VASCULAR FLORA OF OLD CEMETERIES TRANSFORMED INTO PARKS
IN POZNAŃ

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ABSTRACT. In 2011–2012, the vascular flora of all the eight park-like old cemeteries in Poznań was studied. They are former Protestant cemeteries, transformed into parks after the World War 2. Each of them was investigated in both spring and summer. In total, 334 species of vascular plants were found there, including 62 in the tree layer, 91 in the shrub layer, and 181 in the herb layer. Their vascular flora includes 173 taxa (51.8% of the total) introduced into cultivation, most of them in the shrub layer (70 species, i.e. 20.9%). Among plants with symbolic meanings, 52 species are in the tree and shrub layer, and 34 in the herb layer. Currently the symbolism of cemetery plants is of little significance, and they are planted mostly for ornament. Funeral plants in the investigated cemeteries are represented by 74 species. These include 15 species of geophytes, which are indicator plants (phytoindicators) of former cemeteries: *Gagea arvensis*, *G. lutea*, *Galanthus nivalis*, *Hemerocallis fulva*, *Muscari botryoides*, *Narcissus poeticus*, *N. pseudonarcissus*, *Ornithogalum boucheanum*, *O. nutans*, *O. umbellatum*, *Puschkinia scilloides*, *Saponaria officinalis*, *Scilla sibirica*, *Tulipa gesneriana*, and *T. sylvestris*.

KEY WORDS: Poznań, old cemeteries, vascular plants, funeral plants, ergasiophytes

INTRODUCTION

The aesthetic role of cemeteries increased in the 19th century, when the concepts of cemetery parks, cemetery gardens or rural cemeteries were created. Plants started to play a major role in the cemetery space. Cemetery planning involved gardeners, landscape architects. Tall vegetation, shrubs, lawns, and flowers appeared in cemeteries (TANAŚ 2008). Because of the landscape cemetery concept, they are ideal for strolls and contemplation.

In Poland, old cemeteries can be transformed into parks 40 years after the last burial (NIEMIŃSKI 1973). Thanks to the existence of parks at the sites of former cemeteries, they are cared for and maintained, and thus are easy to distinguish in the landscape. They are of both historical and environmental value.

The cemeteries where the proportion of tall vegetation is high are an important link in the system of urban green areas. Their extensive green spaces undoubtedly affect the microclimate of urban districts, and can also play an important visual role in urban landscape (NIEMIŃSKI 1973). According to BORCZ (2002), cemeteries can be classified as urban green

areas because they include groups of trees, alleys, vegetation planted at cemetery edges, solitary trees, and continuously intensively flowering plants.

SIEWNIAK & MITKOWSKA (1998) report that irrespective of the epoch and geographic region, cemeteries fulfilling their major function (as burial sites) nearly always became also green areas. Their boundaries are well-defined, so they are like gardens of special type, always with emphasis on the atmosphere of silence, reflection, and meditation, usually with many sacral objects.

Municipal cemeteries, as wooded habitats, are classified also as urban green areas (SIEWNIAK & MITKOWSKA 1998, DĄBSKI & OLEŚ 2006). The oldest cemeteries are habitat islands in urban and suburban districts, often with old, valuable trees, a well-developed shrub layer, and interesting funeral plants in the herb layer. Before the World War 2, HEMPELMANN (1927) noted that individual lanes in cemeteries, to improve orientation, should be planted with contrasting tree species. Then the visitors would easily find their way even at large cemeteries.

Cemeteries are some of the most valuable forms of our cultural heritage. Now they also reflect the

level of tolerance and sensitivity of the current generations in relation to other cultures or nationalities. This applies e.g. to abandoned German cemeteries (RYDZEWSKA et al. 2011).

In Poznań, the flora of several cemeteries has already been studied: historical cemeteries in Świerczewo (CZARNA 2005) and the Citadel (CZARNA 2016), and currently used ones: Górczyn Cemetery, Nowina Cemetery in Jeżyce, Corpus Christi Cemetery in Bluszczoza St., and John Vianney Parish Cemetery in Lutycka St. (CZARNA et al. 2011).

Before the World War 2, cemeteries were used for burial but in the course of years they acquired the form of specific gardens. The plants were selected carefully, in a planned way, to create a complete composition. This is reflected in the current tree layer of vegetation in these cemeteries (transformed into parks), as the trees have reached maturity.

This study was aimed to analyse the taxonomic composition of vascular plants in park-like old cemeteries in Poznań and to verify the hypothesis that in park-like cemeteries the majority of funeral plants (cemetery phytoindicators) are geophytes.

MATERIAL AND METHODS

In 2011–2012, floristic investigations were conducted in eight park-like cemeteries. They are former Protestant cemeteries, transformed into parks after the World War 2. Each of them was investigated in both spring and summer (Table 1).

Names of spontaneously occurring species follow (MIREK et al. 2002), while names of cultivated species follow (GAWRYŚ 2008).

To determine the ground cover of species, a 7-degree scale of frequency was used: R = negligible (1–2 plants); + = several plants; 1 = very rare (covering 1–5% of cemetery area excluding graves); 2 = rare (5–25%); 3 = moderately frequent (25–50%); 4 = frequent (50–75%); 5 = common (75–100%).

Fig. 1. General floristic similarity of the studied cemeteries visualized using cluster analysis
Explanations – see Table 2.

Abbreviation “cul” indicates that the species was planted (long ago or recently).

Geographical-historical classification follow those proposed by THELLUNG (1915) with some modifications. Ergasiophytes were defined as alien species of cultivated plants introduced intentionally by humans and later neglected, which are permanently naturalised generatively or vegetatively in parks, gardens or cemeteries, but do not invade neighbouring habitats.

While Raunkiaer’s plant life-forms are classified mostly according to RUTKOWSKI (1998), ZARZYCKI et al. (2002). Species new to Poland were determined in comparison to MIREK et al. (2002), species new to Wielkopolska were distinguished in comparison to SZULCZEWSKI (1951), and species new to Poznań were identified in reference to JACKOWIAK (1990). Plants with symbolic meanings were determined on the basis of KOPALIŃSKI (1985), ZIÓŁKOWSKA (1988), KOBIELUS (2006), KOSSAK (2017).

