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Floristic Diversity of Certain Wetlands in Southern Bulgaria

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Abstract. The two-year study on the species composition of higher plants was conducted in three moisture zones in the Maritsa river valley, Bulgaria: "Rice-field Plovdiv", protected zone (PZ) "Rice-field Tsalapitsa" and protected area (PA) "Martvitsata Zlato Pole". The analysis was done, using the floristic methods. There were 154 species of vascular plants identified, which belong to 125 genera and 43 families. The highest floristic diversity was found for PA "Martvitsata Zlato Pole" – 74% of the total number of species found, followed by "Rice-field Plovdiv" (47%) and PZ "Rice-field Tsalapitza" (36%). The families Asteraceae, Poaceae, Fabaceae and Lamiaceae have the largest number of representatives. The total floristic composition of the three tested areas showed the predominance of dicotyledonous taxa. The comparative analysis of the biological types showed the prevalence of the perennial herbaceous plants, followed by the annual plants.

Key words: species composition, vascular plants, moisture zones, floristic diversity.

Introduction

At the beginning of the 20th century, the wetlands in Bulgaria covered 2% of the country's territory and now they have decreased 20 times. Many of them were drained, ploughed or construction took place on those sites, without evaluating their importance (National Plan for Conservation of the Most Significant Wetlands in Bulgaria 2013-2022). As a result, a number of plants spread only in riparian areas, have been included in the Red data book of the Republic of Bulgaria, Vol. I (PEEV *et al.*, 2015) and the Biological Diversity Act (2002) with an endangered status endangered [EN], such as *Nymphaea alba* L., *Utricularia minor* L., *Aldrovanda vesiculosa* or regionally extinct [RE], *Caldesia parnassifolia* (L.) Parl.

The great species diversity of flora and fauna in the riparian wetlands is the reason for their putting under some form of legal protection – protected areas within the meaning of the Protected Areas Act (1998) and/or Natura 2000 protected areas within the meaning of the Biological Diversity Act (2002). When determining the conservation status of most of the wetlands along the Maritsa River, particular attention is paid to the specific species composition of the fauna. The floristic composition of higher plants in those areas has been comparatively poorly studied until now.

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VIHODTSEVSKI (1963) mentioned individual plant species along the Maritsa River valley. The author pointed out some new species for the flora of Bulgaria and some new habitats of rare species. A detailed floristic description has not been made.

Describing the flora of the Maritsa River banks, BONDEV (1991) mentioned the existence of black alder, willow and poplar forests, combined in some places with artificially planted poplar trees and hygrophytic grass communities.

Partial data about the species composition of higher plants along the Maritsa River were found in the plans and reports developed for the conservation of that territory (MESHINEV & APOSTOLOVA, 2006; MARINOV *et al.*, 2007; Management Plan for the protected area for birds BG 0002086, "Rice Fields Tsalapitsa", 2013). The following species were determined as common hygrophytes: *Potamogeton berchtoldii* Fieber, *Potamogeton nodosus* Poir. The presence of helophytes as *Sparganium erectum* L., *Lythrum salicaria* L., *Polygonum hydropiper* L., *Typha latifolia* L., *Epilobium hirsutum* L. along the riverside is significant. The river banks are overgrown with ruderal grassy hygrophytic species and single trees of white willow (*Salix alba* L.).

The lack of detailed floristic studies of the riparian wetlands is the main reason for carrying out the present research, which aims at making an inventory of the species composition and assessing the floristic diversity of three selected representative areas along the Maritsa River valley, subject to different anthropogenic impacts.

Material and Methods

The present study is part of a project of the Faculty of Biology at the University of Plovdiv "Paisii Hilendarski", related to the complex eco-biological assessment of the status of wetlands in southern Bulgaria. The project identified three territories along the Maritsa River and they can be related to two types of standing water ponds – rice paddies and old beds of large lowland rivers – "martvitsi" (oxbow lakes).

Two areas – "Rice Fields Plovdiv" and the protected zone (PZ) BG0002086 "Rice Fields Tsalapitsa" – were floristically explored in detail for the first time. The two territories constitute a complex of wetland areas used at present for rice production, surrounded by low dikes, canals and uncultivated deserted lands. They are located in close proximity to densely populated areas and are subjected to strong anthropogenic pressure.

The second type included the protected area (PA) "Martvitsata" near the village of Zlato pole, Municipality of Dimitrovgrad. It was declared as a protected area by Order RD-476 of MOEW (State Gazette 73/2001). It is the largest wetland of a natural origin along the Maritsa River, its conservation status implying a weaker anthropogenic pressure (Fig. 1).

