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ORIGINAL RESEARCH PAPER

Vascular plant flora in the Cytadela cemeteries in Poznań (Poland)

Aneta Czarna*

Department of Botany, Poznań University of Life Sciences, Wojska Polskiego 71c, 60-625 Poznań, Poland

* Email: czarna@up.poznan.pl**Abstract**

The paper presents the spontaneous vascular flora and the flora originating from old or contemporary plantations found in all six currently existing cemeteries located in immediate vicinity on the slopes of the Cytadela Park in Poznań. These studies were carried out in the years 2011–2014. Over this period, 255 species of vascular plants were found. The most interesting species include: *Chionodoxa luciliae*, *Rumex rugosus*, *Aegopodium podagraria* ‘Variegatum’, *Ficaria verna* f. *plenifolia*, *Galanthus nivalis* f. *pleniflora*, *Ornithogalum boucheanum*, *Ranunculus repens* ‘Plena’, and hybrids: *Dactylis ×intercedens*, *Gagea ×pomeranica*, *Ornithogalum boucheanum* × *O. nutans*, *Viola cyanea* × *V. odorata*. A great number of spring geophytes, namely 31 species, was also found.

Among species occurring spontaneously outside the graves, some were new for Poland, e.g., *Chionodoxa luciliae*, *Ornithogalum boucheanum* × *O. nutans*, *Viola cyanea* × *V. odorata*, while others were new for the Wielkopolska region: *Rumex rugosus*, *Dactylis ×intercedens*, *Gagea ×pomeranica*, as well as new for Poznań: *Erigeron ramosus*, *Lilium bulbiferum*, *Muscari armeniacus*, *M. neglectum*, *Pimpinella nigra*, *Poa subcaerulea*, and *Veronica hederifolia* s. s.

Keywords

cemetery; vascular flora; geophytes; ergasiophytes; Poznań; Cytadela; Wielkopolska

Introduction

The cemeteries on the slopes of the Poznań Cytadela Park are in the southern part of that largest park in Poznań, covering an area of 100 ha. Previously, it constituted the core of the Poznań Military Garrison (Winiary district) and at the same time it was a Church Parish. Here are buried the mortal remains of thousands of war victims from the wars of the nineteenth and twentieth centuries, creating one of the truly attractive, but not very widely known necropolises. About 5800 Soviet soldiers, 1300 French soldiers, and 500 British soldiers were buried here. Including the St. Adalbert's Parish cemetery, the tradition of burials in this place dates back about 180 years [1].

So far, the cemetery vascular flora in Poznań Cytadela has not been listed. Also, other cemetery flora in the currently operating and non-operating Poznań cemeteries has not been listed to date.

An exception in this respect is provided by the active cemeteries in the Poznań districts Jeżyce and Górczyn, the Corpus Christi cemetery at Bluszczowa Street and the St. John Vianney Parish cemetery at the Lutycka and Szczawnicka street crossing [2] as well as in the Świerczewo district [3].

The aim of this study was to analyze the botanical composition of the cemeteries in the Cytadela Park in Poznań and to verify the hypotheses that the introduced species of plants account for more than half of the total flora, while apophytes represent less than 10%.

Material and methods

Floristic studies on all six cemeteries on the southern slopes of Poznań Cytadela were carried out during the vegetation season in the years 2011–2014 (Fig. 1).

In order to define the degree of plant cover, the Braun-Blanquet scale was applied as follows: “r” – 1–2 specimens; “+” – several specimens; 1 – very rare species (1–5 % of the cemetery area outside the graves); 2 – rare species (5–25%); 3 – rather frequent species (25–50%); 4 – frequent species (50–75%); 5 – common species (75–100%).

The geo-historical classifications (GGHs) followed [4] and [5] with certain modifications. Ergasiophytes (Er) were defined as alien species of cultivated plants (sensu [6]) as well as ornamental species purposefully introduced to cultivation and left at planting sites, which have permanently colonized parks, gardens, cemeteries, not encroaching outside these sites, but remaining in vegetative forms. An original classification of ergasio-epicophytes was proposed:

- first ergasio-epicophytes (Er1) – ancient cultivated plants introduced before 1945 and surviving in vegetative forms;
- intermediate ergasio-epicophytes (Er2) – introduced to cultivation relatively recently, between 1945 and 2000, and surviving in vegetative forms;
- contemporary ergasio-epicophytes (Er3) – introduced to cultivation recently, i.e. after 2000, and surviving in vegetative forms.

This assessment was based on own observations conducted in old cemeteries of the Wielkopolska region and on gardening catalogs.

Species which were found in two or three layers of their classification into individual groups of GGHs, LE and GSEg were accounted for two or three times, i.e., in the manner they were reported.

The names of species occurring spontaneously follow Mirek et al. [7], while the names of cultivated plants follow Gawryś [8]. The geo-historical and socio-ecological plant groups have been presented according to Chmiel [9] and Czarna [10], while the Raunkiaer life forms are named mainly after Zarzycki et al. [11]. Species new for Poland have been identified in comparison with the work of Mirek et al. [4]. Species new for the Wielkopolska region are named after Szulczewski [12], whereas the names of species new for Poznań follow Jackowiak [13]. Protected species have been identified based on the Regulation of the Minister of the Environment of 9 October 2014 [14], while species of symbolic importance follow Kopaliński [15], Wysoczyński [16], Zaraś-Januszkiewicz et al. [17].

Cemetery characteristics

The Cytadela Park is the largest park in the city of Poznań with an area of approx. 100 ha, created in the years 1963–1970 on the grounds of the former Winiary Fort. It was named the Park-Monument of the Brotherhood of Arms and Polish-Soviet Friendship. In 1992, this name was changed to the Cytadela Park. In 2008, the park together with other parts of the city was named a monument of history [17].

Within the area of the park, the following cemeteries are located: the Saint Adalbert's Parish Cemetery (*Cmentarz parafii św. Wojciecha*), the Garrison Cemetery (*Cmentarz Garnizonowy*), the Soviet War Heroes Cemetery (*Cmentarz Bohaterów Radzieckich*), the War Commonwealth Cemetery (*Cmentarz Wspólnoty Brytyjskiej*), the Cemetery of Polish Heroes (*Cmentarz Bohaterów Polskich*), and remnants of the former Old Garrison Cemetery, the German Honorary Cemetery and the Russian Orthodox quarter (*Cmentarz Prawosławny*). In the Garrison Cemetery, containing over 1500 graves, graves of military personnel and servicemen are located, including also graves of insurgents of the January Uprising of 1863 and the Wielkopolskie Uprising of 1918, soldiers killed in action in the years 1918–1920, generals, and holders of the *Virtuti Militari* cross. Victims of the Nazi and Soviet terror rule and Poles fighting in spring 1945 to free Poznań (the so-called *Cytdelowcy*) are also buried there. In the area, there are also mass graves with tombstones of Russian and French POWs. The Commonwealth Cemetery, among other things, includes the graves of 48 participants

Fig. 1 Number of species in particular frequency classes in Poznań Cytadela cemeteries (explanations in Tab. 1)

of the so-called Great Escape from Stalag Luft III, some of which were Poles [17].

