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A NEW ASSOCIATION OF RUDERAL WEEDS AT PANČEVAČKI RIT IN SERBIA

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SUMMARY

A several-year study of distribution, phytocoenological differentiation, floristic composition and structure of ruderal flora and vegetation and relevant anthropogenic influence was conducted at Pančevački Rit in Serbia.

Ten clearly distinctive ruderal communities were identified in the study, including the newly formed community *Matricario-Helianthetum annuae.* This community is a unique combination of transitional ruderal and agrestal vegetation developing spontaneously in close vicinity of intensively cultivated agricultural fields, in which sunflower (*Helianthus annuus* L.), an annual crop, appears and persists subspontaneously and often massively, rendering a physiognomical character to ruderal habitats in which ephemeral ruderal weed vegetation often develops, consisting predominantly of annual plants of *Sisymbrion officinalis* R.Tx., Lohm. et Prsg.1950.

Key words: ***Helianthus annuus* L., ruderal vegetation, ruderal community *Matricario-Helianthetum annuae*, Pančevački Rit**

INTRODUCTION

Ruderal or synanthropic (synurban) flora and vegetation make the most dynamic floristic and vegetational complex and the most immediate element of natural environment to man. Anthropogenic influence as a crucial factor initiating the ruderal vegetation, determines the formation, maintaining, spread and dynamics of ruderal flora and vegetation.

The systematics of the genus *Helianthus* has been studied by a considerable number of botanical archaeologists and paleobotanists, while detailed reports have been contributed by Heiser *et al.* (1969, 1954), Heiser (1954, 1955), Thompson *et al.* (1981), and by Watson (1929) and Rogers *et al.* (1981) in monographs on sunflower species in the U.S.

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Due to a huge biological diversity and highly complex biosystematics of the genus *Helianthus,* this study takes a more narrow focus of the new ruderal weed community with the wild sunflower as the dominant species at Pančevački Rit, rather than on issues of general systematics.

Ruderal flora and vegetation have been studied worldwide, as well as Serbia (Slavnić, 1951; Marković, 1964; Janković *et al.*, 1986; Jovanović, 1994; Brandes, 1995, 2004; Jovanović and Mitrović, 1998; Pyšek *et al.*, 2004; Topalić-Trivunović, 2006). In the course of our several-year investigation of the floristic, phytocoenological, phytogeographic and syngenetic/syndynamic character of flora and vegetation at Pančevački Rit, we identified 375 taxa within 10 syntaxonomically and ecologically clearly differentiated ruderal communities, including two new ones. *Matricario-Helianthetum annuae* is one of the two being a combination of transitional ruderal and agrestal vegetation (Stanković-Kalezić, 2007).

Pančevački Rit can be characterized as an ecological entity. The Agricultural Corporation "Belgrade" holds a total of 24,870 ha of land there, including 17,769 ha of arable land, 212 ha of pastures, 5,569 ha of forests, 37 ha of reedbeds and marches and 1,283 ha of non-agricultural land (Vidojević, 2001). Such a large agrarian complex includes different categories of ruderal habitats, whose abundant flora and vegetation create potential natural "hotspots" from which species can spread into arable land.

MATERIALS AND METHODS

Investigation of flora and vegetation was conducted at Pančevački Rit in the region of southwestern Banat, Pančevački Rit, Serbia, is an alluvial plain with mildly undulating terrain, bordered on all sides by the Danube and Tamiš Rivers and the Karaš Canal. Although the region is primarily used for intensive agricultural production by the Agricultural Corporation "Belgrade", different categories of ruderal habitats with abundant ruderal flora and vegetation are found as well.

Plant material was collected and sampled throughout vegetation seasons during the period 1999 and 2000. Various sources of literature were used to determine plant taxa (Hegi, 1928-1931; Josifović *et al.*, 1970-1986; Javorka-Csapody, 1975)

Phytocoenological surveys were conducted according to the methodology of the Zurich-Montpellier school of Braun-Blanquet (1964). Ruderal vegetation was investigated in different habitats (soil types, moisture, exposure to trampling, mowing, *etc.*) and different environments depending on stand size.

Life form of each plant species was determined according to an adapted and elaborated scheme of Ellenberg and Mueller-Dambois (1967), based on the principles promoted by Raunkier and cited in "Serbian Flora" (Stevanović, 1992). The scheme has provided a much more precise and ecologically sensitive approach to the biological spectra of the ruderal flora. Based on the formative principle of the floristic/vegetational plant/geographic scheme by Stevanović (1992), floristic ele-

ments were grouped according to their distributional range, *i.e.*, floristic provinces and regions. Ecological indices for each species were recorded following Kojić *et al.* (1997).

