



THE FLORA OF STUPNIK AND ITS SURROUNDINGS (NORTHWEST CROATIA)

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Stupnik is located in northwest Croatia, 10 km southwest of the city of Zagreb, and the researched area includes villages of Gornji Stupnik and Donji Stupnik, as well as smaller parts of the villages Kalinovica and Lučko. The area was floristically researched in the period from 2002 to 2005 during vegetation seasons. A total of 454 taxa of vascular plants from 81 families were found. Of the identified taxa, the most belonged to Poaceae (8.4%), Asteraceae (7.5%), Fabaceae (5.9%), Lamiaceae (5.8%) and Rosaceae (4.7%). In the life form spectrum hemicryptophytes were dominant (225 taxa; 49.6%), therophytes were also numerous (109 taxa; 24.0%), followed by phanerophytes (50 taxa; 10.9%), geophytes (45 taxa; 10.0%), chamaephytes (14 taxa; 3.1%), and hydrophytes (11 taxa; 2.4%). Phytogeographical analysis showed that Euro-Asiatic geoelement (148 taxa; 32.5%) was predominant, followed by cosmopolites (126 taxa; 27.7%), the European (52 taxa; 11.5%), South-European (41 taxa; 9.0%), Circum-Holarctic geoelement (33 taxa; 7.3%) and Central-European geoelement (19 taxa; 4.2%). The Mediterranean geoelement encompassed 9 taxa (2.0%), the East European-Pontic four taxa (0.9%), the Atlantic two taxa (0.4%), as well as the Southeast European (0.4%) geoelement. The Illyrian-Balkan geoelement was represented by only one species (0.2%). Neophytes were represented with 17 taxa (3.7%) and most of them are invasive alien species. Four species (*Lilium martagon*, *Alopecurus geniculatus*, *Carex vesicaria* and *Glyceria fluitans*) belong to VU category according to the Red Book.

Key words: flora, Stupnik, northwest Croatia

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Stupnik se nalazi u sjeverozapadnoj Hrvatskoj, 10 km jugozapadno od Zagreba. Istraživano područje obuhvaća sela Gornji i Donji Stupnik, te manje dijelove sela Kalinovica i Lučko. Područje smo floristički istraživali tijekom vegetacijske sezone u periodu od 2002. do 2005. godine. Zabilježili smo 454 svojiti vaskularnih biljaka koje pripadaju u 81 porodicu. Najbrojnije porodice su Poaceae (8.4%), Asteraceae (7.5%), Fabaceae (5.9%), Lamiaceae (5.8%) i Rosaceae (4.7%). U spektru životnih oblika dominiraju hemikriptofiti (225 svojiti; 49.6%), brojni su terofiti (109 svojiti; 24.0%), slijede fanerofiti (50 svojiti; 10.9%), geofiti (45 svojiti; 10.0%), hamefiti (14 svojiti; 3.1%) i hidrofiti (11 svojiti; 2.4%). Fitogeografska analiza pokazala je da dominira euroazijski florni element sa 148 svojiti (32.5%),

slijede široko rasprostranjene biljke (126 svojti; 27.7%), europski florni element (52 svojte; 11.5%) te južnoeuropski (41 svojta; 9.0%) i cirkumholarktički florni element (33 svojte; 7.3%). Srednjeeuropski florni element zastupljen je s 19 svojti (4.2%), mediteranski s 9 svojti (2.0%), istočnoeuropsko-pontski s četiri svojte (0.9%), atlantski s dvije svojte (0.4%), isto kao i jugoistočnoeuropski (dvije svojte; 0.4%). Ilirsko-balkanski florni element je zastupljen sa samo jednom vrstom (0.2%). Na istraživanom području zabilježili smo 17 (3.7%) neofita, koji su većinom i invazivne vrste. Prema Crvenoj knjizi, četiri vrste (*Lilium martagon*, *Alopecurus geniculatus*, *Carex vesicaria* i *Glyceria fluitans*) pripadaju kategoriji osjetljiva vrsta (VU).

Ključne riječi: flora, Stupnik, sjeverozapadna Hrvatska

INTRODUCTION

Study area

Stupnik is a site in northwest Croatia, 10 km southwest of the city of Zagreb (Fig. 1). The total area of the researched area is 19.2 km² and it borders with the Stara Karlovačka road, the Zagreb-Rijeka railway and the Zagreb-Karlovac motorway. The researched area includes the villages of Gornji Stupnik and Donji Stupnik, as well as smaller parts of the villages Kalinovica and Lučko, and a small part of Stupnički lug Special Reserve of Forest Vegetation. The researched area is located in the MTB square units 0260/2, 0260/4, 0261/1 and 0261/3 (according to NIKOLIĆ *et al.*, 1998).

So far there have been no floristic records for the investigated area of Stupnik, except for the data on about 52 vascular plants (RAUŠ *et al.*, 1987) from the Stupnički lug Special Reserve of Forest Vegetation. No other floristic surveys of this area exist. The closest area covered by floristic and vegetation studies is a part of the Sava plain from the settlements Lučko and Ježdovec to the banks of the Sava River (URBIHA, 1964), which is in continuation with the northeast border of our researched area. That area is also partially covered by studies of the flora of Turopolje (HULINA, 1989). During research into the ruderal vegetation of continental parts of Croatia, MARKOVIĆ-GOSPODARIĆ (1965) found 17 taxa on a pasture near the Sava side channel in the vicinity of Lučko. While studying the distribution of a neophyte, *Reynoutria japonica* Houtt., in Croatia, TRINAJSTIĆ *et al.* (1994) mentioned Lučko and Rakov Potok (the settlement which spans through the west border of the researched area) as its localities.

