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SPONTANEOUS AND ORNAMENTAL FLORA OF THE PARK OF LUŽNICA MANOR NEAR ZAPREŠIĆ (NORTHWESTERN CROATIA)

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There are a substantial number of manor houses with parks in Croatia but their flora has not been systematically researched. The paper presents systematic research into and an analysis of the flora in the Lužnica manor park near Zaprešić, Northwestern Croatia. Lužnica Park spreads over an area of about 8 ha, presumably dating back to the 18th century and laid out after the construction of the manor. The estate also comprises farm buildings, vegetable garden and orchards, which all make a functional whole together with the main manor house. This research has established the presence of 342 plant species belonging to 233 genera and 80 families, 80 taxa of which belong to ornamental flora (a.s. planted) while 262 are spontaneous species. The flora has been analysed according to taxonomy, chorology, life forms and protected species status. It was also compared to some similar areas in the continental part of Croatia. According to the chorological composition and life forms, the Lužnica park flora is not significantly different from that in the compared areas. Nevertheless it is important to note that the park, although the smallest of the compared areas, abounds in a relatively large number of species, 6 of which are strictly protected by law. Therefore, we recommend that Lužnica park to be officially recognised as a protected area.

Key words: chorotypes, life form, alien species, invasive species, stricktly protected species

Hršak, V., Šegota, V., Irić-Šironja, S. & Sedlar, Z.: Samonikla i uresna flora perivoja dvorca Lužnica kod Zaprešića (sjeverozapadna Hrvatska). Nat. Croat., Vol. 24, No. 1, 37–57, 2015, Zagreb.

U Hrvatskoj postoji veći broj dvoraca s perivojima, ali ne postoje sustavna istraživanja flore u njima. Napravljeno je sistematsko istraživanje i analiza flore perivoja dvorca Lužnica kraj Zaprešića u sjeverozapadnoj Hrvatskoj. Sam perivoj zauzima površinu od oko 8 ha. Unutar njega nalaze se i gospodarski objekti, kuhinjski vrt i voćnjak koji zajedno s dvorcem čine funkcionalnu cjelinu. Pretpostavlja se da je perivoj nastao krajem 18. stoljeća nakon što je izgrađen dvorac. U ovom istraživanju u perivoju su utvrđene 342 biljne svojte. One pripadaju u 233 roda i 80 porodica. Od toga broja su 262 svojte samonikle, a 80 uresne. Flora perivoja je bila analizirana taksonomski, prema flornim elementima i zaštićenim vrstama. Usporedba sa sličnim područjima u kontinentalnom dijelu Hrvatske pokazala je da se bitno ne razlikuje od tih područja. Međutim, ona sadrži relativno velik broj svojti na malom području i 6 strogo zaštićenih svojti, tako da preporučujemo da perivoj dvorca Lužnica postane zaštićeno područje.

Ključne riječi: florni elementi, životni oblici, adventivne vrste, invazivne vrste, strogo zaštićene vrste

INTRODUCTION

Nothwestern Croatia boasts a number of manors that are invariably surrounded by large parks, the first of which date from the 17th century (Opeka near Varaždin, Klenovnik, Lobor) (Šćitaroci, 2005) . The first parks were small and modelled in the French style, while the 19th century brought parks that were landscaped in the English Romantic tradition like Jastrebarsko, Gorica near Pregrada etc. (Marković, 1975; Šćitaroci, 2005).

A park is a highly cultivated green area that may or may not be fenced. Originally, they were the sites of social events and they tend to be smaller than public parks, more cultivated and less accessible to large numbers of people.

Generally, there are insufficient data on flora of the parks around Croatian manors. Exceptions are in the Slavonija and Baranja Region (Eastern Croatia) (Rauš, 1977) for which a comprehensive lists has been made, if only of ornamental dendroflora, and Trsteno Arboretum (the Southernmost part of Croatia) (Kovačević, 1998), where spontaneous vegetation was studied too. Since these are the first complete data on the native and ornamental flora of a manor park in Croatia, the purpose of this research was to perform a taxonomic, ecological, and geographic analysis of the Lužnica manor flora.

MATERIALS AND METHODS

Study area

The Lužnica manor is situated several kilometres west of the town of Zaprešić, not far from the A-road towards the neighbouring Republic of Slovenia.

The first record of the Lužnica manor dates back to 1791, but as it refers to an extensive reconstruction, the castle is assumed to be much older (Šćitaroci, 2005). In the 19th century an annex was built to what is today recognised as a first category monument. Since 1925 the castle has been owned and run by the Sisters of Charity of St. Vincent de Paul. They have always used it for charity and educational purposes and currently it hosts a Spiritual-Educational Center, Mary's Court (Šćitaroci, 2005; Turalija *et al*., 2010).

The park itself covers an area of about 8 ha including farm buildings, arboretum, vegetable garden and orchard making a functional whole together with the main manor house. It is assumed to date back to the 18th century and to have followed the construction of the manor. There are no historical data about the time of the introduction of ornamental plants in the park. At the beginning it featured the characteristics of an English park but subsequently some elements of Romanticism were introduced, such as stone blocks, agaves and a lake, which is evident from the picture postcards from the beginning of the 20th century (Šćitaroci, 2005). Although Lužnica manor is protected as a first category cultural monument its park is still not protected as a horticultural monument.

The climate in the park's area is modestly warm with warm summers and is type Cfb, according to Köppen's classification (Šegota & Filipčić, 2003; Zaninović *et al*., 2008). In the period 1996–2013 the mean annual rainfall was 945.1 mm and mean annual temperature was 10.9 ^{0}C for the station of Šibice in the vicinity of the Lužnica manor (data obtained from Meteorological and Hydrological Service of Croatia). In the winter, snow is of common occurrence and persists 25–40 days (Feldbauer, 2004).

