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Rare, endangered and protected plant species of synanthropic flora of the Kampinos National Park (Central Poland)

Izabella Kirpluk[1] & Anna Bomanowska[2]

[1]Warsaw University Botanic Garden, Aleje Ujazdowskie 4, 00-478 Warszawa, Poland, e-mail: ikirpluk@biol.uw.edu.pl
[2]Department of Geobotany and Plant Ecology, University of Łódź, Banacha 12/16, 90-237 Łodź, Poland, e-mail: knopikaa@biol.uni.lodz.pl

Abstract: The aim of this paper is to present the rare, endangered and protected plant taxons growing in the synanthropic habitats of the Kampinos National Park. The research was conducted on agricultural fields (still maintained) and in ruderal habitats in over a dozen abandoned villages in the Kampinos Forest.
Among species considered to be endangered are: *Agrostemma githago, Asperugo procumbens, Atriplex rosea, Camelina microcarpa, Centunculus minimus, Filago arvensis, Fumaria officinalis, Gagea pratensis, Holosteum umbellatum, Myosurus minimus, Pulicaria vulgaris* and *Radiola linoides*. To the category of rare plant species belong: *Anthemis ruthenica, Arabis glabra, Arnoseris minima, Chenopodium ficifolium, Ch. pedunculare* and *Euphorbia peplus*. Species protected by law, found during the study, include: *Epipactis helleborine, Jovibarba sobolifera* and *Helichrysum arenarium.*
According to our observations some of the segetal plant species, for example *Filago arvensis, Centaurea cyanus* and *Papaver rhoeas*, have tendencies to habitat change. These plant species move from agricultural fields to ruderal habitats. In the Kampinos Forest's synanthropic habitats the species from seminatural non-forest habitats such as *Sedum sexangulare, Eryngium planum, Cerastium semidecandrum,* find their place.

Key words: valuable species, synanthropic habitats, Kampinos National Park (Abbreviation: KNP), Central Poland

1. Introduction

Changes in flora resulting in the decrease in populations, habitat loss and species extinction are one of the most important effects of human impact on vegetation. Synanthropic plants (connected with habitats created and changed by humans) are one of plant groups changing most rapidly and deeply (Svensson & Wigren 1986; Ratyńska & Boratyński 2000; Baessler & Klotz 2006). For centuries, human impact was present in the Kampinos Forest, resulting in deeper and deeper changes in vegetation. Deforestation, for example, has been mentioned at the beginning of the 17th century (Zielony 2004). Forests were cleared for agricultural use and new villages and settlements were established in the area. New habitat types, shaped by anthropogenic impact, are now deeply embeded in the Kampinos landscape with many typical species of plants and animals (Bomanowska & Michalska-Hejduk 2007).

For years, the Kampinos Forest has been affected by different factors which caused environmental degradation. The neighbourhood of a big and still growing city, such as Warsaw, had great influence on the "wild nature" preservation. When, in 1959, the KNP was established some of the changes were halted, but the new ones occurred.

Since the 1970s onwards, in the area of the KNP, the purchase of agricultural lands and building of villages has been conducted (Lenartowicz & Markowski 2004). The abandonment of villages and adjacent fields to the adventage of the Kampinos Forest decreased the range and forms of anthropogenic impact on the forest. These changes have been caused by the decrease in human population and different forms of farming, as well as direct and indirect impact of the surrounding forest, meadow and grassland vegetation. Activities planned by the management of the KNP, such as purchasing and destroying farm buildings and fields, limitation of

human penetration and afforestation, all aimed at renaturalization, are of great importance for the changes in the forest (Kirpluk 1996). Such process of secondary succession supported by afforestation caused withdrawal of field and ruderal vegetation and changes in the appearance of forest and shrub vegetation. As the result, the areas connected with the traditional way of farming, with valuable species of plants, have been disappearing from the Kampinos Forest.

Since the 19th century, protected, rare and endangered species of vascular plants in the Kampinos Forest, which later became a national park, have interested many botanists. However, the scientists focused on the species from the natural or semi-natural habitats (Rostafiński 1872; Łapczyński 1882, 1890; Błoński 1892; Kobendza 1930, 1934; Nowak 1983, Głowacki & Ferchmin 2003; Michalska-Hejduk 2001, 2004, 2006), information on rare and endangered species from the synanthropic habitats can be found only in few scientific works (Kobendza 1930; Nowak 1983; Bomanowska & Michalska-Hejduk 2007, 2008).