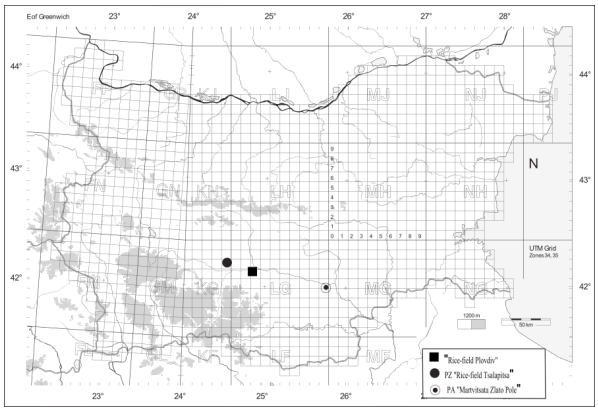

Fig. 1. Indicative map of the locations of the three wetlands in southern Bulgaria.

The study of the species composition of higher plants in the three selected areas was carried out by field surveys and systematic collection of materials in the period 2017-2018. Each of the three territories was labelled as a 5 km long transection, at the center of which a GPS coordinate point was put: "Rice Fields Plovdiv" – N42010'14", E24040'31"; "Rice Fields Tsalapitsa" – N42012'02", E24035'59"; "Martvitsata – Zlato pole" – N42002'12", E25042'55". Locations and sizes of the transects are consistent with the requirement for the highest possible

representativeness and comparability in the analyses of the selected zones.

The taxonomic approach was chosen as basic for the analysis of the floristic composition in the three zones. The ecological spectrum of the flora of these three zones was stated in a previous study - RADOUKOVA *et al.* (2018).

The identification of plant species composition was carried out on-site and under laboratory conditions. The following sources were used for identifying the plant species and their biological type: Flora of NR Bulgaria (YORDANOV, 1963-1979), Guidebook to the higher plants in Bulgaria (KOZHUHAROV, 1992), Key to the Plants in Bulgaria (DELIPAVLOV & CHESHMEDZHIEV, 2003).

The list of the taxa found was alphabetically arranged by the names of families, genera and species.

The quantitative assessment of the floristic diversity was carried out according to the methods of SHMIDT (1980) and the works of KAMELIN (1973) and TOLMACHEV (1986).

The number of species, genera and families of the Bulgarian flora follows the DELIPAVLOV & CHESHMEDJIEV (2003) and ASSYOV & PETROVA (2012).

The species-genus ratio in the families found was calculated according to ASSENOV (2014). The names of the species were updated following The Plant List (2019).

The unified methodology used in collecting and analyzing data from the three zones provides an opportunity for good comparability of the findings.

Results and Discussion

As a result of the two-year inventory carried out in the three studied areas, a total of 154 species of higher plants were found, belonging to 125 genera and 43 families (Appendix 1). The largest number of species was found in the PA "Martvitsata – Zlato Pole" – 115, belonging to 105 genera and 39 families. "Rice Fields Plovdiv" ranked second for the number of species – 72 species of 67 genera and 31 families. The PZ "Rice Fields Tsalapitsa" had the smallest number of species – 58 species, 54 families and 25 genera (Appendix 1). In a 41-kilometer stretch in the middle course of the Maritsa River, between Plovdiv and Parvomay, MARINOV *et al.* (2007) found about 200 species of higher plants belonging to 139 genera and 57 families. GEORGIEV (2012) found 222 species of higher plants of 168 genera and 58 families in the protected area "Nahodishte na blatno kokiche" in Vinitsa village, municipality of Parvomay (18.6 ha).

In the three studied areas, the Magnoliophyta species were represented, as follows: 128 Magnoliopsida species (83.1% of the total number of taxa and 4.4% of the species of Bulgaria) and the 26 Liliopsida species (16.9 % of the total number of taxa and 4% of the species of Bulgaria). Upon the Maritsa River (PA "Nahodishte na blatno kokiche" in Vinitsa village), TASHEV *et al.* (2014) found 46 species belonging to Class Liliopsida, distributed in 31 genera and 11 families, and 175 species belonging to Class Magnoliopsida, distributed in 136 genera and 46 families (Table 1).

The highest number of species was found in the PA "Martvitsata – Zlato Pole" and respectively the number of the representatives of both classes in that area was the highest (98 Magnoliopsida and 17 Liliopsida). Although "Rice Fields Plovdiv" ranked second for the number of species found, the monocotyledonous plants in that area were less in number than those in the PZ "Rice Fields Tsalapitsa" – 11 and 13, respectively (Table 1). The reason is the higher percentage of species of the Poaceae family in the PZ "Rice Fields Tsalapitsa" (Appendix 1).

The ratio of the dicotyledonous to the monocotyledonous plants in the three areas is 4.9:1. It is close to the ratio, known for our country, between the number of the species in the two classes 4.4:1, found by GUSEV *et al.* (2004). The largest share of the dicotyledonous plants was found in the PA "Martvitsata – Zlato Pole" (5.7:1), followed by "Rice Fields Plovdiv" (5.5:1) and the PZ "Rice Fields Tsalapitsa" (3.4:1).