RESULTS

Ten clearly differentiated ruderal communities were identified at 1,283 ha of uncultivated (ruderal) land of the Agricultural Corporation "Belgrade", including the newly-named *Matricario-Helianthetum annuae* community. The community mostly thrives in areas between cultivated fields (maize, soybean, sugar beet and other crops, as well as commercial sunflower and hybrid seed sunflower fields grown on around 1000 ha), along field roads traversing large agricultural fields, and in uncultivated areas along various other paths and local roads. The habitats of this community are moderately nitrified or intensively fertilized (with organic fertilizers) and characterized by moderate moisture and warm temperature.

Floristic composition and structural characteristics of the *Matricario-Helianthetum annuuae* community are shown in a phytocoenological table covering 8 relevés (Table 1).

Figure 1: Matricario-Helianthetum annuuae community (orig.)

The *Matricario-Helianthetum annuuae* community has a flora that includes 60 plant species and is relatively abundant. The community has the optimal period for development in mid-summer, when its stands assume a characteristic look and are readily identifiable by their height, very high density (average coverage 92.50%) and the intensive and eye-catching yellow colour of the dominant species *Helianthus annuus* which stands out because of its abundance and coverage (5439). The height

Table 1: Description of the new ruderal *Matricario-Helianthetum annuuae* community – ass. New

Presence degree	Coverage		1	2	3	4	5	6	7	8	Ecological index				
		Relevé area (m^2)	250	120	150	60	25	60	25	180					
		Total coverage (%)	100	100	100	100	100	50	100	90					
		Stand height (cm)	200	250	120	250	60	80	250	80					
		Grade (%)	0	0	0	0	0	0	0	0					
		No. of species	30	20	13	19	24	23	9	13					
											M	A	R	L	T
V	5439	*Helianthus annuus* L.	4.4	5.5	5.5	5.5	+1	2.2	5.5	1.2	3	3	4	4	4
V	600	*Matricaria inodora* L.	1.2	+1	+1	+1	3.2	+	+1	1.1	3	3	3	3	3
V	288	*Rumex crispus* L.	1.2		+	+1	+	+	+1	2.2	4	3	5	3	4
V	192	*Chenopodium album* L.	+1	1.1	1.1	+1	+	1.1		+	2	3	4	3	3
IV	536	*Cirsium arvense* (L.) Scop.		1.2	+	+1	+	+1		3.2	3	3	4	4	4
IV	224	*Lactuca serriola* L.	+1	+1		+1	+			2.3	2	3	3	5	4
IV	131	*Sorghum halepense* (L.) Pers.	1.2	1.1	+1	+1		+1		+1	2	2	3	4	5
IV	68	*Polygonum lapathifolium* L.	1.2	+1		+1	+	+1			3	3	4	3	3
IV	68	*Chamomilla recutita* (L.) Rausch.	+1	+	1.1	+1			+1		3	3	3	4	4
III	284	*Artemisia vulgaris* L.	2.2			1.1			+1	+	3	3	4	4	3
III	284	*Echinochloa crus-galli* (L.) Beauv.	+1	1.1	2.2			+1			3	3	4	3	3
III	282	*Agropyron repens* (L.) Beauv.	+2					1.2	2.3		3	3	4	4	3
III	222	*Cichorium intybus* L.	2.2				+	+		+	2	4	3	5	4
III	189	*Picris echioids* L.		+1			1.1	1.1		1.1					
III	128	*Setaria glauca* (L.) Beauv.	1.1	1.2	+1			+1			2	3	3	4	4
III	128	*Bromus sterilis* L.	+1				1.1	+1	1.2		2	3	4	3	3
II	470	*Solanum nigrum* L.		+1				3.3			3	3	4	4	3
II	220	*Convolvulus arvensis* L.				2.3	+1				2	4	3	4	3
II	64	*Atriplex patula* L.	1.1	+1							3	4	4	3	3
II	64	*Daucus carota* L.	1.1				+				2	3	2	4	3
II	64	*Poa trivialis* L.				+1	1.1				3	3	4	3	2
II	64	*Sonchus asper* (L.) Hill.					+	1.1			3	3	4	4	3
II	64	*Polygonum aviculare* L.	1.2				+				3	3	4	4	3
II	4	*Conium maculatum* L.	+1		+1		+1				3	3	4	4	4
II	4	*Lytrum salicalia* L.	+1	+1						+	4	3	3	3	3
II	4	*Xanthium strumarium* L.	+1			+1	+				3	3	4	4	5
II	2	*Hibiscum trionum* L.			+			+1			3	3	3	4	4
II	2	*Plantago major* L.	+1				+1				3	3	3	4	3
II	2	*Lathyrus tuberosus* L.		+1			+				2	4	2	4	4
II	2	*Amaranthus retroflexus* L.		+	+						2	3	4	4	4
II	2	*Carduus acanthoides* L.		+				+			2	3	4	4	4
II	2	*Brassica nigra* L.	+1					+1			4	3	4	4	5
II	2	*Arctium lappa* L.			+					+	3	3	5	4	4
II	2	*Abutilon theophrasti* Med.					+	+1			2	3	3	4	5
II	2	*Silene alba* (Mill.) Kr.						+	+1		2	3	4	4	3
II	2	*Helianthus tuberosus* L.					+1			+					
I	468	*Cynodon dactylon* (L.)Pers.				3.3					2	3	3	4	5