The forest community *Epimedio-Carpinetum* (Horvat 1938) Borhidi 1963 (= *Querceto-Carpinetum croaticum* Horvat 1938) is regarded to be the clima zonal community of northwest Croatia (HORVAT, 1949; MARINČEK, 1994).

However, that community is to be found on hilly ground, while in the lowlands, where our study area is located, wet forests of common oak, meadows and plough lands are present. In the forest of Stupnički lug the common oak appears in several community types: *Lonicero caprifoliae-Quercetum roboris* (Rauš 1971) Marinček 1994 s. lat. (= *Carpino betuli-Quercetum roboris* Anić 1959), and *Genisto elatae-Quercetum roboris* Horvat 1938 (ANONYMUS, 1998; HULINA, 1989). One of the characteristics of the area of Stupnik is considerable fragmentation of land into small areas in private owner-

ship, on which maize and other cereals are usually grown, together with smaller areas with other diverse cultivated plants. Meadows are presented with several community types: *Deschampsietum caespitosae* Horvatić 1930 is common within both in forest complexes and its edges, *Caricetum tricostrato-vulpinae* Horvatić 1930 is pre-



Fig. 1. Geographical position of Stupnik (northwest Croatia).

sent on wetlands, while *Bromo-Cynosuretum cristati* Horvatić 1930 and *Arrhenatheretum elatioris* Br.-Bl. 1925 are present on somewhat raised and more permeable terrain. Near the villages, weed and ruderal communities are developed, *Lolio-Plantagineum majoris* Beger 1930 (ANONYMUS, 1998) being the most widespread. The whole area is covered with numerous canals and side channels, with different wetland communities with *Phragmites* and *Carex* spp.

The researched area is a part of the alluvial plan of the Sava River, located on the border of Turopolje region (ANONYMUS, 1998). It is a lowland area with minor altitude differences ranging between 120 and 140 m.

In the Stupnik area, most of the aforementioned plant communities are developed on mineral-marsh soils. These soils are wet during the spring and autumn, sometimes even flooded, whereas during the summer they are dry.

According to the climate classification by Köppen, the investigated area belongs to the temperate C climate (warm-temperate rainy climate) (CRKVENČIĆ *et al.*, 1974).

As floristic surveys in the research area of Stupnik had been sporadic, the aim of the study was to complete this gap, as a part of the floristic studies of Zagreb and its surroundings, which are in progress (cf. <http://hirc.botanic.hr/BioDiv/>). Therefore most of the taxa of the vascular flora for the area of Stupnik are recorded here for the first time.

METHODS

The floristic survey was performed between 2002 and 2005 during the vegetation season. Standard methods of floristic research were used (NIKOLIĆ *et al.*, 1998). Identification of plants was carried out using the following keys: HEGI (1954), TUTIN *et al.* (1964–1993), JAVORKA & CSAPODY (1979), DOMAC (1994), ROTHMALER (1995). The nomenclature used is in agreement with NIKOLIĆ (1994, 1997, 2000, 2007). After the Latin name of a taxon, in brackets, the life forms and chorological types (geoelements) are attributed to each taxon listed in Results. Invasive alien species and threatened taxa are separately marked. Life forms were interpreted according to ELLENBERG *et al.* (1991) and phytogeographical analysis followed HORVATIĆ (1963) and HORVATIĆ *et al.* (1967–1968). For taxa not listed there OBERDORFER (1994), TOMAŠEVIĆ (1998), MARTINČIĆ *et al.* (1999) and ALEGRO *et al.* (2006) are used. Invasive taxa are presented according to NIKOLIĆ (2007) and threatened taxa according to NIKOLIĆ & TOPIĆ (2005). Life form categories are denoted with the following abbreviations: T – therophytes, Hy – hydrophytes, G – geophytes, H – hemicryptophytes, Ch – chamaephytes, and Ph – phanerophytes. Geoelements were described with the following numbers: 1 – Mediterranean, 2 – Illyrian-Balkan, 3 – South-European, 4 – Atlantic, 5 – East European-Pontic, 6 – Southeast-European, 7 – Central-European, 8 – European, 9 – Eurasian, 10 – Circum-Holarctic, 11 – Cosmopolites and 12 – Neophytes. Invasive taxa are denoted with the code IAS (invasive alien species). Threatened taxa are denoted following the IUCN categorisation. Taxa previously recorded in the research area (RAUŠ *et al.*, 1987) are marked with the symbol * after the taxa name.