Table 1. Taxonomic structure of the vascular flora in "Rice-field Plovdiv", PZ "Rice-field Tsalapitsa", PA "Martvitsata Zlato Pole" and in total for the three observed areas.

Taxon	Quantitative characteristics of the studied flora	Magnoliophyta	Magnoliopsida	Liliopsida
Family	Number in general of the three observed areas	43	36	7
	Number for "Rice-field Plovdiv"	31	27	4
	% of the total number found for the three zones	72.1	75	57.1
	Number for PZ "Rice-field Tsalapitsa"	25	20	5
	% of the total number found for the three zones	58.1	55.6	71.4
	Number for PA "Martvitsata Zlato Pole"	38	31	7
	% of the total number found for the three zones	88.4	86.1	100
Genus	Number in general of the three observed areas	125	104	21
	Number for "Rice-field Plovdiv"	67	58	9
	% of the total number found for the three zones	53.6	55.8	42.8
	Number for PZ "Rice-field Tsalapitsa"	54	42	12
	% of the total number found for the three zones	43.2	40.4	57.1
	Number for PA "Martvitsata Zlato Pole"	104	88	16
	% of the total number found for the three zones	83.2	84.6	76.9
Species	Number in general of the three observed areas	154	128	26
	Number for "Rice-field Plovdiv"	72	61	11
	% of the total number found for the three zones	46.8	47.7	42.3
	Number for PZ "Rice-field Tsalapitsa"	58	45	13
	% of the total number found for the three zones	37.7	35.2	50
	Number for PA "Martvitsata Zlato Pole"	115	98	17
	% of the total number found for the three zones	74.7	76.6	65.4

Table 2. Families with the highest participation and relative share of species and genera in "Rice-field Plovdiv", PZ "Rice-field Tsalapitsa", PA "Martvitsata Zlato Pole" and in total for the three observed areas.

Family		Asteraceae	Fabaceae	Poaceae	Lamiaceae
Species					
"Rice-field Plovdiv"	Number	18	5	8	3
	% for three observed areas	62.1	38.5	47.1	30
PZ "Rice-field Tsalapitsa"	Number	15	3	9	1
	% for three observed areas	51.7	23.1	52.9	10
PA "Martvitsata Zlato Pole"	Number	22	9	11	9
	% for three observed areas	75.9	69.2	64.7	90
In general of the three observed areas	Number	29	13	17	10
	% for three observed areas	6	4.5	5.2	6.5
% of the total number of species for Bulgaria		**13.8**	**7.9**	**7.6**	**4**

		Genus			
"Rice-field Plovdiv"	Number	17	5	6	3
	% for three observed areas	70.8	55.6	42.8	37.5
PZ "Rice-field Tsalapitsa"	Number	15	2	8	1
	% for three observed areas	62.5	22.2	57.1	12.5
PA "Martvitsata Zlato Pole"	Number	21	7	10	8
	% for three observed areas	87.5	77.8	71.4	100
In general of the three observed areas	Number	24	9	14	8
	Index Species/Genus	1.1	1	1.3	1

Describing the specific characteristics of flora, it is necessary to identify the families' richest in species and genera (TASHEV & ANGELOVA, 2005). The families represented by the largest number of genera and species in the three studied areas were Asteraceae (24 genera and 29 species), Poaceae (14 genera and 17 species), Fabaceae (9 genera and 13 species) and Lamiaceae (8 genera and 10 species). The number of species and genera in those four families reached 44.8% of the species and 44% of the genera for the three studied territories (Table 2).

As should be expected, the highest percentage of species and genera for those four families was reported in the PA "Martvitsata – Zlato pole" (Table 2). The lowest percentage of those indicators was reported for the PZ "Rice Fields Tsalapitsa", with an exception of Poaceae family, in which the share of the species is 52.9% and the genera – 57.1%, i.e. significantly higher than the values for "Rice Fields Plovdiv" – 47.1% and 42.8%, respectively (Table 2).

The comparison of the most richly represented families in the three areas and the flora of Bulgaria shows a certain difference (VASSILEV & ANDREEV, 1992; GUSEV *et al.*, 1997). Poaceae family, which ranked third in the flora of Bulgaria after Asteraceae and Fabaceae, in the three studied areas was the second for the number of genera and species. The Lamiaceae family, ranking eighth in a relative share of species in the whole flora of Bulgaria, occupied the fourth place in the studied areas, surpassing the families Rosaceae (7 genera, 7 species), Caryophyllaceae (3 genera, 4 species), Brassicaceae (7 genera, 8 species), Scrophulariaceae (2 genera, 3 species).

