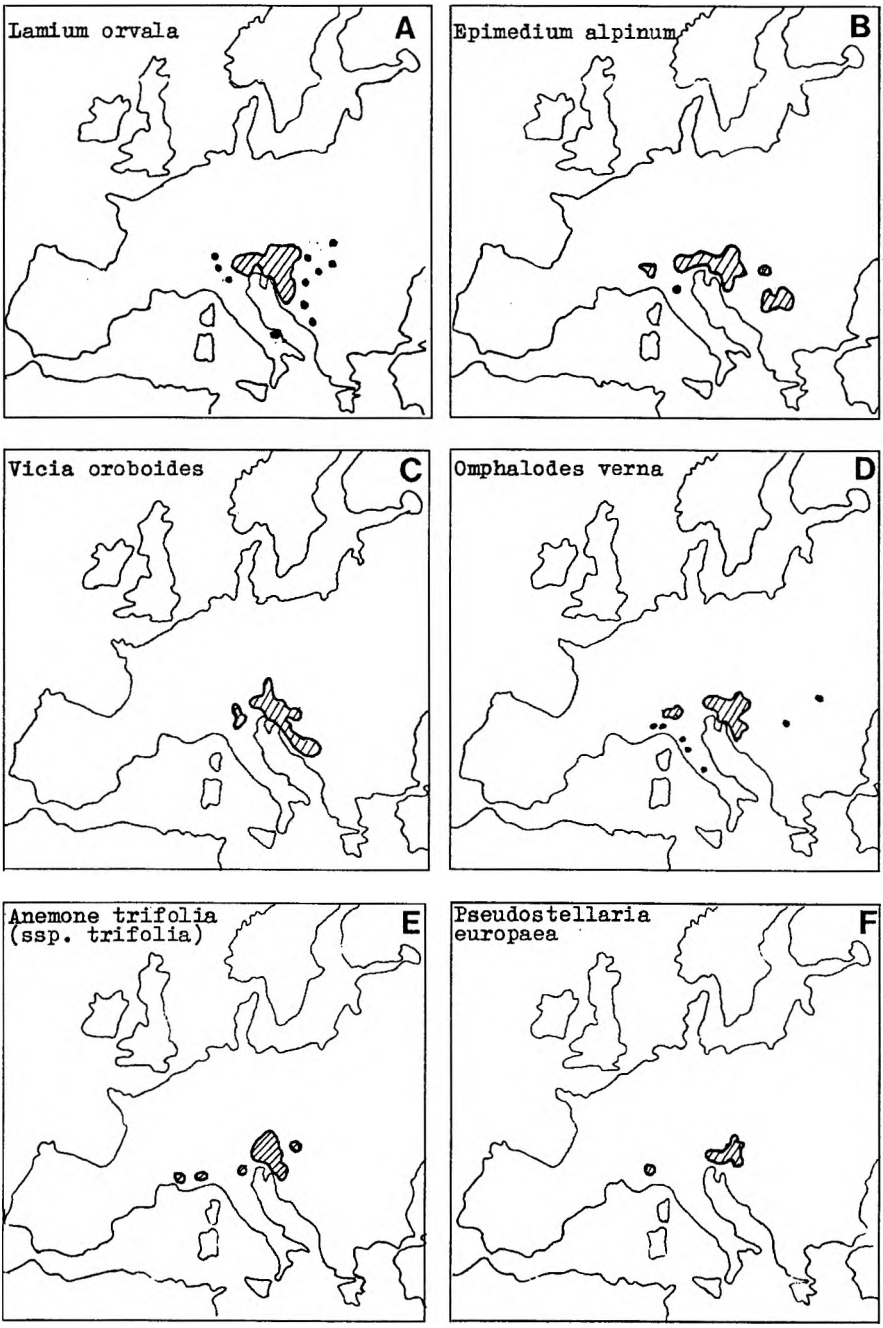

Fig. 3. Illyricoid elements – A (Trinajstić 1992); B, E, F (Meusel et al. 1965); C, D (Meusel et al. 1978)