RESULTS

List of taxa

PTERYDOPHYTA

Equisetaceae

Equisetum arvense L. (G, 10)

Equisetum telmateia Ehrh. (G, 10)

Dryopteridaceae

Dryopteris filix-mas (L.) Schott * (H, 11)

Hypolepidaceae

Pteridium aquilinum (L.) Kuhn. (G, 11)

Woodsiaceae

Athyrium filix-femina (L.) Roth. * (G, 10)

SPERMATOPHYTA

CONIPHEROPHYTINA

Pinaceae

Pinus strobus L. (Ph, 12)

MAGNOLIOPHYTINA

Magnoliatae

Aceraceae

Acer campestre L. (Ph, 8)

Acer negundo L. (Ph, 12, IAS)

Acer pseudoplatanus L. (Ph, 8)

Adoxaceae

Adoxa moschatellina L. (G, 10)

Amaranthaceae

Amaranthus hybridus L. (T, 11)

Amaranthus retroflexus L. (T, 11, IAS)

Apiaceae

Aegopodium podagraria L. * (H, 9)

Angelica sylvestris L. (H, 9)

Carum carvi L. (H, 9)

Chaerophyllum bulbosum L. (H, 9)

Daucus carota L. (H, 9)

Heracleum sphondylium L. (H, 9)

Oenanthe banatica Heuff. (H, 6)

- Pastinaca sativa* L. (H, 9)
Peucedanum oreoselinum (L.) Moench (H, 8)
Pimpinella major (L.) Huds. (H, 8)
Sanicula europaea L. (H, 11)
Torilis japonica (Houtt.) DC. (T, 9)

Apocynaceae

- Vinca minor* L. (Ch, 8)

Araliaceae

- Hedera helix* L. (Ph, 8)

Aristolochiaceae

- Asarum europaeum* L. * (H, 9)

Asclepiadaceae

- Asclepias syriaca* L. (G, 12, IAS)
Vincetoxicum hirundinaria Medik. (H, 9)

Asteraceae

- Achillea millefolium* L. (H, 11)
Ambrosia artemisiifolia L. (T, 12, IAS)
Anthemis arvensis L. (T, 11)
Arctium tomentosum Mill. (H, 9)
Artemisia vulgaris L. (H, 11)
Bellis perennis L. (H, 7)
Bidens frondosa L. (T, 12, IAS)
Buphtalmum salicifolium L. (H, 7)
Carduus acanthoides L. (H, 3)
Centaurea cyanus L. (T, 11)
Centaurea nigrescens Willd. (H, 3)
Chamomilla recutita (L.) Rauschert (T, 11)
Chamomilla suaveolens (Pursh) Rydb. (T, 12, IAS)
Cirsium acaule Scop. (H, 9)
Cirsium arvense (L.) Scop. var. *horridum* Wimm. et Grab. (G, 9)
Cirsium arvense (L.) Scop. var. *vestitum* Wimm. et Grab. (G, 9)
Cirsium vulgare (Savi) Ten. (H, 9)
Conyza canadensis (L.) Cronquist (T, 12, IAS)
Doronicum austriacum Jacq. (H, 3)
Erigeron annuus (L.) Pers. (H, 12, IAS)
Eupatorium cannabinum L. * (H, 9)
Galinsoga parviflora Cav. (T, 12, IAS)
Inula salicina L. (H, 9)
Leucanthemum irtutianum DC. (H, 3)

- Leucanthemum vulgare* Lam. (H, 10)
Matricaria perforata Mérat (T, 11)
Petasites hybridus (L.) Gaertn., B. Mey. et Schreb. (G, 9)
Pulicaria dysenterica (L.) Bernh. (H, 3)
Senecio erraticus Bertol. (H, 1)
Senecio ovirensis (Koch) DC. (H, 7)
Senecio vulgaris L. (T, 11)
Solidago gigantea Aiton (H, 12, IAS)
Tanacetum vulgare L. (H, 9)
Tussilago farfara L. (G, 9)
- Balsaminaceae
- Impatiens noli-tangere* L. * (T, 9)
Impatiens parviflora DC. (T, 9, IAS)
- Berberidaceae
- Berberis vulgaris* L. (Ph, 9)
- Betulaceae
- Alnus glutinosa* (L.) Gaertner * (Ph, 9)
Betula pendula Roth. (Ph, 9)
- Boraginaceae
- Cerinthe minor* L. (T, 3)
Myosotis arvensis (L.) Hill. (T, 9)
Myosotis discolor Pers. (T, 1)
Myosotis ramosissima Rochel (T, 11)
Myosotis scorpioides L. * (H, 10)
Myosotis sylvatica Hoffm. (H, 9)
Pulmonaria angustifolia L. (H, 7)
Pulmonaria officinalis L. (H, 8)
Symphytum officinale L. (H, 8)
Symphytum tuberosum L. (G, 3)
- Brassicaceae
- Alliaria petiolata* (M. Bieb.) Cavara et Grande (H, 9)
Arabidopsis thaliana (L.) Heynh. (T, 11)
A Armoracia rusticana P. Gaertn., B. Mey. et Schreb. (G, 10)
Barbarea vulgaris R.Br. (H, 11)
Brassica rapa L. (T, 12)
Capsella bursa-pastoris (L.) Medik. (T, 11)
Cardamine amara L. (H, 9)
Cardamine bulbifera (L.) Crantz (G, 8)
Cardamine flexuosa With. (H, 11)

- Cardamine hirsuta* L. (T, 11)
Cardamine impatiens L. * (T, 9)
Cardamine pratensis L. (H, 10)
Cardaminopsis arenosa (L.) Hayek (T, 8)
Erophila verna (L.) Chevall. (T, 11)
Lepidium campestre (L.) R.Br. (T, 11)
Lepidium virginicum L. (T, 11, IAS)
Raphanus raphanistrum L. (T, 11)
Rorippa sylvestris (L.) Besser (H, 9)
Sinapis arvensis L. (T, 11)
Thlaspi alliaceum L. (T, 3)