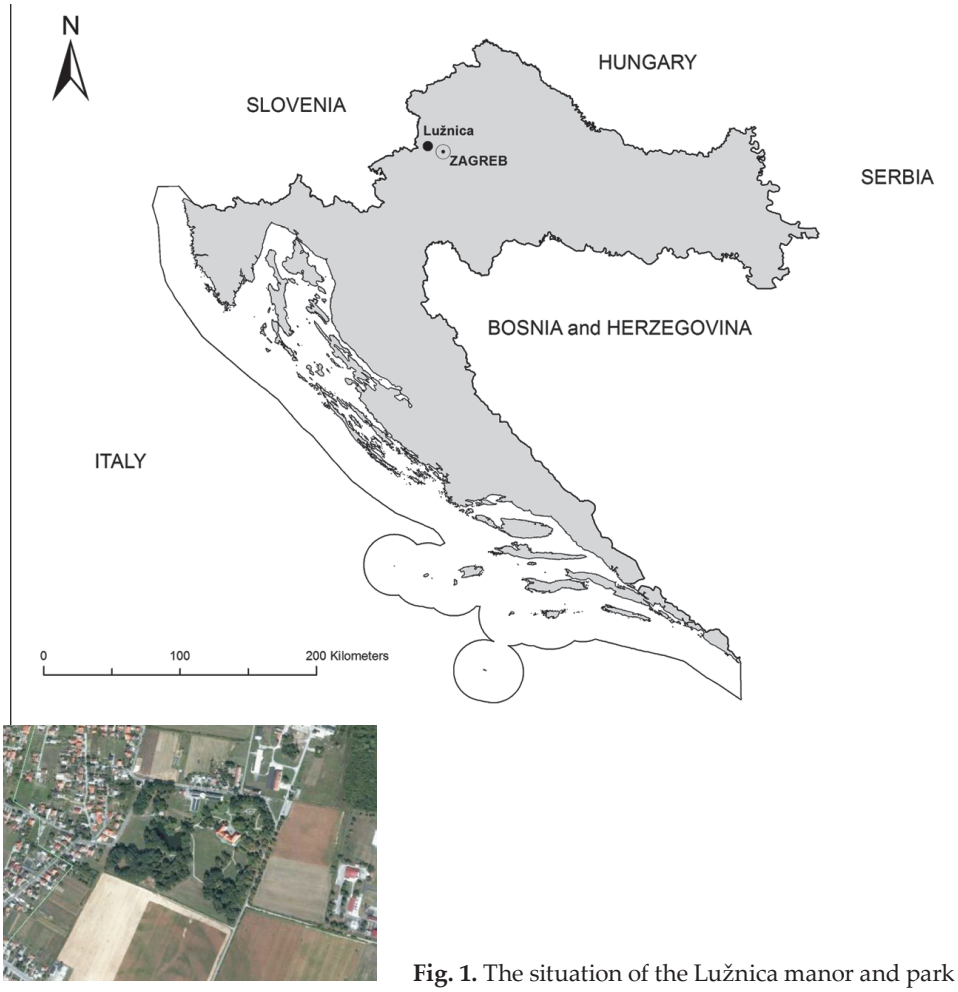

Fig. 1. The situation of the Lužnica manor and park

Data collection

Field research in the park's area was performed on 6 occasions – in March, April, May, June, July and September of 2010. The plant species were identified by the use of the following keys: Domac (2002), Eggenberg & Möhl (2007), Javorka & Csapody (1991), Johnson & More (2004), Lauber & Wagner (2007), Marcell & Csaba (2010), Martinčić *et al*. (1999), Mikolajski *et al*. (2008), Roloff & Bärtels (2008), Rothmaler (2007) Šilić (1990), Tutin *et al*. (1964–1980), and Tutin *et al*. (1993).

The names of the plant taxa and taxonomical solutions are taken for spontaneous flora from the Flora Croatica Database (Nikolić, 2015) and for ornamental flora from Erhardt *et al.* (2000) and Roloff & Bärtels (2008).

Data processing

The flora of the park has been divided into spontaneous and ornamental taxa. The latter were planted while the former sprouted and developed on their own. In this paper,

term *taxa* refers to genus and all lower taxonomical units (species, subspecies, varieties, hybrids and cultivars). Life forms according to Raunkiaer (cf. Frey & Lösch, 2004) and chorotypes of the recorded flora were analysed. Chorotypes for most taxa have been harmonized according to Horvatić (1963) and Horvatić *et al.* (1967–68). For some taxa the chorotypes have been given according to Pignatti (1982) and Tutin *et al.* (1964–1980), Tutin *et al.* (1993).

The spontaneous taxa have been divided into native and alien (adventive) taxa. The former are considered to be those whose natural distribution area is the researched area while the latter refer to those that were intentionally or accidentally brought into the researched area (Mitić *et al.*, 2008). Invasive alien species (IAS) are defined as naturalized plants that produce reproductive offspring, often in very large numbers and at considerable distances from the parent plants and thus have the potential to spread over large areas (produce reproductive offspring more than 100 m away in less than 50 years through generative reproduction and/or more than 6 m in three years through vegetative reproduction (Richardson *et al.*, 2000; Mitić *et al.*, 2008). The invasive alien species in the study area were marked according to Boršić *et al.* (2008).

The flora analysis has been performed according to the threat level to the species and their habitats. The species have been categorised by threat levels according to Nikolić & Topić (2005) and Nikolić (2015).

Strictly protected species were determined following Anonymous (2013).

RESULTS

Taxonomic analysis of the flora

The research has documented 342 plant taxa belonging to 233 genera and 80 families, 80 species of which are part of the ornamental flora while 262 are spontaneous taxa.

Tab. 1. Floristic list. Abbreviations: H – hemicryptophytes, T – therophytes, P – phanerophyte, G – geophytes, Ch – chamaephytes, Helo – helophytes, Hy – hydrophytes, CHol – circumholarctic, cos – (sub) cosmopolitic, Eu – Europa, N Am – North America, S Eu – South Europe, C Eu – Central Europe, EuAs – Eurasia, SE Eu-Pont – South Europe-Pontic, Med – Mediterranean, Illy – Illyrian-Balcan, adv – adventive, cult – cultivar (ornamental), SP – strictly protected by law, IAS – invasive alien species.

	life form	chorotype origin	protection	IAS
PTERYDOPHYTA				
EQUISETOPSIDA				
Equisetaceae				
Equisetum arvense L.	G	CHol		
FILICOPSIDA				
Dryopteridaceae				
Dryopteris filix-mas (L.) Schott.	H	cos		
Woodsiaceae				
Athyrium filix femina (L.) Roth	H	cos		