Recent floristic researches carried out on the agricultural lands within the area of the KNP have shown that synanthropic habitats are the places with many valuable and now endangered species of plants. Among them are both arable weeds and rare endangered plants from ruderal habitats (Bomanowska 1998, 2005, 2006a, 2006b, 2008; Kirpluk 1998, 2003, 2005a, 2005b).

The aim of the article is to present a list of rare, endangered and protected vascular plants from synanthropic habitats (ruderal and segetal) in the chosen villages in the KNP.

2. Material and methods

The article is based on the plant material collected by the authors during field research in the KNP, between 1994 and 2007. The list of endangered and rare species of vascular plants in synanthropic habitats has been made on the basis of the authors' own research and publications (Kirpluk 1996, 1998, 2003, 2005a, 2005b; Bomanowska 2001, 2005, 2006a, 2006b, 2008).

The study area encompasses the ruderal and segetal habitats from the chosen 15 villages in the KNP (Fig. 1). The limit has been set due to the differences in the areas included in the authors' own studies. Only those 15 villages were common to the research of both authors.

The KNP is located in the south-western part of Warsaw Basin mesoregion (Kondracki 1998). In the geobotanical division of Poland (Szafer 1972), it belongs to the Warsaw District in the Mazovia Region. The park is situated in the vicinity of Warsaw (Fig. 1). Detailed characteristics of the environmental conditions of the study area may be found in many publications (e. g. Kaczorowska 1926; Konecka-Betley 1994; Sikorska-Maykowska 1994; Andrzejewska 2003; Andrzejewski 2003; Krogulec 2003).

The research on flora of ruderal habitats in the KNP was carried out between 1992 and 1995 and then again

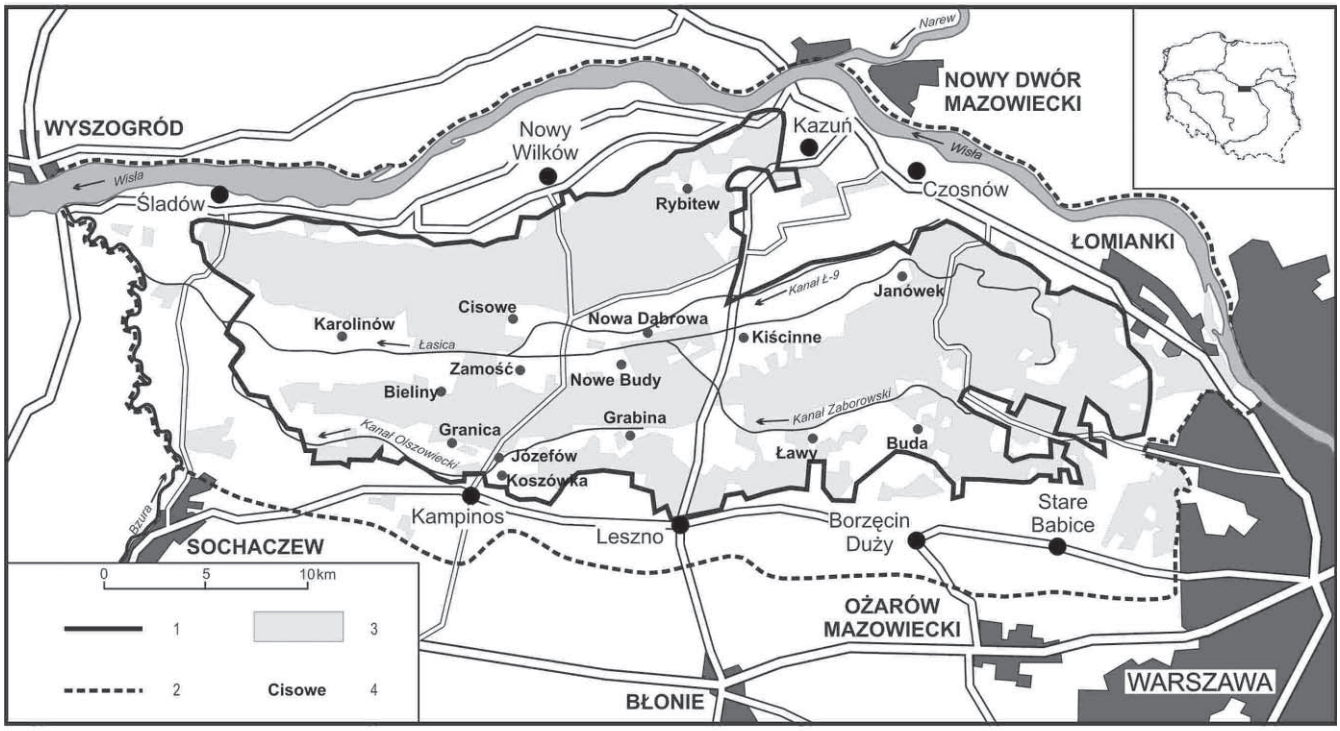

Fig. 1. Localization of villages taken under study in the Kampinos National Park (graphical design – W. Załuski)
Explanations: 1 – borders of the Kampinos National Park, 2 – borders of the buffer zone, 3 – forests, 4 – investigated villages