Campanulaceae

- Campanula glomerata* L. (H, 9)
Campanula patula L. (H, 8)
Campanula trachelium L. (H, 9)
Legousia speculum-veneris (L.) Chaix (T, 3)

Cannabaceae

- Humulus lupulus* L. (H, 9)

Caprifoliaceae

- Lonicera caprifolium* L. (Ph, 3)
Sambucus ebulus L. (H, 8)
Sambucus nigra L. (Ph, 8)
Viburnum opulus L. (Ph, 9)

Caryophyllaceae

- Cerastium fontanum* Baumg. (H, 10)
Cerastium glomeratum Thuill. (T, 11)
Cerastium sylvaticum Waldst. et Kit. (Ch, 3)
Cucubalus baccifer L. (H, 9)
Gypsophylla muralis L. (T, 9)
Lychnis flos-cuculi L. (H, 9)
Moehringia trinervia (L.) Clairv. (T, 9)
Moenchia mantica (L.) Bartl. (T, 3)
Myosoton aquaticum (L.) Moench (H, 9)
Pseudostellaria europaea Schaefflein (G, 7)
Silene latifolia Poir. subsp. *alba* (Miller) Greuter et Burdet (H, 9)
Silene vulgaris (Moench.) Garcke (H, 3)
Spergula arvensis L. (T, 11)
Stellaria graminea L. (H, 9)
Stellaria holostea L. * (H, 9)

- Stellaria media* (L.) Vill. (T, 11)
- Celastraceae
- Euonymus europaeus* L. (Ph, 9)
- Chenopodiaceae
- Chenopodium album* L. (T, 11)
- Cichoriaceae
- Aposeris foetida* (L.) Less. (H, 3)
- Cichorium intybus* L. (H, 11)
- Crepis biennis* L. (H, 7)
- Crepis capillaris* (L.) Wallr. (H, 11)
- Crepis paludosa* (L.) Moench (H, 9)
- Crepis tectorum* L. (T, 9)
- Lactuca serriola* L. (T, 11)
- Lapsana communis* L. (T, 9)
- Leontodon autumnalis* L. (H, 9)
- Leontodon hispidus* L. subsp. *danubialis* (Jacq.) Simonk. (H, 7)
- Leontodon hispidus* L. subsp. *hispidus* (H, 3)
- Mycelis muralis* (L.) Dumort. * (H, 9)
- Picris hieracioides* L. (H, 9)
- Sonchus asper* (L.) Hill (T, 1)
- Sonchus oleraceus* L. (T, 11)
- Taraxacum officinale* Weber (H, 11)
- Tragopogon pratensis* L. (H, 9)
- Tragopogon pratensis* L. subsp. *orientalis* (L.) Čelak. (H, 9)
- Clusiaceae
- Hypericum humifusum* L. (Ch, 11)
- Hypericum maculatum* Crantz (H, 9)
- Hypericum perforatum* L. (H, 11)
- Hypericum tetrapterum* Fries (H, 9)
- Convolvulaceae
- Calystegia sepium* (L.) R. Br. (H, 11)
- Convolvulus arvensis* L. (G, 11)
- Cornaceae
- Cornus sanguinea* L. (PH, 8)
- Corylaceae
- Carpinus betulus* L. * (Ph, 7)
- Corylus avellana* L. * (Ph, 8)
- Crassulaceae
- Sedum sexangulare* L. (Ch, 7)

Cucubirtaceae

Bryonia alba L. (H, 5)

Cuscutaceae

Cuscuta epithymum (L.) L. (T, 11)

Dipsacaceae

Dipsacus laciniatus L. (H, 9)

Knautia arvensis (L.) Coult. (H, 9)

Knautia drymeia Heuff. (H, 3)

Scabiosa triandra L. (H, 3)

Succisella inflexa (Kluk) Beck (H, 8)

Euphorbiaceae

Euphorbia angulata Jacq. (H, 3)

Euphorbia cyparissias L. (H, 9)

Euphorbia dulcis L. (H, 7)

Euphorbia epithymoides L. (H, 5)

Euphorbia falcata L. (T, 3)

Euphorbia helioscopia L. (T, 11)

Euphorbia platyphyllos L. (T, 3)

Euphorbia serrulata Thuill. (T, 9)

Euphorbia virgata Waldst. et Kit. (H, 9)

Mercurialis perrenis L. (G, 8)

Fabaceae

Anthyllis vulneraria L. (H, 7)

Chamaecytisus triflorus (Lam.) Skalická (Ch, 3)

Coronilla varia L. (H, 8)

Cytisus scoparius (L.) Link (Ch, 4)

Galega officinalis L. (H, 6)

Genista tinctoria L. (Ph, 9)

Lathyrus pratensis L. (H, 9)

Lathyrus tuberosus L. (H, 9)

Lotus corniculatus L. (H, 11)

Medicago falcata L. (H, 9)

Medicago lupulina L. (H, 11)

Medicago sativa L. (H, 12)

Melilotus albus Medik. (H, 9)

Melilotus officinalis (L.) Lam. (H, 9)

Ononis repens L. (H, 8)

Ononis spinosa L. (H, 8)

Robinia pseudoacacia L. (Ph, 12, IAS)