SPERMATOPHYTA				
CONIFEROPHYTINA				
Ginkoaceae				
Ginkgo biloba L.	P	As		
Buxaceae				
Buxus sempervirens L.	P	Eu		
Cupressaceae				
Chamaecyparis lawsoniana (Murr.) Parl. 'Van Pelt's Blue'	P	cult		
Juniperus chinensis L. 'Stricta'	P	cult		
Juniperus squamata Buch.-Ham. ex D. Don 'Blue Star'	P	cult		
Juniperus virginiana L.	P	N Am		
Thuja occidentalis L. 'Danica'	P	cult		
Pinaceae				
Abies alba Mill.	P	S Eu		
Larix decidua Mill.	P	Eu		
Picea abies (L.) Karsten.	P	EuAs		
Picea abies (L.) H. Karst. 'Nidiformis'	P	cult		
Picea glauca (Moench) Voss var. *albertiana* (S. Br.) Sarg. 'Conica'	P	cult		
Picea pungens Engelm.	P	N Am		
Pinus nigra Arnold	P	S Eu		
Pinus strobus L.	P	N Am		
Pinus sylvestris L.	P	EuAs		
Taxaceae				
Taxus baccata L.	P	EuAs	SP	
MAGNOLIOPHYTA				
Magnoliaceae				
Liriodendron tulipifera L.	P	N Am		
Magnolia liliflora Desrouss	P	As		
Fumariaceae				
Corydalis bulbosa (L.) DC	G	EuAs		
Papaveraceae				
Chelidonium majus L.	H	EuAs		
Berberidaceae				
Berberis thunbergii DC.	P	As		
Mahonia aquifolium (Pursh.) Nutt.	Ch	N Am		
Ranunculaceae				
Anemone nemorosa L.	G	Eu		
Helleborus atrorubens Waldst. et Kit.	H	Illy	SP	
Isopyrum thalictroides L.	G	EuAs		
Ranunculus acris L.	H	EuAs		

Ranunculus ficaria L.	G	EuAs		
Ranunculus lanuginosus L.	H	Eu		
Ranunculus repens L.	H	EuAs		
Ranunculus sardous Crantz.	H	cos		
Corylaceae				
Carpinus betulus L.	P	EuAs		
Corylus avellana L.	P	Eu		
Fagaceae				
Castanea sativa Miller	P	S Eu		
Fagus sylvatica L.	P	C Eu		
Quercus robur L.	P	Eu		
Hamamelidaceae				
Liquidambar styraciflua L.	P	N Am		
Platanaceae				
Platanus x *hispanica* Mill. ex Muench.	P	hyb		
Juglandaceae				
Juglans nigra L.	P	N Am		
Juglans regia L.	P	As		
Pterocarya fraxinifolia (Lam.) Spach.	P	EuAs		
Moraceae				
Ficus carica L.	P	As		
Morus alba L.	P	As		
Morus alba L. 'Pendula'	P	cult		
Ulmaceae				
Celtis australis L.	P	S Eu		
Ulmus glabra Huds.	P	Eu		
Ulmus laevis Pall.	P	C Eu		
Ulmus minor Miller	P	Eu		
Urticaceae				
Urtica dioica L.	H	cos		
Brassicaceae				
Alliaria petiolata (M.Bieb.) Cavara et Grande	H	Eu		
Arabis turrita L.	H	S Eu		
Armoracia rusticana P.Gaertn., B.Mey. et Schreb.	G	SE Eu-Pont		
Capsella bursa-pastoris (L.) Medik.	T	cos		
Cardamine bulbifera (L.) Crantz.	G	Eu		
Cardamine hirsuta L.	T	cos		
Cardamine impatiens L.	H	EuAs		
Cardamine pratensis L.	H	CHol		
Diplotaxis viminea (L.) DC.	T	Med		
Hesperis matronalis L.	H	SE Eu-Pont		
Iberis sempervirens L.	H	S Eu		
Rorippa lippizensis (Wulfen) Rchb.	H	Illy	SP	
Sinapis arvensis L.	T	cos		

Thlaspi arvense L.	T	cos		
Malvaceae				
Hibiscus syriacus L.	P	As		
Malva sylvestris L.	H	cos		
Tiliaceae				
Tilia cordata Mill.	P	Eu		
Tilia platyphyllos Scop.	P	C Eu		
Primulaceae				
Anagallis arvensis L.	T	EuAs		
Cyclamen purpurascens Mill.	G	S Eu		
Lysimachia nummularia L.	Ch	Eu		
Primula veris L.	H	EuAs		
Primula vulgaris Huds.	H	EuAs		
Salicaceae				
Populus alba L.	P	EuAs		
Salix babylonica L. var. *pekinensis* A. Henry 'Tortuosa'	P	cult		
Salix caprea L.	P	EuAs		
Salix x sepulcralis Simonkai	P	hyb		
Clusiaceae				
Hypericum perforatum L.	H	EuAs		
Hypericum tetrapterum Fr.	H	Eu		
Begoniaceae				
Begonia semperflorens Link & Otto	T	S Am		
Violaceae				
Viola hirta L.	H	EuAs		
Viola odorata L.	H	Eu		
Viola reichenbachiana Jord. ex Boreau	H	Eu		
Viola x *wittrockiana* Gams (?)	H	hyb		
Caryophyllaceae				
Cerastium brachypetalum Pers.	T	S Eu		
Cerastium glomeratum Thuill.	T	cos		
Cerastium tomentosum L.	T	S Eu		
Silene latifolia Poir. ssp. *alba* (Mill.) Greuter et Bourdet	H	EuAs		
Stellaria graminea L.	H	EuAs		
Stellaria media (L.) Vill.	T	cos		
Chenopodiaceae				
Chenopodium album L.	T	cos		
Chenopodium polyspermum L.	T	EuAs		
Portulacaceae				
Portulaca oleracea L.	T	cos		