between 2004 and 2007 (Kirpluk 1996, 1998, 2003, 2005a, 2005b). 15 almost abandoned villages, which have similar size of ruderal habitats, have been singled out for the research. The chosen villages are scattered around the Park and many of them are isolated from roads and a rail hub by forest and meadows, therefore, the access to them is difficult and penetration by humans scarce.

Floristic studies were carried out in all ruderal habitats, which means: roadsides, barnyards of abandoned farms or ruins, rubbles, rubbish piles, fields around them and vegetation in the proximity of houses and fences. For each village one floristic list including the frequency of species occurrence has been made.

The research of segetal flora was carried out between 1994 and 1999 and supplemented between 2004 and 2005 (Bomanowska 2001, 2008). The study was conducted on the fields in the KNP (the protection zone excluded). Observations have been made on segetal habitats (cereal crops, root crops, stubble fields, vegetable gardens) and black fallows (ploughed fields but not sown during particular years).

Fieldwork employed the cartogram method with a regular grid. A grid of basic squares 1 km by 1 km based on the ATPOL grid (Zając 1978) was applied. Floristic lists were prepared for each cartogram square. The study procedure was described in detail in the earlier papers by Bomanowska (2001, 2005, 2006a). In the present paper, floristic data for segetal habitats from only 14 abandoned villages have been used. The villages were chosen according to the same criteria as for ruderal flora. Only Karolinów village was excluded from the study due to the lack of segetal habitats.

For the sake of purpose of the research and for the unity of data the term "site" means the presence of the species in a particular village, in both ruderal and segetal habitats. The size of the area of vegetation is not taken into consideration.

According to the aim of the research, the focus has been on the endangered species. The most important source were national red lists of segetal and vascular plants (Warcholińska 1994; Zarzycki & Szeląg 2006). The publications of Warcholińska (2004) and Bomanowska (2008) were used as well. Categories of the degree of threat to the analysed species followed the above mentioned authors. Legally protected species were chosen according to the Regulation of the Minister of Environment (2004). A group of rarely found species in the chosen villages was singled out in the study. The group includes species rare not only in the Kampinos Forest, but also in Poland (Zając & Zając 2001). All of these species were named "species of special care". The species nomenclature followed Mirek *et al*. (2002).

3. Results and discussion

As a result of the floristic study, 73 valuable species in total were recorded in the synanthropic habitats of the KNP (Appendix 1). In the 15 analysed villages, in segetal and ruderal habitats, there were found sites of 5 species included in the Polish red list of vascular plants and of 3 legally protected ones (Table 1). Among the most valuable species are 2 critically endangered (CR): *Asperugo procumbens* and *Atriplex rosea* and 3 vulnerable ones (VU): *Gagea pratensis*, *Myosurus minimus* and *Pulicaria vulgaris*. In the studied villages most of the species occurred in 1-2 sites.

In the distinguished group many endangered and rare segetal weeds are represented (32 species). The species that were found in a few sites, such as: *Camelina microcarpa*, *Centunculus minimus*, *Chondrilla juncea*, *Filago arvensis*, *Fumaria officinalis*, *Hypericum humifusum*, *Juncus capitatus* and *Papaver strigosum,* are worthy of special notice. This group comprises also one protected species – *Helichrysum arenarium.*

In the list, 24 very rare species (with 1 to 3 sites) and 12 relatively rare ones (with more than 3 sites) in synanthropic habitats were included (Table 1). Among those ones, 2 protected species, such as: *Epipactis helleborine* and *Jovibarba sobolifera,* were taken into account. A considerable number of taxons included in the groups have their ecological optimum beyond fields and ruderal habitats and many of them are plants not endangered on a nation-wide scale. The species were included in the list because they represent a valuable component for the nature of the Kampinos National Park non-forest grassland communities. Among those ones are: *Allium vineale*, *Cerastium semidecandrum*, *Eryngium planum*, *Gypsophila fastigiata* and *Sedum sexangulare*. These species are rare and endangered in the KNP because their sites disappear due to habitat changes and secondary succession (Głowacki & Ferchmin 2003). The presented list of species reflects specific character of the studied area, in that the presence and activity of man through the centuries have had a strong impact on vegetation. This is expressed for instance in the status of protected species.

