



VASCULAR FLORA IN COMMUNAL CEMETERIES OF THE POZNAŃ (WESTERN POLAND)

ANETA CZARNA, KATARZYNA AMBROŻY-DERĘGOWSKA

K. Ambroży-Deręgowska, Department of Mathematical and Statistical Methods, Poznań University of Life Sciences, Wojska Polskiego 28, 60–637 Poznań, Poland, e-mail: ambrozy@up.poznan.pl

A. Czarna, Department of Botany, Poznań University of Life Sciences, Wojska Polskiego 71 C, 60-625 Poznań, Poland, e-mail: aneta.czarna@up.poznan.pl

ABSTRACT. In 2015–2018, both communal cemeteries in Poznań were studied: Junikowo and Miłostowo (covering nearly 100 ha each). In total, 603 species of vascular plants were found there: 34 in the tree layer, 109 in the shrub layer, and 460 in the herb layer. Their vascular flora includes 350 cultivated taxa (58.1%) mostly in the herb layer (228 species, 37.9% of the total). Native species planted in the herbaceous layer in both cemeteries included *Aegopodium podagraria*, *Armeria elongata*, *Campanula rapunculoides*, *Dryopteris filix-mas*, *Lysimachia nummularia*, *Origanum vulgare*, and *Sedum reflexum*. Among protected, rare, and interesting ornamentals in the studied cemeteries, particularly noteworthy are e.g. *Alyssum saxatile*, *Aquilegia vulgaris*, *Asarum europaeum*, *Aster alpinus*, *Colchicum autumnale*, *Corydalis solida*, *Dianthus gratianopolitanus*, *Erica tetralix*, *Fritillaria meleagris*, *Galanthus nivalis*, *Gypsophila paniculata*, *Hepatica nobilis*, *Iris sibirica*, *Jovibarba sobolifera*, *Lathyrus latifolius*, *Leucoium vernum*, *Matteucia struthiopteris*, *Myosotis sylvatica*, *Poa chaixii*, *Polemonium coeruleum*, *Polygonatum multiflorum*, *Salvia nemorosa*, *Thymus praecox*, and *Trollius europaeus*. The most commonly cultivated herbs are represented by some recently introduced species, e.g. *Arabis caucasica*, *Begonia sempervirens*, *B. tuberhybrida*, *Bellis perennis* ‘Plena’, *Cerastium bibersteinii*, as well as species introduced before the year 2000 (culA), e.g. *Convallaria majalis*, *Galanthus nivalis*, *Saponaria officinalis*, and *Vinca minor*. All the above-mentioned species are classified as funeral species, typical of cemeteries in Poland.

KEY WORDS: communal cemetery, ergasiophytes, Poland, Poznań, species diversity, urban green areas, vascular plants

INTRODUCTION

Communal cemeteries are burial sites for all inhabitants, irrespective of their religious beliefs, and account for only a small proportion of cemeteries in Poland. Usually they are large and designed in an interesting way. The largest one in Poland is the Central Cemetery in Szczecin.

Both historical and currently used cemeteries are some of the most important elements of landscape. Considering the usually small acreage of green areas in cities and towns, and the low forest coverage in central Poland (including the Wielkopolska region), more attention should be paid to the quality and acreage of vegetation in cemeteries. Vegetation in cemeteries plays important functions in spatial systems, isolates grave lots, and reduces noise. It creates a space for reflection and silence, which are necessary in those places, and also forms a beautiful

background for architecture. At the time of increasing pollution, tall vegetation in cemeteries also plays an environmental role (ŁUKASIEWICZ & ŁUKASIEWICZ 2006).

Vegetation is an important component, which borders cemeteries, emphasizes its spatial structure, constitutes the background and neighbourhood of graves (BANIUKIEWICZ 1994). Tall vegetation is a natural protection against wind, as it diminishes its force (BIAŁOBOK 1985, ŁUKASIEWICZ & ŁUKASIEWICZ 2006). Scientific literature concerning cemetery plants and vegetation is very limited. Botanical research on cemeteries was pioneered by ROJECKA (1932). Publications by BOULLY DES LESDAINS (1948) concern only single cemeteries in large cities: London and Paris. His later study (PYŠEK 1987) was conducted in a municipal cemetery covering 19 ha, established in 1901.

Another interesting foreign study was devoted to conservation of an old cemetery, established in

1840 (ZISENIS 1998). It covers an area of 25 ha, is located in a wooded part of London, in semi-natural forests with *Acer pseudoplatanus* and *Fraxinus excelsior*, and *Hedera helix* in the herbaceous layer. After World War II it was neglected, and since 1969 it has not been used for burials. In the late 1970s many trees were felled, especially sycamore (*Acer pseudoplatanus*) was removed, as it was regarded as less valuable. Due to this, in the created gaps, *Reynoutria japonica* has spread very quickly and still dominates there. In the 1980s, felling was continued and additionally many new, native trees and shrubs were planted, to increase species diversity. However, the gaps were colonized by ruderal vegetation. In such conditions, common forest species were unlikely to flourish. The author suggested that ecological succession should be enabled in the cemetery (ZISENIS 1998).

In the last few decades, cemeteries were studied by many naturalists, particularly geobotanists (CZARNA & PISKORZ 2005, CZARNA & ANTKOWIAK 2008, JĘDRZEJKO & WALUSIAK 2008, KOWARIK et al. 2016, NOWIŃSKA et al. 2020), taxonomists (McBARRON et al. 1988, GALERA et al. 1993, CZARNA 2001, 2004, CZARNA & NOWIŃSKA 2011, HEWITT 2013, BUCHHOLZ et al. 2016, OTVES et al. 2016), phytosociologists (HUSSAIN et al. 2011, TRZASKOWSKA & KARZMARZ 2013, OTVES et al. 2016), and ecologists (KUNICK 1990, SUKOPP 1990, WITTIG et al. 1993, LISOWSKA et al. 1994, RAHMONOV et al. 2010, KOWARIK et al. 2016, AL-AKL et al. 2018, YILMAZA et al. 2018). Some publications concern single species or genera associated with cemeteries: *Celastrus scandens* (BIAŁOBOK 1993), *Rosa* spp. (CZARNA 2016c), and *Hedera helix* (CZARNA 2017a). Floristic research problems concerning the specificity of the plant cover of cemeteries have attracted the attention of many botanists, especially Polish ones.