Polygonaceae				
Fallopia convolvulus (L.) A. Love	T	cos		
Polygonum aviculare L.	T	cos		
Polygonum lapathifolium L.	T	Eu		
Polygonum mite Schrank.	T	Eu		
Rumex acetosa L.	H	CHol		
Rumex conglomeratus Murray.	H	EuAs		
Rumex crispus L.	H	cos		
Rumex obtusifolius L.	H	Eu		
Apiaceae				
Aegopodium podagraria L.	G	EuAs		
Aethusa cynapium L.	T	EuAs		
Anthriscus sylvestris (L.) Hoffm.	H	EuAs		
Daucus carota L.	H	cos		
Heracleum sphondylium L.	H	EuAs		
Araliaceae				
Hedera helix L.	P	Med		
Aquifoliaceae				
Ilex aquifolium L.	P	Eu	SP	
Celastraceae				
Euonymus europaeus L.	P	EuAs		
Euonymus japonicus Thunb. 'Ovatus aureus'	P	cult		
Cornaceae				
Aucuba japonica Thunb.	P	As		
Cornus mas L.	P	SE Eu-Pont		
Cornus sanguinea L.	P	Eu		
Euphorbiaceae				
Euphorbia carniolica Jacq.	H	Illy		
Euphorbia helioscopia L.	T	cos		
Fabaceae				
Amorpha fruticosa L.	P	adv		I
Coronilla varia L.	H	C Eu		
Galega officinalis L.	H	SE Eu-Pont		
Gleditsia triacanthos L.	P	N Am		
Hippocrepis comosa L.	H	Med		
Lathyrus pratensis L.	H	EuAs		
Lotus corniculatus L.	H	cos		
Medicago falcata L.	H	EuAs		
Medicago lupulina L.	T	cos		
Robinia pseudoacacia L.	P	adv		I
Sophora japonica (L.) Schott.	P	As		
Trifolium pratense L.	H	EuAs		
Trifolium repens L.	H	cos		
Vicia angustifolia L. ssp. *segetalis* (Thuill.) Corb.	T	EuAs		
Vicia cracca L.	H	EuAs		

Geraniaceae				
Geranium columbinum L.	T	EuAs		
Geranium molle L.	T	EuAs		
Geranium phaeum L.	H	S Eu		
Geranium robertianum L.	T	cos		
Oxalidaceae				
Oxalis acetosella L.	H	CHol		
Oxalis corniculata L.	H	cos		
Oxalis tetraphylla Cav.	G	N Am		
Oxalis dillenii Jacq.	T	adv		
Lythraceae				
Lythrum salicaria L.	H	cos		
Onagraceae				
Circaea lutetiana L.	G	CHol		
Epilobium parviflorum Schreber	H	EuAs		
Oenothera biennis L.	H	adv		I
Vitaceae				
Vitis vinifera L.	P	As		
Crassulaceae				
Sedum kirilowii Regel	T	As		
Sedum spectabile Boreau	H	As		
Grossulariaceae				
Ribes rubrum L.	P	Eu		
Rosaceae				
Chaenomeles speciosa (Sweet.)	P	As		
Cotoneaster horizontalis Dene.	P	As		
Crataegus laevigata (Poir.) DC.	P	C Eu		
Crataegus monogyna Jacq.	P	EuAs		
Cydonia oblonga L.	P	As		
Duchesnea indica (Andrews) Focke	H	adv		I
Filipendula vulgaris Moench	H	Eu		
Fragaria moschata Duchesne.	H	C Eu		
Fragaria vesca L.	H	CHol		
Geum urbanum L.	H	EuAs		
Malus domestica Borkh.	P	As		
Potentilla erecta (L.) Raeuschel.	H	EuAs		
Potentilla fruticosa L.	Ch	CHol		
Potentilla reptans L.	H	cos		
Prunus avium L.	P	SE Eu-Pont		
Prunus cerasifera Ehrh. 'Nigra'	P	cult		
Prunus domestica L.	P	As		
Prunus laurocerasus L.	P	EuAs		
Prunus padus L.	P	C Eu		
Prunus persica (L.) Batsch.	P	As		
Pyracantha M. Roem. 'Golden Charmer'	P	hyb		
Pyrus communis L.	P	As		

Rosa spp. (cult. div.)	P	cult		
Rubus caesius L.	Ch	EuAs		
Rubus plicatus Weihe et Nees	P	C Eu		
Spiraea bumalda Burv. 'Anthony Waterer'	P	cult		
Spiraea chamaedryfolia L.	Ch	EuAs		
Spiraea vanhouttei (Briott.) Zbl.	P	hyb		
Saxifragaceae				
Bergenia crassifolia (L.) Fritsch	H	As		
Hydrangeaceae				
Deutzia scabra Thunb.	P	As		
Hydrangea macrophylla (Thunb.) Ser.	P	As		
Philadelphus coronarius L.	P	Eu		
Philadelphus coronarius L. 'Primuliflorus'	P	cult		
Aceraceae				
Acer campestre L.	P	Eu		
Acer negundo L.	P	adv		I
Acer platanoides L.	P	Eu		
Acer pseudoplatanus L.	P	Eu		
Hippocastanaceae				
Aesculus hippocastanum L.	P	As		
Simaroubaceae				
Ailanthus altissima (Mill.) Swingle.	P	adv		I
Asteraceae				
Achillea millefolium L.	H	CHol		
Ambrosia artemisiifolia L.	T	adv		I
Arctium lappa L.	H	EuAs		
Arctium minus Bemh.	H	Eu		
Artemisia vulgaris L.	H	CHol		
Aster novae angliae L.	H	N Am		
Aster novi-belgii L.	H	N Am		
Bellis perennis L.	H	Eu		
Bidens frondosa L.	T	adv		I
Bidens tripartita L.	T	cos		
Centaurea jacea L.	H	EuAs		
Chamomilla recutita (L.) Rauschert	T	cos		
Cirsium arvense (L.) Scop.	G	EuAs		
Cirsium oleraceum (L.) Scop.	H	EuAs		
Conyza canadensis (L.) Cronquist	T	adv		I
Erigeron annuus (L.) Pers.	T	adv		I
Galinsoga parviflora Cav.	T	adv		I
Leucanthemum vulgare Lam.	H	EuAs		
Matricaria perforata Merat	T	EuAs		
Rudbeckia laciniata L.	H	adv		I
Senecio bicolor (Willd.) Tod. ssp. *cineraria* (DC.) Chater	H	Eu		
Senecio vulgaris L.	T	EuAs		
Serratula tinctoria L.	H	EuAs		
Solidago gigantea Aiton.	H	adv		I
Tanacetum corymbosum (L.) Sch. Bip.	H	EuAs		
Tussilago farfara L.	G	EuAs		