- Trifolium arvense* L. (T, 9)
Trifolium campestre Schreber (T, 11)
Trifolium dubium Sibth. (T, 3)
Trifolium patens Schreber (T, 3)
Trifolium pratense L. (H, 9)
Trifolium repens L. (H, 11)
Vicia angustifolia L. (T, 8)
Vicia cracca L. (H, 9)
Vicia grandiflora Scop. (T, 5)
Vicia tetrasperma (L.) Schreber (T, 9)
- Fagaceae
- Castanea sativa* Miller (Ph, 3)
Fagus sylvatica L. * (Ph, 8)
Quercus robur L. * (Ph, 8)
- Fumariaceae
- Corydalis solida* (L.) Clairv. (G, 9)
Fumaria officinalis L. (T, 11)
- Gentianaceae
- Centaureum erythraea* Rafn. (T, 11)
Centaureum pulchellum (Sw.) Druce (T, 9)
- Geraniaceae
- Erodium cicutarium* (L.) L' Hér. (T, 11)
Geranium columbinum L. (T, 9)
Geranium dissectum L. (T, 11)
Geranium phaeum L. (H, 3)
Geranium robertianum L. * (H, 11)
- Lamiaceae
- Ajuga reptans* L. * (H, 9)
Ballota nigra L. (H, 3)
Betonica officinalis L. (H, 8)
Clinopodium vulgare L. (H, 11)
Galeopsis ladanum L. (T, 9)
Galeopsis speciosa Mill. (T, 8)
Galeopsis tetrahit L. * (T, 9)
Glechoma hederacea L. * (Ch, 10)
Lamium galeobdolon (L.) L. * (Ch, 9)
Lamium maculatum L. (T, 9)
Lamium oroala L. (T, 2)
Lamium purpureum L. (T, 9)

- Lycopus europaeus* L. * (H, 9)
Melissa officinalis L. (H, 1)
Mentha arvensis L. (H, 10)
Mentha longifolia (L.) Hudson (H, 11)
Mentha pulegium L. (H, 9)
Mentha x smithiana R. A. Graham (H, 10)
Prunella vulgaris L. * (H, 11)
Salvia pratensis L. (H, 8)
Scutellaria hastifolia L. (H, 1)
Stachys annua (L.) L. (T, 8)
Stachys palustris L. (G, 10)
Stachys sylvatica L. (T, 9)
Teucrium chamaedrys L. (Ch, 3)
Thymus longicaulis C. Presl (Ch, 1)
- Loranthaceae
Loranthus europaeus Jacq. (H, 8)
- Lythraceae
Lythrum hyssopifolia L. (T, 11)
Lythrum salicaria L. * (H, 11)
- Malvaceae
Althaea officinalis L. (H, 5)
Malva alcea L. (H, 3)
Malva moschata L. (H, 3)
Malva neglecta Wallr. (T, 11)
Malva sylvestris L. (H, 11)
- Nymphaeaceae
Nuphar lutea (L.) Sm. (Hy, 9)
- Oleaceae
Fraxinus excelsior L. (Ph, 8)
Fraxinus ornus L. (Ph, 3)
Ligustrum vulgare L. (Ph, 7)
- Onagraceae
Circaea lutetiana L. * (G, 11)
Epilobium hirsutum L. (H, 9)
Epilobium parviflorum Schreber (H, 9)
Epilobium tetragonum L. subsp. *tetragonum* (H, 9)
- Oxalidaceae
Oxalis acetosella L. * (H, 11)
Oxalis fontana Bunge * (T, 12)

Papaveraceae

Chelidonium majus L. (H, 11)

Papaver rhoeas L. (T, 11)

Plantaginaceae

Plantago lanceolata L. (H, 11)

Plantago major L. (H, 11)

Plantago major L. subsp. *intermedia* (Gilib.) Lange (H, 11)

Plantago media L. (H, 9)

Polygalaceae

Polygala vulgaris L. (H, 9)

Polygonaceae

Fallopia convolvulus (L.) A. Löve (T, 11)

Polygonum aviculare L. (T, 11)

Polygonum minus Hudson (T, 11)

Polygonum persicaria L. (T, 11)

Reynoutria japonica Houtt. (H, 12, IAS)

Rumex acetosa L. (H, 11)

Rumex acetosella L. (H, 11)

Portulacaceae

Portulaca oleracea L. (T, 11)

Primulaceae

Anagallis arvensis L. (T, 11)

Anagallis coerulea Schreber (T, 11)

Lysimachia nummularia L. * (Ch, 8)

Lysimachia vulgaris L. (H, 9)

Primula vulgaris Huds. (H, 3)

Ranunculaceae

Anemone nemorosa L. * (G, 11)

Caltha palustris L. (H, 11)

Clematis vitalba L. (PH, 8)

Consolida regalis S.F.Gray subsp. *regalis* (T, 3)

Isopyrum thalictroides L. (G, 9)

Ranunculus acris L. (H, 11)

Ranunculus arvensis L. (T, 11)

Ranunculus auricomus L. (H, 9)

Ranunculus ficaria L. * (H, 8)

Ranunculus flammula L. (H, 8)

Ranunculus lanuginosus L. (H, 7)

Ranunculus repens L. * (H, 11)