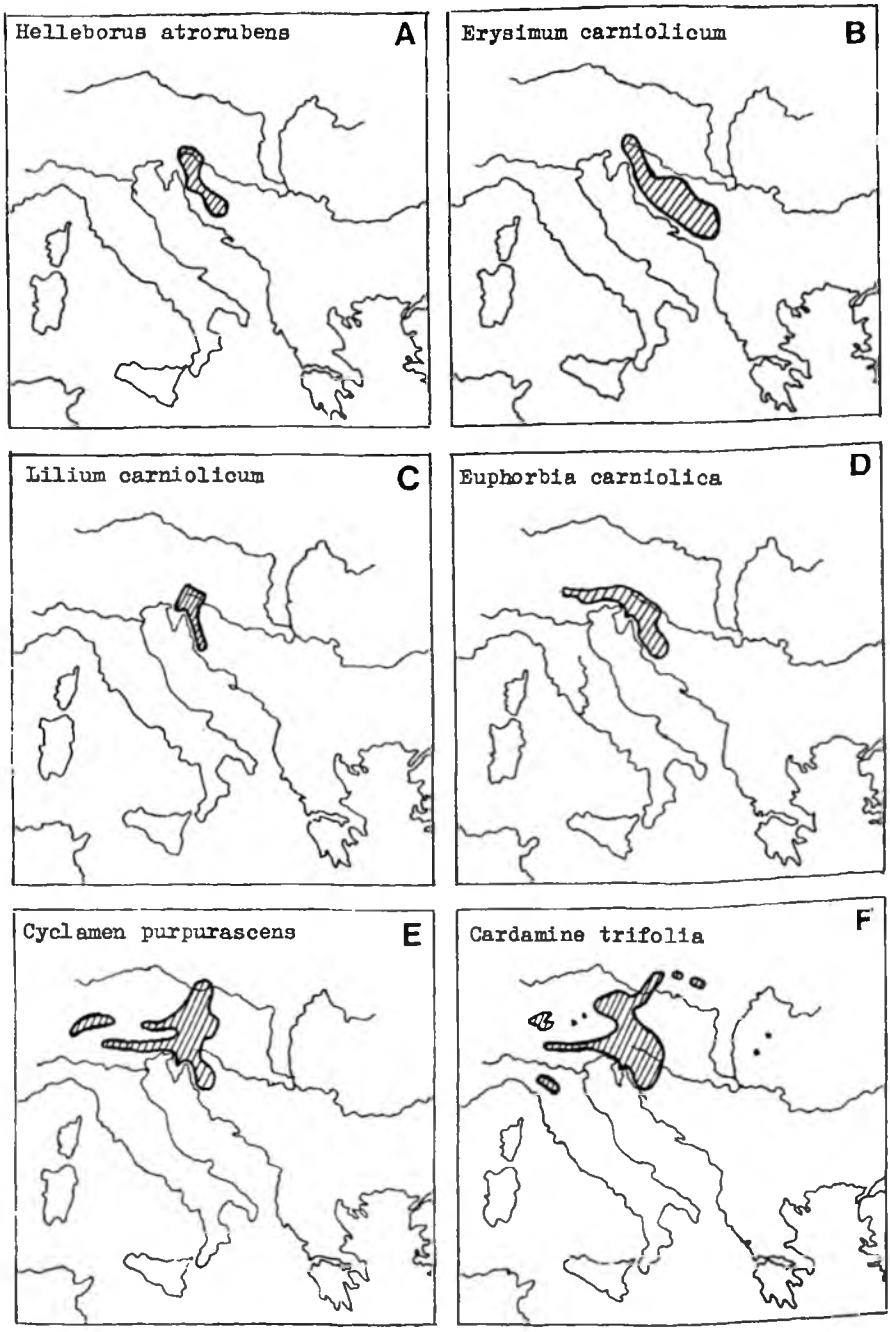

Fig. 4. Illyricoid elements – A, D, F (Meusel et al. 1965); E (Meusel et al. 1978); Illyrian elements – B (Jalas and Suominen 1994); C (orig.)