Table 1. List of the investigated park-like old cemeteries in Poznań

No.	Polish name	Street	Denomination	Graves	Use	Date of research
I	Malta	Świętojańska	Catholic	none	mown	24.04.2012 24.07.2012
II	Park Górczyński	Ostrobramska	Protestant	none	mown	20.04.2012 26.07.2012
III	Park K. Marcinkowskiego	Towarowa	Protestant	none	mown	04.04.2011 23.07.2012
IV	Park Lubuski	Królowej Jadwigi	Protestant	none	mown	22.04.2012 23.07.2012
V	Park G. Manitiusa	Grunwaldzka	Protestant	none	mown	02.04.2011 30.08.2011
VI	Park. im. Gen. J. H. Dąbrowskiego	Ogrodowa	Protestant	none	mown	22.04.2012 23.07.2012
VII	Plac Kosynierów	Słowiańska	Protestant	1 grave	mown	22.04.2012 30.07.2012
VIII	Park near Hotel Vivaldi	Winogrody	Protestant	none	no management	22.04.2012 24.07.2012

The species that occurred in 2–3 layers of vegetation in the studied cemeteries, were counted twice or thrice in the classification of life-forms and geographical-historical groups, i.e. as they occurred.

General floristic similarity of the studied cemeteries was visualized using cluster analysis. The dendrogram was generated by Statistica software on the basis of Euclidean distances and the unweighted pair-group average. The dendrogram (Fig. 1) was generated on the basis of species occurrence assessed using the Braun-Blanquet scale. The scale was transformed into a numerical scale as follows: r into 1, + into 2, 1 into 3, 2 into 4, 3 into 5, 4 into 6, and 5 into 7. Each species was used in the analysis only once, even if it occurred in many layers.

RESULTS

In all the eight park-like old cemeteries in Poznań, 334 species of vascular plants were found. The tree layer consisted of 62 species, the shrub layer of 91, and the herb layer of 181 (Table 2). Numbers of

recorded species were the highest in cemeteries III (155 species), I (119), and VIII (108), whereas the lowest in cemeteries VI (58) and V (66) (Table 3).

In general, the highest number of species represented frequency class “+” (341 records), followed by classes “1” (226) and “R” (121) (Table 3). Only one species (*Aesculus hippocastanum*) in one cemetery (VI) was included in the highest frequency class “5”. Also frequency class “4” was represented by only one species (*Lolium multiflorum*), in the same cemetery (VI). Plants of frequency class “3” were found in cemeteries III (1 species), IV (5), V (6), VII (1), and VIII (3). The lowest frequency class, “R”, was represented by the largest numbers of species in cemeteries I, III, IV, and VI. Frequency classes “2” and “3” included the largest numbers of species in cemetery III.

Raunkiaer's life-forms are adaptations to survival in unfavourable periods, such as winter and droughts. Vascular plants of park-like cemeteries in Poznań represent six life-forms: megaphanerophytes, nanophanerophytes, chamaephytes, geophytes, therophytes, and hemicyrptophytes. Among

Table 2. Occurrence of vascular plants in park-like cemeteries in Poznań and their classification into life-forms (LF), geographical-historical groups (GH), symbolic plants (S), and funeral plants (F)

Species	Cemetery								LF	GH	Symbolic (S) and funeral (F) plants
	I	II	III	IV	V	VI	VII	VIII			
Tree layer											
<i>Abies concolor</i> (Gordon & Glend.) Lindl. ex Hildebr.	–	–	2 cul	1 cul	1 cul	–	–	–	F1	ErW	S
<i>Acer campestre</i> L.	–	1 cul	1 cul	–	–	–	–	–	F1	Ap2/Sp2	S
<i>Acer negundo</i> L.	–	–	1 cul	–	–	–	1 cul	–	F1	Kn	S
<i>Acer platanoides</i> L.	2 cul	2 cul	2 cul	3 cul	2 cul	1 cul	3 cul	3 cul	F1	Ap2	S, F
<i>Acer pseudoplatanus</i> L.	1 cul	1 cul	1 cul	–	1 cul	1 cul	–	1 cul	F1	Ap2	S, F
<i>Acer saccharinum</i> L.	–	–	–	1 cul	–	–	–	1 cul	F1	ErW	S
<i>Acer tataricum</i> L.	–	–	1 cul	1 cul	–	–	–	–	F1	ErW	S
<i>Aesculus carnea</i> Hayne	–	–	1 cul	–	–	–	–	–	F1	ErW	S
<i>Aesculus hippocastanum</i> L.	1 cul	–	1 cul	3 cul	1 cul	4 cul	–	2 cul	F1	Kn	S, F
<i>Ailanthus altissima</i> Swingle	1 cul	–	1 cul	–	–	–	–	–	F1	Kn	
<i>Betula pendula</i> Roth	–	–	1 cul	–	–	–	–	–	F1	Ap2	S
<i>Carpinus betulus</i> L.	1 cul	1 cul	1 cul	1 cul	–	–	–	–	F1	Sp2	
<i>Catalpa bignonioides</i> Walter	–	–	1 cul	–	–	–	–	–	F1	ErW	
<i>Cerasus mahaleb</i> (L.) Mill.	–	–	1 cul	–	–	–	–	–	F1	Kn	
<i>Crataegus</i> × <i>media</i> Bechst.	–	–	–	–	–	1 cul	–	–	F2	ErW	S
<i>Crataegus monogyna</i> Jacq.	–	–	1 cul	–	–	–	–	–	F2	Ap2/Sp2	S
<i>Fagus sylvatica</i> L.	1 cul	1 cul	1 cul	–	–	–	–	–	F1	Ap2/Sp2	S
<i>Fagus sylvatica</i> L. ‘Pendula’	–	–	–	–	1 cul	–	–	–	F1	ErW	S, F
<i>Fraxinus excelsior</i> L.	2 cul	2 cul	1 cul	1 cul	2 cul	1 cul	1 cul	1 cul	F1	Ap2	S, F
<i>Fraxinus excelsior</i> L. ‘Diversifolia’	–	–	–	–	–	1 cul	–	–	F1	ErW	S
<i>Fraxinus excelsior</i> L. ‘Pendula’	–	1 cul	–	–	1 cul	–	–	–	F1	ErW	S, F
<i>Fraxinus pennsylvanica</i> Marshall	–	–	1 cul	–	–	–	–	–	F1	Kn	S
<i>Gleditsia triacanthos</i> L.	–	–	1 cul	–	–	–	–	–	F1	ErW	
<i>Hedera helix</i> L.	–	–	–	–	–	–	–	1 cul	C	Kn	S, F
<i>Juglans regia</i> L.	1 cul	–	–	–	–	–	–	–	F1	Kn	S
<i>Malus domestica</i> Borkh.	–	–	1 cul	1 cul	–	–	–	–	F1	Kn	S
<i>Malus</i> × <i>oxysepala</i> Czarna & Nowińska	–	–	1	–	–	–	–	–	F1	Ap1×ErG	S
<i>Malus</i> × <i>purpurea</i> Rehder	1 cul	–	1 cul	1 cul	–	–	–	–	F1	ErW	S
<i>Morus alba</i> L.	–	–	–	1 cul	–	–	–	–	F1	ErW	S
<i>Morus nigra</i> L.	1 cul	–	–	–	–	–	–	–	F1	ErW	S
<i>Padus serotina</i> (Ehrh.) Borkh.	–	1 cul	–	–	–	–	–	–	F1	Kn	S
<i>Picea abies</i> (L.) H. Karst.	–	–	–	1 cul	–	–	–	–	F1	Kn	S
<i>Picea pungens</i> Engelm.	1 cul	–	1 cul	–	1 cul	–	1 cul	–	F1	ErG	S