A relatively large number of species and genera were reported for the families Apiaceae (6 genera, 6 species), Brassicaceae (5 genera, 5 species), Rosaceae (7 genera, 7 species), but only in the PA "Martvitsata – Zlato Pole" (Appendix 1).

In total for the three areas, 58.1% of the families are represented by 1 genus, 18.6% by 2 genera, 6.9% by 3 genera. 7 of the families are represented by more than 5 genera, i.e. 16.3%. The largest number of families, represented by only 1 genus, was found in the PA "Martvitsata – Zlato pole" – 25, followed by "Rice Fields Plovdiv"– 20 families (Fig. 2). In "Martvitsata – Zlato Pole" the largest number of families with more than 5 genera were identified – 7, or 16.3% of the total number of species found in the three areas and 17.9% of those found in the protected area.

With regard to the number of species in a family, 44.2% of all the families found in the three areas, are represented by 1 species. The families with more than 5 species are 6 or 13.9%. The largest percentage of families with 1 species was reported in PA "Martvitsata – Zlato Pole" – 67.4% of the total number of families found in the three areas or 74.4% for the protected area. The largest number of families with more than 5 species was reported for the same area – 7 or 16.3%. In the other two studied areas "Rice Fields Plovdiv" and "Rice Fields Tsalapitsa", the number of the families represented by 1 species was the same – 17 or 39.5% of all the species found and 54.5% and 68%,

respectively, of the species composition in each of the two areas (Fig. 3).

The found species/genus ratio was about 1.5 because most of the genera were represented by 1 or 2 species only (Table 2).

A total of 15 species of trees and shrubs and 139 species of herbaceous plants were found in the flora of the three studied areas. The trees and shrubs belong to 11 genera and 6 families and the herbaceous plants to 115 genera and 37 families. In the middle course of the Maritsa River between Plovdiv and Parvomay, MARINOV *et al.* (2007) found 23 species of trees, 11 species of shrubs, 5 species of lianas and 160 species of herbaceous plants. In PA "Nahodishte na blatno kokiche" on the Maritsa river, TASHEV *et al.* (2014) found that the perennial herbaceous species were most represented – 117 or 52.7%, followed by the annual – 43 species (19.4%), trees – 14 species (6.3%), shrubs – 12 species (5.4%).

In PA "Martvitsata – Zlato Pole" and "Rice Fields Plovdiv" the tree and shrub species found belong to 5 families. In the first area, the genera found are 11 and in the second one – 6. Five species of trees and shrubs, belonging to 2 families, were identified in the PZ "Rice Fields Tsalapitsa". Deforestation of riparian wetlands, used for rice growing, was included in a number of management plans (Ministry of Environment and Water. Regional Inspectorate of Environment and Water – Plovdiv). They state that the riparian vegetation on the banks of the rice paddies is dominated by low and high herbaceous vegetation – 85%. Shrub communities are 5% and trees with a height of less than 10 m – 10%.

The highest number of tree and shrub species was found in the PA "Martvitsata – Zlato pole" – 12. In "Rice Fields Plovdiv" and PZ "Rice Fields Tsalapitsa" the same number of those species was found, i.e. 6 in each area.

Tree plants found in the three areas are divided into four groups by their biological type, the largest being the number of trees. The biological type of semi-shrub – shrub was found only in the PA "Martvitsata – Zlato pole" (Table 3).

The herbaceous species identified in the three studied areas refer to 6 biological groups (Table 4). Perennial species are prevailing. They represent 51.4% of the total number of herbaceous plants and 46.1% of the total number of species found in the three areas. The largest share of perennial herbaceous plants was found in PA "Martvitsata – Zlato pole" (50% of the group of herbaceous plants, 33.1% of the total number of species in the three areas and 44.3% of the total number of species in that concrete area). The second group of herbaceous plants is that of the annual species. They occupy 29.7% of the herbaceous plants found in the three areas and 26.6% of the total number of species. Comparing the three studied areas, the largest share of annual herbaceous plants was found in the PZ "Rice Fields Tsalapitsa" (40.4% of the herbaceous species, 36.2% of the total number of species in that area). The fact that the annual herbaceous species are of big number is indicative for the strong anthropogenic impact, due to deforestation, erosion and agricultural activity.

Conclusions

Anthropogenic pressure on the flora was reported in the studied areas PA "Martvitsata – Zlato pole", PZ "Rice Fields Tsalapitsa" and "Rice Fields Plovdiv", expressed in a reduced share of tree species and a high percentage of annual herbaceous plants.

The most significant anthropogenic impact was found in PZ "Rice Fields Tsalapitsa", where the lowest total number of species and the largest share of annual herbaceous plants were reported compared to the flora of the other two studied areas.