- Ranunculus sardous* Crantz (T, 11)
Ranunculus sceleratus L. (T, 9)
Ranunculus trichophyllus Chaix (Hy, 9)
Thalictrum flavum L. (H, 9)
Thalictrum lucidum L. (H, 8)

Rhamnaceae

- Frangula alnus* Mill. * (Ph, 11)

Rosaceae

- Agrimonia eupatoria* L. (H, 10)
Crataegus laevigata (Poir.) DC. (Ph, 8)
Crataegus monogyna Jacq. (Ph, 9)
Filipendula ulmaria (L.) Maxim. (H, 9)
Filipendula vulgaris Moench (H, 9)
Fragaria vesca L. (H, 11)
Fragaria viridis Duchesne (H, 9)
Geum urbanum L. (H, 11)
Potentilla erecta (L.) Raeuschel (H, 9)
Potentilla reptans L. (H, 11)
Prunus spinosa L. (Ph, 9)
Pyrus pyraeaster Burgsd. (Ph, 9)
Rosa corymbifera Borkh. (Ph, 11)
Rosa gallica L. (Ph, 8)
Rubus bifrons Vest (Ph, 11)
Rubus canescens DC. (Ph, 3)
Rubus discolor Weihe et Ness (Ph, 7)
Rubus hirtus Waldst. et Kit. * (Ph, 8)
Rubus plicatus Weihe et Ness (Ph, 7)
Sanguisorba minor Scop. subsp. *muricata* Briq. (H, 11)
Sanguisorba officinalis L. (H, 8)

Rubiaceae

- Asperula aristata* L. subsp. *scabra* (J.Presl. et C.Presl.) Nyman (H, 3)
Cruciata glabra (L.) Ehrend. (H, 11)
Cruciata laevipes Opiz (H, 9)
Galium aparine L. (T, 11)
Galium mollugo L. (H, 9)
Galium odoratum (L.) Scop.* (G, 9)
Galium palustre L. * (H, 11)
Galium sylvaticum L. (G, 8)
Galium verum L. (H, 11)

Salicaceae

- Populus nigra* L. (Ph, 11)
- Populus tremula* L. (Ph, 9)
- Salix alba* L. (Ph, 9)
- Salix caprea* L. * (Ph, 9)
- Salix cinerea* L. (Ph, 9)
- Salix eleagnos* Scop. (Ph, 3)
- Salix fragilis* L. (Ph, 9)
- Salix purpurea* L. (Ph, 9)
- Salix repens* L. (Ch, 9)
- Salix triandra* L. (Ph, 9)
- Salix x rubens* Schrank (Ph, 9)

Saxifragaceae

- Chrysosplenium alternifolium* L. (H, 10)

Scrophulariaceae

- Gratiola officinalis* L. (H, 11)
- Kickxia elatine* (L.) Dumort. (T, 1)
- Lathraea squamaria* L. (G, 9)
- Linaria vulgaris* Mill. (H, 9)
- Melampyrum pratense* L. (T, 9)
- Odontites vulgaris* Moench (T, 8)
- Rhinanthus minor* L. (T, 10)
- Scrophularia nodosa* L. * (H, 10)
- Scrophularia umbrosa* Dumort. (H, 9)
- Verbascum blattaria* L. (H, 11)
- Verbascum phlomoides* L. (H, 8)
- Veronica anagallis-aquatica* L. (Hy, 3)
- Veronica arvensis* L. (T, 9)
- Veronica chamaedrys* L. (Ch, 9)
- Veronica hederifolia* L. (T, 9)
- Veronica montana* L. * (Ch, 3)
- Veronica officinalis* L. (Ch, 10)
- Veronica persica* Poir. (T, 11, IAS)
- Veronica polita* Fri. (T, 9)
- Veronica serpyllifolia* L. (H, 11)

Solanaceae

- Solanum dulcamara* L. * (Ch, 11)
- Solanum nigrum* L. (T, 11)

Staphyleaceae

Staphylea pinnata L. (Ph, 8)

Tiliaceae

Tilia cordata Mill. (Ph, 8)

Ulmaceae

Ulmus minor Miller (Ph, 11)

Urticaceae

Urtica dioica L. * (H, 11)

Valerianaceae

Valeriana officinalis L. (H, 9)

Valerianella locusta (L.) Laterrade (T, 11)

Verbenaceae

Verbena officinalis L. (H, 11)

Violaceae

Viola arvensis Murray (T, 11)

Viola canina L. (H, 9)

Viola hirta L. (H, 9)

Viola odorata L. (H, 8)

Viola reichenbachiana Jord. Ex Boreau * (H, 9)

Viola riviniana Rchb. (H, 8)

Liliatae

Alismataceae

Alisma lanceolatum With. (Hy, 11)

Alisma plantago – aquatica L. (Hy, 11)

Amaryllidaceae

Galanthus nivalis L. (G, 9)

Leucojum vernalis L. (G, 8)

Araceae

Arum maculatum L. (G, 8)

Cyperaceae

Carex acutiformis Ehrh. (H, 9)

Carex brizoides L. * (H, 7)

Carex divulsa Stokes (H, 11)

Carex elata All. (H, 8)

Carex hirta L. (G, 9)

Carex ovalis Gooden. (H, 10)

Carex pallescens L. (H, 10)

Carex remota L. * (H, 10)