Species	Cemetery								LF	GH	Symbolic (S) and funeral (F) plants
	I	II	III	IV	V	VI	VII	VIII			
<i>Pinus strobus</i> L.	–	1 cul	–	–	–	–	–	–	F1	Kn	S
<i>Platanus</i> × <i>hispanica</i> Mill. ex Münchh.	–	3 cul	1 cul	1 cul	1 cul	–	–	–	F1	ErW	
<i>Populus alba</i> L.	1 cul	1 cul	1 cul	–	–	–	1 cul	1 cul	F1	Ap2	S
<i>Populus</i> × <i>canadensis</i> Moench	–	–	1 cul	–	–	–	–	1 cul	F1	ErW	S
<i>Populus nigra</i> L.	–	–	1 cul	1 cul	–	–	–	–	F1	Ap2/Sp2	S
<i>Populus tremula</i> L.	–	–	1 cul	1 cul	–	–	1 cul	1 cul	F1	Ap2	S
<i>Prunus cerasifera</i> Ehrh.	1 cul	–	1 cul	2 cul	–	–	–	–	F1	Kn	S
<i>Prunus cerasifera</i> Ehrh. 'Atropurpurea'	–	–	1 cul	1 cul	–	–	–	–	F1	Kn	S
<i>Prunus domestica</i> L.	–	1	–	–	–	–	–	–	F1	ErW	S
<i>Pseudotsuga menziesii</i> (Mirb.) Franco	1 cul	–	1 cul	1 cul	–	–	–	–	F1	Kn	
<i>Pyrus pyraister</i> (L.) Burgsd.	–	–	1 cul	1 cul	–	–	–	1 cul	F1	Kn	S
<i>Quercus robur</i> L.	–	2 cul	1 cul	2 cul	2 cul	2 cul	–	–	F1	Ap2/Sp2	S, F
<i>Quercus rubra</i> L.	–	–	–	–	1 cul	–	–	–	F1	Kn	S, F
<i>Quercus robur</i> × <i>Q. petraea</i>	–	–	–	–	1 cul	–	–	–	F1	Ap2/Sp2	S
<i>Rhamnus cathartica</i> L.	–	–	1	1	–	–	–	–	F1	Ap2/Sp2	
<i>Robinia pseudoacacia</i> L.	1 cul	1 cul	2 cul	1 cul	–	1 cul	1 cul	1 cul	F1	Kn	S, F
<i>Salix alba</i> L.	–	–	1 cul	–	–	–	–	–	F1	Ap2	S
<i>Salix alba</i> L. 'Tristis'	–	–	1 cul	–	–	–	–	–	F1	ErW	S, F
<i>Sophora japonica</i> L.	–	–	1 cul	–	–	–	–	–	F1	ErW	F
<i>Sorbus aucuparia</i> L. emend. Hedl.	–	–	1 cul	–	–	–	–	–	F1	Ap2/Sp2	S
<i>Sorbus intermedia</i> (Ehrh.) Pers.	–	–	1 cul	–	–	–	–	–	F1	ErG	S, F
<i>Thuja plicata</i> Donn ex D. Don	–	1 cul	–	–	1 cul	–	–	–	F1	ErW	S, F
<i>Tilia americana</i>	–	–	1 cul	–	–	–	–	–	F1	ErW	S,
<i>Tilia cordata</i> Mill.	–	2 cul	–	1 cul	3 cul	1 cul	1 cul	1 cul	F1	Ap2	S, F
<i>Tilia</i> 'Euchlora'	2 cul	–	1 cul	1 cul	3 cul	–	–	–	F1	ErW	S, F
<i>Tilia platyphyllos</i> Scop.	–	3 cul	1 cul	1 cul	1 cul	1 cul	–	2 cul	F1	ErG	S, F
<i>Ulmus glabra</i> Huds.	–	–	–	–	1 cul	–	–	–	F1	Ap2	S
<i>Ulmus laevis</i> Pall.	1 cul	1 cul	1 cul	2 cul	1 cul	1 cul	1 cul	–	F1	Ap2/Sp2	S
<i>Viscum album</i> L.	+	+	1	1	+	+	1	+	C	Ap1	S
Shrub layer											
<i>Abies concolor</i> (Gordon & Glend.) Lindl. ex Hildebr.	–	–	+ cul	–	–	–	–	–	F1	ErW	S
<i>Acer campestre</i> L.	–	1	–	–	–	–	–	–	F1	Ap2/Sp2	S
<i>Acer platanoides</i> L.	+	–	+	+	–	–	+	1	F1	Ap1	S
<i>Acer pseudoplatanus</i> L.	–	+	–	–	–	–	–	+	F1	Ap1	S
<i>Aesculus hippocastanum</i> L.	–	–	–	–	–	–	–	2	F1	Kn	S
<i>Amelanchier spicata</i> Lam.	–	+ cul	–	–	–	–	–	1 cul	F2	Kn	
<i>Berberis thunbergii</i> DC.	–	–	+ cul	–	–	–	+ cul	–	F2	ErW	S
<i>Berberis vulgaris</i> L.	+ cul	–	+ cul	1 cul	–	–	–	–	F2	Ap2/Sp2	S
<i>Betula pendula</i> Roth	+ cul	–	–	–	–	–	–	–	F1	Ap2	S
<i>Caragana arborescens</i> Lam.	–	–	+ cul	–	–	–	–	–	F2	ErG	F
<i>Carpinus betulus</i> L.	–	+ cul	–	–	–	–	–	–	F1	Sp2	
<i>Catalpa bignonioides</i> Walter	–	–	–	+ cul	–	–	–	–	F1	ErW	
<i>Castanea sativa</i> Mill.	+ cul	–	–	–	–	–	–	–	F1	ErW	S
<i>Cerasus avium</i> (L.) Moench	–	+	–	–	–	–	–	–	F1	Kn	S, F
<i>Cerasus mahaleb</i> (L.) Mill.	–	–	–	–	–	–	–	+ cul	F1	Kn	F
<i>Clematis vitalba</i> L.	–	–	–	–	+ cul	–	–	+ cul	C	Kn	F
<i>Cornus alba</i> L.	–	–	–	–	–	+ cul	–	–	F2	ErW	
<i>Cornus mas</i> L.	–	–	+ cul	+ cul	–	–	–	–	F1	ErW	
<i>Corylus avellana</i> L.	1 cul	–	–	–	–	–	–	–	F2	Sp2	S
<i>Cotinus coggygria</i> Scop.	–	–	–	–	–	+ cul	–	–	F2	ErW	
<i>Crataegus monogyna</i> Jacq.	–	–	+ cul	–	–	–	–	–	F1	Ap2/Sp2	S
<i>Euonymus europaea</i> L.	–	–	+	+	–	–	–	+	F2	Ap1/Sp1	
<i>Euonymus fortunei</i> (Turcz.) Hand.-Mazz.	–	–	+ cul	–	–	–	–	–	F2	ErW	
<i>Fagus sylvatica</i> L.	–	+ cul	–	+ cul	–	–	–	–	F1	Ap1/Sp1	S
<i>Fagus sylvatica</i> L. 'Atropurpurea'	–	–	–	+ cul	–	+ cul	–	–	F1	ErW	S
<i>Forsythia</i> × <i>intermedia</i> Zabel	+ cul	+ cul	+ cul	1 cul	+ cul	–	+ cul	–	F2	ErW	
<i>Fraxinus excelsior</i> L.	–	+	1	+	–	–	–	+	F1	Ap1	S
<i>Ginkgo biloba</i> L.	–	–	+ cul	–	–	–	–	–	F1	ErW	
<i>Hedera helix</i> L.	–	–	–	–	–	–	–	1 cul	C	Kn	S, F
<i>Juglans regia</i> L.	–	–	–	–	–	–	+	+	F1	Kn	S
<i>Juniperus horizontalis</i> Moench	–	–	–	1 cul	–	–	–	–	F2	ErW	S, F
<i>Larix polonica</i> Racib.	+ cul	–	–	–	–	–	–	–	F1	Sp2	S
<i>Laurocerasus officinalis</i> Roem.	–	–	+ cul	–	–	–	–	–	F2	ErW	