In the first botanical studies of cemeteries in Poland, researchers usually focused on trees (SICIŃSKI 1989, STYPIŃSKI 1978) and also on shrubs: in the largest cemetery in Poland, i.e. the Central Cemetery in Szczecin (STACHAK & GRINN 1993), and in Szczecin-Golecino (STACHAK & ZIELIŃSKI 1995). Similarly, in Wrocław several inventories of trees and shrubs have been conducted – in Osobowicki, Grabiszyński, and both Jewish cemeteries – but those studies commissioned by the Wrocław Cemetery Administration, have not been published. Literature on ornamental plants used to decorate graves is even poorer, except for the richly illustrated, popular guide written by RAK (1998), and a monograph on ornamental plants in rural cemeteries of Lower Silesia (DĘBICZ 2012).

In Poland, the first publication on vascular plants growing spontaneously in currently used cemeteries was the vascular flora of cemeteries in left-bank Warsaw (GALERA et al. 1993), followed by reports on vascular plants in cemeteries in the towns of Jarocin (CZARNA 2004) and Zakopane (CZARNA & PISKORZ 2005).

Floristic studies of European cities have often omitted cemeteries. Chorological research in the whole city of Poznań was conducted by JACKOWIAK (1990, 1993), but he did not take into account cemeteries, both open and closed.

In Poznań, however, other floristic studies have been conducted: in old cemeteries in the districts of Dębiec (CZARNA 2005), Cytadela (CZARNA 2016a), and the Cemetery of the Meritorious (CZARNA 2016b), in seven parks that used to be Protestant cemeteries (CZARNA 2017b), and in currently used parochial cemeteries: in the districts of Górczyn, Nowina (Jeżyce), Corpus Christi Cemetery in Bluszczowa Street, and John Vianney Parish Cemetery in Lutycka Street (CZARNA et al. 2011).

This study was aimed to compare the taxonomic composition of vascular flora of communal cemeteries in Poznań and to verify two hypotheses: 1) there are many annual species in the currently used cemeteries, where new species are continuously introduced to cultivation and plant husbandry practices are performed on and around graves; 2) the cemeteries are rich in species that have escaped from cultivation on graves, because human disturbance (burials and systematic husbandry practices, introduction of new ornamental plants) favours short-term occurrence of casual species (ergasiophytophytes).

STUDY AREAS

Within the administrative limits of the city of Poznań, 27 cemeteries are located. However, 11 of them are no longer used for burial, but have been mostly transformed into urban parks. Two of the currently used cemeteries are communal – in Junikowo and Miłostowo – while the others are owned by parishes (Fig. 1).

The cemetery in Junikowo is situated in the western part of the city, in the district of Grunwald, between Grunwaldzka and Cmentarna Streets. In respect of area, it ranks second (after the one in Miłostowo), covering 92.69 ha, but in respect of the number of buried people, it ranks first (about 139 000 – CMENATRZ JUNIKOWO...). This necropolis was opened in 1948. It includes special sections created for insurrectionists who took part in the Wielkopolska uprising of 1918–1919, for soldiers of Home Army (Armia Krajowa), officers of Polish Army, and labour movement activists. Also monumental mausolea of Romani families and columbaria attract attention. In 1948, a botanical paper about the cemetery was published, entitled “A study of woody vegetation of the cemetery in Junikowo”, where 10 plant associations were distinguished. Most of the cemetery area was then covered by the association *Corynephorum canescentis typicum* (FLAKOWA 1948).

The communal cemetery in Miłostowo is situated in the eastern part of the city, in the district of

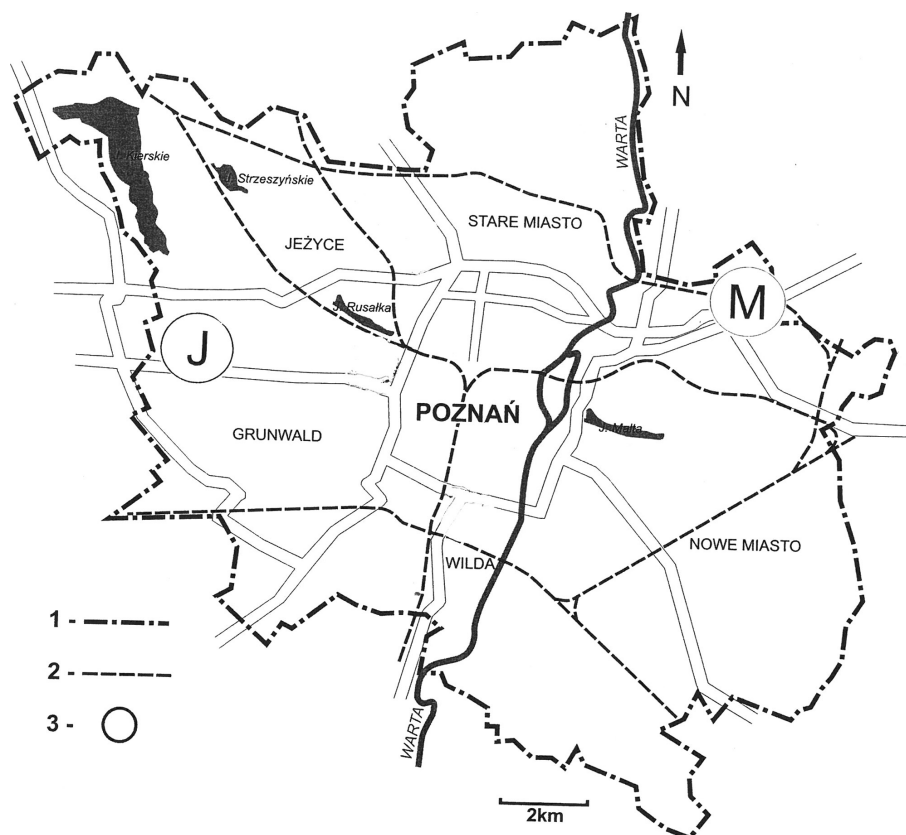


Fig. 1. Location of the examined Poznań cemeteries: J – Junikowo, M – Miłostowo
1 – boundaries of the Poznań city, 2 – railway lines, 3 – examined cemeteries.

Nowe Miasto, between Warszawska and Gnieźnieńska Streets. It covers an area of 98.69 ha, was opened in 1943, and about 81 000 people have been buried there (CMENTARZ MIŁOSTOWO...). It includes special sections for Polish, Soviet, and German soldiers, who died during the 2nd World War, for Jews killed during the war and Jewish tombstones from the inexistent cemetery in Głogowska Street, and many graves moved after the war from Orthodox and Protestant cemeteries in the city centre. In 1993, a modern crematorium was built there, with the first Polish columbarium located in its vicinity. The cemetery was established on sand dunes, where many tree and shrub species were planted to stabilize the ground in the 1940s. From this cemetery, the position of *Veronica prostrata* is given (WÓJCIK et al. 2021).