In the Poznań Cytadela Park, the vegetation covered mainly the slopes, which was distinctly visible on the photos taken from airplanes in the period 1919–1939. The condition of tree stands was the object of main interest and care of a known Poznań-based naturalist, Prof. Adam Wodziczko [1].

Presently, the greatest care is provided to greenery in the Commonwealth Cemetery. In recent years, many herbaceous perennial plants with showy flowers have been planted there. The Cemetery of Polish Heroes

is sown with grass. Thus, both of them differ markedly from the other cemeteries of the Cytadela Park.

Results

Within the area of the six studied cemeteries of Poznań Cytadela, the occurrence of 255 species of vascular plants was recorded (Tab. 1). Among them, 76% of vascular flora species were introduced when the cemeteries were established or are planted presently.

The analysis of the frequency of occurrence of plant species showed that the most numerous group represents the species that include several specimens – almost 50% (the second degree in the 7-point frequency scale; Fig. 1). A total of 20 species were classified as rare and they accounted for over 7%. They mainly included the following tree species: *Acer pseudoplatanus*, *Betula pendula*, *Carpinus betulus*, *Aesculus hippocastanum*, *Fraxinus excelsior*, *Quercus robur*, *Robinia pseudoacacia*, *Tilia cordata*, *T. platyphyllos*, but also *Viscum album*, as well as herbaceous plants: *Gagea lutea*, *Galium aparine*, *Ornithogalum boucheanum*, *O. nutans*, *Scilla sibirica*, *Taraxacum officinale*, *Viola odorata*. Two species were reported in the third cover degree (*Aegopodium podagraria*, *Aesculus hippocastanum*) and one in the fourth cover degree (*Acer platanoides*). No species were found in the fifth cover degree.

A high presence of species in the first cover degree was due to cultivation (additional sowing of grass, addition of ornamental plants on almost 1/2 of the cemetery area), while the remaining part of the cemetery is less frequently visited and utilized. Therefore, *Aegopodium podagraria* reached a high cover degree.

The species recorded in all studied cemeteries of Poznań constitute a full spectrum of the life forms according to Raunkiaer (Tab. 1). The most numerous group in four studied cemeteries is represented by hemicryptophytes (over 43%). This is due to the presence of the old part (1/2 of the total cemetery area), where almost no human interference takes place, as well as very numerous plantings of herbaceous perennials in the Commonwealth Cemetery.

Moreover, a considerable share of geophytes (32 species) was found – with their greatest number in the oldest part of the Cytadela cemetery (Fig. 2). Interesting geophytes recorded between the graves included the following: *Allium oleraceum*, *A. scorodoprasum*, *A. vineale*, *Anemone nemorosa*, *A. ranunculoides*, *Chionodoxa luciliae*, *Convallaria majalis*, *Corydalis solida*, *Crocus chrysanthus*, *C. vernus*, *Ficaria verna*, *F. verna* f. *plenifolia*, *Gagea arvensis*, *G. lutea*, *G. minima*, *G. x pomeranica*, *G. pratensis*, *Galanthus nivalis*, *G. nivalis* f. *pleniflora*, *Lilium bulbiferum*, *Muscari armeniacus*, *M. botryoides*, *M. neglectum*, *Narcissus jonquilla*, *N. poeticus*, *Ornithogalum nutans*, *O. boucheanum*, *O. boucheanum* × *O. nutans*, *O. umbellatum*, *Scilla sibirica*, *Tulipa kaufmanniana*, *T. sylvestris*. Very interesting geophytes found in the studied

cemeteries include two hybrids: *Gagea × pomeranica*, *Ornithogalum boucheanum* × *O. nutans*. Their appearance was possible thanks to the presence of the parental species, potentially found only in cemeteries and in the parks of former manors. The above-mentioned geophytes include exclusively spring species. Mega- and nanophanerophytes in these cemeteries are represented by a similar number of species (about 11% each). The high proportion of therophytes (49 species) is associated with the presence of footpaths in the southern and eastern parts of the cemeteries.

An analysis of the share of the particular vascular plant species in the studied cemeteries according to the geo-historical division indicates that the most numerous group consists of indigenous species – apophytes, which account together for over 47% of the total flora in the studied cemeteries (Fig. 3). It is connected with the presence of the cemetery's old no-longer-used section of forest-like character (about 1/2 of the total area) as well as the current additional planting of the following indigenous species: *Aegopodium podagraria* 'Variegatum', *Ajuga reptans* 'Atropurpurea', *Arabis alpina*, *Armeria maritima* subsp. *elongata*, *Campanula persicifolia*, *Carex ornithopoda* 'Variegata', *Geranium sanguineum*, *Potentilla reptans* 'Plena'. Among alien species, the highest share is found for plants which were introduced into cultivation and have remained as such for a long time, but which do not spread beyond the locality where they were introduced (e.g., in cemeteries, as it is in this case). They represent ergasiophytes (86 species). Still another group identified comprises plant species which are cultivated, but do not run wild. They are represented by 22 species which were introduced and are still additionally planted in the Cemetery of Polish Heroes and in the Cemetery of the British Commonwealth.

The vegetation of the studied sites originates from 15 groups of synergetic plant communities. Many of the species found there prefer communities of fertile deciduous forests and shrub communities (53 species). Apart from trees and shrubs, which were almost exclusively introduced at the time the cemetery was established, many herbaceous plants were also planted. These include: *Aegopodium podagraria*, *Ajuga reptans*, *Anemone nemorosa*, *A. ranunculoides*, *Aquilegia vulgaris*, *Campanula persicifolia*, *Chaerophyllum aromaticum*, *Convallaria majalis*, *Corydalis solida*, *Ficaria verna*, *Gagea lutea*, *Galanthus nivalis*, *Geranium sanguineum*, *Lamium maculatum*, *Myosotis sylvatica*. A rather numerous group also consists of species usually growing in nitrophilous thicket communities and in forest edge communities (23 species). A significant participation is also shown for semi-natural and anthropogenic meadow and pasture communities from the *Arrhenatheretalia* order (17 species). Species with no closer phytosociological affiliation (group 19) are most numerous represented in all the cemeteries (100 species). This is observed for all plants taken into consideration, also those planted in the Cemetery of Polish Heroes and in the Cemetery of British Commonwealth.

Among the spontaneously occurring species in the studied cemeteries, in the shrub layer there were three species: *Acer campestre*, *Euonymus europaeus*, and *Sambucus nigra*.

Problematic indigenous species which could have been formerly introduced to cultivation in the studied cemeteries and which have survived until the present include the following: *Campanula rapunculoides*, *Chaerophyllum aromaticum*, *Ficaria verna*, *Gagea pratensis*, *Hedera helix*, and *Vinca minor*.