Cichoriaceae				
Cychorium intybus L.	H	cos		
Crepis biennis L.	T	Eu		
Crepis foetida L.	T	S Eu		
Lactuca saligna L.	T	SE Eu-Pont		
Lactuca serriola L.	H	cos		
Lapsana communis L.	T	EuAs		
Leontodon autumnalis L.	H	EuAs		
Leontodon hispidus L. ssp. *danubialis* (Jacq.) Simonk.	H	Eu		
Picris hieracioides L.	H	EuAs		
Sonchus asper (L.) Hill.	T	EuAs		
Taraxacum officinale Weber.	H	CHol		
Tragopogon pratensis L.	H	EuAs		
Adoxaceae				
Adoxa moschatellina L.	G	CHol		
Caprifoliaceae				
Lonicera caprifolium L.	P	S Eu		
Lonicera pileata Oliv.	P	As		
Sambucus nigra L.	P	Eu		
Symphoricarpos albus (L.) Blake	P	N Am		
Symphoricarpos x *chenaultii* Rehder	P	hyb		
Viburnum opulus L.	P	EuAs		
Weigela florida (Sieb.& Zucc.) A. DC.	P	As		
Dipsacaceae				
Dipsacus fullonum L.	H	S Eu		
Knautia arvensis (L.) Coult.	H	EuAs		
Apocynaceae				
Vinca major L.	Ch	Med		
Vinca minor L.	Ch	Eu		
Boraginaceae				
Myosotis arvensis (L.) Hill.	T	EuAs		
Myosotis laxa Lehm. ssp. *cespitosa* (C.F.Schultz) Nordh.	H	EuAs		
Pulmonaria officinalis L.	H	C Eu		
Symphytum officinale L.	H	Eu		
Symphytum tuberosum L.	G	S Eu		
Lamiaceae				
Ajuga reptans L.	H	Illy		
Ajuga reptans L. 'Atropurpurea'	H	cult		
Clinopodium vulgare L.	H	CHol		
Galeopsis speciosa Mill.	T	EuAs		
Glechoma hederacea L.	H	CHol		
Lamium amplexicaule L.	T	EuAs		
Lamium galeobdolon (L.) L.	H	EuAs		
Lamium maculatum L.	H	EuAs		
Lamium orvala L.	H	Illy		
Lavandula angustifolia Mill.	P	Eu		

Lycopus europaeus L.	H	EuAs		
Mentha aquatica L.	HELO	cos		
Mentha arvensis L	H	CHol		
Prunella grandfiora (L.) Scholler.	H	Eu		
Prunella vulgaris L.	H	EuAs		
Rosmarinus officinalis L.	P	Med		
Salvia pratensis L.	H	Eu		
Salvia splendens Sellow ex Roem.& Schult	H	S Am		
Stachys byzantina K. Koch.	H	As		
Stachys palustris L.	H	CHol		
Stachys sylvatica L.	H	EuAs		
Verbenaceae				
Verbena officinalis L.	H	cos		
Plantaginaceae				
Plantago lanceolata L.	H	EuAs		
Plantago major L. ssp. *intermedia* (Gilib.) Lange.	H	EuAs		
Plantago media L.	H	SE Eu-Pont		
Rubiaceae				
Cruciata laevipes Opiz.	H	EuAs		
Galium aparine L.	T	EuAs		
Galium mollugo L.	H	EuAs		
Galium verum L.	H	EuAs		
Oleaceae				
Forsythia x *intermedia* Zab.	P	hyb		
Fraxinus angustifolia Vahl.	P	SE Eu-Pont		
Fraxinus excelsior L.	P	EuAs		
Ligustrum vulgare L.	P	Eu		
Syringa vulgaris L.	P	EuAs		
Scrophulariaceae				
Linaria vulgaris Mill.	H	EuAs		
Scrophularia nodosa L.	H	CHol		
Scrophularia umbrosa Dumort.	H	EuAs		
Veronica arvensis L.	T	EuAs		
Veronica chamaedrys L.	H	EuAs		
Veronica hederifolia L.	T	EuAs		
Veronica persica Poir.	T	adv		I
Veronica polita Fr.	T	EuAs		
Convolvulaceae				
Calystegia sepium (L.) R.Br.	H	cos		
Convolvulus arvensis L.	G	cos		
Polemoniaceae				
Phlox paniculata L.	H	N Am		
Solanaceae				
Petunia x *hybrida* Vilm.	T	hyb		
Solanum dulcamara L.	Ch	cos		
Solanum jasminoides Paxton 'Album'	P	cult		

Solanum nigrum L.	T	cos		
LILIOPSIDA				
Potamogetonaceae				
Potamogeton natans L.	Hy	cos		
Araceae				
Arum maculatum L.	G	C Eu		
Cyperaceae				
Carex hirta L.	G	EuAs		
Carex muricata L.	H	EuAs		
Carex otrubae Podp.	H	S Eu		
Carex remota L.	H	CHol		
Carex sylvatica Huds.	H	EuAs		
Poaceae				
Agrostis stolonifera L.	H	cos		
Alopecurus pratensis L.	H	EuAs		
Anthoxanthum odoratum L.	H	EuAs		
Arrhenatherum elatius (L.) P.Beauv. ex J.Presl et C.Presl	H	EuAs		
Avenula pubescens (Dumort.) Dumort.	H	EuAs		
Brachypodium sylvaticum (Huds.) P.Beauv.	H	EuAs		
Bromus hordeaceus L.	T	cos		
Bromus sterilis L.	T	EuAs		
Dactylis glomerata L.	H	cos		
Digitaria sanguinalis (L.) Scop.	T	cos		
Echinochloa crus-galli (L.) P.Beauv.	T	cos		
Elymus repens (L.) Gould	G	CHol		
Festuca arundinacea Schreb. ssp. *uechtritziana* (Wiesb.) Hegi	H	EuAs		
Festuca gigantea (L.) Vill.	H	EuAs		
Festuca pratensis Huds.	H	EuAs		
Holcus lanatus L.	H	EuAs		
Lagurus ovatus L.	T	Med		
Lolium perenne L.	H	cos		
Miscantus sinensis (Thunb.) Andersson 'Zebrinus'	H	cult		
Panicum capillare L.	T	adv		I
Phalaris arundinacea L.	H	CHol		
Poa annua L.	T	cos		
Poa trivialis L.	H	cos		
Setaria pumila (Poir.) Schult.	H	cos		
Sorghum halepense (L.) Pers.	G	adv		I
Trisetum flavescens (L.) P.Beauv.	H	EuAs		
Zea mays L.	T	adv		
Juncaceae				
Juncus effusus L.	H	cos		
Agavaceae				
Yuca filamentosa L.	P	N Am		
Amaryllidaceae				