- Carex sylvatica* Huds. (H, 8)
Carex tomentosa L. (H, 9)
Carex vesicaria L. (H, 10, VU)
Carex vulpina L. (H, 11)
Eleocharis palustris (L.) Roem. et Schult. (Hy, 11)
Scirpus sylvaticus L. (G, 10)

Iridaceae

- Crocus vernus* (L.) Hill subsp. *vernus* (G, 3)
Iris pseudacorus L. (G, 9)

Juncaceae

- Juncus bufonius* L. (T, 11)
Juncus compressus Jacq. (G, 11)
Juncus effusus L. * (H, 9)
Juncus inflexus L. (H, 9)
Juncus tenuis Willd. (H, 11, IAS)
Luzula campestris (L.) DC. (H, 11)
Luzula pilosa (L.) Willd. * (H, 10)

Lemnaceae

- Lemna minor* L. (Hy, 11)

Liliaceae

- Allium ursinum* L. (G, 9)
Colchicum autumnale L. (G, 7)
Convallaria majalis L. (G, 10)
Gagea lutea (L.) Ker Gawl. (G, 9)
Gagea pratensis (Pers.) Dumort. (G, 7)
Lilium martagon L. (G, 9, VU/NT)
Maianthemum bifolium (L.) F. W. Schmidt (G, 10)
Ornithogalum umbellatum L. (G, 3)
Paris quadrifolia L. (G, 9)
Polygonatum multiflorum (L.) All. (G, 10)
Scilla bifolia L. (G, 3)
Veratrum album L. * (H, 9)

Orchidaceae

- Orchis morio* L. (G, 9)

Poaceae

- Agrostis gigantea* Roth (H, 10)
Alopecurus geniculatus L. (H, 1, VU)
Alopecurus pratensis L. (H, 9)
Anthoxanthum odoratum L. (H, 9)

- Arrhenatherum elatius* (L.) P. Beauv. ex J. Presl et C. Presl (H, 8)
Brachypodium sylvaticum (Huds.) P. Beauv. (H, 9)
Briza media L. (H, 9)
Bromus hordeaceus L. subsp. *hordeaceus* (T, 11)
Bromus inermis Leyss. (H, 9)
Bromus racemosus L. (T, 11)
Bromus sterilis L. (T, 11)
Cynodon dactylon (L.) Pers. (H, 11)
Cynosurus cristatus L. (H, 11)
Dactylis glomerata L. (H, 9)
Deschampsia cespitosa (L.) P. Beauv. (H, 11)
Digitaria sanguinalis (L.) Scop. (T, 11)
Echinochloa crus-galli (L.) P. Beauv. (T, 11)
Festuca arundinacea Schreb. (H, 9)
Festuca gigantea (L.) Vill. * (H, 9)
Festuca pratensis Huds. (H, 9)
Festuca tenuifolia Sibth. (H, 4)
Gaudinia fragilis (L.) P. Beauv. (T, 3)
Glyceria fluitans (L.) R. Br. (Hy, 11, VU)
Holcus lanatus L. (H, 9)
Hordeum murinum L. (T, 11)
Lolium multiflorum Lam. (H, 1)
Lolium perenne L. (H, 8)
Melica uniflora Retz. (H, 8)
Milium effusum L. (H, 10)
Phalaris arundinacea L. (H, 10)
Phleum pratense L. (H, 10)
Phragmites australis (Cav.) Trin. ex Steud. (Hy, 11)
Poa annua L. (T, 11)
Poa nemoralis L. (H, 10)
Poa pratensis L. (H, 11)
Setaria pumila (Poir.) Schult. (T, 11)
Sorghum halepense (L.) Pers. (G, 11, IAS)
Trisetum flavescens (L.) P. Beauv. (H, 10)

Sparganiaceae

- Sparganium erectum* L. (Hy, 9)

Typhaceae

- Typha latifolia* L. (Hy, 11)

DISCUSSION

In the area of Stupnik and its surroundings, a total of 454 taxa of vascular plants were found. Five of them were Pteridophyta, one is a gymnosperm, and from the most numerous angiosperms, 365 belonged to dicots and 83 to monocots. We confirmed 46 out of 52 taxa identified by Rauš and co-workers during their previous phytosociological study (RAUŠ *et al.*, 1987), but not *Polygonum hydropiper* L., *Dryopteris carthusiana* (Vill.) H. P. Fuchs, *Succisa pratensis* Moench, *Melampyrum sylvaticum* L., *Prunus avium* L., and *Tephrosia crispa* (Jacq.) Rchb.

Families with relatively high numbers of taxa were (Tab. 1): Poaceae (8.43%), Asteraceae (7.54%), Fabaceae (5.99%), Lamiaceae (5.77%), Rosaceae (4.66%), Brassicaceae (4.43%), Scrophulariaceae (4.43%), Cichoriaceae (3.99%), Ranunculaceae (3.77%), Caryophyllaceae (3.55%), Cyperaceae (3.10%), Liliaceae (2.88%), Apiaceae (2.66%), Salicaceae (2.44%), Boraginaceae (2.21%), and Euphorbiaceae (2.21%).

Life form analysis (Tab. 2) showed that hemicryptophytes were dominant (225 taxa; 49.6%), therophytes were also numerous (109 taxa; 24.0%), followed by phanerophytes (50 taxa; 10.9%), geophytes (45 taxa; 10.0%), chamaephytes (14 taxa; 3.1%), and hydrophytes (11 taxa; 2.4%). The number of therophytes is much bigger than expected for this region (according to HORVAT, 1949), most probably due to anthropogenic influence. Analysis of life forms showed that the research area belongs to the temperate warm humid climate (ELLENBERG *et al.*, 1991).