In the studied cemeteries, a rich indigenous flora of cultivated plants was found in the herbaceous layer. They include: *Aegopodium podagraria*, *A. podagraria* 'Variegatum', *Ajuga reptans* 'Atropurpurea', *Anemone nemorosa*, *A. ranunculoides*, *Aquilegia vulgaris*, *Armeria maritima* subsp. *elongata*, *Calluna vulgaris*, *Campanula persicifolia*, *C. rapunculoides*, *Carex ornithopoda* 'Variegata', *Chaerophyllum aromaticum*, *Convallaria majalis*, *Corydalis solida*, *Dianthus gratianopolitanus*, *Festuca pallens*, *Ficaria verna*, *F. verna* f. *plenifolia*, *Gagea lutea*, *G. minima*, *G. Pratensis*, *Galanthus nivalis*, *Galanthus nivalis* f. *pleniflora*, *Geranium sanguineum*, *Inula ensifolia*, *Lamium maculatum*, *Molinia coerulea* 'Variegata', *Myosotis sylvatica*, *Origanum vulgare*, *Potentilla reptans* 'Plena', *Sedum reflexum*, *Thymus praecox*, and *T. serpyllum*.

Among old cultivated vascular plants classified as permanent species, in the old cemeteries the following plants were found in the shrub layer: *Buxus sempervirens*, *Cerasus mahaleb*, *Clematis vitalba*, *Ligustrum vulgare*, *Philadelphus coronarius*, *Ribes alpinum*, *Symphoricarpos albus*, *Syringa vulgaris*, *Taxus baccata*, *Thuja occidentalis*,

Tab. 1 Vascular plants in Poznań Cytadela cemeteries.

Species	FC	LF	GGHs	GSEg	S, Ch, R
Tree layer					
<i>Acer campestre</i> L.	1 cul	F1	Ap2	1	
<i>Acer platanoides</i> L.	4 cul	F1	Ap2	1	
<i>Acer pseudoplatanus</i> L.	2 cul	F1	Ap2	1	
<i>Aesculus hippocastanum</i> L.	3 cul	F1	Kn	19	
<i>Ailanthus altissima</i> Swingle	1 cul	F1	Kn	19	
<i>Betula pendula</i> Roth	2 cul	F1	Ap2	2	S
<i>Carpinus betulus</i> L.	2 cul	F1	Ap2	1	
<i>Crataegus intricata</i> Lange	1 cul	F1	Er2	19	S
<i>Fagus sylvatica</i> L.	1 cul	F1	Ap2	1	
<i>Fagus sylvatica</i> L. 'Atropunicea'	1 cul	F1	Cul	19	
<i>Fraxinus excelsior</i> L.	2 cul	F1	Ap2	1	
<i>Hedera helix</i> L.	1	C1 li	Kn	1	S
<i>Pinus ×rhaetica</i> Brügger	1 cul	F1	Ap2	1	S
<i>Pinus strobus</i> L.	1 cul	F1	Kn	19	S
<i>Pinus sylvestris</i> L.	1 cul	F1	Ap2	5	S
<i>Populus ×canadensis</i> Moench	1 cul	F1	Er2	7	S
<i>Prunus cerasifera</i> Ehrh.	1 cul	F1	Kn	3	
<i>Pseudotsuga menziesii</i> (Mirb.) Franco	1 cul	F1	Kn	2	
<i>Quercus robur</i> L.	2 cul	F1	Ap2	1	S
<i>Robinia pseudoacacia</i> L.	2 cul	F1	Kn	14	S
<i>Sorbus aucuparia</i> L.	1 cul	F1	Ap2	2	S
<i>Thuja plicata</i> Donn ex D. Don	1 cul	F1	Er1	19	S
<i>Thuja occidentalis</i> L.	1 cul	F1	Er1	19	S
<i>Tilia cordata</i> Mill.	2 cul	F1	Ap2	1	S
<i>Tilia platyphyllos</i> Scop.	2 cul	F1	Ap2	1	S
<i>Ulmus minor</i> Mill. Emend. Richens	1 cul	F1	Ap2	1	S
<i>Ulmus glabra</i> Huds.	1 cul	F1	Ap2	1	S
<i>Ulmus laevis</i> Pall.	1 cul	F1	Ap2	1	S
<i>Viscum album</i> L.	2	C1 ppep	Kn	1	S
Shrub layer					
<i>Acer campestre</i> L.	+	F1	Ap1	1	
<i>Ailanthus altissima</i> Swingle	+	F1	Kn	19	
<i>Berberis thunbergii</i> DC.	+ cul	F2	Er2	19	S
<i>Buxus sempervirens</i> L.	+ cul	F2	Er1	19	S
<i>Caragana arborescens</i> Lam.	+ cul	F2	Er2	19	

Tab. 1 Continued

Species	FC	LF	GGHs	GSEg	S, Ch, R
<i>Cerasus mahaleb</i> (L.) Mill.	+ cul	F2	Kn	19	
<i>Celastrus orbiculata</i> Thunb.	+ cul	F2	Er2	19	
<i>Clematis vitalba</i> L.	+ cul	F2	Kn	19	
<i>Cornus stolonifera</i> Michx.	1 cul	F2	Er2	19	
<i>Cotoneaster lucidus</i> Schltdl.	+ cul	F2	Er2	19	
<i>Deutzia scabra</i> Thunb.	+ cul	F2	Er2	19	
<i>Euonymus europaeus</i> L.	1	F2	Ap1	1	
<i>Euonymus fortunei</i> (Turcz.) Hand.-Mazz.	+ cul	F2	Er3	19	
<i>Forsythia ×intermedia</i> Zabel	+ cul	F2	Er2	19	
<i>Hedera helix</i> L.	+	C1 li	Kn	1	S
<i>Juniperus ×pfitzeriana</i> (L. Späth) P. A. Schmidt	+ cul	F2	Er3	19	S
<i>Ligustrum vulgare</i> L.	1 cul	F2	Er2	19	
<i>Lonicera tatarica</i> L.	+ cul	F2	Kn	19	
<i>Mahonia aquifolia</i> (Pursh) Nutt.	+ cul	F2	Er1	19	S
<i>Philadelphus coronarius</i> L.	1 cul	F2	Er2	19	
<i>Ribes alpinum</i> L.	+ cul	F2	Ap2	16	
<i>Rosa multiflora</i> Thunb.	+ cul	F2	Er2	19	S
<i>Sambucus nigra</i> L.	1	F2	Kn	3	S
<i>Spiraea ×vanhouttei</i> (Briot) Zabel	1 cul	F2	Er2	19	
<i>Symphoricarpos albus</i> (L.) S. F. Blake	1 cul	F2	Er1	19	
<i>Syringa japonica</i> (Maxim.) Decne.	r cul	F2	Er2	19	S
<i>Syringa vulgaris</i> L.	+ cul	F2	Er1	19	S
<i>Taxus baccata</i> L.	2 cul	F1	Ap2	1	S, Ch
<i>Thuja occidentalis</i> L.	2 cul	F1	Er1	19	S
<i>Tsuga canadensis</i> (L.) Carr.	+ cul	F1	Er2	19	
<i>Viburnum lantana</i> L.	+ cul	F2	Er2	19	S
<i>Viburnum opulus</i> L. 'Roseum'	+ cul	F2	Cul	7	S
Herb layer					
<i>Acer platanoides</i> L.	1	F1	Ap1	1	
<i>Acer pseudoplatanus</i> L.	1	F1	Ap1	1	
<i>Achillea millefolium</i> L. s.s.	+	H1	Ap1	9	
<i>Aegopodium podagraria</i> L.	3 cul	H1	Ap2	1	
<i>Aegopodium podagraria</i> L. 'Variegatum'	+ cul	H1	Cul	1	
<i>Ajuga reptans</i> L. 'Artropurpurea'	+ cul	H1	Cul	1	S
<i>Alchemilla mollis</i> (Buser) Rothm.	+ cul	H1	Er3	19	
<i>Alliaria petiolata</i> (M. Bieb.) Cavara & Grande	1	T2	Ap1	3	