Asparagus officinalis belongs to species cultivated at present and escaping from cultivation and, on the other hand, it is a species of foreign origin, thus, it has the status of ergasiophygophyte (Sudnik-Wójcikowska & Koźniewska 1988) with a tendency to become naturalized.

Two protected species only can be recognized as typical apophyta, which means native species naturalized in synanthropic habitats. The first one is *Epipactis helleborine* which appeared recently in ruderal habitats in 3 villages included in the floristic study since 1994 (Kirpluk 2005a, 2005b). The second one is *Helichrysum*

arenarium which widened its range. Over the last few years, a considerable increase in a number of its sites has been observed in ruderal habitats of the abandoned villages in the Kampinos Forest. This effect undoubtedly may be connected with right habitat conditions favourable for grassland species in most of the studied villages. However, this situation seems only temporary if one takes into account proceeding of secondary succession (Głowacki & Ferchmin 2003) and afforestation (Kotowska 2003) in this area.

The obtained results of the study show that some rare plants of natural habitats have a tendency to move into the anthropogenically changed habitats, which was also observed in many other regions of the country (Adamowski 2006; Bzdon & Ciosek 2006; Jakubska *et al*. 2006; Nowak 2006; Nowak 2008).

The occurrence of valuable species in synanthropic habitats in 15 studied objects was differentiated (Fig. 2). Most species of the distinguished group (34) were recorded in the Buda village, fewest in Grabina (9) and Karolinów (12). In all the other villages a number of species ranged from 18 to 28 (Appendix 1). Similar regularities were observed with regard to the considered habitats. Fewest species, only 3, occurred in segetal habitats in Grabina and most species (22) were recorded in Buda. In the majority of objects in segetal habitats from 10 to 19 species were recorded (Appendix 1, Fig. 2). In ruderal habitats, fewest species (6) were also noted in Grabina whereas most species occurred in the Janówek, Cisowe and Ławy villages: 20, 20 and 23, respectively. In all the other villages there were from 12 to 18 species. In the vast majority of the studied villages more species were recorded in ruderal than in segetal habitats and only in the Bieliny and Buda villages a higher number of species occurred in field habitats (Fig. 2).

The overwhelming majority of the distinguished species, as many as 63, occurred in ruderal habitats and 41 out of those ones exclusively in such habitats. In segetal habitats 35 species were noted, of which 10 occurred only in fields. There were 21 species common to both types of habitats (Table 1). A high number of species recorded in ruderal habitats results from the fact that the habitats are strongly diversified and therefore they create conditions suitable for growth of many different plant species (Ratyńska & Boratyński 2000; Kotowska 2003). All protected species and most endangered ones on a nation-wide scale were found only in ruderal habitats. Many rare segetal species were also noted on ruins of farm buildings and former farmyards. Some of those species, such as: *Agrostemma githago*, *Anchusa arvensis*, *Centaurea cyanus*, *Consolida regalis*, *Digitaria sanguinalis* and *Papaver rhoeas,* occurred equally often in fields as in ruderal habitats. *Camelina microcarpa*, *Centunculus minimus* and *Filago arvensis* had in turn their sites in the studied villages only in ruderal habitats (Table 1). Such ecological tendencies and ruderalisation of segetal species are observed in other regions of Poland and Europe as well (Svensson & Wigren 1986; Ratyńska & Boratyński 2000; Sutcliffe & Kay 2000; Nowak 2006).

The distinguished species are influenced by varied agents which endanger persistence of their populations within the studied area. These are for instance: habitat changes, spontaneous succession and afforestation, thus the same agents that cause alterations of the whole