The third sub-group is represented by the species which within the polymorphous genera belong to separate taxonomically isolated sub-genera. These are (Fig. 3 A-D; 6 A)

Geranium phaeum
Helleborus niger
Lamium orvala
Omphalodes verna
Senecio ovirensis
Vicia oroboides

Finally, the fourth sub-group is represanted by species of polymorphous genera which have recently become distributed in the Illyrian space only or have their solitary localities in the adjacent regions, but which are not taxonomically isolated. These are (Figs.3 E; 4 A, D, E, F)

Anemone trifolia
Cardamine trifolia
Carex pilosa
Cerastium sylvaticum
Cyclamen purpurascens
Erythronium dens-canis
Euphorbia carniolica
Euphorbia dulcis
Helleborus atrorubens
Homogyne sylvestris
Knautia drymeia
Laserpitium peucedanoides
Potentilla carniolica

A special curiosity are the species of the genus *Dentaria* whose exact centre of differentiation is in the south Alpine – west Illyrian part of Europe. In Samoborsko gorje the following species of the genus *Dentaria* are represented (Fig. 5 B; 8 D)

Dentaria bulbifera
Dentaria ennaeaphyllos
Dentaria polyphylla
Dentaria trifolia

Mountain species in the lowland refuge

In Samoborsko gorje, there is a small group of species found generally in shady places in beech forests. It comprises:

Asplenium viride
Valeriana tripteris
Veronica urticifolia

Boreal species in the lowland refuge

Due to the very warm dolomitic ground, this specific group in Samoborsko gorje is represanted by three species only which are connected with silicate rocks. These are