Tab. 1 Continued

Species	FC	LF	GGHs	GSEg	S, Ch, R
<i>Allium oleraceum</i> L.	R	G1	Ap1	4	S
<i>Allium scorodoprasum</i> L.	1 cul	G1	Kn	4	S
<i>Allium vineale</i> L.	1	G1	Kn	4	S
<i>Anchusa officinalis</i> L.	R	H1	Ap1	14	
<i>Anemone nemorosa</i> L.	+ cul	G1	Ap2	1	S
<i>Anemone ranunculoides</i> L.	+ cul	G1	Ap2	1	S
<i>Antennaria dioica</i> (L.) Gaertn.	+ cul	H1	Ap2	5	
<i>Anthriscus sylvestris</i> (L.) Hoffm.	+	H1	Ap1	3	
<i>Aquilegia vulgaris</i> L.	r cul	H1	Ap2	1	S, Ch
<i>Arabis alpina</i> L.	+ cul	H1	Ap2	19	
<i>Arenaria serpyllifolia</i> L.	+	T1	Ap1	5	
<i>Armeria maritima</i> subsp. <i>elongata</i> (Hoffm.) Bonnier	+ cul	H1	Ap2	5	
<i>Arrhenatherum elatius</i> (L.) P. Beauv. Ex J. Presl & C. Presl	1	H1	Ap1	9	
<i>Aster novi-belgii</i> L.	+ cul	H1	Er3	19	
<i>Aster novae-angliae</i> L.	+ cul	H1	Er3	19	
<i>Aubrieta ×cultorum</i> Bergmans	+ cul	H1	Er3	19	
<i>Bellis perennis</i> L.	1	T2, H1	Ap1	9	S
<i>Bergenia cordifolia</i> (Haw.) Sternb.	+ cul	H1	Er1	19	S
<i>Brachypodium sylvaticum</i> (Huds.) P. Beauv.	+	H1	Ap1	1	
<i>Brassica oleracea</i> L. var. <i>acephala</i> auct.	+ cul	T0	Cul	19	
<i>Bromus hordeaceus</i> L.	+	T1	Ap1	14	
<i>Bromus sterilis</i> L.	+	T1	Ar	3	
<i>Bromus tectorum</i> L.	+	T1	Ar	15	
<i>Calluna vulgaris</i> (L.) Hull.	r cul	C1	Ap2	5	
<i>Campanula persicifolia</i> L.	+ cul	H1	Ap2	2	S
<i>Campanula poscharskyana</i> Degen	+ cul	H1	Er3	19	S
<i>Campanula rapunculoides</i> L.	+ cul	H1	Ap2	16	S
<i>Capsella bursa-pastoris</i> (L.) Medik.	+	T1	Ar	16	
<i>Cardaminopsis arenosa</i> (L.) Hayek	+	H1	Ap1	9	
<i>Carex hirta</i> L.	R	G1	Ap1	10	
<i>Carex muskingumensis</i> Schwein.	+ cul	H1	Er3	19	
<i>Carex ornithopoda</i> Willd. 'Variegata'	r cul	H1	Cul	5	
<i>Carex spicata</i> Huds.	+	H1	Ap1	2	
<i>Cerastium biebersteinii</i> DC.	+ cul	H1	Er2	19	
<i>Cerastium holosteoides</i> Fr. emend. Hyl.	+	H1	Ap1	9	

Tab. 1 Continued

Species	FC	LF	GGHs	GSEg	S, Ch, R
<i>Cerastium semidecandrum</i> L.	+	T2	Ap1	5	
<i>Cerastium tomentosum</i> L.	+ cul	H1	Er2	19	
<i>Chaerophyllum aromaticum</i> L.	+ cul	H1	Ap2	3	
<i>Chaerophyllum temulum</i> L.	R	T2	Ap1	3	
<i>Chamomilla suaveolens</i> (Pursh) Rydb.	R	T1	Kn	10	
<i>Chelidonium majus</i> L.	1	H1	Ap1	3	
<i>Chenopodium hybridum</i> L.	+	T1	Ar	16	
<i>Chenopodium album</i> L.	+	T1	Ap1	16	
<i>Chionodoxa luciliae</i> Boiss.	r cul	G1	Er2	19	
<i>Chrysanthemum ×hortorum</i> L. Bailey	+ cul	H1	Er2	19	S
<i>Cirsium arvense</i> (L.) Scop.	R	G1	Ap1	13	
<i>Convallaria majalis</i> L.	1 cul	G1	Ap2	2	S, Ch
<i>Conyza canadensis</i> (L.) Cronquist	+	T1	Kn	15	
<i>Corydalis solida</i> Sm.	R cul	G1	Ap2	1	
<i>Crocus chrysanthus</i> (Herb.) Herb.	+ cul	G1	Er2	19	
<i>Crocus vernus</i> (L.) Hill	r cul	G1	Er2	19	S
<i>Dactylis glomerata</i> L.	1	H1	Ap1	9	
<i>Dactylis ×intercedens</i> Domin	+	H1	Ap1×Ap1	9	
<i>Dactylis polygama</i> Horv.	+	H1	Ap1	1	
<i>Dianthus chinensis</i> L.	r cul	T1, T2, H1	Er3	19	S
<i>Dianthus gratianopolitanus</i> Vill.	+ cul	H1	Ap2	5	S,Ch,R
<i>Dicentra formosa</i> (Andereus) Walp.	+ cul	H1	Er3	19	
<i>Dicentra spectabilis</i> (L.) Lem.	+ cul	H1	Er3	19	
<i>Diplotaxis muralis</i> (L.) DC.	r	T1	Kn	15	
<i>Doronicum orientale</i> Hoffm.	+ cul	H1	Er2	19	
<i>Echinacea purpurea</i> (L.) Moench	+ cul	H1	Er3	19	
<i>Epilobium adnatum</i> Griseb.	r	C2, H1	Ap1	12	
<i>Erigeron annuus</i> (L.) Pers.	r cul	T2	Kn	19	
<i>Erigeron speciosus</i> (Lidl.) DC.	+ cul	H1	Er3	19	
<i>Erigeron ramosus</i> (Walt.) B.S.P.	r cul	T2	Kn	19	
<i>Euphorbia peplus</i> L.	+	T1	Ar	16	
<i>Festuca arundinacea</i> Schreb.	r	H1	Ap1	10	
<i>Festuca pallens</i> Host	+ cul	H1	Ap2	19	
<i>Festuca trachyphylla</i> (Hack.) Krajina	r	H1	Ap1	5	
<i>Ficaria verna</i> Huds.	2 cul	G1	Ap2	1	
<i>Ficaria verna</i> Huds. f. <i>Plenifolia</i>	+ cul	G1	Cul	1	