Species	Cemetery								LF	GH	Symbolic (S) and funeral (F) plants
	I	II	III	IV	V	VI	VII	VIII			
<i>Ligustrum vulgare</i> L.	+ cul	+ cul	+ cul	+ cul	-	-	-	+ cul	F2	ErW	F
<i>Lonicera × bella</i> Zabel	-	+ cul	+ cul	-	-	-	-	-	F2	ErW	
<i>Lonicera maackii</i> (Rupr.) Herder	-	-	+ cul	-	-	-	-	-	F2	ErW	
<i>Lonicera tatarica</i> L.	-	+ cul	-	+ cul	+ cul	-	-	-	F2	ErW	
<i>Lonicera xylosteum</i> L.	-	-	+ cul	-	+ cul	-	-	-	F2	Ap2/Sp2	
<i>Lycium barbatum</i> L.	-	-	+ cul	1 cul	-	-	-	-	F2	Kn	
<i>Mahonia aquifolium</i> (Pursh) Nutt.	-	-	-	+ cul	+ cul	-	-	-	F2	ErW	S, F
<i>Malus baccata</i> (L.) Borkh.	-	-	1 cul	-	-	-	-	-	F1	ErW	S
<i>Malus × purpurea</i> Rehder	-	-	1 cul	-	-	-	-	-	F1	ErW	S
<i>Morus alba</i> L.	-	-	-	-	-	-	-	+ cul	F1	ErW	S
<i>Padus avium</i> Mill.	-	-	-	+ cul	-	-	-	-	F2	Sp1	S, F
<i>Padus serotina</i> (Ehrh.) Borkh.	-	-	-	-	-	-	-	+	F2	Kn	S, F
<i>Parthenocissus quinquefolia</i> (L.) Planch. in A. & C.DC.	+ cul	-	-	-	-	-	-	-	C	ErW	F
<i>Persica vulgaris</i> Mill.	+	-	-	-	-	-	-	-	F2	ErG	
<i>Philadelphus coronarius</i> L.	-	1 cul	1 cul	-	+ cul	-	-	-	F2	ErW	F
<i>Physocarpus opulifolius</i> (L.) Maxim.	-	-	-	-	+ cul	+ cul	-	-	F2	ErW	
<i>Picea abies</i> (L.) H. Karst.	+ cul	-	-	-	-	-	-	-	F1	Kn	S
<i>Picea pungens</i> Engelm.	+ cul	-	+ cul	-	-	-	-	-	F1	ErW	S
<i>Pinus sylvestris</i> L.	+ cul	-	-	-	-	-	-	-	F1	Ap2	S
<i>Platanus × hispanica</i> Münchhch	-	-	1 cul	+ cul	+ cul	-	-	-	F1	ErW	
<i>Populus alba</i> L.	-	-	-	-	-	-	-	+	F1	Ap1	S
<i>Potentilla fruticosa</i> L.	-	-	1 cul	-	-	-	-	-	F2	ErW	
<i>Prunus cerasifera</i> Ehrh.	+	-	+	-	-	-	-	-	F1	Kn	S
<i>Prunus spinosa</i> L.	-	-	-	-	-	-	-	+	F2	Ap1	S
<i>Pseudotsuga menziesii</i> (Mirb.) Franco	+ cul	-	-	-	-	-	-	-	F1	Kn	
<i>Pyracantha coccinea</i> M. Roem.	-	-	+ cul	+ cul	-	-	-	-	F2	ErW	
<i>Quercus robur</i> L.	-	+ cul	+ cul	-	-	-	+ cul	+ cul	F1	Ap2/Sp2	S, F
<i>Rhamnus cathartica</i> L.	-	-	+	-	-	-	-	-	F2	Ap1/Sp1	
<i>Rhododendron catawbiense</i> Michx.	-	-	+ cul	-	-	-	-	-	F2	ErW	
<i>Ribes alpinum</i> L.	-	1 cul	-	-	-	-	+ cul	-	F2	ErW	
<i>Ribes sanguineum</i> Pursh	-	-	-	-	-	+ cul	-	-	F2	ErW	
<i>Robinia pseudoacacia</i> L.	-	+	1	-	+	-	+	-	F1	Kn	S
<i>Rosa blanda</i> Aiton	-	1 cul	-	-	-	-	-	-	F2	ErW	S, F
<i>Rosa canina</i> L.	-	1	-	-	-	-	-	+	F2	Ap1	S
<i>Rosa dumalis</i> Bechst. emend. Boulenger	-	-	-	+	-	-	-	-	F2	Ap1	S
<i>Rosa multiflora</i> Thunb.	-	-	1 cul	-	-	-	-	-	F2	Kn	S, F
<i>Rosa</i> 'Poznań'	-	-	1 cul	-	-	-	-	-	F2	ErW	S
<i>Rosa majalis</i> × <i>R. rugosa</i>	-	-	-	1 cul	-	-	-	-	F2	ErW	S, F
<i>Rosa × rugotida</i> Belder & Wijnands	-	-	-	1 cul	-	-	-	-	F2	ErW	S, F
<i>Sambucus nigra</i> L.	-	+	1	+	-	+	-	+	F2	Ap1	S
<i>Sorbus aucuparia</i> L. emend. Hedl.	-	-	-	-	-	-	+	-	F1	Ap1/Sp1	S
<i>Sorbus intermedia</i> (Ehrh.) Pers.	-	-	-	+ cul	-	-	-	-	F1	ErG	S
<i>Spiraea</i> 'Arguta'	-	+ cul	-	+ cul	-	-	-	-	F2	ErW	
<i>Spiraea chamedrifolia</i> L. emend. Jacq.	-	-	-	-	+ cul	-	-	-	F2	ErW	F
<i>Spiraea × vanhouttei</i> (Briot) Zabel	-	2 cul	1 cul	+ cul	+ cul	-	-	-	F2	ErW	
<i>Symphoricarpos albus</i> (L.) S.F. Blanke	-	2 cul	2 cul	1 cul	1 cul	-	-	-	F2	ErW	F
<i>Symphoricarpos × chenaultii</i> Rehder	-	-	1 cul	1 cul	-	-	-	-	F2	ErW	
<i>Symphoricarpos orbicularis</i> Moench	-	-	1 cul	-	-	-	-	-	F2	ErW	
<i>Syringa vulgaris</i> L.	+ cul	-	+ cul	+ cul	+ cul	-	-	+ cul	F2	ErW	S, F
<i>Taxus baccata</i> L.	-	-	+ cul	1 cul	+ cul	-	-	-	F2	ErG	S, F
<i>Thuja orientalis</i> L.	+ cul	-	-	-	-	-	-	-	F1	ErW	S, F
<i>Tilia</i> 'Euchlora'	-	-	-	-	-	+ cul	-	-	F1	ErW	S, F
<i>Tilia cordata</i> Mill.	-	+	+	-	-	+	-	-	F1	Ap2	S, F
<i>Tilia platyphyllos</i> Scop.	+ cul	-	-	-	-	-	-	-	F1	ErG	S, F
<i>Ulmus laevis</i> Pall.	-	+	-	-	-	-	-	-	F1	Ap2	S
<i>Viburnum lantana</i> L.	-	-	+ cul	-	-	-	-	-	F2	ErW	S
<i>Viburnum rhytidophyllum</i> Hemsl.	-	-	-	-	+ cul	-	-	-	F2	ErW	S
<i>Weigela floryda</i> (Bunge) A. DC.	-	-	-	-	-	+ cul	-	-	F2	ErW	
Herb layer											
<i>Acer campestre</i> L.	-	-	-	-	R	-	-	-	F1	Ap2/Sp2	S
<i>Acer negundo</i> L.	-	-	-	-	-	-	-	R	F1	Kn	S
<i>Acer platanoides</i> L.	-	+	-	-	-	-	-	1	F1	Ap1	S