Tab. 1. The most abundant families in the area of Stupnik and its surroundings.

Family	Number of taxa	%
POACEAE	38	8.43
ASTERACEAE	34	7.54
FABACEAE	27	5.99
LAMIACEAE	26	5.77
ROSACEAE	21	4.66
BRASSICACEAE	20	4.43
SCROPHULARIACEAE	20	4.43
CICHORIACEAE	18	3.99
RANUNCULACEAE	17	3.77
CARYOPHYLLACEAE	16	3.55
CYPERACEAE	14	3.10
LILIACEAE	13	2.88
APIACEAE	12	2.66
SALICACEAE	11	2.44
BORAGINACEAE	10	2.21
EUPHORBIACEAE	10	2.21

Tab. 2. Life form spectrum of the flora of Stupnik and its surroundings.

Life form	Symbol	Number of taxa	%
Therophytes	T	109	24.0
Hydrophytes	Hy	11	2.4
Geophytes	G	45	10.0
Hemicryptophytes	H	225	49.6
Chamaephytes	Ch	14	3.1
Phanerophytes	Ph	50	10.9

Tab. 3. Phytogeographical analysis of the flora of Stupnik and its surroundings.

Goelement	Symbol	Number of taxa	%
Mediterranean	1	9	2.0
Illyrian-Balkan	2	1	0.2
South-European	3	41	9.0
Atlantic	4	2	0.4
East European-Pontic	5	4	0.9
Southeast-European	6	2	0.4
Central-European	7	19	4.2
European	8	52	11.5%
Eurasian	9	148	32.5
Circum-Holarctic	10	33	7.3
Cosmopolites	11	126	27.7
Neophytes	12	17	3.7

Phytogeographical analysis (Tab. 3) showed that Eurasian goeement predominated (148 taxa; 32.5%), followed by cosmopolites (126 taxa; 27.7%), the European goeement (52 taxa; 11.5%), the South-European (41 taxa; 9.0%) and Circum-Holarctic goeements (33 taxa; 7.3%). The Central-European goeement encompassed 19 taxa (4.2%), 17 taxa (3.7%) were neophytes, the Mediterranean goeement was represented with 9 taxa (2.0%), the East-European-Pontic with 4 (0.9%), while the Atlantic and Southeast-European goeement with two taxa (0.4%). The Illyrian-Balkan goeement was represented with only one taxon (0.2%), *Lamium orvala*. Composition of goeements showed that the research area belongs to the lower woody Euro-Siberian-North American region of the Holarctic (cf. HORVATÍĆ, 1967).

In the flora of Stupnik 17 invasive alien species were found, among which neophytes predominated. *Pinus strobus* and *Acer negundo* were probably planted in the zone of the forest Stupnički lug. *Acer negundo* later expanded on its own. Some taxa from the preliminary list of invasive alien species for Croatia (DOBROVIĆ *et al.*, 2006;

NIKOLIĆ, 2007) were also earlier known as neophytes and invasive species in the flora of Croatia: such as *Ambrosia artemisiifolia*, *Galinsoga parviflora*, *Solidago gigantea* (e.g. TRINAJSTIĆ, 1984; ŠOŠTARIĆ & MARKOVIĆ, 1998), and *Conyza canadensis* (MILOVIĆ, 2004). From the 1960s findings of *Bidens frondosa* along the entire length of river Sava were recorded (MARKOVIĆ, 1970). For the Lučko area *Asclepias syriaca* was mentioned by MARKOVIĆ-GOSPODARIĆ (1965). In the 1970s, *Reynoutria japonica* started to expand, and spread quickly alongside the Sava River (TRINAJSTIĆ *et al.*, 1994). *Chamomilla suaveolens* was known from the middle of the 20th century from Gorski kotar and the Lika region, from where it later spread to Hrvatsko Zagorje and more recently to Turopolje (MARKOVIĆ & LUKAČ, 1993). As inventory and monitoring of invasive alien taxa is necessary for real knowledge about their impact on the indigenous flora and biodiversity of Croatia (cf. MITIĆ *et al.*, 2006), these data will contribute to initial information for future IAS studies.

According to the new Red Book of Vascular Plants of Croatia (NIKOLIĆ & TOPIĆ, 2005) *Lilium martagon*, *Alopecurus geniculatus*, *Carex vesicaria* and *Glyceria fluitans* are species faced with high extinction risk and indicate the significance of the studied area.

In comparison of number of species per km², with some other floristically researched continental areas in Croatia (cf. STANČIĆ, 1994; ŠOŠTARIĆ & MARKOVIĆ, 1998; ALEGRO *et al.*, 2006), we can conclude that the floristic diversity of the research area is relatively high, probably mostly because of the habitat diversity and human impact. Namely, in the past, the vegetation of the studied area was oak-hornbeam and beech forests with stabile and smaller number of species (ŠOŠTARIĆ, 2004), but anthropogenic activities changed such habitats and caused increasing number of plant taxa adapted to new habitats, as has been shown for some other continental areas in Croatia (e. g. ALEGRO *et al.*, 2006).

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