Betula pubescens
Equisetum hyemale
Ranunculus cassubicus

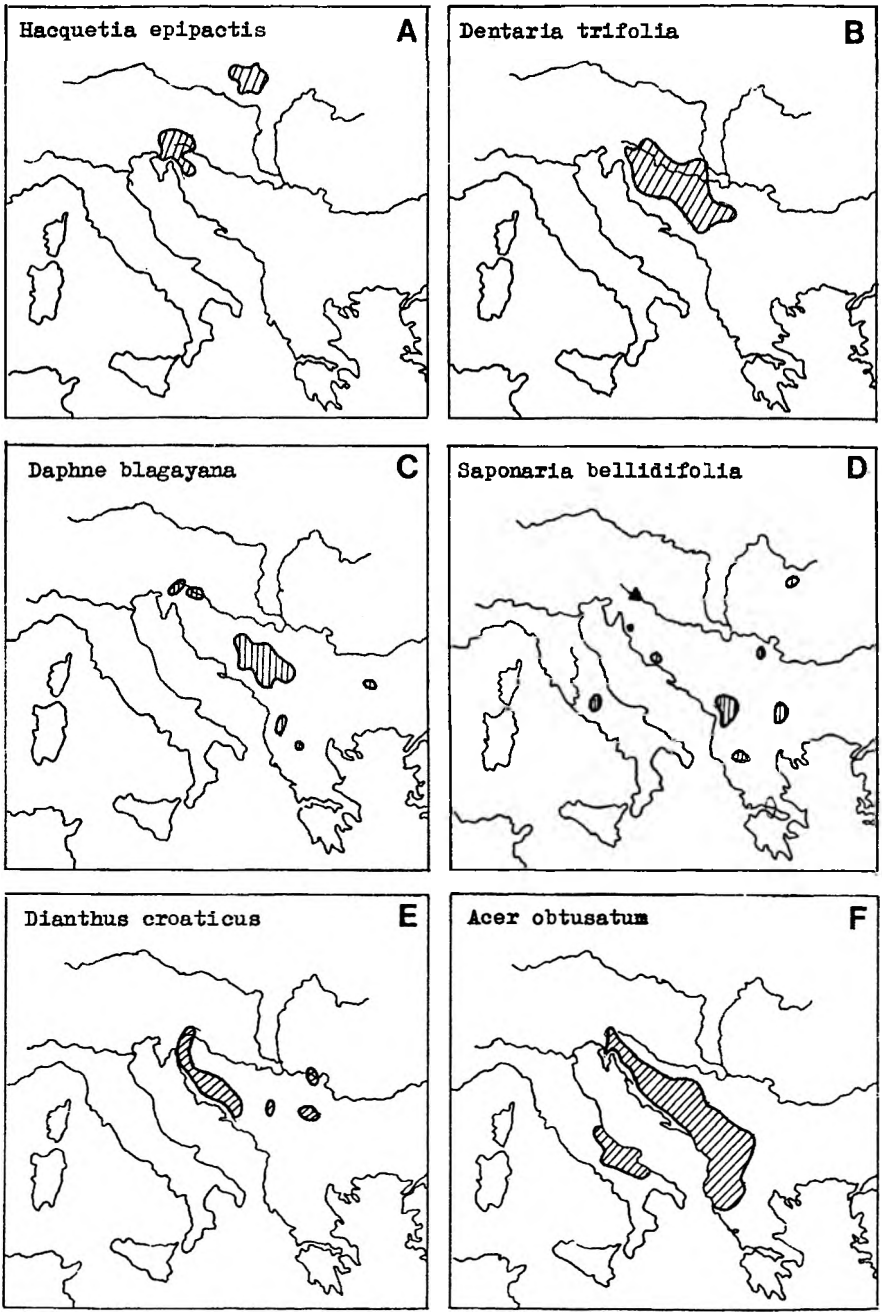

Fig. 5. Illyricoid elements – A (Meusel et al. 1978); B (Trinajstić 1990); Illyrian elements – C (Meusel et al. 1978); E (Jalas and Suominen 1986 corr.); Illyrian-appennine elements D (Jalas and Suominen 1986 corr.); F (Fukarek 1975)

Illyrian species on the N-W border

The warm dolomitic lithological ground is the main reason why in Samoborsko gorje many typical Illyrian species are found more or less widely spread but here they are all located on the N-W border of their range in this part of Europe.

Among them are the following west-illyric species of limited distribution (Fig. 4 B; 8 F)

Erysimum carniolicum
Lilium carniolicum
Silene hayekiana

The following species have a little larger Illyrian distribution (Fig. 5 C, E; 6 F; 8 E)

Cytisanthus radiatus
Daphne blagayana
Dianthus croaticus
Polygala chamaebuxus

while the species *Acer obtusatum* spreads in addition to the Illyrian space, to the central part of the Apennine Peninsula (Fig. 5 F) as well (cf. Fukarek 1975).

Alpine species on the S-E border

A small group of species, also connected with the dolomitic ground, exists in Samoborsko gorje practically on its south-east border. Along the coastal Dinaric Alps only these species are distributed in the south-east direction but without passing toVelebit. In Samoborsko gorje these are the species (Fig. 6 C)

Campanula thyrsoides subsp. *thyrsoides*
Daphne cneorum
Genista januensis
Leontodon incanus

West-Pannonian endemic plants

The typical Pannonian endemic plants are connected with the lowland of Pannonia, and partly with the saline (halophitic) soils as well. In the Pannonian region on the dolomitic hills of its western part in Austria, Slovenia, Croatia and Hungary many endemic species of particular polymorphous and progressive genera with a relatively limited distribution have been differentiated. In Samoborsko gorje these are (Fig. 8 A, B)

Iris croatica
Sesleria kalnikensis

Samobor stenoendemic species

In Samoborsko gorje only one stenoendemic species has been discovered so far. This is *Alyssum samoborense* (Kušan 1970) which later was included