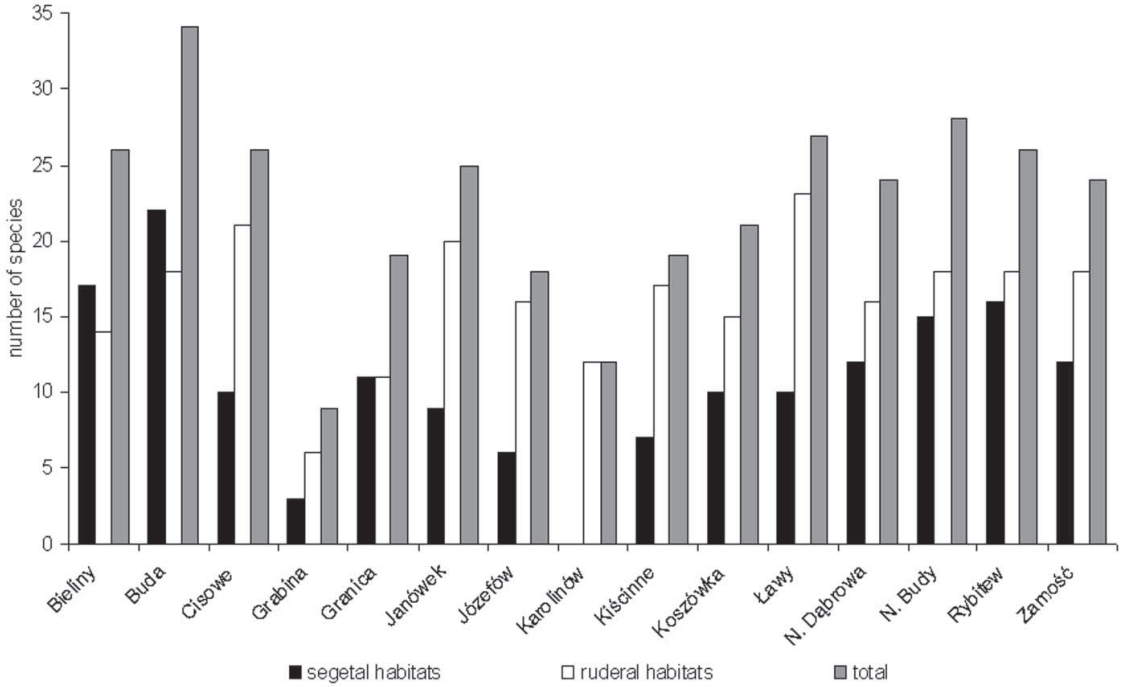

Fig. 2. Number of valuable species occurring in segetal and ruderal habitats of the chosen villages in the Kampinos National Park

Table 1. Rare, endangered and protected plant species of synanthropic flora of the Kampinos National Park

Species	No. of records in habitats		No. of sites (villages)	Category of threat				Species protection
	segetal	ruderal		KNP	PC-seg	PL-seg	PL-vas	
Species threatened on the national scale								
Asperugo procumbens L.	.	2	2	.	CR	V	E	.
Atriplex rosea L.	.	2	2	.	.	.	E	.
Gagea pratensis (Pers.) Dumort.	3	.	3	NT	VU	I	V	.
Myosurus minimus L.	2	.	2	EN	VU	I	V	.
Pulicaria vulgaris Gaertn.	.	1	1	.	.	.	V	.
Threatened segetal species								
Agrostemma githago L.	8	6	11	LC	VU	V	.	.
Anagallis arvensis L.	2	.	2	NT	.	V	.	.
Anchusa arvensis (L.) M.Bieb.	7	9	11	LC	LR	.	.	.
Anthemis tinctoria L.	.	2	2	.	VU	R	.	.
Asparagus officinalis L.	.	11*	11*	.	DD	.	.	.
Avena strigosa Schreb.	3	.	3	DD	VU	E	.	.
Camelina microcarpa Andrz.	.	1	1	EX/CR	VU	V	.	.
Centaurea cyanus L.	14	13	15	.	VU	I	.	.
Centunculus minimus L.	.	1	1	CR	VU	V	.	.
Cerastium semidecandrum L.	2	5	6	.	DD	.	.	.
Chenopodium polyspermum L.	5	5	7	NT	DD	I	.	.
Chondrilla juncea L.	.	1	1	.	DD	.	.	.
Consolida regalis Gray	5	8	10	NT	VU	I	.	.
Cynoglossum officinale L.	.	5	5	.	DD	.	.	.
Digitaria sanguinalis (L.) Scop.	7	7	11	LC	VU	I	.	.
Eryngium planum L.	.	5	5	.	DD	.	.	.
Filago arvensis L.	.	1	1	EX/CR	DD	I	.	.
Fumaria officinalis L.	1	.	1	VU	LR	I	.	.
Gnaphalium luteo-album L.	2	.	2	EN	VU	V	.	.
Helichrysum arenarium (L.) Moench	.	10	10	.	VU	.	.	PP
Herniaria glabra L.	4	2	6	NT	DD	I	.	.
Holosteum umbellatum L.	2	.	2	NT	VU	I	.	.
Hypericum humifusum L.	5	1	6	NT	VU	V	.	.
Juncus capitatus Weigel	1	.	1	EN	VU	R	.	.
Malva pusilla Sm.	.	14	14	.	DD	I	.	.
Papaver argemone L.	1	8	9	VU		.	.	.
Papaver dubium L.	7	9	14	LC	VU	I	.	.
Papaver rhoeas L.	10	13	14	.	VU	I	.	.
Papaver strigosum (Boenn.) Schur**	.	1	1	.		R	.	.
Scabiosa ochroleuca L.	.	2	2	.	DD	.	.	.
Sedum maximum (L.) Hoffm.	1	7	7	.	DD	I	.	.
Sinapis arvensis L.	10	13	13	.	VU	I	.	.
Very rare species (1- 3 sites)								
Agrimonia procera Wallr.	.	1	1	.	.	.	.	.
Alchemilla monticola Opiz	.	1	1	.	.	.	.	.
Allium vineale L.	2	.	2	.	.	.	.	.
Anthemis ruthenica M.Bieb.	.	1	1	.	.	.	.	.
Arabis glabra (L.) Bernh.	.	1	1	.	.	.	.	.
Astragalus glycyphyllos L.	.	2	2	.	.	.	.	.
Chenopodium ficifolium Sm.	.	2	2	.	.	.	.	.
Clinopodium vulgare L.	.	1	1	.	.	.	.	.
Epipactis helleborine (L.) Crantz	.	3	3	.	.	.	.	SP
Euphorbia peplus L.	.	1	1	.	.	.	.	.
Filago minima (Sm.) Pers.	3	.	3	.	.	.	.	.
Filipendula vulgaris Moench	.	1	1	.	.	.	.	.
Galeopsis ladanum L.	.	2	2	.	.	.	.	.
Gypsophila fastigiata L.	.	1	1	.	.	.	.	.
Inula salicina L.	.	2	2	.	.	.	.	.
Jovibarba sobolifera (Sims) Opiz	.	1	1	.	.	.	.	SP
Myosotis ramosissima Rochel	.	1	1	.	.	.	.	.
Scleranthus polycarpos L.	.	1	1	.	.	.	.	.
Sedum sexangulare L.	.	3	3	.	.	.	.	.
Senecio erucifolius L.	.	2	2	.	.	.	.	.
Teesdalea nudicaulis (L.) R.Br.	1	.	1	.	.	.	.	.
Trisetum flavescens (L.) P. Beauv.	.	2	2	.	.	.	.	.
Veronica longifolia L.	2	1	3	.	.	.	.	.
Vicia lathyroides L.	.	1	1	.	.	.	.	.