Table 1: (Cont.) Description of the new ruderal *Matricario-Helianthetum annuuae* community – ass. New

I	219	*Lolium perenne* L.					2.2	3	3	4	4	3
I	62	*Calystegia sepium* (L.)R.Br.			1.2			4	4	4	3	3
I	62	*Ambrosia artemisiifolia* L.				1.1		2	3	3	4	4
I	62	*Dipsacus silvester* Huds.	1.1					3	4	3	4	4
I	62	*Taraxacum officinale* Web.	1.1					3	3	4	4	3
I	1	*Linaria vulgaris* Mill.	+1					3	3	3	4	3
I	1	*Verbena officinalis* L.	+					2	3	4	4	3
I	1	*Lotus corniculatus* L.	+1					2	4	3	4	3
I	1	*Epilobium adnatum* Gris.	+1									
I	1	*Erigeron annuus* (L.) Pers.	+					3	3	3	4	4
I	1	*Bidens tripartitus* L.	+					4	3	4	4	3
I	1	*Galium aparine* L.		+1				3	3	5	3	3
I	1	*Lycopus exaltatus* L.		+1				4	3	3	3	3
I	1	*Sonchus arvensis* L.		+				3	3	4	3	3
I	1	*Melilotus albus* Med.			+1			2	3	2	4	3
I	1	*Pastinaca sativa* L.			+1			3	4	3	4	3
I	1	*Lamium purpureum* L.			+1			3	4	4	4	3
I	1	*Crepis setosa* Hall.			+2			2	3	3	4	5
I	1	*Medicago sativa* L.				+		2	4	3	4	4
I	1	*Torilis arvensis* (Huds.) Lk.				+		2	4	3	4	4
I	1	*Vicia cracca* L.					+1	3	3	3	4	3
I	1	*Capsella bursa-pastoris* (L.) Med.					+	2	3	3	4	3
I	1	*Aster salignus* Willd.					+	3	4	4	3	3

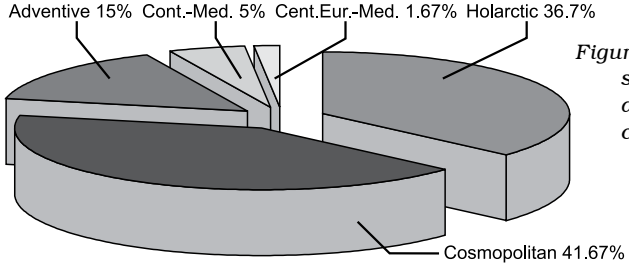

Figure 2: Floristic regions represented in the Matricario-Helianthetum annuuae community at Pančevački Rit

T=therophytes; H=hemicryptophytes; G=geophytes, and S=scandentophytes

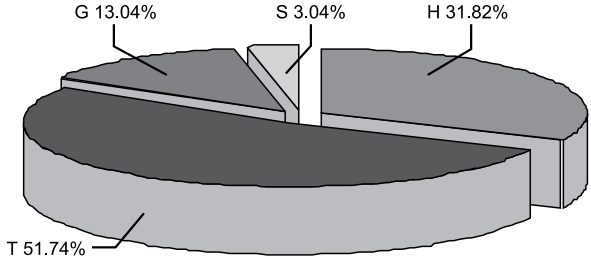

Figure 3: Plant life forms in the Matricario-Helianthetum annuuae community at Pančevački Rit