Galanthus nivalis L.	G	EuAs		
Leucojum vernum L.	G	Eu		
Narcissus poeticus L.	G	adv		
Iridaceae				
Crocus ancyrensis (Herb.) Maw 'Golden Bunch'	G	cult		
Crocus vernus (L.) Hill. ssp. *vernus*	G	S Eu		
Iris pseudacorus L.	G	EuAs	SP	
Asparagaceae				
Hosta ventricosa Stearn	H	As		
Hosta ventricosa Stearn 'Aureomarginata'	H	cult		
Liliaceae				
Allium ursinum L.	G	C Eu		
Convallaria majalis L.	G	Eu		
Ruscus aculeatus L.	Ch	Med		
Scilla bifolia L.	G	S Eu		
Orchidaceae				
Orchis morio L.	G	C Eu	SP	

The most abundant families in the spontaneous flora are: Poaceae with 26 taxa (9.5%), Asteraceae with 23 species (8.4%) and, Rosaceae with 17 taxa (6.2%). If combined, the Asteraceae and Cichoriaceae families form the most abundant Compositae family accounting for 13 % of all taxa in the spontaneous flora.

In the ornamental flora the most abundant families are Rosaceae with 14 taxa (17.5%), Cupressaceae and Pinaceae with 5 taxa (6.3%) each, and Caprifoliaceae, Lamiaceae and Hydrangeaceae with 4 taxa (5,0%) each.

Life forms analysis

The most common life forms in the spontaneous flora are hemicryptophytes with 123 taxa (46.9%), followed by therophytes (21.4%), and phanerophytes (16.8%). The geophytes are represented by 30 taxa (11.5%) and chamaephytes by 7 taxa (2.7%). Helophytes and hydrophytes were represented by only one taxon (0.4%) each (**Fig. 2**). Taking into account the whole flora of the park (ornamental included), the ratio of the hemicryptophytes falls to 39,8% and that of phanerophytes rises to 30,4% (**Tab. 3**).

Chorotype analysis

Chorotype analysis was performed only with respect to spontaneous flora (**Fig. 3**). The most taxa in the spontaneous flora belong to the Euroasian chorotype (95 taxa), followed by the (sub)cosmopolitan chorotype (47 taxa), and by the European chorotype (32 taxa). The Illyrian-balkan chorotype was represented by only 4 taxa.

The ornamental flora was analysed according to areas of native distribution (Erhardt *et al.*, 2000). The most taxa originate from Asia (26 taxa) and North America (14 taxa), accounting for 50 % of the total ornamental flora. Cultivars and hybrids account for ap-

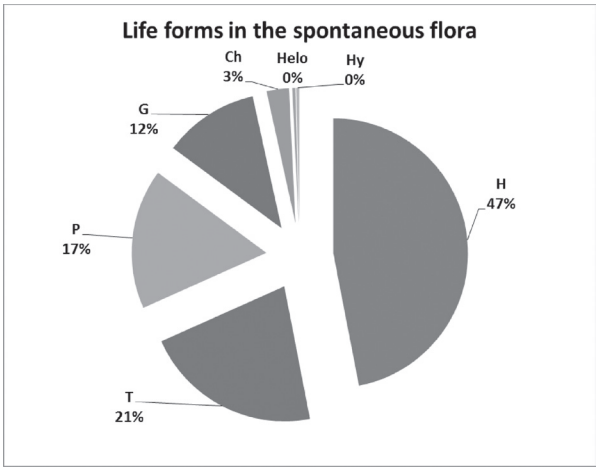

Fig. 2. Spectrum of the life forms for the spontaneous flora of park of Lužnica manor (H – hemicryptophytes; T – therophytes; P – phanerophytes; G – geophytes; Ch – chamaephytes; Helo – helophytes; Hy – hydrophytes).

Tab. 2. List of threatened species and their statuses according to Red Book of Vascular Flora of Croatia (LC- least concern; NT – near threatened; VU – vulnerable; DD – data deficient).

Nr.	Species	Red Book Status
1	*Cyclamen purpuracens* Mill.	NT
2	*Galanthus nivalis* L.	LC
3	*Helleborus atrorubens* Waldst. et Kit.	LC
4	*Ilex aquifolium* L.	VU
5	*Orchis morio* L.	NT
6	*Poa annua* L.	LC
7	*Ruscus aculeatus* L.	LC
8	*Scrophularia umbrosa* Dumort.	DD
9	*Serratula tinctoria* L.	LC
10	*Taxus baccata* L.	VU

proximately 25 %, while the remaining 25 % are the taxa originating from Europe, Eurasia and South America.

Analysis of the alien flora

Of 262 spontaneous taxa recorded in the researched area 243 (92.7 %) belong to the native flora as the Lužnica park is situated within their natural distribution area.

Of 19 recorded alien (adventive) taxa, 16 (6,1%) can be labelled as invasive (**Tab. 1**). According to Pyšek *et al*. (2010), up to 84 (32,1%) of recorded spontaneous taxa are of alien origin.

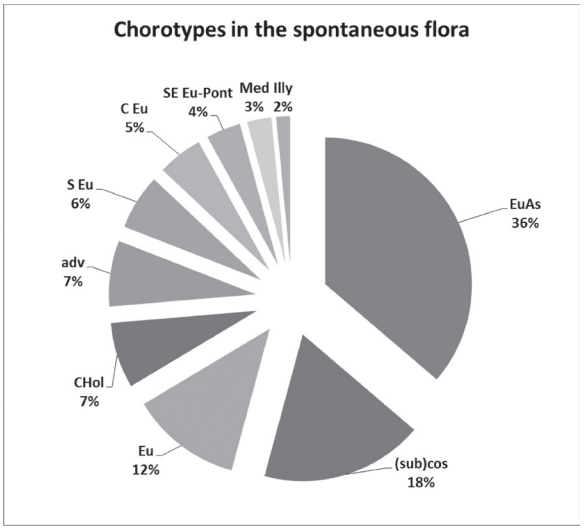

Fig. 3. Chorotype rates in the spontaneous flora. (EuAs – Euroasian, (sub)cos – (sub)cosmopolitan, Eu – European, CHol – circum-holarctic, adv – adventive, S Eu – south European, C Eu – central European, SE Eu-Pont – south European-Pontic, Med – Mediterranean, Illy – Illyrian-Balkan)