The largest number of higher plants and the highest percentage of tree species found in PA "Martvitsata – Zlato pole" compared to the other two areas, define the protected area as the least affected by the anthropogenic impact.

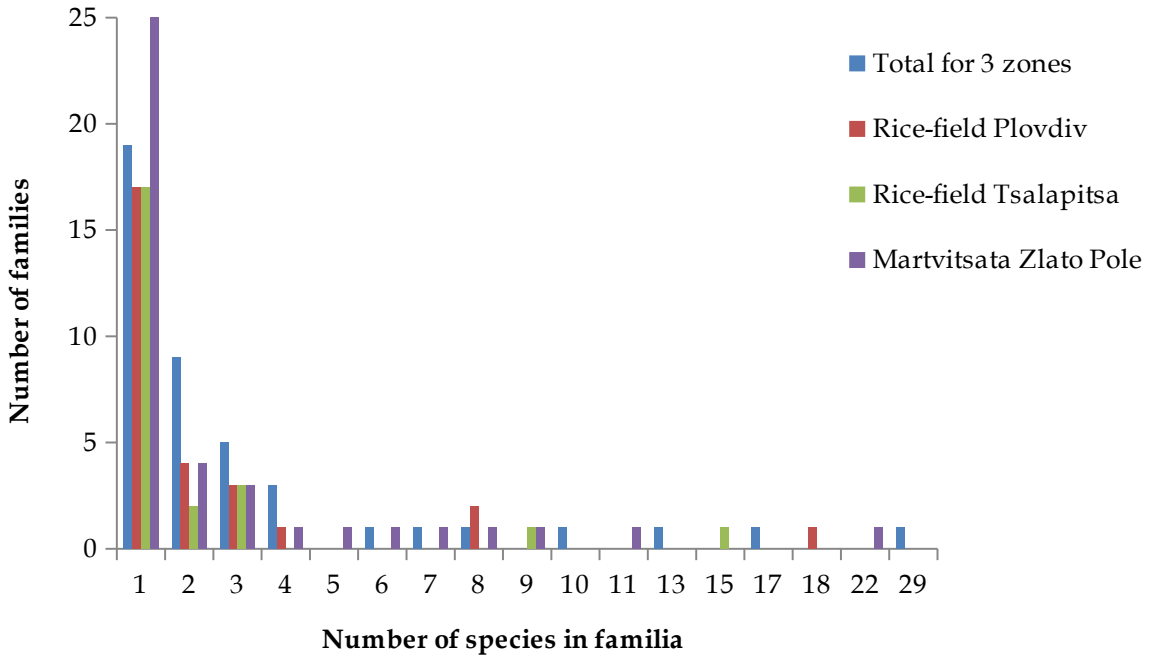

Fig. 2. Relative participation of families with different number of genera in the flora of "Rice-field Plovdiv", PZ "Rice-field Tsalapitsa", PA "Martvitsata Zlato Pole" in total for the three observed areas.