of the plant cover is 60-250 cm, depending on survey season and predominant participation of high and medium high plants (Meg-Alt=20 species; Meg=13; Mes-Meg=15; Mes-Alt=3). Apart from *Helianthus annuus* (Figure 1), species of the community, it is composed of a combination of several other species: *Matricaria inodora* L., *Chenopodium album* L., *Cirsium arvense* (L.) Scop., *Sorghum halepense* (L.) Pers., *Polygonum lapathifolium* L., *Rumex crispus* L., *Chamomilla recutita* (L.) Rausch. and *Lactuca serriola* L. The general apperance of a stand is further characterized by some species with the secondary and tertiary presence, such as *Echinochloa crus-galli* (L.) Beauv., *Cichorium intybus* L., *Artemisia vulgaris* L., *Agropyron repens* (L.) Beauv., *Solanum nigrum* L. and *Convolvulus arvensis* L., which have high coverage in some stands.

An analysis of the distribution ranges of the community *Matricario-Helianthetum annuuae* indicates that five basic floristic regions are represented (Figure 2). The most widespread are cosmopolitan species with 25 representatives (41.66%), including *Matricaria inodora, Chamomilla recutita, Rumex crispus, Setaria glauca* (L.) Beauv., *Echinochla crus-galli, Cichorium intybus*, and *Agropyron repens* which are particularly frequent. The broad holarctic floristic region is represented with 22 species (36.67%). Adventive plant distribution is represented with 9 species (15%), including *Helianthus annuus* as the most dominant one. The continental-Mediterranean floristic region is typically represented by the species *Picris echioides* L.

Analysis of the distribution ranges of vegetation with quantification of the individual life-forms in this plant community gives us a more detailed picture of ecological conditions and character of the habitat of the *Matricario-Helianthetum annuuae* community (Figure 3).

Twenty-five species representing therophytes (T) account for half of all individuals in the community (51.74%). Scapose forms (T scap) are most widespread and include 19 species (*Chamomilla recutita, Chenopodium album, Solanum nigrum, Picris echioides*) with *Helianthus annuus* and *Matricaria inodora* as the dominant species. *Echinochloa crus-galli, Setaria glauca*, and *Bromus sterilis* represent the group of caespitose forms (T caesp), while *Capsella bursa-pastoris* (L.) Med. is the only representative of the rosette form (T ros). Hemicryptophytes (H) are most widely represented in qualitative terms with 27 species, but their percentage (31.82%) was significantly lower than that of therophytes. Similar to therophytes, the life-form of hemicryptophytes is mostly represented by the scapose form (H scap) (*Artemisia vulgaris, Cichorium intybus, Lactuca serriola, Conium maculatum, Rumex crispus*). Geophytes (G) included 5 species (*Cirsium arvense, Cynodon dactylon, Lathyrus tuberosus, Sorghum halepense*, and *Agropyron repens*), characterized by very large numbers, but only accounting for 13.04% of the plant spectrum compared with the total number of individuals in the community. *Scandentophytes* (lianas, S; 3.04%) have three representatives, the most frequent being the geophyte *Convolvulus arvensis*.

Ecological indices for the *Matricario-Helianthetum annuuae* association (Table 2) show that most of its species have adjusted to habitats that are moderately moist and with neutral soil pH. Mineral matter is present in different amounts, but most plants develop optimally in habitats with medium supply of mineral matter. Most of these species have optimal growth in moderately warm habitats under full daylight.

Table 2: Ecological indices for stands of the *Matricario-Helianthetum annuuae* community

Ecological index	Ecological index of species									
	M		A		R		L		T	
	No. of species	%	No. of species	%	No. of species	%	No. of species	%	No. of species	%
1	-	-	-	-	-	-	-	-	-	-
2	22	37.93	1	1.72	3	5.17	-	-	1	1.72
3	30	51.72	45	78.95	25	43.10	14	24.14	33	56.90
4	6	10.34	12	20.69	27	46.55	42	72.41	18	31.03
5	-	-	-	-	3	5.17	2	3.45	6	10.34
Average	2.72		3.19		3.51		3.79		3.50	

M-moisture; A-soil acidity; R-soil richness in available nitrogen; L-light; T-temperature

DISCUSSION

Of the four *Helianthus* species found in the Vojvodina Province, three belong to the category of naturalized adventive species [*H. tuberous* L., *H. decapetalus* L. and *H. scabberimus* (*pauciflorus*) L.], while *H. annuus* belongs to the category of ephemerals as an introducted species unable to form stable populations, but able to colonize newly disturbed environments (Boža, 1979, Jovanović, 1994; Vrbničanin *et al.*, 2004). However, the newly-formed ruderal *Matricario-Helianthetum annuuae* community at Pančevački Rit with the presence of *H. annuus* in other ruderal communities (Stanković-Kalezić *et al.*, 2007) and in agrestal phytocoenoses along with other weed species (Ivanović, 2000; Stanković-Kalezić *et al.*, 2004) are indications of a changing status of this species and its invasive character.