MATERIAL AND METHODS

Field research in the communal cemetery in Junikowo was conducted on 14 August 2015, 1 April 2016, 20 April 2018, and 28 July 2018, whereas in Miłostowo, on 20 August 2015, 2 April 2016, 21 April 2018, and 29 July 2018.

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

Plant cover was estimated visually using the Londo scale, composed of 13 classes (LONDO 1976,

DIERSCHKE 1994): 0.1 – <1% of the cemetery area; 0.2 – 1–3%; 0.4 – 3–5%; 1 – 5–15%; 2 – 15–25%; 3 – 25–35%; 4 – 35–45%; 5 – 45–55%; 6 – 55–65%; 7 – 65–75%; 8 – 75–85%; 9 – 85–95%; 10 – 95–100%. The abbreviation “cul” denotes a species that was cultivated earlier (before the year 2000: culA) or recently (after 2000: culB). Such a division was introduced because in the last 20 years the Polish gardening market has been enriched with many interesting species, which are now permanently naturalized as ornamental plants in cemeteries. Evidence is provided by catalogues of cultivated plants, published by the Association of Nursery Growers in Warsaw, as well as by the W. Legutko Seed Trade Company.

The geographical-historical classification (GH) follows (NAEGELI & THELLUNG 1905), with some modifications. Ergasiophytes (Er) were defined as alien species of cultivated plants introduced intentionally by humans and later neglected, which are permanently naturalised and reproduce vegetatively or persist in parks, gardens, and cemeteries, but do not invade neighbouring habitats. It was necessary to distinguish the group of hemiapophytes *sensu* KRAWIECOWA & ROSTAŃSKI (1972), i.e. species that are native to Poland but found outside their natural ranges of distribution.

Plant species were assigned to geographical-historical groups according to ZAJĄC et al. (1998), TOKARSKA-GUZIŁ (2005) for kenophytes; ZAJĄC (1979)

and ZAJĄC & ZAJĄC (2014) for archaeophytes; ROSTAŃSKI & SOWA (1986–1987), URBISZ (2012), and JACKOWIAK et al. (2017) for ephemerophytes, and on the basis of information extracted from RUTKOWSKI (1998), MIREK et al. (2002), and CHMIEL (2006) as well as own observations in the field (CZARNA 2009 and unpublished data).

Socio-ecological groups (SE) are based on the concepts of CHMIEL (2006) and CZARNA (2009) while Raunkiaer life-forms (LF) are mostly in accordance with RUTKOWSKI (1998), ZARZYCKI et al. (2002) and ERHARDT et al. (2008). Among plant life-forms, trees taller than 4 m were classified as the tree layer, while plants lower than 1 m were classified as the herb layer.

The species that occurred in 2–3 layers of vegetation in the studied cemeteries, when assigning them to groups SE, LF, and GH, were recorded twice or thrice, i.e. as they occurred.

In the classification based on the reason for introduction to cultivation, the following categories were used: P – plant habit; L – leaves; K – flowers or inflorescences; O – fruits; D – dried specimens (used in funeral wreaths). For this purpose, we used catalogues of cultivated plants published by the Association of Nursery Growers in Warsaw, and books illustrated with photographs (e.g. WIELKA ENCYKLOPEDIA... 1993).

Plants typical of cemeteries (funeral plants) were determined on the basis of field research on old and currently used cemeteries in the Wielkopolska region. Protected species were determined on the basis of the Regulation of the Minister of Environmental Protection (ROZPORZĄDZENIE... 2014).

RESULTS

In total, in the communal cemeteries in Poznań, 603 taxa of vascular plants were recorded: 34 in the tree layer, 109 in the shrub layer, and 460 in the herb layer (Table 1). In the Miłostowo cemetery, 430 species were recorded, compared to 516 in Junikowo.

In both cemeteries, the majority of species were in the lowest plant cover class, i.e. “0.1” (281 taxa in Junikowo and 241 in Miłostowo), followed by the second class “0.2” (73 and 80, respectively) or “0.4” (102 and 63, respectively; Table 2). Also species included in plant cover class “1” were quite numerous (47 and 35, respectively). The highest plant cover class represented in this study was “3”, and it included only 3 tree species in Miłostowo: *Acer platanoides*, *Betula pendula*, and *Pinus sylvestris*. No species reached the higher plant cover classes (4–10).

Cultivated plants were particularly numerous in the cemetery in Junikowo (289 taxa), compared to 211 in Miłostowo. Nearly half of the plants have been introduced to cultivation recently (culB: 142 in Junikowo and 99 in Miłostowo). Earlier

cultivated plants were represented (culA) by 147 taxa in Junikowo and 112 in Miłostowo.

Among cultivated plants, the above-mentioned 3 tree species covered 25–35% of the cemetery area (class “3”) in Junikowo. The next plant cover class (“2”) was represented in Junikowo by 9 species: *Acer platanoides*, *A. pseudoplatanus*, *Betula pendula*, *Buxus sempervirens*, *Fraxinus excelsior*, *Pinus sylvestris*, *Quercus robur*, *Saponaria officinalis*, *Thuja occidentalis*; and 6 in Miłostowo: *Acer pseudoplatanus*, *Buxus sempervirens*, *Fraxinus excelsior*, *Quercus robur*, *Caragana arborescens*, and *Thuja occidentalis*.

Raunkiaer life-forms are adaptations of plants to survival in unfavourable periods, such as winter and droughts. Vascular plants in the studied communal cemeteries represent 7 life-forms: megaphanerophytes, nanophanerophytes, chamaephytes, geophytes, helophytes, therophytes, and hemicryptophytes (Table 3). Among Raunkiaer life-forms, hemicryptophytes are the most numerous in the study areas (212 in Junikowo and 184 in Miłostowo), followed by therophytes (124 and 105, respectively). Contributions of megaphanerophytes and nanophanerophytes are similar in both cemeteries: megaphanerophytes are represented by 61 species in Junikowo and 50 in Miłostowo, while nanophanerophytes by 65 species in Junikowo and 45 in Miłostowo.