Tab. 1 Continued

Species	FC	LF	GGHs	GSEg	S, Ch, R
<i>Fraxinus excelsior</i> L.	+	F1	Ap1	1	
<i>Gagea arvensis</i> (Pers.) Dumort	+ cul	G1	Ar	3	R
<i>Gagea lutea</i> (L.) Ker Gawl.	2 cul	G1	Ap2	1	
<i>Gagea</i> × <i>pomeranica</i> R. Ruthe	+	G1	Ap2×Ap2	21	
<i>Gagea pratensis</i> (Pers.) Dumort	1 cul	G1	Ap2	3	
<i>Galanthus nivalis</i> L.	1 cul	G1	Ap2	1	S, Ch
<i>Galanthus nivalis</i> L. f. <i>pleniflora</i>	+ cul	G1	Cul	1	S, Ch
<i>Galeobdolon argentatum</i> (L.) L.	+ cul	H1	Er2	1	
<i>Galeopsis pubescens</i> Besser	+	T1	Ap1	2	
<i>Galium aparine</i> L.	2	T1	Ap1	3	
<i>Galium mollugo</i> L. s. s.	r	H1	Ap1	9	
<i>Geranium</i> × <i>magnificum</i> Hyl.	+ cul	H1	Er3	19	
<i>Geranium macrorrhizum</i> L.	+ cul	H1	Er3	19	
<i>Geranium</i> × <i>oxonianum</i> Yeo	r cul	H1	Er3	19	
<i>Geranium pusillum</i> Burm. F. ex L.	+	T1	Ar	16	
<i>Geranium robertianum</i> L.	+	T1	Ap1	3	
<i>Geranium sanguineum</i> L.	+ cul	H1	Ap2	4	
<i>Geranium sanguineum</i> L. 'Album'	+ cul	H1	Cul	4	
<i>Geum urbanum</i> L.	+	H1	Ap1	3	
<i>Glechoma hederacea</i> L.	1	H1	Ap1	3	S
<i>Hedera helix</i> L.	1 cul	C1 li	Kn	1	S
<i>Hemerocallis fulva</i> (L.) L.	+ cul	H1	Er1	19	
<i>Heuchera</i> × <i>brizoides</i> hort. ex Lemoine	+ cul	H1	Er3	19	
<i>Impatiens parviflora</i> DC.	1	T1	Kn	3	
<i>Inula ensifolia</i> L.	+ cul	H1	Ap2	19	R
<i>Iris germanica</i> L.	+ cul	H1	Er1	19	S
<i>Lamium album</i> L.	1 cul	H1	Ar	3	S
<i>Lamium amplexicaule</i> L.	r	T1	Ar	16	
<i>Lamium maculatum</i> L.	+ cul	H1	Ap2	1	
<i>Lamium purpureum</i> L.	+	T1	Ar	16	
<i>Lapsana communis</i> L. s. s.	+	T1	Ap1	3	
<i>Lavandula angustifolia</i> Mill.	r cul	H1	Er3	19	S
<i>Liatris spicata</i> (L.) Willd.	+ cul	H1	Er3	19	
<i>Lilium bulbiferum</i> L.	r cul	G1	Kn	1	S, Ch
<i>Lolium perenne</i> L.	1	H1	Ap1	10	
<i>Medicago lupulina</i> L.	r	H1, T1	Ap1	9	

Tab. 1 Continued

Species	FC	LF	GGHs	GSEg	S, Ch, R
<i>Melandrium album</i> (Mill.) Garke	+	H1	Ap1	14	
<i>Miscanthus sinensis</i> Andersson	r cul	G1	Er3	19	
<i>Moehringia trinervia</i> (L.) Clairv.	+	H, T1	Ap1	2	
<i>Molinia coerulea</i> (L.) Moench 'Variegata'	+ cul	H1	Cul	19	
<i>Muscari armeniacus</i> Leichtlin ex Baker	r cul	G1	Er3	19	
<i>Muscari botryoides</i> (L.) Mill.	r cul	G1	Er2	19	S
<i>Muscari neglectum</i> Guss. Ex Ten.	r cul	G1	Er2	19	S
<i>Myosotis ramosissima</i> Rochel	r	T1	Ap1	4	
<i>Myosotis sparsiflora</i> Mikan ex Pohl	+ cul	T2	Ap2	3	
<i>Myosotis stricta</i> Link ex Roem. & Schult.	r	T1	Ap1	17	S
<i>Myosotis sylvatica</i> Ehrh. Ex Hoffm.	1 cul	T2	Ap2	1	S
<i>Nepeta ×faassenii</i> Bergmans ex Stearn	+ cul	H1	Er3	19	
<i>Narcissus jonquilla</i> L.	r cul	G1	Er2	19	S
<i>Narcissus poëticus</i> L.	r cul	G1	Er1	19	S
<i>Origanum vulgare</i> L.	+ cul	H1	Ap2	2	
<i>Ornithogalum boucheanum</i> Asch.	2	G1	Kn	16	
<i>Ornithogalum boucheanum</i> Asch. × <i>O. nutans</i> L.	1	G1	Kn×Kn	19	
<i>Ornithogalum nutans</i> L.	2	G1	Kn	16	
<i>Ornithogalum umbellatum</i> L.	1	G1	Kn	3	S
<i>Oxalis dilleii</i> Jacq.	+	T1, H1	Kn	19	
<i>Pachysandra terminalis</i> Siebold & Zucc	r cul	C1	Er3	19	
<i>Paeonia latifolia</i> Pall	r cul	H1	Er2	19	S
<i>Phlox paniculata</i> L.	+ cul	H1	Er2	19	S
<i>Phlox subulata</i> L.	+ cul	H1	Er2	19	
<i>Physostegia virginiana</i> (L.) Benth.	+ cul	H1	Er3	19	
<i>Pimpinella nigra</i> Mill.	r	H1	Ap1	9	
<i>Pimpinella saxifraga</i> L.	r	H1	Ap1	9	
<i>Plantago major</i> L. s. s.	+	H1	Ap1	10	
<i>Poa annua</i> L.	+	T1	Ap1	10	
<i>Poa compressa</i> L.	+	H1	Ap1	14	
<i>Poa nemoralis</i> L.	1	H1	Ap1	2	
<i>Poa pratensis</i> L. s. s.	1	H1	Ap1	9	
<i>Poa subcerulea</i> Sm.	+	H1	Ap1	9	
<i>Potentilla reptans</i> L.	+	H1	Ap1	10	
<i>Primula juliae</i> Kusn.	r cul	H1	Er3	19	
<i>Primula rosea</i> Royle	1 cul	H1	Er3	19	