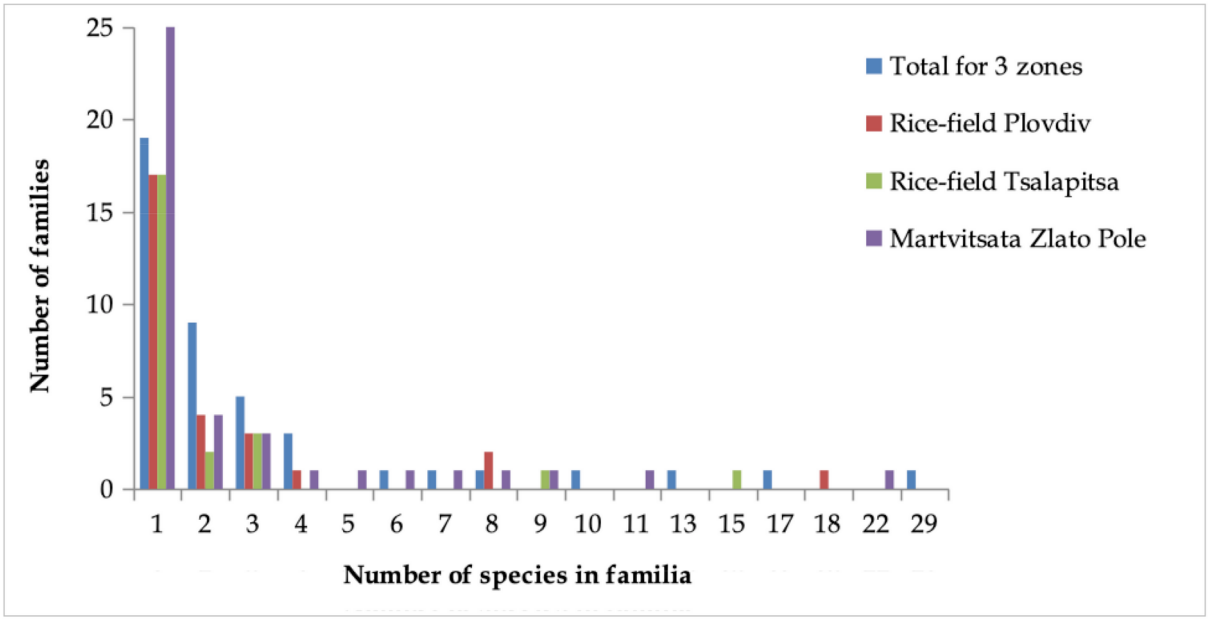

Fig. 3. Distribution of families with different number of species in the flora of "Rice-field Plovdiv", PZ "Rice-field Tsalapitsa", PA "Martvitsata Zlato Pole" and in total for the three observed areas.

Table 3. Distribution of tree plants in the flora of "Rice-field Plovdiv", PZ "Rice-field Tsalapitsa", PA "Martvitsata Zlato Pole" and in total for the three observed areas. Abbreviation: t- Tree, s - Shrub, h-s -Half-shrub.

Zone	Biological type	t	s	t-s	h-s
In general of the three observed areas	Number	7	4	3	1
	% of the total number in the group	43.8	25	18.8	6.6
	% of the total number of species	4.5	2.6	1.9	0.6
"Rice-field Plovdiv"	Number	3	1	2	
	% of the total number in the group	50	16.6	33.3	
	% of the total number of species	1.9	0.6	1.3	
	% of the total number of species in that area	4.2	1.4	2.8	
PZ "Rice-field Tsalapitsa",	Number	3	2	1	
	% of the total number in the group	50	33.3	16.6	
	% of the total number of species	1.9	1.3	0.6	
	% of the total number of species in that area	5.2	3.4	1.7	
PA "Martvitsata Zlato Pole"	Number	5	4	2	1
	% of the total number in the group	38.4	30.8	15.4	15.4
	% of the total number of species	3.2	2.6	1.3	1.3
	% of the total number of species in that area	4.3	3.5	1.7	1.7

Table 4. Distribution of herbaceous plants in the flora of "Rice-field Plovdiv", PZ "Rice-field Tsalapitsa", PA "Martvitsata Zlato Pole" and in total for the three observed areas. Abbreviation: ph - perennial herbaceous; a - annual; b – biennial.

Zone	Biological type	a	b	a-b	a - ph	b - ph	ph
In general of the three observed areas	Number	42	5	13	2	6	71
	% of the total number in the group	29.7	3.6	9.4	1.4	4.3	51.4
	% of the total number of species	26.6	3.24	8.4	1.3	3.8	46.1
"Rice-field Plovdiv"	Number	23	5	5	1	2	30
	% of the total number in the group	34.8	7.6	7.6	1.5	3	45.5
	% of the total number of species	14.9	3.2	3.2	0.6	1.3	19.5
	% of the total number of species in that area	31.9	6.9	6.9	1.4	2.8	41.7
PZ "Rice-field Tsalapitsa"	Number	21	1	3	1	1	25
	% of the total number in the group	40.4	1.9	5.8	1.9	1.9	48.1
	% of the total number of species	13.6	1.5	1.9	1.5	1.5	16.2
	% of the total number of species in that area	36.2	1.7	5.2	1.7	1.7	43.1
PA "Martvitsata Zlato Pole"	Number	33	6	9	1	3	51
	% of the total number in the group	31.4	5.9	8.8	0.9	2.9	50
	% of the total number of species	20.8	3.9	5.8	1.5	1.9	33.1
	% of the total number of species in that area	27.8	5.2	7.8	0.9	2.6	44.3

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Appendix 1. List of taxa found in "Rice-field Plovdiv", PZ "Rice-field Tsalapitsa", PA "Martvitsata Zlato Pole" and in general of the three observed areas.