The newly described *Matricario-Helianthetum annuuae* community represents a unique ruderal-agrestal combination of vegetation, transitional in character, which spontaneously develops in close surroundings of agricultural fields under intensive cultivation. Sunflower (*Helianthus annuus* L.), which is an annual crop, occurs in the community subspontaneously and often massively, persists independently, giving a physiognomic character to ruderal habitats in which ephemeral ruderal weed vegetation is frequent and includes predominantly annual plants of *Sisymbrion officinalis* R.Tx., Lohm. et Prsg. 1950.

Besides the significant presence of *Helianthus annuus* (49.36% of total plant coverage) in the *Matricario-Helianthetum annuuae* community at Pančevački Rit, the species is also found, but more sporadically, in other stands of ruderal communities and crops in arable fields. Of 10 established ruderal communities at Pan-

čevački Rit, *Helianthus annuus* was found in five ruderal associations with coverage of 0.02 to 2.61% (Stanković-Kalezić *et al.*, 2007).

At Pančevački Rit, which is a major agrarian complex, there are different categories of ruderal habitats in which abundant ruderal flora and vegetation are developing and creating potential "hotspots" of new invasive adventive species that may spread into arable fields (Stanković-Kalezić *et al.*, 2007). In agrestal phytocoenoses, *Helianthus annuus* grows along with other weed species in row crops, where its coverage varies, but tends to increase over the years. This raises ecological concerns and indicates a need for control of this weed species (Ivanović, 2000). Analysis and monitoring of invasive species in a wider area of the Vojvodina Province in similar row crops (maize, sugar beet, soybean, *etc.*) have indicated a significant presence of *Helianthus annuus* in regional weed vegetation suggesting a need to take a closer look at these populations in order to develop a strategy for suppressing further spread of this species as well as some other invasive plants (Stanković-Kalezić *et al.*, 2004).

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NUEVA ASOCIACIÓN DE MALEZAS RUDERALES EN PANČEVAČKI RIT EN SERBIA

RESUMEN

Se condujo un estudio a lo largo de muchos años sobre la distribución, diferenciación fitocoenológica, de composición florística y estructura de la vegetación y flora ruderal y la influencia antropogénica sobre ésta en Pancevacki Rit en Serbia.

Se identificaron claramente diez comunidades ruderales distintivas en este estudio, incluyendo la comunidad *Matricario-Helianthetum annuae* recientemente formada. Esta comunidad es una combinación única de vegetación ruderal y agreste que se desarrolla espontáneamente en la vecindad de campos con agricultura intensiva, en los cuales el girasol (*Helianthus annuus* L.), un cultivo anual, aparece y persiste subespontáneamente y a menudo masivamente, dando un carácter fisionómico a los hábitats ruderales en los cuales la vegetación de malezas ruderales efímeras a menudo se desarrolla, consistiendo predominantemente en especies anuales de la alianza *Sisymbrion officinalis* R.Tx., Lohm. et Prsg. 1950.

NOUVELLES COMMUNAUTÉS D'HERBES RUDÉRALES DANS LES TERRAINS MARÉCAGEUX DE PANČEVO, SERBIE

RÉSUMÉ

Une étude pluri-annuelle de la distribution, de la differentiation phytocoénologique, de la composition floristique, de la structure de la flore rudérale et de la végétation, et de l' influence anthropogénique a été conduite à Pančevački Rit en Serbie.

Dix communautés rudérales distinctes ont été identifiées, y compris la communauté nouvellement formée *Matricario-Helianthetum annuae.* Cette communauté est une combinaison unique de végétation de transition rudérale-agreste qui ce développe spontanément à la proximité de champs cultivés de façon intensive, dans laquelle le tournesol (*Helianthus annuus* L.), une espèce annuelle, apparaît et persiste de façon subspontanée et souvent de façon massive, conférant une physionomie aux habitats rudéraux dans lesquels une végétation éphémère se développe souvent, consistant de façon prédominante de plante annuelle de l'alliance *Sisymbrion officinalis* R.Tx., Lohm. et Prsg.1950.