Tab. 1 Continued

Species	FC	LF	GGHs	GSEg	S, Ch, R
<i>Ranunculus acris</i> L. s. s.	r	H1	Ap1	9	
<i>Ranunculus repens</i> L.	+	H1	Ap1	10	
<i>Ranunculus repens</i> L. 'Plena'	+ cul	H1	Cul	10	
<i>Rumex acetosa</i> L.	r	H1	Ap1	9	
<i>Rumex acetosella</i> L.	r	T1, G1, H1	Ap1	5	
<i>Rumex crispus</i> L.	r	H1	Ap1	10	
<i>Rumex obtusifolius</i> L.	r	H1	Ap1	13	
<i>Rumex rugosus</i> Campd.	r	H1	Kn	19	
<i>Rumex thyrsiflorus</i> Fingerh.	r	H1	Ap1	14	
<i>Salvia splendens</i> Sellow ex Roemer & J. A. Schultes	+ cul	T0	Cul	19	S
<i>Saponaria officinalis</i> L.	r cul	H1	Ar	19	S
<i>Saxifraga aizoon</i> Jacq.	+ cul	H1	Er3	19	
<i>Scilla sibirica</i> Haw.	2 cul	G1	Er1	16	S
<i>Sedum album</i> L.	+ cul	C2	Er2	19	
<i>Sedum reflexum</i> L.	+ cul	C2	Ap2	5	
<i>Sedum sexangulare</i> L.	+ cul	C2	Ap2	5	
<i>Sedum spectabile</i> Boreau	2 cul	C2	Er2	19	
<i>Sedum spurium</i> M. Bieb.	+ cul	C2	Er1	19	
<i>Sempervivum tectorum</i> L.	+ cul	C2	Er2	19	
<i>Senecio vernalis</i> Waldst. & Kit.	r	T1	Kn	15	
<i>Senecio vulgaris</i> L.	r	T1	Ar	16	
<i>Solidago gigantea</i> Aiton	+	G1, H1	Kn	13	
<i>Stachys lanata</i> Jacq. non Crantz	+ cul	H1	Er3	19	
<i>Stellaria media</i> (L.) Vill.	1	T1	Ap1	16	
<i>Stellaria pallida</i> (Dumort.) Piré	1	T2	Ap1	14	
<i>Taraxacum officinale</i> Web.	2	H1	Ap1	13	S
<i>Tagetes erecta</i> L.	+ cul	T0	Cul	19	S
<i>Thymus praecox</i> Opiz	+ cul	C1	Ap2	18	
<i>Thymus serpyllum</i> L. emend. Fr.	+ cul	C1	Ap2	5	
<i>Thymus vulgaris</i> L.	+ cul	C1	Er3	19	
<i>Tradescantia viridis</i> L.	+ cul	H1	Er3	19	
<i>Trifolium pratense</i> L.	R	H1	Ap1	9	
<i>Trifolium repens</i> L.	+	H1	Ap1	10	
<i>Tulipa gernerana</i> L.	r cul	G1	Er2	19	S
<i>Tulipa sylvestris</i> L.	1 cul	G1	Er1	16	S

Tab. 1 Continued

Species	FC	LF	GGHs	GSEg	S, Ch, R
<i>Urtica dioica</i> L.	1	H1	Ap1	3	
<i>Verbascum lychnitis</i> L.	r	T2	Ap1	5	S
<i>Verbena elegans</i> Kuth	+ cul	H1	Er3	19	
<i>Veronica chamaedrys</i> L. s. s.	1	H1	Ap1	9	
<i>Veronica hederifolia</i> L. s. s.	+	T1	Kn	17	
<i>Veronica sublobata</i> M. A. Fisch.	1	T1	Ap1	3	
<i>Veronica triphyllos</i> L.	r	T1	Ar	17	
<i>Vinca minor</i> L.	+ cul	C1	Er1	19	S
<i>Vinca minor</i> L. 'Illumination'	r cul	C1	Er1	19	S
<i>Viola cyanea</i> Čelak.	1	H1	Kn	3	S
<i>Viola cyanea</i> Čelak. × <i>V. odorata</i> L.	+	H1	Kn×Kn	3	S
<i>Viola odorata</i> L.	2 cul	H1	Kn	3	S
<i>Waldsteinia geoides</i> Willd.	+ cul	H1	Er3	19	
<i>Waldsteinia ternata</i> (Stephan) Fritsch	+ cul	H1	Er3	19	
<i>Yucca filamentosa</i> L.	r cul	H1	Er3	19	

FC (frequency classes): "r" – 1–2 specimens; "+" – several specimens; 1 – very rare species (1–5% of cemetery area outside the 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; C1 – woody chamaephytes; C2 – non-woody chamaephytes; G1 – geophytes; G0 – non-wintering geophytes; H1 – hemicryptophytes; H0 – non-wintering hemicryptophytes; T1 – annual therophytes; T2 – biennial therophytes; T0 – non-wintering therophytes; li – climber; pp – parasite; ppep – semiparasite.

GGHs (geographic-historical status): autapophytes (Ap1) – species, which penetrated spontaneously from natural localities to localities changed by human activity; hemeroapophytes (Ap2) – cultivated native species; Ar – archaeophytes; Kn – kenophytes; Er1 – primary ergasioepycophytes (cultivated plants introduced before 1945); Er2 – secondary ergasioepycophytes (introduced to cultivation relatively recently, in 1945–2000); Er3 – latest ergasioepycophytes (introduced into cultivation after the year 2000); Cul – seasonal species.

GSe (socioecological groups): 1 – fertile broad-leaved forests and shrub communities (*Fagetalia*, *Prunetalia*); 2 – acidophilous or xerothermic oak forests, mixed coniferous forests and their substitute shrub, herb, or grassland communities (*Quercion robori-petraeae*, *Quercion petraeae*, *Epilobion*, *Nardetalia*); 3 – nitrophilous shrub or herb communities (*Sambuco-Salicion*, *Alliarion*); 4 – xerothermic herb or grassland communities (*Trifolio-Geranieta*, *Festuco-Brometeta*); 5 – pine forests or sandy grassland (*Dicrano-Pinion*, *Sedo-Sclerantheteta*, *Corynephoroteta*); 6 – swamp alder forests, woodless fens, bogs, and intermediate mires (*Alnion*, *Magnocaricion*, *Caricetalia fuscae*, *Sphagnion fuscii*); 7 – riparian forests and thickets, reeds and aquatic vegetation (*Salicion*, *Phragmition*, *Glycerio-Sparganion*, *Potamogetoneteta*, *Lemneteta*, *Utricularieteta*); 8 – humid meadows and tall herb communities (*Molinietalia*); 9 – fresh and moderately humid meadows (*Arrhenatheretalia*); 10 – nitrophilous floodplain and treaded communities (*Plantagineta*); 11 – salt marshes and halophilous grasslands (*Thero-Salicornieteta*, *Astereteta trifolium*); 12 – therophyte communities on wet and humid sites (*Bidenteteta*, *Nanocyperion*); 13 – mesophilous communities of tall perennials (*Arction*); 14 – xerothermic, perennial ruderal communities (*Onopordon*); 15 – short-term, pioneer ruderal communities (*Sisymbion*, *Eragrostion*); 16 – weed communities of gardens and root crop fields (*Polygono-Chenopodietalia*, *Poo-Oxalidetum*, *Cardamine hirsuta*); 17 – weed communities of cereal fields (*Aperetalia*); 18 – epilithic communities (*Asplenieteta*); 19 – species of unknown phytosociological affiliation.