Species	Cemetery								LF	GH	Symbolic (S) and funeral (F) plants
	I	II	III	IV	V	VI	VII	VIII			
<i>Erigeron ramosus</i> (Walters) Britton, Sterns & Poggenb.	R cul	–	–	–	–	–	–	–	T2	Kn	F
<i>Erodium cicutaria</i> (L.) L'Hér.	–	–	+	R	–	–	–	–	T1	Ap1	
<i>Erophila verna</i> (L.) Chevell.	–	–	–	–	–	–	+	–	T1	Ap1	
<i>Euphorbia helioscopia</i> L.	–	–	R	–	–	–	–	–	T1	Ar	
<i>Euphorbia peplus</i> L.	–	–	R	R	–	–	–	–	T1	Ar	
<i>Falcaria vulgaris</i> Bernh.	–	–	–	–	–	–	+ cul	1 cul	H	Ap1	
<i>Fallopia dumetorum</i> (L.) Holub	R	–	–	–	–	–	–	–	T1	Ap1/Sp1	
<i>Festuca rubra</i> L. s.s.	1.1	–	–	–	–	–	–	–	H	Ap1	
<i>Ficaria verna</i> Huds.	1 cul	1 cul	2 cul	3 cul	3 cul	1 cul	+ cul	3 cul	G	Ap2/Sp2	
<i>Gagea arvensis</i> (Pers.) Dumort.	1 cul	+ cul	–	1 cul	2 cul	–	+ cul	+ cul	G	Ar	F
<i>Gagea lutea</i> (L.) Ker Gawl.	1 cul	–	1 cul	3 cul	3 cul	1 cul	+ cul	2 cul	G	Sp2	F
<i>Gagea pratensis</i> (Pers.) Dumort.	2	3	3	3	3	1	2	1	G	Ap2	
<i>Galanthus nivalis</i> L.	+ cul	–	–	1 cul	R cul	–	–	+ cul	G	Ap2	S, F
<i>Galeopsis pubescens</i> Besser	+	–	–	–	–	–	–	–	T1	Ap1/Sp1	
<i>Galinsoga ciliata</i> (Raf.) S.F. Blake	+	–	R	R	–	–	–	–	T1	Kn	
<i>Galinsoga parviflora</i> Cav.	+	+	+	R	–	–	–	–	T1	Kn	
<i>Galium mollugo</i> L. s.s.	+	–	–	–	–	–	–	–	H	Ap1	
<i>Geranium molle</i> L.	–	–	+	R	–	–	–	–	T1	Kn	
<i>Geranium pusillum</i> Burm. F. ex L.	R	–	R	R	R	R	R	–	T1	Ar	
<i>Geranium pratense</i> L.	–	–	–	–	–	–	–	+	H	Ap1	
<i>Geum urbanum</i> L.	–	+	–	–	–	–	–	+	H	Ap1	
<i>Glechoma hederacea</i> L.	+	+	+	+	+	+	–	–	H	Ap1	
<i>Hedera helix</i> L.	–	+ cul	–	–	–	–	–	1 cul	C	Kn	S, F
<i>Helichrysum arenarium</i> (L.) Moench	–	–	–	–	–	–	R	–	H	Ap1	
<i>Hemerocallis citrina</i> Baroni	–	–	1 cul	–	–	–	–	–	H	ErW	
<i>Hemerocallis fulva</i> L.	–	–	+ cul	–	–	–	–	+	H	ErW	F
<i>Hieracium pilosella</i> L.	+	–	–	–	–	–	–	–	H	Ap1	
<i>Holosteum umbellatum</i> L.	–	–	–	–	–	–	+	–	T1	Ap1	
<i>Hordeum murinum</i> L.	–	–	R	R	–	–	–	R	T2	Ar	
<i>Hyoscyamus niger</i> L.	–	–	R	–	–	–	–	–	T1	Ar	
<i>Impatiens parviflora</i> DC.	R	–	–	–	–	–	–	+	T1	Kn	
<i>Juglans regia</i> L.	R	–	–	–	–	–	–	–	F1	Kn	
<i>Lactuca serriola</i> L.	–	R	–	–	–	–	–	R	T2	Ar	
<i>Lamium album</i> L.	+ cul	+ cul	+ cul	R cul	R cul	1 cul	–	1 cul	H	Ar	F
<i>Lamium purpureum</i> L.	+	–	+	–	–	R	+	+	T1	Ar	
<i>Lapsana communis</i> L. s.s.	–	–	+	–	–	–	–	+	T1	Ap1/Sp1	
<i>Lavendula angustifolia</i> Mill.	–	–	+ cul	–	–	–	–	–	C	ErW	S
<i>Leontodon autumnalis</i> L.	R	–	R	R	–	–	–	–	H	Ap1	
<i>Lobelia erinus</i> L.	–	–	+ cul	–	–	–	–	–	T0	Er0	
<i>Lolium multiflorum</i> Lam.	–	–	1	–	–	4	–	–	H	Kn	
<i>Lolium perenne</i> L.	1	2	2	2	3	1	2	+	H	Ap1	
<i>Malva neglecta</i> Wallr.	R	–	R	+	–	R	+	–	T2	Ar	
<i>Malva pusilla</i> Sm.	–	–	–	–	–	R	–	–	T2	Ar	
<i>Malva sylvestris</i> L.	–	–	–	–	–	R	–	–	T2	Ar	
<i>Medicago falcata</i> L.	–	–	–	–	–	–	+	–	H	Ap1	
<i>Melandrium album</i> (Mill.) Garcke	+	–	–	–	–	–	–	R	H	Ap1	
<i>Mentha longifolia</i> (L.) L.	+ cul	–	–	–	–	–	–	–	H	Ap2	
<i>Moehringia trinervia</i> (L.) Clairv.	+	–	–	–	–	–	–	+	H	Ap1/Sp1	
<i>Muscari botryoides</i> (L.) Mill.	+ cul	R cul	+ cul	–	–	–	–	–	G	ErW	F
<i>Myosotis sylvatica</i> Ehrh. ex Hoffm.	+ cul	–	–	–	–	–	–	–	T1	ErG	S, F
<i>Narcissus poeticus</i> L.	–	R cul	–	–	–	–	–	–	G	ErW	S, F
<i>Narcissus pseudonarcissus</i> L.	–	R cul	–	–	–	–	–	–	G	ErW	S, F
<i>Onopordon acanthium</i> L.	–	–	R	–	–	–	–	–	T2	Ar	
<i>Ornithogalum boucheanum</i> Asch.	2 cul	–	–	–	–	–	–	–	G	ErG	F
<i>Ornithogalum nutans</i> L.	–	–	–	–	–	1 cul	–	–	G	ErG	F
<i>Ornithogalum umbellatum</i> L.	1 cul	1 cul	2 cul	+ cul	1 cul	+ cul	+ cul	1 cul	G	ErG	F
<i>Oxalis dillenii</i> Jacq.	+	–	+	+	+	–	–	–	T1	Kn	
<i>Oxalis corniculata</i> L. × <i>O. dillenii</i> Jacq.	+	–	–	–	–	–	–	–	T1	Kn×Kn	
<i>Pachysandra terminalis</i> Siebold & Zucc.	–	–	+ cul	–	–	–	–	–	C	ErW	
<i>Papaver rhoeas</i> L.	–	–	R	–	–	–	–	–	T1	Ar	S
<i>Papaver somniferum</i> L.	R	–	–	–	–	–	–	–	T1	Ef	S
<i>Phalaris arundinacea</i> L.	–	–	–	–	–	–	–	R	H	Ap1	