Other rare species								
Alliaria petiolata (M.Bieb.) Cavara & Grande	2	2	4	.	.	.	.	.
Arnoseris minima (L.) Scweigg. & Korte	8	5	11	.	.	.	.	.
Bromus sterilis L.	1	4	5	.	.	.	.	.
Dianthus carthusianorum L.	.	4	4	.	.	.	.	.
Dianthus deltoides L.	2	6	7	.	.	.	.	.
Malva sylvestris L.	.	5	5	.	.	.	.	.
Nepeta cataria L.	.	5	5	.	.	.	.	.
Spergula morisonii Boreau	9	1	10	.	.	.	.	.
Thlaspi arvense L.	8	4	9	.	.	.	.	.
Veronica agrestis L.	3	1	4	.	.	.	.	.
Veronica hederifolia L.	9	2	9	.	.	.	.	.
Veronica verna L.	8	4	9	.	.	.	.	.

Explanations: * – cultivated species, often escaping from gardens, ** – *Papaver rhoeas* var. *strigosum* Koch. – taxon often included into *P. rhoeas* L., but distinguished by some of the researchers; KNP – threatened segetal species in Kampinos National Park (Bomanowska 2008), EX/CR – locally extinct in segetal habitats, CR – critically endangered, EN – endangered, VU – vulnerable, NT – near threatened, LC – least concern, DD – data deficient; PC-seg – threatened segetal species in central Poland (Warcholińska 2004), CR – critically endangered, VU – vulnerable, LR – lower risk, DD – data deficient; PL-seg – threatened segetal species in Poland (Warcholińska 1994), E – endangered, V – vulnerable, R – rare, I – indeterminate; PL-vas – threatened vascular plants in Poland (Zarzycki & Szeląg 2006), E – declining – critically endangered, V – vulnerable; protected species (according to the Regulation 2004), SP – strictly protected, PP – partly protected

nonforest flora of the KNP (Głowacki & Ferchmin 2003; Michalska-Hejduk 2006). However, the sites of many synanthropic species in the Kampinos National Park, like in other regions of the country, rapidly shrink or even disappear mainly and directly because of reduced man's activity, including fallowing arable land and abandoning homesteads (Svensson & Wigren 1986; Ratyńska & Boratyński 2000; Sutcliffe & Kay 2000, Siciński 2003; Kirpluk 2005a; Bomanowska & Michalska-Hejduk 2008; Bomanowska 2008).