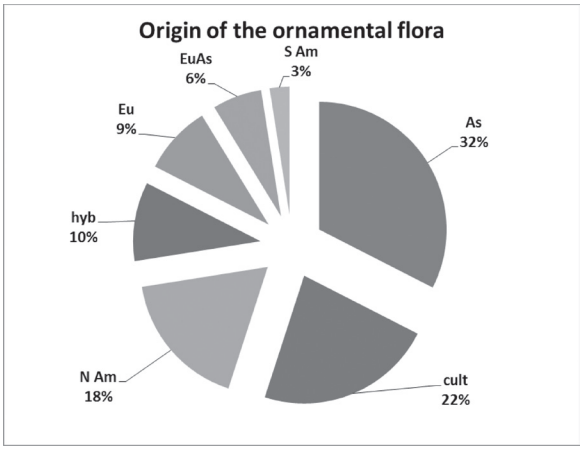

Fig. 4. Origin of the ornamental flora in the Park. (As – Asia, cult – cultivars, N Am – North America, hyb – hybrids, Eu – Europa, EuAs – Eurasia, S Am – South America)

Threatened and protected species

The research has identified a total of 10 taxa that have the 'risk of extinction' status according to the Red Book of Vascular Flora of Croatia (Nikolić & Topić, 2005); they are displayed in Tab. 2. It is interesting to notice that the investigation has not revealed a single species with critically endangered (CR) or endangered status (EN).

The park area hosts 6 wild-growins indigenous taxa protected by the Rules on strictly protected species (Anonymous, 2013a) according to the Nature Protection Act (Anonymous, 2013b) (Tab. 1).

DISCUSSION

The flora of the Lužnica manor was researched during the vegetation season in 2010. In the area of about 8 ha, in all 342 species of vascular plants were recorded: 274 spontaneous and 68 ornamental taxs. The most comparable areas with floristic data are the Maksimir Forest Park (Mitić *et al*., in press), and the relatively similar area around Jarun

Tab. 3. Life form ratios (in percentages) for Lužnica and some other seminatural areas in NW Croatia. Jarun (Vuković *et al*., 2013), Konjšćina (Stančić, 1994), Martinci (Martinko, 2009), Vukova Gorica (Alegro *et al*., 2006), Stupnik (Mitić *et al*., 2007), Savica (Alegro *et al*., 2013), Maksimir (Mitić *et al*., in press). For Lužnica the ratios are presented for complete (spontaeous ad ornamental) flora.

	Lužnica	Jarun	Konjščina	Martinci	Vukova Gorica	Stupnik	Savica	Maksimir
H	39.77	42,41	45,00	52,10	52,30	49,60	47,20	43,22
P	30.41	13,00	8,90	15,10	11,40	10,90	14,20	17,59
T	17.25	24,77	24,00	16,10	13,50	24,00	19,10	17,59
G	9.36	16,10	13,90	13,70	13,50	10,00	10,10	15,33
Ch	2.63	1,86	8,00	2,70	4,00	3,10	1,40	4,27
Hy	0,29	1,86	3,30	0,30	1,30	2,40	5,90	2,01

Tab. 4. Chorotype ratios (in percentages) for Lužnica and some areas in NW Croatia with seminatural landscapes. Jarun (Vuković *et al*., 2013), Konjšćina (Stančić, 1994), Martinci (Martinko, 2009), Vukova Gorica (Alegro *et al*., 2006), Stupnik (Mitić *et al*., 2007), Savica (Alegro *et al*., 2013), Maksimir (Mitić *et al*., in press).

	Lužnica	Jarun	Konjščina	Martinci	Vukova Gorica	Stupnik	Savica	Maksimir
EuAs	36.26	44.10	33.20	34.80	31.90	32.50	48.30	45.73
Cos	17.94	8.39	26.40	25.20	23.10	27.70	3.10	1.51
Eu	12.21	7.76	11.50	11.00	12.60	11.50	3.80	15.83
adv-cult	7.25	9,94	5,50	7,90	3,40	3,70	13,20	8,29
CHol	7.25	5.28	7.90	6.60	8.40	8.40	8.70	6.53
SEu	6.10	–	0.50	1.00	0.60	0.40	–	3.52
CEu	4.97	5.90	2.90	3.80	4.80	4.20	6.30	0.50
SEu-Pont	3.82	0.93	0.90	1.00	1.20	0.90	2.10	1.51
Med	2.67	9.63	1.00	1.00	1.50	2.00	9.70	10.30
Illy	1.53	0.31	0.70	–	1.20	0.20	0.70	2.01

Lake (Vuković *et al.*, 2013) – both in the greater Zagreb area. The Maksimir Forest Park is a protected area where the relatively natural grounds were used to create a park by the planting of many tree and shrub species, which is analogous to the Lužnica Park. In the much larger area of 316 ha, 398 plant taxa were found, which makes only 56 taxa more than in the much smaller area of only 8 ha of Lužnica Park. In the 235 ha of the Jarun Lake area, which is designated as a sports and recreation area, 323 plant taxa have been determined (Vuković *et al.*, 2013). This smaller number of taxa in a significantly larger area than in Lužnica can be accounted for by the fact that far more taxa were planted in Lužnica manor park than in the Jarun sports and recreational park, where fewer ornamental taxa were planted. Besides that, the number of visitors to Jarun is much higher and their activities are more intensive and different in general.

A comparison of the share of families from the same region, such as Maksimir Forest Park (Mitić *et al.*, in press), Medvednica Nature Park (Dobrović *et al.*, 2006), Mount Strahinjščica (Regula-Bevilacqua & Šegulja, 2000), Vukova Gorica (Alegro *et al.*, 2006), Stupnik and the surroundings (Mitić *et al.*, 2007), Jarun Lake (Vuković *et al.*, 2013), reveals taxa presented in a practically identical order. The greatest share is of grasses (Poaceae) followed by Asteraceae. Likewise if Asteraceae and Cichoriaceae are taken together as one Compositae family they will head the list, both in Lužnica and in the other areas. Therefore, by its relative share the Lužnica Park does not differ from the other areas, which are under more intensive human impact within the same phytogeographical area.