S – species of symbolic importance; Ch – protected species; R – species entered in regional red lists or red books.

Fig. 2 Number of species representing different life forms in the Poznań Cytadela cemetery (explanations in Tab. 1).

Fig. 3 Number of species according to geo-historical status in the cemeteries of Poznań Cytadela (explanations in Tab. 1).

T. orientalis, while in the herbaceous layer there were: *Aegopodium podagraria*, *Aquilegia vulgaris*, *Bergenia cordifolia*, *Chaerophyllum aromaticum*, *Gagea arvensis*, *Galanthus nivalis*, *Hedera helix*, *Hemerocallis fulva*, *Iris germanica*, *Lamium album*, *Lilium bulbiferum*, *Muscari neglectum*, *Myosotis sylvatica*, *Narcissus poeticus*, *Ornithogalum boucheanum*, *O. nutans*, *O. umbellatum*, *Saponaria officinalis*, *Scilla sibirica*, *Sedum spurium*, *Sempervivum tectorum*, *Tulipa syvestris*, *Vinca minor*, *Viola cyanea*, and *V. odorata*. The above-mentioned species are very good phytoindicators of old post-cemetery localities within the area of the entire Wielkopolska region [16].

In the Poznań Cytadela cemeteries, a total of 60 species of symbolic importance were also found. A total of 11 species are protected in Poland – at the same time, all of them are plants of symbolic importance (Tab. 1). Moreover, two species planted there which are entered in the Polish red book of plants were also reported, i.e., *Dianthus gratinopolitanus* [18] and *Inula ensifolia* [19].

Among the plants found in the cemeteries of the Poznań Cytadela, one should mention those associated with active cemeteries: *Campanula rapunculoides*, *Erigeron annuus*, *E. ramosus*, and *Solidago gigantea*.

Discussion

No studies are being conducted on vascular flora in necropolises during mapping of selected larger areas of Poland. Also, in the city of Poznań no studies have been conducted on the operating cemeteries or the former cemeteries that exist at present only as parks [20]. This was done for the first time for the central Wielkopolska region [10].

Botanical analyses of the flora in cemeteries have been conducted in few operating [13,21] or closed cemeteries [22,23]. First of all, the primary aim of these studies was to create a complete list of species, including basic analysis of life forms as well as geo-historical and socio-geographical groups. Only now such studies are being fully initiated: they are being conducted on a larger number of cemeteries using numerical methods [24]. Such large-scale studies facilitate a comprehensive analysis of directions of diversification of flora in the cemeteries as well as factors modifying their biodiversity.

Among plants reported in the cemeteries of Poznań Cytadela, the largest share was found for ergasiophytes (approx. 33%). The group next in rank comprises apophytes (approx. 49%), with spontaneophytes ranking third (approx. 17%). The above percentage shares of reported plants result from the introduction of many native and alien species, among them many species of trees and shrubs, as well as ornamental herbaceous plants. In turn, the most recent plantings are alien ornamental herbaceous

perennials. Among all the reported species of vascular plants, as many as 76% taxa were introduced at the time when the cemeteries were established or are being planted at present.

Species of ornamental plants introduced in the past to decorate the cemeteries and surviving there as well as those planted at present are ergasiophytes. In the past, these species were classified as ephemerophytes, i.e., species that penetrate wild localities from cultivation, persist for 1, 2, or 3 years and then die [13].

In the old cemeteries, a large degree of cover is found for all the layers: trees, shrubs, and herbaceous plants [23]. In exceptional cases, the shrub layer is prevented from development. This happens when a given cemetery is a tourist attraction [24]. In Poznań, all the three well-developed layers may be found in the old closed Catholic cemetery in the district of Świerczewo [3]. In the operating cemeteries in Poznań [2], the herbaceous layer has not reached a considerable degree of cover due to frequent raking and treading.

The problematic indigenous species which could have been previously introduced to cultivation in the studied cemeteries and which have survived until the present include *Gagea pratensis*, *Hedera helix*, *Ligustrum vulgare*, *Ornithogalum umbellatum*, and *Vinca minor*.

Conclusions

- During the studies carried out in the years 2011–2014 in the cemeteries of the Poznań Cytadela Park, 255 vascular plant species were found. The interesting species include: *Chionodoxa luciliae*, *Rumex rugosus*, *Aegopodium podagraria* 'Variegatum', *Ficaria verna* f. *plenifolia*, *Galanthus nivalis* f. *pleniflora*, *Ornithogalum boucheanum*, *Ranunculus repens* 'Plena', and spontaneous hybrids: *Dactylis* × *intercedens*, *Gagea* × *pomeranica*, *Ornithogalum boucheanum* × *O. nutans*, *Viola cyanea* × *V. odorata*. The three last hybrids have a chance of developing only in cemeteries and in old parks where these species were earlier introduced to be cultivated as ornamental plants.
- In the cemeteries as well as in the manor parks, many spring bulbous plants were planted because after a long winter colorful plants were much appreciated. Such spring geophytes introduced in the studied cemeteries of Poznań Cytadela include the following: *Allium oleraceum*, *A. scorodoprasum*, *A. vineale*, *Anemone nemorosa*, *A. ranunculoides*, *Chionodoxa luciliae*, *Convallaria majalis*, *Corydalis solida*, *Crocus chrysanthus*, *C. vernus*, *Ficaria verna*, *F. verna* f. *plenifolia*, *Gagea arvensis*, *G. lutea*, *G. x pomeranica*, *G. pratensis*, *Galanthus nivalis*, *G. nivalis* f. *pleniflora*, *Lilium bulbiferum*, *Muscari armeniacus*, *M. botryoides*, *M. neglectum*, *Narcissus jonquilla*, *N. poëticus*, *Ornithogalum nutans*, *O. boucheanum*, *O. boucheanum* × *O. nutans*, *O. umbellatum*, *Scilla sibirica*, *Tulipa kaufmanniana*, *T. sylvestris*.
- The most numerous group is represented by the species that occur in several specimens in a given area, i.e., in almost 43% (the 2nd degree of cover in the 7-point scale). Then, there occurred rare and very rare species. The species *Aegopodium podagraria* and *Aesculus hippocastanum* occurred in the 3rd degree of cover, while *Acer platanoides* occurred in the 4th degree of cover. No species occurred in the 5th degree of cover.
- Because of their decorative value and symbolic meaning, roses were willingly used to decorate single graves or even the whole cemeteries. In the studied cemeteries of Poznań Cytadela, only *Rosa multiflora* was found. It is a rose species introduced relatively recently to cultivation in gardens, parks, and cemeteries.
- *Hedera helix*, which signifies resurrection and immortality of the soul and which winds around other plants or objects, symbolizes a lasting and true memory of the deceased.
- The most recent and rarely cultivated vascular plants (erasiophytes) in the cemeteries, found only in the Cemetery of Polish Heroes and in the Cemetery of the British Commonwealth in Poznań Cytadela, include the following: *Alchemilla mollis*, *Echinacea purpurea*, *Campanula poscharskyana*, *Carex muskingumensis*, *Galeobdolon argentatum*, *Geranium oxonianum*, *Heuchera xbrizoides*, *Lavandula*

angustifolia, *Liatris spicata*, *Miscanthus sinensis*, *Nepeta ×faassenii*, *Primula juliae*, *Primula rosea*, *Stachys lanata*, *Tradescantia viridis*, *Verbena elegans*, *Waldsteinia geoides*, *W. ternate*, *Yucca filamentosa*, etc.