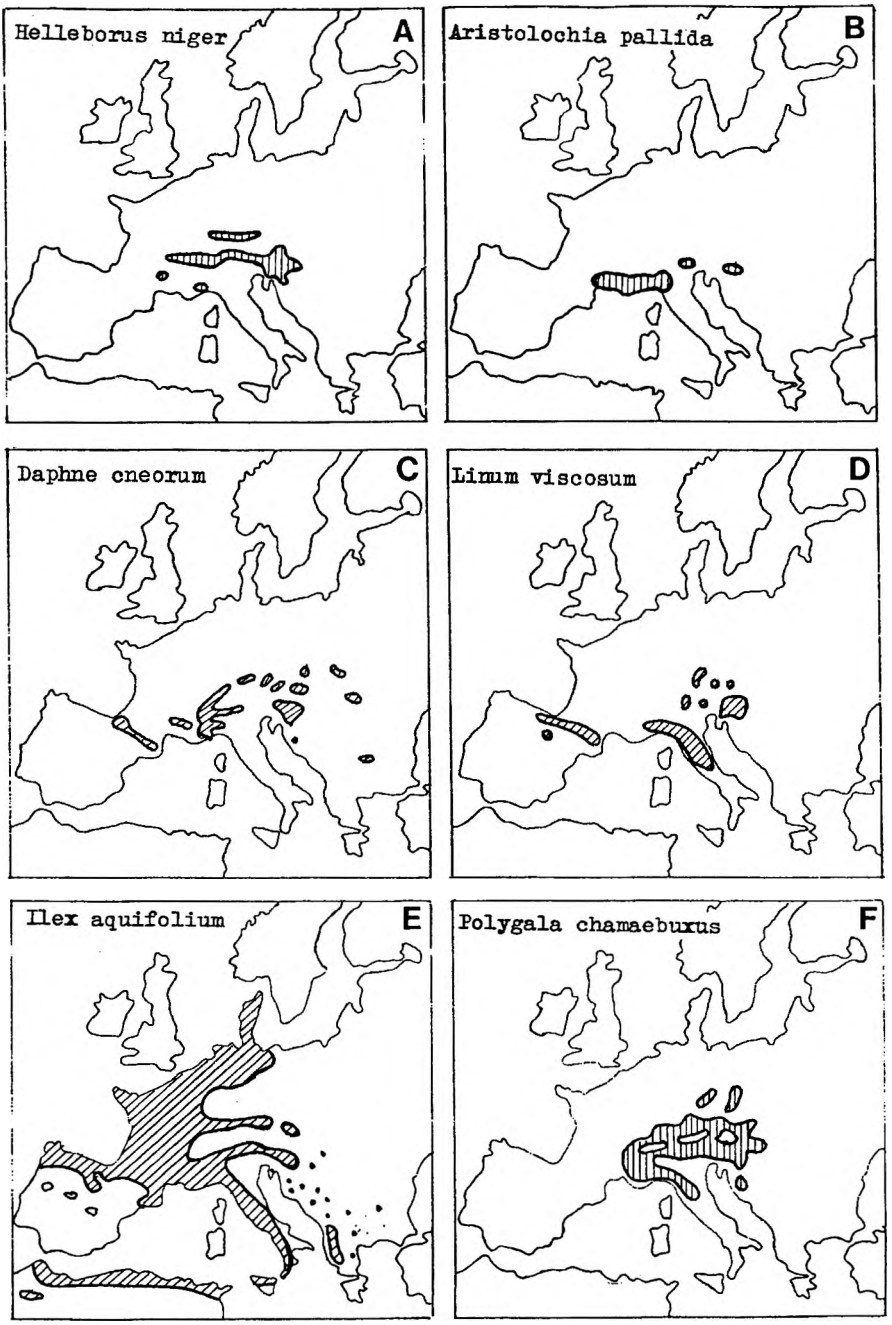

Fig. 6. Illyricoid elements – A (Meusel et al. 1965); Alpine elements B (Trinajstić 1990a); C, D, F; West European elements E (Meusel et al. 1978)