With regard to life forms (Fig. 2) Lužnica Park is notably richest in hemicryptophytes, which is usual in a temperate climate zone (Horvat, 1949). It is also worth noticing that the share of phanerophytes in the total (spontaneous and ornamental) flora in Lužnica is higher than in the other, similar areas. In Lužnica there were 30.4 % phanerophytes, more than in the other similar areas, where the phanerophyts share is 8.9–14.2 % (Tab. 3). This is due to the fact that a greater number of trees and shrubs were planted in Lužnica to embellish the park than in all the other mentioned areas. The share of therophytes points to the intensity of the human impact, i.e. the higher it is the greater the share of therophytes (Pyšek *et al.*, 2010). The proportion of therophytes share is higher in the Jarun Lake area, (24.77%) than in the Lužnica Park area (17.25%). As the former is a sports and recreational area that is intensively used, at least in the summer season, the impact is undoubtedly higher, which opens more possibilities for the establishment of therophytes as annual plants. In Lužnica Park the most intensive human activities are performed within the context of park maintenance, while all other human activities are less intensive. Walking activities are of low intensity as they do not occur daily as they do at Jarun Lake. The share of therophytes in Lužnica Park is similar to that in other areas in the region (Tab. 3).

The chorotype analysis shows that in Lužnica, as well as in other seminatural areas, Euro-Asian plants account for the greatest share. They are followed in abundance by cosmopolitan plants, which is similar to the situation in most other seminatural landscapes, such as Konjščina (Stančić, 1994), Martinci (Martinko, 2009), and Vukova Gorica (Alegro *et al.*, 2006). Although the numbers of some chorotypes differ up to 10 percent, the ranking of the most frequent ones stays the same. Nevertheless the order is somewhat different in the Jarun Lake area (Vuković *et al.*, 2013) and in the Savica area (Alegro *et al.*, 2013), where a higher share of Mediterranean species and a smaller share of cosmopolitan plants than in Lužnica or other areas is evidens. These differences are mostly the result of different approaches to chorology (Alegro *et al.*, 2013).

Of 262 spontaneous taxa, 92,7% are native and 7,3% are alien taxa (Horvatić, 1963; Horvatić *et al*., 1967–68), 16 (6,1%) of which are invasive types (Tab. 1). In contrast, based on the list of the alien flora of the Czech Republic (Pyšek *et al*., 2002) almost 30% alien taxa have been determined in the spontaneous flora of the Lužnica Park. This discrepancy is due to Pyšek's (2002) wider conception of archaeophytes in spontaneous flora. The comparison of the share of invasive species in the flora of the corresponding areas leads to the conclusion that there are more invasive species in the Savica (8.6 %) and Jarun (7.74 %) areas and fewer invasive species in the Stupnik area (3.7%) than in the Lužnica Park. This can be explained by the fact that, unlike Jarun and even more Savica, Lužnica has been maintained and cultivated most intensively, which is why the invasive species are removed more vigorously. Stupnik has fewer invasive species than Lužnica, as it is a rural and urban area of entirely dissimilar characteristics and thus hardly comparable to Lužnica.

Finally, it can be concluded that the rather rich native flora that exists in the very small area and the diverse ornamental flora in Lužnica Manor Park represents an area that lacks and yet deserves some form of protection, either in category of "*park*" (*Croatian: perivoj*) according to Act on protection and conservation of cultural heritage (Anonymous, 1999–2014), or as "*monument of the park architecture*" (*Croatian: spomenik parkovne arhitekture*) according to the Nature Protection Act (Anonymous, 2013).

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SAŽETAK

Samonikla i uresna flora perivoja dvorca Lužnica kod Zaprešića (sjeverozapadna Hrvatska)

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U Hrvatskoj postoji veći broj dvoraca s perivojima, ali ne postoje sustavna istraživanja flore u njima. Napravljeno je sistematsko istraživanje i analiza flore perivoja dvorca Lužnica kraj Zaprešića u sjeverozapadnoj Hrvatskoj. Sam perivoj zauzima površinu od oko 8 ha. Unutar njega nalaze se i gospodarski objekti, arboretum, kuhinjski vrt i voćnjak koji zajedno s dvorcem čine funkcionalnu cjelinu. Pretpostavlja se da je perivoj nastao krajem 18. stoljeća, nakon što je izgrađen dvorac. U ovom istraživanju u perivoju su utvrđene 342 biljne svojte. One pripadaju u 233 roda i 80 porodica. Od toga 80 vrsta pripada uresnoj flori, a 262 su autohtone svojte. U autohtonoj flori najbrojnije porodice su: Poaceae s 26 svojti (9,5%), Asteraceae s 23 svojte (8,4%), Lamiaceae sa 17 svojti (6,5%) itd. Ukoliko se spoje zajedno porodice Asteraceae i Cichoriaceae u porodicu Compositae, onda ta porodica postaje najbrojnija s 13% svojti. U uresnoj flori najbrojnija je porodica Rosaceae sa 14 svojti (17,5%), Cupressaceae i Pinaceae s po 5 svojti (6,3%) i Caprifoliaceae, Lamiaceae i Hydrangeaceae s po 4 svojte (5,0%). Analiza flornih elemenata u autohtnoj flori pokazala je da najviše svojti pripada euroazijskom flornom elementu (95 svojti), zatim po brojnosti dolazi (sub)kozmopolitski element (47 svojti), europski element (32 svojte), adventivne biljke (19 svojti), dok je ilirsko-balkanski florni element zastupljen sa samo 4 svojte. U uresnoj flori najviše je azijskih (26), kultivara (18), sjevernoameričkih (14) i hibridnih (8) svojti. To iznosi oko 75% ukupne uresne flore, a u ostalih 25% su svojte iz Europe, Euroazije i Južne Amerike. Od 262 svojte samonikle flore koje su zabilježene na istraživanom području autohtonoj flori pripada 92,7% svojti. Pridošlica je zabilježeno 19, od kojih 16 možemo označiti invazivnim. Na istraživanom području utvrđeno je ukupno 10 svojti koje imaju određeni status u Crvenoj knjizi vaskularne flore Republike Hrvatske. Na području perivoja zabilježeno je 6 vrsta koje su strogo zaštićene Pravilnikom o strogo zaštićenim vrstama. U usporedbi s nekim drugim sličnim područjima iz iste biljnogeografske regije, može se reći da perivoj dvorca Lužnica ima relativno velik broj vrsta na vrlo malom području od samo 8 ha i da zavrjeđuje određeni oblik zaštite kojeg za sada nema, za razliku od samog dvorca koji ima status zaštićenog spomenika kulture.