Species	Cemetery								LF	GH	Symbolic (S) and funeral (F) plants
	I	II	III	IV	V	VI	VII	VIII			
<i>Picris hieracioides</i> L.	R	–	–	–	–	–	–	–	H	Ap1	
<i>Plantago lanceolata</i> L.	+	+	+	+	–	1	1	–	H	Ap1	
<i>Plantago major</i> L. s.s.	+	1	+	1	–	–	–	–	H	Ap1	
<i>Poa annua</i> L.	+	–	–	1	1	1	+	+	T2	Ap1	
<i>Poa nemoralis</i> L.	–	1	–	–	–	–	–	1	H	Ap1/Sp1	
<i>Poa pratensis</i> L. s.s.	+	–	2	–	1	2	2	+	H	Ap1	
<i>Polygonum aviculare</i> L.	1	+	1	2	–	–	+	–	T1	Ap1	
<i>Polygonum persicaria</i> L.	R	–	–	–	–	–	–	–	T1	Ap1	
<i>Populus alba</i> L.	–	–	+	–	–	–	–	–	F1	Ap1	
<i>Potentilla argentea</i> L. s.s.	–	–	+	–	–	–	+	+	H	Ap1	
<i>Potentilla reptans</i> L.	R	–	–	+	–	–	–	–	H	Ap1	
<i>Puschkinia scilloides</i> Adams	–	–	1 cul	–	–	–	–	–	G	ErG	F
<i>Ranunculus repens</i> L.	–	+	–	–	–	–	–	–	H	Ap1	
<i>Robinia pseudoacacia</i> L.	+	–	+	–	–	–	–	–	F1	Kn	S
<i>Rubus caesius</i> L.	–	–	–	–	–	–	–	+	C	Ap1/Sp1	
<i>Rumex crispus</i> L.	–	+	–	–	–	–	–	R	H	Ap1	
<i>Rumex obtusifolius</i> L.	–	+	–	–	–	R	R	–	H	Ap1	
<i>Rumex thyrsiflorus</i> Fingerh.	+	–	–	–	–	–	–	–	H	Ap1	
<i>Sambucus nigra</i> L.	R	R	–	–	–	–	–	–	F2	Ap1	
<i>Saponaria officinalis</i> L.	–	–	–	–	–	–	+ cul	1 cul	G	Ap1	F
<i>Scilla sibirica</i> Haw.	–	–	1 cul	R cul	R cul	–	–	+ cul	G	ErG	S, F
<i>Scleranthus perennis</i> L.	–	–	–	–	–	–	R	–	H	Ap1	
<i>Sedum acre</i> L.	–	–	–	–	–	–	+	–	H	Ap1	
<i>Sedum reflexum</i> L.	–	–	+ cul	–	–	–	–	–	H	Sp2	
<i>Setaria viridis</i> (L.) P. Beauv.	–	–	+	–	–	–	+	–	T1	Ar	
<i>Silene vulgaris</i> (Moench) Garcke	–	–	–	–	–	–	+	–	H	Ap1	
<i>Solanum nigrum</i> L. emend. Mill.	+	–	R	–	–	–	–	–	T1	Ar	
<i>Solidago canadensis</i> L.	–	–	–	–	+ cul	–	–	R cul	G	Kn	
<i>Solidago gigantea</i> Aiton	–	R cul	–	–	–	–	–	R cul	G	Kn	
<i>Sonchus oleraceus</i> L.	+	–	R	R	–	R	–	–	T1	Ar	
<i>Stellaria media</i> (L.) Vill.	+	–	1	+	+	+	+	+	T1	Ap1	
<i>Stellaria pallida</i> (Dumort.) Piré	1	–	1	+	+	+	+	1	T2	Ap1	
<i>Tanacetum vulgare</i> L.	–	–	–	–	–	–	–	+	H	Ap1	
<i>Taraxacum officinale</i> Web.	1	1	1	1	1	1	2	+	H	Ap1	
<i>Tilia cordata</i> Mill.	+	–	–	–	–	+	–	–	F1	Ap1	
<i>Torilis japonica</i> (Houtt.) DC.	–	–	–	–	–	–	–	+	T2	Ap1	
<i>Trifolium campestre</i> Schreb.	R	–	–	–	–	–	–	–	T1	Ap1	
<i>Trifolium pretense</i> L.	R	+	–	–	–	–	–	–	H	Ap1	
<i>Trifolium repens</i> L.	+	+	1	+	+	+	2	–	H	Ap1	
<i>Tulipa gesneriana</i> L.	–	–	+ cul	–	–	–	–	+ cul	G	ErW	F
<i>Tulipa sylvestris</i> L.	1 cul	–	2 cul	–	–	1 cul	–	–	G	ErG	F
<i>Ulmus laevis</i> Pall.	–	–	R	R	–	–	–	–	F1	Ap1/Sp1	
<i>Urtica dioica</i> L.	R	–	–	–	–	–	+	1	H	Ap1/Sp1	
<i>Urtica urens</i> L.	–	–	–	R	–	–	–	–	T1	Ar	
<i>Verbascum lychnitis</i> L.	R	–	–	–	–	–	–	–	T2	Ap1	
<i>Veronica arvensis</i> L.	R	–	–	–	–	–	+	–	T1	Ar	
<i>Veronica chamaedrys</i> L. s.s	–	+	+	R	R	–	–	+	H	Ap1	
<i>Veronica persica</i> Poir.	–	–	–	–	–	R	–	–	T1	Kn	
<i>Veronica polita</i> Fr.	–	–	–	–	–	R	–	–	T1	Ar	
<i>Veronica sublobata</i> M.A. Fisch.	1	1	2	1	1	1	1	1	T1	Ap1	
<i>Veronica triphyllos</i> L.	–	–	–	–	–	–	+	–	T1	Ar	
<i>Vinca major</i> L.	–	–	1 cul	–	–	–	–	–	H	ErW	
<i>Vinca minor</i> L.	–	–	–	–	–	–	–	1 cul	C	ErW	S, F
<i>Viola cyanea</i> Čelak.	–	–	+ cul	–	–	–	–	1 cul	H	Kn	S, F
<i>Viola odorata</i> L.	1 cul	1 cul	1 cul	+ cul	+ cul	R cul	+ cul	1 cul	H	Kn	S, F