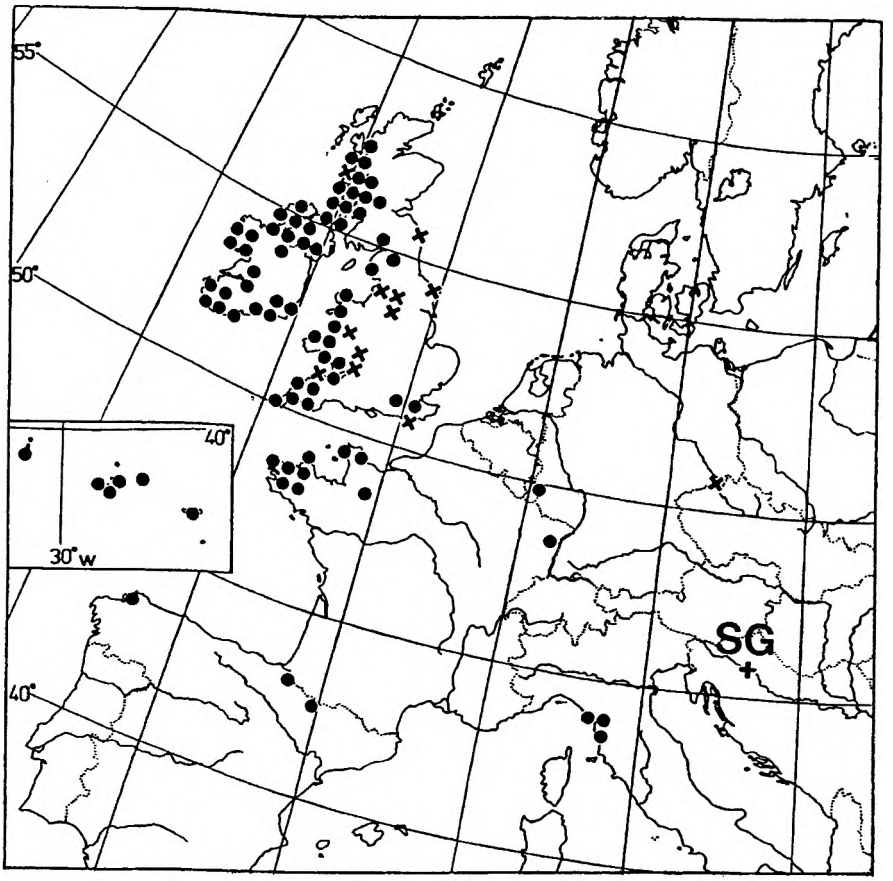

Fig. 7. Distribution of the species *Hymenophyllum tunbrigense* (Jalas and Suominen 1972)

(Trinajstić 1983) into the complex of the species *A. montanum*. However, *A. samoborense*, as reported orally by T. Wraber is a hexaploid (2n = 6x) so it could perhaps be considered as a separate species (Fig. 8 C).

Isolated Samobor localities of rare species of Croatian flora

Relatively large numbers of species of different recent distribution all over Europe have in Samoborsko gorje either their only locality, or their few localities in the Croatian flora.

The only locality (cf. Hirc 1903, Degen 1906, Pevalek 1930) has been noted for the species (Fig. 5 D; 7)

Hymenophyllum tunbrigense
Saponaria bellidifolia

although neither of these two species has been found again lately.