In the tree layer, among the earlier introduced species (i.e. before the year 2000, culA), megaphanerophytes are represented most numerously (26 in Junikowo, and 18 in Miłostowo). In Junikowo, 14 megaphanerophytes were in plant cover class “1”, followed by classes “2” and “0.4”, represented by 6 species each. In Miłostowo, the largest group of megaphanerophytes (8) were also in plant cover class “1”, followed by classes “3” and “2”, represented by 3 species each. In each cemetery, one earlier cultivated chamaephyte was recorded (plant cover class “0.4”). In Junikowo also a nanophanerophyte was present (class “0.4”, Table 6).

In the shrub layer, group culA included primarily nanophanerophytes (41 in Junikowo and 25 in Miłostowo), mostly representing plant cover class “0.4” (24 in Junikowo and 12 in Miłostowo). In both cemeteries in this layer also megaphanerophytes were recorded (10 in Junikowo and 9 in Miłostowo) as well as chamaephytes (1 in each; Table 6).

In both cemeteries, the tree layer did not include any species recently introduced to cultivation (culB). In the shrub layer, however, megaphanerophytes of this type are represented by 6 species in Junikowo and 7 in Miłostowo. Similarly, nanophanerophytes of this type are represented by 7 and 5 species, respectively. In both cemeteries, both life-forms were mostly in plant cover classes “0.2” or “0.4” (Table 6).

Spontaneous plants in the shrub layer included in Junikowo 13 megaphanerophytes mostly plant cover class “0.4” and “1”), 11 nanophanerophytes (mostly

Table 1. List and characteristics of vascular plant species in communal cemeteries in Poznań

Species	PC in Junikowo	PC in Mitos-towo	GH	LF	SE	Reason for introduction	Protected species
Tree layer							
<i>Acer campestre</i>	1 culA	1 culA	Ap	M	1	P	
<i>Acer negundo</i>	1 culA	1 culA	Kn	M	3	P	
<i>Acer platanoides</i>	2 culA	3 culA	Ap	M	1	P	
<i>Acer pseudoplatanus</i>	2 culA	2 culA	Ap	M	1	P	
<i>Acer saccharinum</i>	1 culA		ErT	M	20	P	
<i>Acer tataricum</i>	0.4 culA		ErT	M	20	P, L	
<i>Ailanthus altissima</i>	1 culA		Kn	M	20	P, O	
<i>Betula pendula</i>	2 culA	3 culA	Ap	M	2	P	
<i>Cerasus mahaleb</i>	0.4 culA		Kn	N	20	P, K	
<i>Fraxinus excelsior</i>	2 culA	2 culA	Ap	M	1	P	
<i>Hedera helix</i>	0.4 culA	0.4 culA	Kn	Ch	1	P, L, K	
<i>Larix decidua</i>	0.4 culA		Sp	M	2	P	
<i>Larix kaempferi</i>	0.4 culA		ErT	M	20	P	
<i>Malus ×purpurea</i>	0.4 culA	0.2 culA	ErT	M	20	P, K, O	
<i>Padus serotina</i>	1 culA	0.2 culA	Kn	M	5	P, L	
<i>Picea abies</i>	1 culA	0.4 culA	Kn	M	2	P	
<i>Picea glauca</i>		1 culA	ErT	M	20	P	
<i>Pinus nigra</i>		1 culA	ErT	M	20	P	
<i>Pinus strobus</i>		1 culA	Kn	M	20	P	
<i>Pinus sylvestris</i>	2 culA	3 culA	Ap	M	5	P	
<i>Populus alba</i>		0.4 culA	Ap	M	7	P	
<i>Populus nigra</i>	1 culA		Ap	M	7	P	
<i>Populus tremula</i>	1 culA	1 culA	Ap	M	2	P, L	
<i>Pseudotsuga menziesii</i>	1 culA		Kn	M	2	P	
<i>Quercus robur</i>	2 culA	2 culA	Ap	M	1	P	
<i>Quercus rubra</i>	1 culA		Kn	M	2	P, L	
<i>Robinia pseudoacacia</i>	1 culA	1 culA	Kn	M	14	P	
<i>Salix alba</i> 'Pendula'	0.4 culA		ErT	M	20	P	
<i>Sorbus aucuparia</i>	1 culA		Ap	M	2	P, O	
<i>Tilia cordata</i>	1 culA	1 culA	Ap	M	1	P	
<i>Tilia ×euchlora</i>	0.4 culA		ErT	M	20	P	
<i>Tilia platyphyllos</i>	1 culA		Ap	M	1	P	
<i>Viscum album</i>	2	2	Kn	Ch	1	–	
<i>Viscum laxum</i>		0.4	Kn	Ch	5	–	
Shrub layer							
<i>Abies concolor</i>		0.4 culB	ErT	M	20	P	
<i>Abies koreana</i>	0.2 culB		ErT	M	20	P, O	
<i>Acer campestre</i>	1	1	Ap	M	1	P	
<i>Acer negundo</i>	1	0.4	Kn	M	3	P	
<i>Acer platanoides</i>	2		Ap	M	1	P	
<i>Acer pseudoplatanus</i>	0.4	0.4	Ap	M	1	P	
<i>Ailanthus altissima</i>	0.2		Kn	M	20	L	
<i>Amelanchier spicata</i>	0.4 culA		Kn	N	2	P, K	
<i>Berberis julianae</i>		0.4 culA	ErT	N	20	P, L	
<i>Berberis thunbergii</i>	0.4 culA		ErT	N	20	P, L	
<i>Berberis vulgaris</i>	0.4 culA	0.4 culA	Ap	N	20	P, L	
<i>Betula pendula</i>	1 culA	1 culA	Ap	N	2	P	
<i>Buxus sempervirens</i>	2 culA	2 culA	ErT	N	20	P	
<i>Caragana arborescens</i>	1 culA	2 culA	ErW	N	20	P	
<i>Carpinus betulus</i>		0.2 culB	Sp	M	1	P	
<i>Celastrus orbiculatus</i>	0.2 culA		ErW	N	20	P, O	
<i>Cerasus mahaleb</i>		1 culB	Kn	N	20	P, K	
<i>Chaenomeles japonica</i>	0.4 culA		ErT	N	20	P, K	
<i>Chaenomeles speciosa</i>	0.4 culA		ErT	N	20	P, K	
<i>Chaenomeles ×superba</i>	0.4 culA		ErT	N	20	P, K	