FC (frequency classes): R – 1–2 specimens, + – several specimens, 1 – very rare (covering 1–5% of cemetery area excluding graves), 2 – rare (5–25%), 3 – moderately frequent (25–50%), 4 – frequent (50–75%), 5 – very frequent (75–100%); cul – cultivated, introduced in the past or presently introduced to cultivation.

LF (life-forms): F1 – megaphanerophytes, F2 – nanophanerophytes, C – chamaephytes, G – geophytes, H – hemicryptophytes, T1 – annual therophytes, T2 – biennial therophytes, T0 – non-wintering therophytes; li – climber, pp – parasite, ppep – semi-parasite.

GH (geographical-historical status): spontaneously occurring spontaneophytes (Sp1), planted spontaneophytes (Sp2), semi-synanthropic spontaneophytes (Ap/Sp), autapophytes (Ap1) – species that penetrated spontaneously from natural localities to localities changed by human activity, hemeroapophytes (Ap2) – cultivated native species, archaeophytes (Ar), kenophytes (Kn), ephemeroophytes (Ef), vegetatively spreading ergasiophytes (ErW), generatively spreading ergasiophytes (ErG), non-wintering ergasiophytes (Er0).

Table 3. Numbers of species included in frequency classes in park-like old cemeteries in Poznań

Frequency class	I	II	III	IV	V	VI	VII	VIII	Total
R	26	7	23	18	9	20	6	12	121
+	59	41	56	36	27	16	45	61	341
1	28	25	64	32	20	18	14	26	227
2	6	10	11	5	4	2	7	6	51
3	–	–	1	5	6	–	1	3	16
4	–	–	–	–	–	1	–	–	1
5	–	–	–	–	–	1	–	–	1
Total	119	83	155	96	66	58	73	108	758

them, in general the most diverse were megaphanerophytes (101 species) and hemicryptophytes (67). Also in individual cemeteries megaphanerophytes were the most numerous, except for cemeteries VII and VIII, where hemicryptophytes dominated. In contrast, many annual therophytes were recorded in cemeteries I (26) and III (26) (Table 4).

Interestingly, also the proportion of geophytes was relatively high (31 species). Those plants can survive in unfavourable conditions thanks to deeply hidden buds, protected against drought and low temperature, which increases their chance to survive in: cemeteries. This group includes primarily bulb plants flowering in spring, e.g. *Gagea arvensis*, *G. lutea*, *Galanthus nivalis*, *Muscari botryoides*, *Narcissus poeticus*, *N. pseudonarcissus*, *Ornithogalum boucheanum*, *O. nutans*, *O. umbellatum*, *Puschkinia scilloides*, *Scilla sibirica*, *Tulipa gesneriana*, and *T. sylvestris*.