- In the studied cemeteries, a rich indigenous flora was found in the herbaceous layer, including: *Aegopodium podagraria*, *A. podagraria* 'Variegatum', *Anemone nemorosa*, *A. ranunculoides*, *Antennaria dioica*, *Aquilegia vulgaris*, *Ajuga reptans* 'Atropurpurea', *Arabis alpina*, *Armeria maritima* subsp. *elongata*, *Calluna vulgaris*, *Campanula persicifolia*, *C. rapunculoides*, *Carex ornithopoda* 'Variegata', *Corydalis solida*, *Chaerophyllum aromaticum*, *Convallaria majalis*, *Crocus vernus*, *Dianthus gratianopolitanus*, *Doronicum orientale*, *Festuca pallens*, *Ficaria verna*, *Ficaria verna* f. *plenifolia*, *Gagea arvensis*, *G. lutea*, *Galanthus nivalis*, *Galanthus nivalis* f. *pleniflora*, *Geranium sanguineum*, *Inula ensifolia*, *Lamium maculatum*, *Lilium bulbiferum*, *Molinia coerulea*, *Myosotis sparsiflora*, *M. sylvatica*, *Origanum vulgare*, *Ranunculus repens* 'Plena', *Saxifraga aizoon*, *Sedum sexangulare*, *Thymus praecox*, and *T. serpyllum*.
- The hypothesis that in the cemeteries there are many planted species was confirmed (Fig. 1), while it may not be said that there is a limited number of spontaneous apophytes (65 species).

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Flora roślin naczyniowych cmentarzy na Cytadeli w Poznaniu

Streszczenie

W niniejszej pracy po raz pierwszy przedstawiono florę naczyniową występującą na cmentarzach poznańskiej Cytadeli. Na ich obszarze stwierdzono występowanie 255 gatunków roślin naczyniowych. Wśród taksonów są gatunki nowe dla Polski [7]: *Chionodoxa luciliae*, *Ornithogalum boucheanum* × *O. nutans*, *Viola cyanea* × *V. odorata*, a także Wielkopolski [28]: *Rumex rugosus*, *Dactylis xintercedens*, *Gagea xpomoranica* i Poznania [13]: *Erigeron ramosus*, *Lilium bulbiferum*, *Muscari armeniacum*, *M. neglectum*, *Pimpinella nigra*, *Poa subcaerulea*, *Veronica hederifolia* s. s.

Na badanych cmentarzach występuje dużo wiosennych geofitów (30 gatunków). Są to: *Allium scorodoprasum*, *Anemone nemorosa*, *A. ranunculoides*, *Chionodoxa luciliae*, *Convallaria majalis*, *Corydalis solida*, *Crocus chrysanthus*, *C. vernus*, *Ficaria verna*, *F. verna* f. *plenifolia*, *Gagea arvensis*, *G. lutea*, *G. pratensis*, *Galanthus nivalis*, *G. nivalis* f. *pleniflora*, *Lilium bulbiferum*, *Muscari armeniacum*, *M. botryoides*, *M. neglectum*, *Narcissus jonquilla*, *N. poeticus*, *Ornithogalum boucheanum*, *O. nutans*, *O. umbellatum*, *Scilla sibirica*, *Tulipa gesneriana*, *T. sylvestris*.

Spośród starych uprawianych roślin naczyniowych zaliczonych do „trwałych gatunków cmentarnych” wymienić należy występujące w warstwie zielnej: *Aegopodium podagraria*, *A. podagraria* ‘Variegatum’, *Aquilegia vulgaris*, *Bergenia cordifolia*, *Campanula rapunculoides*, *Clematis vitalba*, *Convallaria majalis*, *Gagea arvensis*, *G. lutea*, *G. pratensis*, *Galanthus nivalis*, *Galanthus nivalis* f. *pleniflora*, *Hedera helix*, *Hemerocallis fulva*, *Iris germanica*, *Lamium album*, *Lilium bulbiferum*, *Muscari botryoides*, *M. neglectum*, *Myosotis sylvatica*, *Narcissus poeticus*, *Ornithogalum boucheanum*, *O. nutans*, *O. umbellatum*, *Saponaria officinalis*, *Scilla sibirica*, *Sedum spurium*, *Solidago canadensis*, *Tulipa sylvestris*, *Vinca minor*, *Viola cyanea* i *V. odorata*. Wymienione gatunki na terenie całej Wielkopolski są bardzo dobrymi fitoindykatorami starych miejsc cmentarnych, gdy brak substancji nagrobnej.

Najnowsze uprawiane rośliny naczyniowe (ergazjofity) na cmentarzach, stwierdzone zostały tylko na Cmentarzu Wspólnoty Brytyjskiej poznańskiej Cytadeli, zaliczyć należy do nich: *Alchemilla mollis*, *Campanula poscharskyana*, *Carex muskingumensis*, *Galeobdolon argentatum*,

Lavandula angustifolia, *Nepeta ×faassenii*, *Stachys lanata*, *Verbena ×hybrida*, *Waldsteinia geoides*, *W. ternata* i in.

Na badanych cmentarzach stwierdzono w warstwie zielnej bogatą florę rodzimych roślin uprawianych. Są to: *Aegopodium podagraria*, *Anemone nemorosa*, *A. ranunculoides*, *Aquilegia vulgaris*, *Armeria maritima* subsp. *elongata*, *Campanula persicifolia*, *C. rapunculoides*, *Ficaria verna*, *Gagea lutea*, *G. minima*, *Galanthus nivalis*, *Geranium sanguineum*, *Lamium maculatum*, *Myosotis sylvatica*, *Origanum vulgare*, *Saxifraga aizoon*, *Thymus praecox* i *T. serpyllum*. Wśród form i odmian uprawianych rodzimych gatunków wymienić należy: *Aegopodium podagraria* 'Variegatum', *Ajuga reptans* 'Atropurpurea', *Carex ornithopoda* 'Variegata', *Ficaria verna* f. *plenifolia*, *Galanthus nivalis* f. *pleniflora*, *Ranunculus repens* 'Plena'.