Species	PC in Junikowo	PC in Miłos-towo	GH	LF	SE	Reason for intro-duction	Protected species
<i>Chamaecyparis lawsoniana</i>	1 culA	0.4 culA	ErT	M	20	P	
<i>Chamaecyparis nootkatensis</i>	0.4 culA	0.4 culA	ErT	M	20	P	
<i>Chamaecyparis obtusa</i>		0.4 culA	ErT	M	20	P	
<i>Chamaecyparis pisifera</i>	0.4 culA	0.4 culA	ErT	M	20	P	
<i>Clematis vitalba</i>	0.4		Kn	N	20	P, K, O	
<i>Cornus alba</i>	0.4 culA		ErW	N	20	P, L, O	
<i>Corylus avellana</i>	0.4	0.1	Sp	N	1	P	
<i>Crataegus monogyna</i>	1	1	Ap	N	1	–	
<i>Euonymus europaea</i>	0.4	0.4	Ap	N	1	–	
<i>Fagus sylvatica</i> ‘Purpurea’		0.4 culB	ErT	M	20	P, L	
<i>Forsythia</i> × <i>intermedia</i>	1 culA	1 culA	ErW	N	20	P, K	
<i>Frangula alnus</i>		0.4	Sp	N	6	–	
<i>Ginkgo biloba</i>		0.2 culB	ErT	M	20	P, L	
<i>Hedera helix</i>	1 culA	0.2 culA	Kn	Ch	1	P, L	
<i>Humulus lupulus</i>	0.4	1	Ap	H	7	–	
<i>Hydrangea macrophylla</i>		0.4 culB	ErW	N	20	P, K	
<i>Juglans regia</i>	0.2	0.1	Kn	M	20	–	
<i>Juniperus chinensis</i>	0.4 culA	0.4 culA	ErT	M	20	P	
<i>Juniperus communis</i>	0.4 culA	0.4 culA	Sp	N	5	P	
<i>Juniperus horizontalis</i>	0.4 culA	0.4 culA	ErT	N	20	P	
<i>Juniperus</i> × <i>pfitzerina</i>	0.4 culA	0.4 culA	ErT	N	20	P	
<i>Juniperus sabina</i>	0.4 culA	0.4 culA	HAp	N	20	P	
<i>Juniperus squamata</i>	1 culA	1 culA	ErT	N	20	P	
<i>Kalmia latifolia</i>	0.2 culB		ErT	N	20	P	
<i>Larix decidua</i>	0.2 culB		Ap	M	2	P, O	
<i>Laurocerasus officinalis</i>		0.2 culB	ErW	N	20	P, K	
<i>Ligustrum vulgare</i>	0.4 culA	0.4 culA	ErG	N	4	P, K, O	
<i>Lonicera xylosteum</i>	1 culA	1 culA	Ap	N	1	P, O	
<i>Magnolia</i> × <i>soulangeana</i>	0.2 culB		ErT	N	20	P, K	
<i>Mahonia aquifolia</i>	0.4 culA	0.2 culA	Kn	N	20	P, L, K, O	
<i>Padus avium</i>	0.4	0.2	Sp	M	1	–	
<i>Padus serotina</i>	0.4 culA		Kn	M	5	P, L, O	
<i>Parthenocissus quinquefolia</i>	0.4 culB		ErW	N	20	P, L	
<i>Philadelphus coronarius</i>	0.4 culA	0.1 culA	ErW	N	20	P, K	
<i>Physocarpus opulifolius</i>	1 culA	0.4 culA	ErW	N	20	P, L, O	
<i>Picea abies</i>	1 culA	0.4 culB	Kn	M	2	P	
<i>Picea glauca</i>	0.2 culB		ErT	M	20	P	
<i>Picea pungens</i>	0.2 culB	0.4 culB	ErT	M	20	P, L	
<i>Pieris japonica</i>	0.2 culB		ErT	N	20	P, L	
<i>Pinus mugo</i>	1 culA	0.4 culA	HAp	N	20	P	+
<i>Pinus ponderosa</i>	0.4 culB		ErT	M	20	P	
<i>Pinus</i> × <i>rhaetica</i>	0.4 culA	1 culA	ErW	M	20	P	
<i>Populus alba</i>		0.4	Ap	M	7	–	
<i>Populus nigra</i> ‘Italica’	0.4 culB		ErT	M	20	P	
<i>Populus tremula</i>	1	1	Ap	M	2	–	
<i>Potentilla fruticosa</i>		1 culA	ErW	N	20	P, K	
<i>Prunus cerasifera</i>	0.4	0.4	Kn	M	20	–	
<i>Prunus spinosa</i>	0.2	0.2	Ap	N	4	–	
<i>Pseudotsuga menziesii</i>		0.2	Kn	M	2	P	
<i>Pyracantha coccinea</i>	0.4 culA		ErW	N	20	P, K, O	
<i>Pyrus pyraster</i>	0.4		Kn	M	20	–	
<i>Quercus robur</i>	1		Ap	M	1	–	
<i>Quercus rubra</i>	0.4		Kn	M	2	–	
<i>Rhamnus cathartica</i>	0.4		Ap	N	1	–	
<i>Rhus typhina</i>	0.4 culB	0.2 culB	ErW	N	20	P, K	
<i>Ribes alpinum</i>	0.4 culA	0.1 culA	ErW	N	20	P, K	
<i>Robinia pseudoacacia</i>	1	0.4	Kn	M	14	–	