On the list of the endangered segetal plants of the KNP (Bomanowska 2008) there were 38 species, out of which 13, such as: *Adonis aestivalis*, *Bromus arvensis*, *B. secalinus*, *Lolium remotum*, *Misopates orontium*, *Polycnemum arvense,* were recognized as locally extinct. All the other species, such as: *Camelina microcarpa*, *Centunculus minimus*, *Filago arvensis,* strongly decreased the number and abundance of their sites. The causes of the segetal species' recession and their contemporary occurrence within the area of the Kampinos National Park were characterized in earlier studies by Bomanowska (2001, 2006a, 2008).

Considering the direction of changes that is being observed in the studied area (abandoning farms, fallowing) fields and often their further afforestation) one can suppose that under reduced anthropopressure flora of still present segetal habitats in the abandoned Kampinos villages will become impoverished and more and more of native species will appear there instead, spreading in the course of secondary succession from neighbouring natural or semi-natural communities.

4. Final remarks

The collected data showed that the synanthropic habitats of the abandoned villages within the Kampinos National Park are refuges for many interesting plant species. Among them one can find such species as: protected, endangered on a local and nation-wide scale, dying out weeds of field crops and rare ruderal ones.

Preserving remains of old villages – fields and ruderal habitats connected with farm buildings and communication routes – favours protection of the local floristic diversity. Moreover, mid-forest fields and remains of old forest settlements enrich cultural landscape of the park and protect historical and cultural heritage of the Kampinos Forest.

Considering values of the agricultural and settlement areas of the Kampinos Forest it is essential to keep extensively used arable lands within the boundaries of the national park. A continuous impact of management by man is a necessary condition of preserving both individual plant species and whole plant communities.

The obtained data may become the ground for action aimed at protecting valuable species of flora in the areas connected with traditional agriculture in the Kampinos National Park.

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Appendix 1. List of valuable species recorded in segetal and ruderal habitats of the chosen villages in the Kampinos National Park