Familia	Genus	Species	Biological types	Rice-field Plovdiv	Rice-field Tsalapitsa	Martvitsata Zlato Pole
Apiaceae	*Anthriscus*	*A. sylvestris* (L.) Hoffm.	ph			+
	Chaerophyllum	*Ch. temulentum* L.	a - b			+
	Conium	*C. maculatum* L.	a	+	+	+
	Daucus	*D. carota* L.	a-b			+
	Heracleum	*H. sibiricum* L.	b - ph			+
	Torilis	*T. arvensis* (Huds.) Link	a			+
Aristolochiaceae	*Aristolochia*	*A. clematitis* L.	ph		+	+
Asteraceae	*Achillea*	*A. crithmifolia* Friv. ex Hampe	ph	+		
		A. setacea Walds. et Kit.	ph			+
	Anthemis	*A. austriaca* Jacq.	a – b			+
	Arctium	*A. lappa* L.	b	+		+
	Artemisia	*A. absinthium L.*	ph	+		
		A. vulgaris L.	ph	+	+	+
	Bidens	*B. tripartita* L.	a			+
	Carduus	*C. acanthoides* L.	a	+	+	+
	Carthamus	*C. lanatus* L.	a		+	+
	Centaurea	*C. solstitialis* L.	a	+	+	+
	Chamomilla	*Ch. recutita* (L.) Rauschert	a	+	+	+
	Chondrilla	*Ch. juncea* L.	a			+
	Cichorium	*C. intybus* L.	ph	+	+	+
	Cirsium	*C. arvense* (L.) Scop.	ph	+		+
		C. vulgare (Savi) Ten.	b		+	+
	Conyza	*C. canadensis* (L.) Cronquist	a	+	+	+
	Crepis	*C. biennis* L.	a – b	+		
		C. tectorum L.	ph			+
	Erigeron	*E. acer* L.	a – ph	+		
	Filago	*F. arvensis* L.	a	+		
		F. vulgaris Lam.	a			+
	Helminthotheca	*H. echioides* (L.) Holub	a		+	+
	Inula	*I. ensifolia L.*	ph		+	
	Lactuca	*L. serriola* L.	a – b	+	+	+
	Onopordum	*O. acanthium L.*	a	+	+	
	Picris	*P. hieracioides* L.	a – ph		+	+
	Taraxacum	*T. officinale* F.H.Wigg.	ph	+		+
	Tragopogon	*T. dubius* Scop.	a	+	+	+
	Xanthium	*X. strumarium* L.	a	+		+
Boraginaceae	*Anchusa*	*A. officinalis* L.	ph			+
	Cynoglossum	*C. officinale* L.	a			+
	Echium	*E. italicum* L.	b	+		+
Brassicaceae	*Capsella*	*C. bursa-pastoris* (L.) Medik.	a – b	+	+	+
	Cardaria	*C. draba* (L.) Desv.	ph	+	+	
	Descurainia	*D. sophia* (L.) Webb ex Prantl	a – b			+
	Erysimum	*E. diffusum* Ehrh.	b – ph			+
	Rorippa	*R. prolifera* Simonk.	a – b			+
	Sisymbrium	*S. officinale* (L.) Scop.	a – b	+		
		S. orientale L.	a – b			+
	Thlaspi	*T. arvense* L.	b	+		
Butomaceae	*Butomus*	*B. umbellatus L.*	ph			+
Cannabaceae	*Cannabis*	*C. sativa* L.	a	+		+
	Humulus	*H. lupulus* L.	ph	+		

Caprifoliaceae	*Sambucus*	*S. ebulus* L.	ph			+
		S. nigra L.	s – t	+		
Caryophyllaceae	*Dianthus*	*D. armeria* L.	a – b		+	
		D. campestris M. Bieb.	ph			+
	Herniaria	*H. hirsuta* L.	a – b			+
	Silene	*S. vulgaris* (Moench) Garcke	ph	+		
Chenopodiaceae	*Chenopodium*	*Ch. album* L.	a	+		+
Convolvulaceae	*Calystegia*	*C. silvatica* (Kit.) Griseb.	ph	+		
	Convolvulus	*C. arvensis* L.	ph	+	+	+
Cuscutaceae	*Cuscuta*	*C. europaea* L.	a			+
Cyperaceae	*Cyperus*	*C. longus L.*	ph		+	
	Scirpus	*S. lacustris* L.	ph			+
Dipsacaceae	*Dipsacus*	*D. laciniatus* L.	b	+		+
	Scabiosa	*S. columbaria L.*	b – ph	+		
Euphorbiacea	*Euphorbia*	*E. cyparissias* L.	ph			+
		E. salicifolia Host.	ph	+		
Fabaceae	*Amorpha*	*A. fruticosa* L.	s			+
	Dorycnium	*D. herbaceum* Vill.	ph			+
	Galega	*G. officinalis L.*	ph	+		
	Lotus	*L. corniculatus* L.	ph	+	+	+
	Medicago	*M. lupulina* L.	b	+		+
	Melilotus	*M. albus* Medik.	a	+		
	Trifolium	*T. affine* C. Presl	a			+
		T. arvense L.	a			+
		T. repens L.	ph			+
	Trigonella	*T. caerulea* (L.) Ser.	a	+		+
	Vicia	*V. cracca* L.	ph			+
		V. dalmatica A. Kern.	ph		+	
		V. lathyroides L.	a		+	
Geraniaceae	*Erodium*	*E. cicutarium* (L.) L'Her	a	+	+	+
	Geranium	*G. dissectum* L.	a	+		
		G. palustre L.	ph	+		
Haloragaceae	*Myriophyllum*	*M. spicatum* L.	ph			+
Hydrocharitaceae	*Hydrocharis*	*H. morsus-ranae L.*	ph			+
Hypericaceae	*Hypericum*	*H. perforatum* L.	ph	+	+	+
Lamiaceae	*Ballota*	*B. nigra L.*	ph	+	+	+
	Clinopodium	*C. vulgare* L.	ph			+
	Glechoma	*G. hederacea* L.	ph	+		+
	Lamium	*L. garganicum* L.	ph			+
		L. purpureum L.	a – b	+		
	Lycopus	*L. europaeus L.*	ph			+
	Marrubium	*M. peregrinum* L.	ph			+
		M. vulgare L.	ph			+
	Mentha	*M. aquatica* L.	ph			+
	Scutellaria	*S. altissima* L.	ph			+
Lemnaceae	*Lemna*	*L. minor* L.	ph	+	+	+
Lythraceae	*Lythrum*	*L. salicaria* L.	ph	+		+
Malvaceae	*Malva*	*M. sylvestris* L.	b – ph	+	+	+
Oleaceae	*Fraxinus*	*F. americana* L.	t	+		
Onagraceae	*Epilobium*	*E. hirsutum L.*	ph	+	+	
Papaveraceae	*Papaver*	*P. rhoeas* L.	a	+	+	+
	Aegilops	*Ae. cylindrica* Host	a			+
	Agropyron	*A. repens* (L.) P. Beauv.	ph	+		
	Avena	*A. fatua* L.	a		+	+
	Bromus	*B. mollis* L.	a	+		+
		B. tectorum L.	a	+		+
		B. sterilis L.	a	+	+	