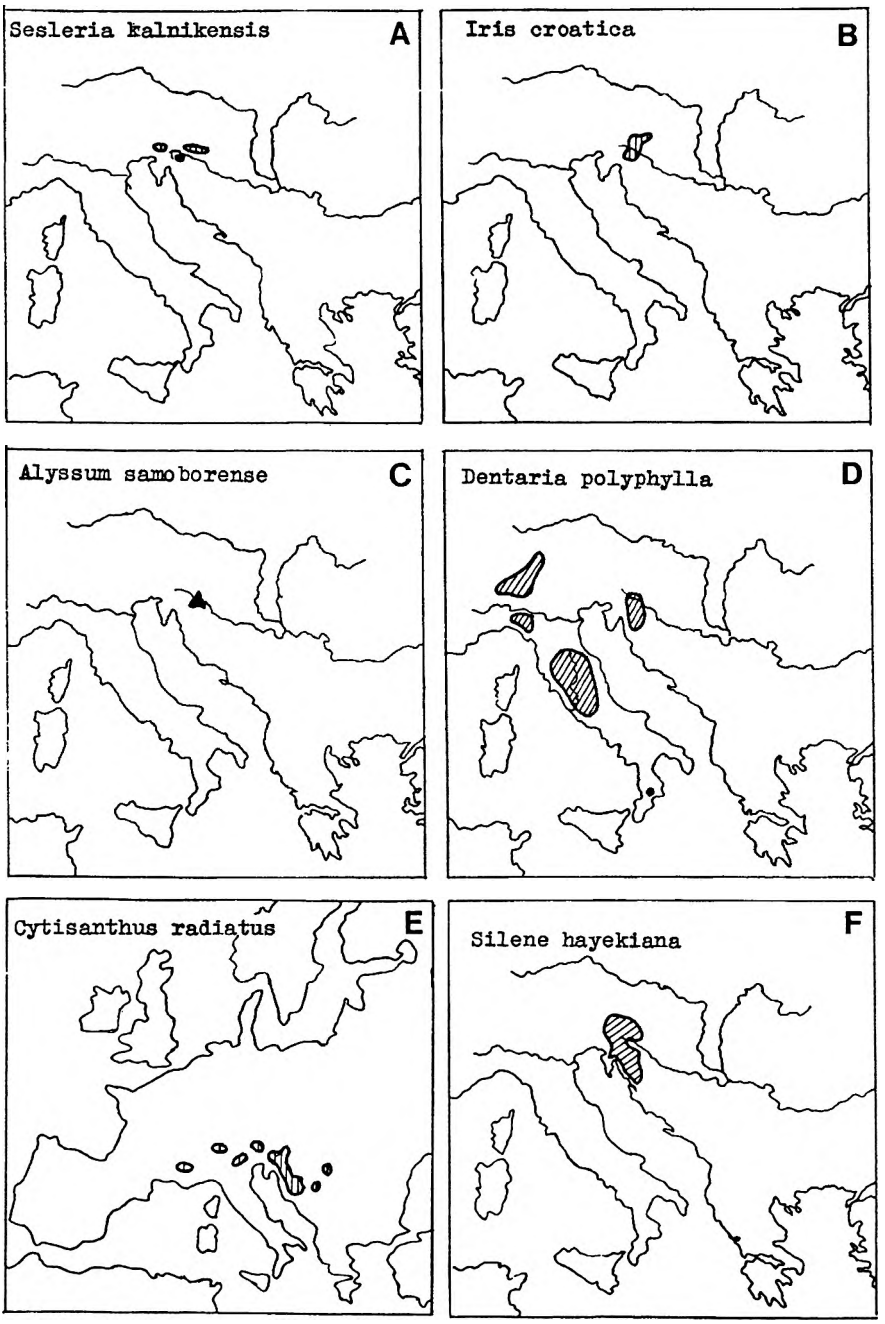

Fig. 8. Westpannonian endemic plants – A, B; Samobor endemic plants – C (orig.); Mountain elements – D (Meusel et al. 1965); E (Meusel et al. 1978); Illyrian endemic plants – F (*Jalas* and *Suominen* 1986 modif.).

The following species from Samoborsko gorje have few localities in the Croatian flora (Fig. 6 B, D, E)

Aristolochia pallida
Ilex aquifolium
Linum viscosum
Staphyllea pinnata

Sarmatian elements

From this geoelement, in Samoborsko gorje the following species are represented:

Aster amellus
Evonymus verrucosa
Hierochloë australis
Lathyrus niger

Conclusion

A chorollogical and phytogeographical analysis of some characteristic plant species of Samoborsko gorje shows that Samoborsko gorje is an important refuge in which during the near geological past the species of different florogenetic origin and of different phylogenetic age found their shelter and have been preserved until these days. As the most important among them, the following groups of species can be mentioned:

Illyricoid elements
Mountain species in the lowland refuge
Boreal species in the lowland refuge
Illyrian species on the N-W border
Alpine species on the S-E border
West Pannonian endemic species
Samobor stenoendem
Isolated Samobor localities of species with different distribution
Sarmatian elements

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SAŽETAK

SAMOBORSKO GORJE – REFUGIJALNO PODRUČJE RAZLIČITIH FLORNIH ELEMENATA IZMEĐU ALPA I DINARIDA

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Zbog svoga značajnog geografskog položaja Samoborsko gorje predstavlja, u fitogeografskom smislu, most između Alpa i Dinarida, te dio zapadne granice Panonske nizine u najširem smislu, kao i granično područje između zapadne i jugoistočne Europe. Zato je tu, na razmjerno malenom prostoru skupljeno mnoštvo biljnih vrsta vrlo različite geneze i različite recentne rasprostranjenosti. To Samoborskom gorju daje obilježje dobro izraženoga refugija, što se najvećim dijelom može zahvaliti upravo dolomitnoj litološkoj podlozi, a manjim dijelom mjestimičnoj zastupljenosti različitih silikatnih stijena.

U radu su istaknute sljedeće značajne fitogeografske skupine:

Ilirikoidni elementi
Planinske vrste u nizinskom refugiju
Borealne vrste u nizinskom refugiju
Ilirske vrste na sjeverozapadnoj granici
Alpske vrste na jugoistočnoj granici
Zapadnopanonske endemične vrste
Samoborski stenoendemi
Izolirana samoborska nalazišta vrsta različite rasprostranjenosti
Sarmatski elementi

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