Species	PC in Junikowo	PC in Miłos-towo	GH	LF	SE	Reason for intro-duction	Protected species
<i>Rosa blanda</i>	0.2 culA		ErW	N	20	P, K	
<i>Rosa canina</i>	0.4	0.4	Ap	N	4	–	
<i>Rosa dumalis</i>	0.4		Ap	N	4	–	
<i>Rosa gallica</i>	0.4 culA		HAp	N	4	P, K	+
<i>Rosa glauca</i>	0.4 culA		ErW	N	20	P, K	
<i>Rosa multiflora</i>	0.4 culA	0.4 culA	Kn	N	20	P, K, O	
<i>Rosa rubiginosa</i>	0.2	0.4	Ap	N	4	–	
<i>Rosa rugosa</i>	0.4 culA		ErW	N	20	P, K, O	
<i>Rubus armeniacus</i>	0.2		Kn	N	20	–	
<i>Rubus plicatus</i>		0.4	Sp	N	2	–	
<i>Salix acutifolia</i>	0.4 culA		ErW	N	5	P	
<i>Salix caprea</i>	0.2 culB	0.1 culB	Ap	N	3	P, K	
<i>Salix matsudana</i>		0.1 culB	ErW	M	20	P	
<i>Salix purpurea</i>		0.2	Ap	N	7		
<i>Sambucus nigra</i>	0.4	0.1	Ap	N	3	–	
<i>Sarothamnus scoparius</i>		0.4	Kn	Ch	5	P, K	
<i>Sorbaria sorbifolia</i>	0.1 culA		ErW	N	20	P, L, K	
<i>Sorbus aucuparia</i>		1	Ap	M	2	P, O	
<i>Sorbus intermedia</i>		0.2 culA	Kn	M	20	P, O	
<i>Spiraea 'Arguta'</i>	0.2 culA		ErW	N	20	P, K	
<i>Spiraea chamaedrifolia</i>	0.4 culA	0.4 culA	ErW	N	20	P, K	
<i>Spiraea japonica</i>	0.2 culA		ErW	N	20	P, K	
<i>Spiraea vanhuteii</i>	1 culA	0.4 culA	ErW	N	20	P, K	
<i>Symphoricarpos albus</i>	1 culA	1 culA	ErW	N	20	P, O	
<i>Symphoricarpos orbiculatus</i>	0.4 culA		ErW	N	20	P, O	
<i>Syringa vulgaris</i>	1 culA	1 culA	ErW	N	20	P, K	
<i>Tamarix parviflora</i>	0.4 culB		ErW	N	20	P, K	
<i>Taxus baccata</i>	1 culA	1 culA	HAp	N	20	P, O	+
<i>Thuja occidentalis</i>	2 culA	2 culA	ErT	M	20	P, L	
<i>Thuja orientalis</i>	1 culA	1 culA	ErT	M	20	P, L	
<i>Thuja plicata</i>	1 culA		ErT	M	20	P, L	
<i>Viburnum opulus 'Plena'</i>	0.4 culA		ErT	N	20	P, K	
Herb layer							
<i>Acer platanoides</i>	0.4	0.2	Ap	M	1	–	
<i>Alchemilla mollis</i>	0.2 culB		ErW	H	20	P, L, K	
<i>Achillea filipendulina</i>	0.2 culB		ErW	H	20	P, K, L	
<i>Achillea millefolium</i>	0.4		Ap	H	9	–	
<i>Achillea pannonica</i>	0.4	0.2	Ap	H	4	–	
<i>Achillea ptarmica 'Plena'</i>	0.1 culA		ErW	H	20	P, K	
<i>Acinos arvensis</i>		0.4	Ap	T	5	–	
<i>Aegopodium podagraria</i>	0.2 culA	0.1 culA	Sp	H	1	P, L	
<i>Aegopodium podagraria 'Variegata'</i>	0.1 culB	0.1 culB	ErW	H	20	P, L	
<i>Ageratum houstonianum</i>	0.1 culB	0.1 culB	ErO	T	20	K	
<i>Agrimonia eupatoria</i>	0.4		Ap	H	4	–	
<i>Agropyron cristatum</i>	0.1 culB		Ef	H	20	D	
<i>Agrostis capillaris</i>	0.4	0.4	Ap	H	5	–	
<i>Agrostis gigantea</i>	0.2	0.2	Ap	H	8	–	
<i>Agrostis stolonifera</i>	0.1		Ap	H	10	–	
<i>Agrostis vinealis</i>	0.1		Sp	H	5	–	
<i>Ailanthus altissima</i>	0.1		Kn	M	20	–	
<i>Ajuga reptans 'Atropurpurea'</i>	0.1 culA	0.1 culA	ErW	H	20	P, L	
<i>Alcea rosea</i>	0.1 culB		ErG	H	20	K	
<i>Alliaria petiolata</i>	0.4	0.4	Ap	H	3	–	
<i>Allium moly</i>	0.1 culB		ErW	G	20	K	
<i>Allium vineale</i>	0.4	0.2	Ap	G	4	–	
<i>Alyssum saxatile</i>	0.2 culA	0.2 culA	HAp	H	20	P, K	
<i>Amaranthus caudatus</i>	0.2 culB		ErG	T	20	P, K	