Villages	Bieliny [ED 12]*		Buda [ED 14]		Cisowe [ED 13]		Grabina [ED 13]		Granica [ED 12]		Janówek [ED 04, ED 14]		Józefów [ED 13]		Karolinów ** [ED 12]	Kiścinne [ED 14]		Koszówka [ED 13]		Ławy [ED 14]		Nowa Dąbrowa [ED 13]		Nowe Budy [ED 13]		Rybitew [ED 03]		Zamość [ED 13]	
	1		2		3		4		5		6		7		8	9		10		11		12		13		14		15	
Species	S	R	S	R	S	R	S	R	S	R	S	R	S	R	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R
Agrimonia procera Wallr.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Agrostemma githago L.	+	.	+	.	.	+	.	.	+	.	+	.	.	+	.	+	+	.	.	.	.	+	+	+	.	+	+	.	+
Alchemilla monticola Opiz	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alliaria petiolata (M. Bieb.) Cavara & Grande	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Allium vineale L.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anagallis arvensis L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	
Anchusa arvensis (L.) M. Bieb.	+	.	+	+	+	+	.	.	.	+	.	+	.	.	.	+	+	+	.	+	+	.	+	.	+	.	.	+	+
Anthemis ruthenica M. Bieb.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthemis tinctoria L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.
Arabis glabra (L.) Bernh.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arnoseris minima (L.) Schweigg. & Korte	+	.	+	.	+	.	.	+	+	.	+	+	.	.	.	.	+	.	+	+	+	+	.	+	.	.	.	.	.
Asparagus officinalis L.	.	+	.	+	.	+	.	.	.	+	.	+	.	+	+	.	+	.	+	.	+	.	.	.	+	.	.	.	.
Asperugo procumbens L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+
Astragalus glycyphyllos L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Atriplex rosea L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Avena strigosa Schreb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	+	.	.	.
Bromus sterilis L.	.	.	.	+	.	.	.	.	+	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Camelina microcarpa Andrz.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Centaurea cyanus L.	+	+	+	+	+	+	+		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Centunculus minimus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cerastium semidecandrum L.	.	.	.	+	.	.	.	.	.	.	.	+	+	+	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.
Chenopodium ficifolium Sm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.
Chenopodium polyspermum L.	.	.	+	.	.	+	.	.	+	+	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	+	+	+	.
Chondrilla juncea L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clinopodium vulgare L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Consolida regalis Gray	.	+	+	.	.	.	.	+	.	.	.	+	+	.	+	.	+	+	.	.	.	.	.	.	.	+	+	+	+
Cynoglossum officinale L.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+
Dianthus carthusianorum L.	.	.	.	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Dianthus deltoides L.	+	.	.	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	+	+	.	.	.
Digitaria sanguinalis (L.) Scop.	.	+	.	+	+	.	.	+	.	.	.	+	.	.	.	.	.	+	+	+	+	+	+	.	+	.	+	.	.
Epipactis helleborine (L.) Crantz	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
Eryngium planum L.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	+	.	+
Euphorbia peplus L.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Filago arvensis L.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Filago minima (Sm.) Pers.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Filipendula vulgaris Moench	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Fumaria officinalis L.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Villages	Bieliny [ED 12]*		Buda [ED 14]		Cisowe [ED 13]		Grabina [ED 13]		Granica [ED 12]		Janówek [ED 04, ED 14]		Józefów [ED 13]		Karolinów ** [ED 12]	Kiścinne [ED 14]		Koszówka [ED 13]		Ławy [ED 14]		Nowa Dąbrowa [ED 13]		Nowe Budy [ED 13]		Rybitew [ED 03]		Zamość [ED 13]	
	1		2		3		4		5		6		7		8	9		10		11		12		13		14		15	
Species	S	R	S	R	S	R	S	R	S	R	S	R	S	R	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R
Gagea pratensis (Pers.) Dumort.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Galeopsis ladanum L.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gnaphalium luteo-album L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Gypsophila fastigiata L.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helichrysum arenarium (L.) Moench	.	.	.	+	.	.	.	.	.	+	.	+	.	.	.	.	+	.	+	.	+	.	+	.	+	.	+	.	+
Herniaria glabra L.	.	.	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.
Holosteum umbellatum L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Hypericum humifusum L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	+	.	+	.	.	.
Inula salicina L.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Iris sibirica L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Jovibarba sobolifera (Sims) Opiz	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus capitatus Weigel	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Malva pusilla Sm.	.	+	.	+	.	+	.	.	.	+	.	+	.	+	+	.	+	.	+	.	+	.	+	.	+	.	+	.	+
Malva sylvestris L.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.
Myosotis ramosissima Rochel	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Myosurus minimus L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Nepeta cataria L.	.	+	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Papaver argemone L.	+	.	.	+	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	+	.	+	.	+	.	.	.	+
Papaver dubium L.	+	.	.	+	+	+	.	+	.	+	.	.	+	.	+	.	+	+	.	+	.	.	+	.	+	+	.	+	+
Papaver rhoeas L.	+	+	+	+	+	+	.	.	+	+	+	+	+	+	+	+	+	.	+	.	+	.	+	+	+	+	+	+	+
Papaver strigosum (Boenn.) Schur	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Pulicaria vulgaris Gaertn.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Scabiosa ochroleuca L.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Scleranthus polycarpos L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Sedum maximum (L.) Hoffm.	.	+	+	+	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	+	.	.
Sedum sexangulare L.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.
Senecio erucifolius L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Sinapis arvensis L.	+	+	+	+	+	+	.	.	+	+	+	+		+	.	.	+	.	+	+	+	+	+	+	+	+	+	+	+
Spergula morisonii Boreau	.	.	+	.	.	+	.	.	.	.	+	.	+	.	.	+	.	+	.	+	.	+	.	+	.	.	.	+	.
Teesdalea nudicaulis (L.) R. Br.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thlaspi arvense L.	+	.	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	+	+	.	.	+	.	+	+	+	+	.	+
Trisetum flavescens (L.) P. Beauv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+
Veronica agrestis L.	.	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Veronica hederifolia L.	+	.	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	+	.	+	+	.	.	+	.
Veronica longifolia L.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.
Veronica verna L.	+	+	+	.	+	.	.	.	.	.	+	.	.	.	+	+	+	+	+	.	.	.	.	.	.	+	.	+	.
Vicia lathyroides L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Number of species on habitats	17	14	22	18	10	20	3	6	11	11	9	20	6	16	12	7	17	10	15	10	23	12	16	15	17	16	18	12	18
Number of species in village	26		34		25		9		19		25		18		12	19		21		27		24		27		26		24	

Explanations: * – number of ATPOL square, ** – only of ruderal habitats, S – segetal habitats, R – ruderal habitats