Out of the 315 taxa recorded in this study, native species (apophytes and spontaneophytes) accounted for more than 50%. However, in individual cemeteries their proportion varied from 33% (cemetery VI) to 67% (cemetery III). In all cemeteries, apophytes were represented by *Acer platanoides*, *Bellis perennis*, *Ficaria verna*, *Fraxinus excelsior*, *Gagea pratensis*, *Lolium perenne*, *Tanacetum vulgare*, *Taraxacum officinale*, *Ulmus laevis*, and *Veronica sublobata*. Among alien plants, the largest number of species belonged to the group of ergasiophytes (71 species), followed by kenophytes (56) (Table 5). In all cemeteries, kenophytes were represented by *Conyza canadensis*, *Ornithogalum umbellatum* and *Viola odorata*. The smallest numbers of

Table 5. Numbers of species included in geographical-historical groups in park-like old cemeteries in Poznań

Group	I	II	III	IV	V	VI	VII	VIII	Total
Sp1	1	1	1	1	0	0	0	1	5
Sp2	4	4	5	3	2	1	1	3	23
Sp1/Ap1	5	3	4	3	1	2	2	7	27
Sp2/Ap2	5	8	14	7	6	3	3	3	49
Ap1	39	23	31	27	17	26	33	46	232
Ap2	8	8	9	5	6	6	6	7	55
Ar	14	5	17	11	6	9	10	9	81
Kn	20	12	25	16	9	6	5	20	113
Kn×Kn	1	0	0	0	0	0	0	0	1
Ef	1	0	0	0	0	0	0	0	1
ErW	13	17	36	18	13	4	11	8	120
ErG	8	2	11	5	6	1	2	5	39
ErG×Ap1	0	0	1	0	0	0	0	0	1
ErO	0	0	1	0	0	0	0	0	1
Total	119	83	155	96	66	58	73	108	758

species of ergasiophytes were recorded in cemeteries VII (5) and VI (6), because their herbaceous layer was completely transformed by destruction of the former ground cover and sowing of new lawns.

Funeral plants are represented in the studied cemeteries by 74 species. The best indicator plants of cemeteries (including geophytes, distinguished by underlining) are *Aster novi-belgii*, *Aesculus carnea*, *A. hippocastanum*, *Campanula rapunculoides*, *Caragana arborescens*, *Erigeron annuus*, *E. ramosus*, *Fagus sylvatica* 'Atropurpurea', *F. sylvatica* 'Pendula', *Fraxinus excelsior* 'Pendula', *Gagea arvensis*, *G. lutea*, *Galanthus nivalis*, *Hedera helix*, *Hemerocallis fulva*, *Lamium album*, *Ligustrum vulgare*, *Lonicera tatarica*, *Mahonia aquifolium*, *Muscari botryoides*, *Myosotis sylvatica*, *Narcissus poeticus*, *N. pseudonarcissus*, *Ornithogalum boucheanum*, *O. nutans*, *O. umbellatum*, *Parthenocissus quinquefolia*, *Philadelphus coronarius*, *Platanus ×hispanica*, *Ribes alpinum*, *Salix alba* 'Tristis', *Saponaria officinalis*, *Scilla sibirica*, *Sedum reflexum*, *Spiraea chamaedrifolia*, *Symphoricarpos albus*, *Syringa vulgaris*, *Thuja plicata*, *Tulipa gesneriana*, *T. sylvestris*, *Vinca minor*, *Viola cyanea*, and *V. odorata*.

Description of the process of synanthropization by means of indices allows to determine its rate and various aspects of anthropogenic transformations of flora. The following indices were analysed in this study according to CHMIEL (2006).

- indices of flora synanthropization: WSc = 168%, WSt = 212% (WSc = total synanthropization index, WSt = permanent synanthropization index)
- indices of apophytization: WAPc = 75.6%, WAPt = 87.7% (WAPc = total apophytization index, WAPt = permanent apophytization index)
- indices of flora anthropophytization: WANc = 92.5%, WANt = 87.7% (WANc = total anthropophytization index, WANt = permanent anthropophytization index)
- indices of flora archaeophytization: WARc = 19.5%, WARt = 31.8% (WARc = total archaeo-

Table 4. Numbers of species included in plant life-form categories in park-like old cemeteries in Poznań

Life-form	I	II	III	IV	V	VI	VII	VIII	Total
F1	31	25	53	34	19	14	14	27	217
F2	6	12	26	15	11	4	3	6	83
C	3	2	4	1	2	1	1	4	18
G	13	11	15	11	13	8	8	19	98
H	34	23	26	17	13	13	29	34	189
T1	26	6	25	14	6	11	14	8	110
T2	7	3	5	4	2	7	4	10	42
T0	–	–	1	–	–	–	–	–	1
Total	120	82	155	96	66	58	73	108	758

- phytization index, WART = permanent archaeophytization index)
- e) indices of flora kenophytization: WKNc = 36.7%, WKNt = 55.5% (WKNc = total kenophytization index, WKNt = permanent kenophytization index)
 - f) flora modernization index: WM = 6.3%
 - g) index of floristic fluctuations: WF = 0.25%.

On the basis of the diagram of cemetery similarity, three groups of cemeteries were distinguished (Fig. 1). One group is composed of cemeteries I (near Świętojańska St.), VII (near Kosynierów Square), and VIII (near Winogrody St.), the similar second group consists of cemeteries IV (near Królowej Jadwigi St.), V (near Grunwaldzka St.), and VI (near Ogrodowa St.), and the third, least similar group comprises cemeteries II (near Ostrobramska St.) and III (near Towarowa St.).

DISCUSSION

The dendroflora of cemeteries and parks has been studied by many researchers. In comparison to other habitats explored floristically, cemeteries and parks that were formerly cemeteries have a rich dendroflora, characteristic of cemeteries.

Parks that were formerly cemeteries, because of the species richness and age of the dendroflora, are valuable because of their nature and history. The most common species of woody plants, found in all the investigated cemeteries, are *Acer platanoides* and *Fraxinus excelsior*. Floristic species richness is the highest in cemetery III (155 species), and the lowest in cemetery VI (58 species).

KONON et al. (2005), who studied the dendroflora of six cemeteries in Lednica Landscape Park, recorded 23 species of trees and shrubs: 19 broad-leaved and four coniferous. In comparison, the dendroflora of eight parks that were formerly cemeteries includes 61 species of trees and 91 species in the shrub layer. In research on four active cemeteries in Poznań (CZARNA et al. 2011), 89 species of trees and shrubs were found. It is noteworthy that in the urban cemeteries the number of species of trees and shrubs is much higher than in the village cemeteries. Similar disproportions were reported by KARCZMARZ & TRZASKOWSKA (2013).

The flora of old cemeteries in Poznań is clearly distinguished from the flora of medieval fortified settlements (CELKA 1999), flora of Poznań (JACKOWIAK 1990), and flora of the eastern part of Gniezno Lakeland (CHMIEL 2006) by its high indices of synanthropization, apophytization, anthropophytization, kenophytization, and archaeophytization, whereas indices of floristic fluctuations and flora modernization are very low.

A taxon new to the Polish flora is *Rosa* 'Poznań'. Roses as a genus were frequently used for planting in old cemeteries (CZARNA 1999).

It is noteworthy that a native species recorded in six cemeteries – *Aegopodium podagraria* – had a symbolic meaning: it symbolized faith because of the shape of its leaves. It was certainly planted in cemeteries as an ornamental groundcover plant (KOSSAK 2017).

Results of this study confirm the hypothesis that many funeral plants are geophytes (17 species). The most interesting among them is *Tulipa sylvestris*. Besides, funeral plants include 26 species of trees (7.8% of the total), 31 species of shrubs (9.3%), and 33 herbaceous species (9.9%).

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