Species	PC in Junikowo	PC in Miłos-towo	GH	LF	SE	Reason for intro- duction	Protected species
<i>Amaranthus chlorostachys</i>	0.1		Kn	T	16	–	
<i>Amaranthus paniculatus</i>		0.2 culB	ErG	T	20	P, K	
<i>Amaranthus retroflexus</i>	0.1	0.1	Kn	T	16	–	
<i>Anagallis arvensis</i>	0.1	0.1	Ar	T	16	–	
<i>Anaphalis margaritacea</i>	0.1 culB		ErW	H	20	P, K	
<i>Anchusa officinalis</i>	0.1	0.1	Ap	H	14	–	
<i>Anemone coronaria</i>		0.1 culB	ErO	H	20	K	
<i>Anemone sylvestris</i>	0.1 culA		HAp	H	4	K	+
<i>Antennaria dioica</i>	0.1 culB		Sp	H	5	P, K	
<i>Anthriscus sylvestris</i>	0.4	0.4	Ap	H	3	–	
<i>Antirrhinum majus</i>	0.1 culB		ErG	T	20	P, K	
<i>Apera spica-venti</i>	0.1	0.1	Ar	T	17	–	
<i>Aptenia cordifolia</i>	0.1 culB		ErO	H	20	P, K, L	
<i>Aquilegia vulgaris</i>	0.1 culA	0.2 culA	HAp	H	1	P, K	+
<i>Arabidopsis thaliana</i>	0.2	0.1	Ap	T	17	–	
<i>Arabis caucasica</i>	0.4 culA	0.1 culA	ErW	H	20	P, K	
<i>Arabis ferdinandi-coburgii</i>	0.1 culB		ErW	H	20	P, K	
<i>Arenaria serpyllifolia</i>	0.2	0.1	Ap	T	5	–	
<i>Argyranthemum frutescens</i>	0.1 culB	0.1 culB	ErO	H	20	P, K	
<i>Armeria elongata</i>	0.1 culA	0.1 culA	Ap	H	5	P, K	
<i>Arrhenatherum elatius</i>	0.2	0.1	Ap	H	9	–	
<i>Artemisia campestris</i>	0.2	0.2	Ap	H	5	–	
<i>Artemisia ludoviciana</i>	0.1 culB		ErW	H	20	P, L	
<i>Artemisia vulgaris</i>	0.4	0.2	Ap	H	13	–	
<i>Asarum europaeum</i>	0.1 culB		HAp	H	1	P, L	+
<i>Aster alpinus</i>	0.1 culB		HAp	H	20	K	
<i>Aster chinensis</i>		0.1 culB	ErO	T	20	K	
<i>Aster novae-angliae</i>		0.1 culA	Kn	H	20	P, K	
<i>Aster novi-belgii</i>	0.2 culA	0.2 culA	Kn	H	20	P, K	
<i>Asteriscus maritimus</i>	0.1 culB		ErO	H	20	K	
<i>Astilbe ×arendsii</i>	0.1 culB	0.1 culB	ErW	H	20	P, K	
<i>Astragalus cicer</i>		0.1	Ap	H	4	–	
<i>Astragalus glycyphyllos</i>	0.1	0.1	Ap	H	2	–	
<i>Atriplex patula</i>	0.4	0.2	Ap	T	16	–	
<i>Aubrieta ×cultorum</i>	0.2 culB	0.2 culB	ErW	H	20	P, K	
<i>Avenula pubescens</i>		0.2	Ap	H	9	–	
<i>Ballota nigra</i>	0.2	0.1	Ar	H	14	–	
<i>Begonia semperflorens</i>	1 culB	0.4 culB	ErO	T	20	K, L	
<i>Begonia ×tuberhybrida</i>	0.4 culB	0.2 culB	ErO	H	20	K, L	
<i>Bellis perennis</i> ‘Plena’	0.4 culB	0.4 culB	ErW	H	20	K	
<i>Bergenia cordifolia</i>	0.1 culA	0.2 culA	ErW	H	20	P, L, K	
<i>Berteroa incana</i>	0.4	0.2	Ap	T	14	–	
<i>Bidens ferulifolius</i>	0.1 culB	0.1 culB	ErO	T	20	P, K	
<i>Bidens frondosa</i>	0.1	0.2	Kn	T	12	–	
<i>Bromus carinatus</i>	0.1		Kn	H	10	–	
<i>Bromus hordaceus</i>	0.4	0.4	Ap	T	14	–	
<i>Bromus inermis</i>	1	1	Ap	H	14	–	
<i>Bromus sterilis</i>	0.4	0.2	Ar	T	3	–	
<i>Bromus tectorum</i>	0.4	0.2	Ar	T	15	–	
<i>Brunnera macrophylla</i>		0.1 culB	ErW	H	20	P, K, L	
<i>Calamagrostis epigejos</i>	0.4	0.4	Ap	G	2	–	
<i>Calendula officinalis</i>	0.1 culB		ErG	T	20	K	
<i>Calluna vulgaris</i>	0.4 culB	0.2 culB	Sp	Ch	5	P, K	
<i>Camelina microcarpa</i>	0.1		Ar	T	17	O, D	
<i>Camelina sativa</i>	0.1		Ar	T	17	O, D	
<i>Campanula carpatica</i>	0.4 culB	0.1 culB	ErG	H	20	P, K	
<i>Campanula glomerata</i>	0.1 culA		Ap	H	4	P, K	

Species	PC in Junikowo	PC in Miłostowo	GH	LF	SE	Reason for introduction	Protected species
<i>Campanula patula</i>		0.1	Ap	H	9	–	
<i>Campanula rapunculoides</i>	0.4 culA	0.1 culA	Ap	H	1	P, K	
<i>Canna indica</i>		0.1 culB	Er0	H	20	P, K, L	
<i>Cannabis sativa</i>		0.1	Kn	T	14	–	
<i>Capsella bursa-pastoris</i>	0.2	0.4	Ar	T	16	–	
<i>Cardamine hirsuta</i>	0.1	0.1	Ap	T	19	–	
<i>Cardaminopsis arenosa</i>	0.2	0.2	Ap	H	9	–	
<i>Carex hirta</i>	0.4	0.2	Ap	G	10	–	
<i>Carex praecox</i>	0.4	0.4	Ap	H	5	–	
<i>Celosia argentata</i>	0.1 culB	0.1 culB	Er0	T	20	K	
<i>Centaurea dealbata</i>	0.1 culA		ErW	H	20	P, K	
<i>Centaurea scabiosa</i>	0.1		Ap	H	4	–	
<i>Centaurea stoebe</i>	0.2	0.2	Ap	H	5	–	
<i>Cerastium arvense</i>	0.4	0.2	Ap	H	9	–	
<i>Cerastium bibersteinii</i>	0.4 culA	0.2 culA	ErW	H	20	P, K, L	
<i>Cerastium glomeratum</i>	0.1	0.1	Ap	H	19	–	
<i>Cerastium holosteoides</i>	0.1	0.1	Ap	H	9	–	
<i>Cerastium semidecandrum</i>	0.4	0.2	Ap	T	5	–	
<i>Chaerophyllum temulum</i>	0.4	0.4	Ap	T	3	–	
<i>Chelidonium majus</i>	0.4	0.2	Ap	H	3	–	
<i>Chenopodium album</i>	0.1	0.1	Ap	T	16	–	
<i>Chenopodium polyspermum</i>	0.1		Ap	T	12	–	
<i>Chenopodium strictum</i>	0.1	0.1	Kn	T	15	–	
<i>Chenopodium suecicum</i>	0.1		Ar	T	16	–	
<i>Chionodoxa forbesii</i>	0.1 culB		ErG	G	20	K	
<i>Chionodoxa lucillae</i>	0.1 culB		ErG	G	20	K	
<i>Chondrilla juncea</i>	0.2	0.1	Ap	H	5	–	
<i>Chrysanthemum ×grandiflorum</i>	0.1 culA	0.1 culA	ErW	H	20	P, K	
<i>Cichorium intybus</i>	0.1	0.1	Ar	H	14	–	
<i>Cirsium arvense</i>	0.1	0.1	Ap	G	13	–	
<i>Cirsium vulgare</i>	0.1		Ap	T	13	–	
<i>Clarkia amoena</i>	0.1 culB		Er0	T	20	K	
<i>Colchicum autumnale</i>	0.1 culB		HAp	G	9	K	+
<i>Coleus blumei</i>		0.1 culB	Er0	T	20	L	
<i>Consolida ajacis</i>	0.1 culA		ErG	T	20	K	
<i>Consolida orientalis</i>	0.1 culA		ErG	T	20	K	
<i>Convallaria majalis</i>	0.4 culA	0.2 culA	Sp	G	2	P, L, K	
<i>Convolvulus arvensis</i>	0.2	0.1	Ap	H	14	–	
<i>Conyza canadensis</i>	0.4	0.2	Kn	T	15	–	
<i>Coreopsis grandiflora</i>	0.1 culB		ErG	H	20	P, K	
<i>Corispermum leptopterum</i>		0.1	Kn	T	15	–	
<i>Corydalis solida</i>		0.1 culB	HAp	G	1	P	
<i>Corynephorus canescens</i>	0.1	0.4	Ap	H	5	–	
<i>Cosmos bipinnatus</i>		0.1 culB	ErG	T	20	K	
<i>Cotoneaster divaricatus</i>	0.1 culA	0.1 culA	ErT	N	20	P, O	
<i>Cotoneaster horizontalis</i>	0.1 culA	0.1 culA	ErT	N	20	P, O	
<i>Cotoneaster ×suecicus</i>	0.1 culA	0.1 culA	ErT	N	20	P, O	
<i>Crepis capillaris</i>		0.1	Ap	H	9	–	
<i>Crepis tectorum</i>	0.1	0.1	Ap	T	16	–	
<i>Crococsmia masoniorum</i>	0.1 culB		Er0	G	20	K	
<i>Crocus chrysanthus</i>	0.1 culB	0.1 culB	ErW	G	20	K	
<i>Crocus vernus</i>	0.1 culB	0.1 culB	ErW	G	20	K	
<i>Dactylis glomerata</i>	0.4	0.4	Ap	H	9	–	
<i>Dahlia ×hortensis</i>	0.1 culB	0.1 culB	Er0	H	20	P, K	
<i>Daucus carota</i>	0.4	0.1	Ap	H	9	–	
<i>Descurainia sophia</i>		0.1	Ar	T	16	–	
<i>Dianthus barbatus</i>	0.1 culA	0.1 culA	ErG	C	20	K	