Poaceae	*Bothriochloa*	*B. ischaemum* (L.) Keng	ph		+	
	Cynodon	*C. dactylon* (L.)Pers.	ph	+	+	+
	Dasypyrum	*D. villosum* (M.Bieb.)Maire	a			+
	Festuca	*F. pratensis* Huds.	ph			+
	Hordeum	*H. murinum* L.	a	+	+	+
	Lolium	*L. perenne* L.	ph	+	+	+
	Phragmites	*P. australis* (Cav.) Steud.	ph	+	+	+
	Poa	*P. pratensis* L.	ph			+
	Setaria	*S. glauca* (L.) P.Beauv.	a		+	
		S. viridis (L.) P.Beauv.	a		+	
	Sorghum	*S. halepense* Pers.	ph		+	
Plantaginaceae	*Plantago*	*P. lanceolata* L.	ph			+
		P. major L.	ph	+	+	+
Polygonaceae	*Persicaria*	*P. hydropiper* (L.) Spach	a	+	+	+
	Polygonum	*P. aviculare* L.	a	+	+	+
	Rumex	*R. crispus* L.	ph	+	+	
		R. pulcher L.	ph			+
Portulacaceae	*Portulaca*	*P. oleraceae* L.	a		+	
Potamogetonaceae	*Potamogeton*	*P. crispus* L.	ph	+	+	+
		P. nodosus Poir	ph		+	
Rosaceae	*Agrimonia*	*A. eupatoria* L.	ph			+
	Crataegus	*C. monogyna* Jacq.	s - t			+
	Potentilla	*P. reptans* L.	ph			+
	Prunus	*P. cerasifera* Ehrh.	s - t	+	+	+
	Pyrus	*P. pyraster* (L.) Burgsd.	t			+
	Rosa	*R. canina* L.	s		+	+
	Rubus	*R. caesius* L.	*s*	+	+	+
Rubiaceae	*Galium*	*G. aparine* L.	a	+		+
		G. palustre L.	ph			+
		G. verum L.	ph			+
Scrophullariaceae	*Linaria*	*L. vulgaris* Mill.	ph			+
	Verbascum	*V. blattaria* L.	b			+
		V. speciosum Schrad.	ph		+	
Salicaceae	*Populus*	*P. nigra* L.	t		+	+
	Salix	*S. alba* L.	t		+	+
		S. fragilis L.	t	+	+	+
		S. purpurea L.	s			+
Sapindaceae	*Koelreuteria*	*K. paniculata* Laxm.	t	+		
Simarubiaceae	*Ailanthus*	*A. altissima* (Mill.) Swingle	t			+
Solanaceae	*Datura*	*D. stramonium* L.	a			+
	Solanum	*S. dulcamara* L.	hs			+
		S. nigrum L.	hs			+
Sparganiaceae	*Sparganium*	*S. erectum* L.	ph			+
Typhaceae	*Typha*	*T. angustifolia L.*	ph	+	+	+
		T. latifolia L.	ph		+	
Urticaceae	*Urtica*	*U. dioica* L.	ph	+	+	+
Verbenaceae	*Verbena*	*V. officinalis* L.	ph			+
43	**125**	**154**		**72**	**58**	**115**