Species	PC in Junikowo	PC in Miłos-towo	GH	LF	SE	Reason for intro-duction	Protected species
<i>Dianthus caryophyllus</i>		0.1 culB	Er0	H	20	K	
<i>Dianthus chinensis</i>	0.1 culB	0.1 culB	Er0	T	20	K	
<i>Dianthus gratianopolitanus</i>	0.1 culB		HAp	C	2	P, K	+
<i>Dicentra formosa</i>		0.1 culB	ErW	H	20	P, K	
<i>Digitaria ischaemum</i>	0.1	0.1	Ar	T	16	–	
<i>Digitaria sanguinalis</i>	0.1	0.2	Ar	T	15	–	
<i>Dimorphoteca sinuata</i>	0.1 culB		Er0	T	20	K	
<i>Diploxaxis muralis</i>	0.1	0.1	Kn	H	15	–	
<i>Diploxaxis muralis</i> × <i>D. tenuifolia</i>	0.1		KnXKn	H	15	–	
<i>Diploxaxis tenuifolia</i>	0.1		Kn	H	15	–	
<i>Dipsacus sylvestris</i>	0.1		ErG	H	20	K, D	
<i>Doronicum orientale</i>	0.1 culA	0.1 culA	ErW	H	20	P, K	
<i>Dorotheanthus bellidiformis</i>	0.1 culB		Er0	T	20	P, K	
<i>Dryopteris filix-mas</i>	0.1 culA	0.1 culA	Ap	H	2	P	
<i>Echinacea purpurea</i>	0.1 culB		ErW	H	20	K	
<i>Echinochloa crus-galli</i>	0.1		Ar	T	16	–	
<i>Echium vulgare</i>	0.1		Ap	T	14	–	
<i>Elymus repens</i>	0.2	0.1	Ap	G	10	–	
<i>Epilobium ciliatum</i>	0.1	0.1	Kn	H	12	–	
<i>Epipactis helleborine</i>		0.1	Ap	G	1	–	+
<i>Equisetum arvense</i>	0.4	0.2	Ap	G	16	–	
<i>Eragrostis albensis</i>	0.1		Kn	T	20	–	
<i>Eragrostis minor</i>	0.1	0.1	Kn	T	15	–	
<i>Eranthis hyemalis</i>	0.1 culB		ErG	G	20	K	
<i>Erica gracillis</i>	0.1 culB	0.1 culB	Er0	Ch	20	P, K	
<i>Erica tetralix</i>	0.1 culB		HAp	Ch	6	P, K	+
<i>Erigeron annuus</i>	0.1 culA	0.1 culA	Kn	T	13	K	
<i>Erigeron ramosus</i>	0.1 culA	0.1 culA	Kn	T	13	K	
<i>Erodium cicutarium</i>	0.1	0.1	Ap	T	16	–	
<i>Erophila verna</i>	0.1	0.1	Ap	T	5	–	
<i>Erysimum cheiranthoides</i>	0.1	0.1	Ap	T	16	–	
<i>Erysimum cheiri</i>	0.1 culB		ErG	C	20	K	
<i>Erysimum hieracifolium</i>	0.1		Ap	H	4	–	
<i>Eschscholzia californica</i>		0.1 culB	ErG	T	20	K	
<i>Euonymus fortunei</i>	0.2 culA	0.2 culA	ErW	N	20	P	
<i>Eupatorium cannabinum</i>	0.1		Sp	H	7	–	
<i>Eupatorium purpureum</i>	0.1 culB		ErW	H	20	P, K	
<i>Euphorbia cyparissias</i>	0.1 culA	0.4	Ap	H	4	P, K	
<i>Euphorbia marginata</i>	0.1 culB	0.1 culB	ErG	T	16	P, L	
<i>Euphorbia myrsinites</i>	0.1 culB		ErW	H	20	P	
<i>Fallopia convolvulus</i>	0.1	0.2	Ar	T	16	–	
<i>Fallopia dumetorum</i>	0.4	0.1	Ap	T	2	–	
<i>Festuca arundinacea</i>	0.1	0.1	Ap	H	10	–	
<i>Festuca cinerea</i>	0.1 culB	0.1 culB	ErW	H	20	P, L	
<i>Festuca pratensis</i>	0.4		Ap	H	9	–	
<i>Festuca rubra</i>	1	1	Ap	H	9	–	
<i>Festuca trachyphylla</i>	2	1	Ap	H	5	–	
<i>Ficaria verna</i>	1	1	Ap	G	1	–	
<i>Filago minima</i>		0.4	Ap	T	5	–	
<i>Fraxinus excelsior</i>	0.1		Ap	M	1	–	
<i>Fritillaria meleagris</i>	0.1 culB		HAp	G	8	K	+
<i>Gagea pratensis</i>	1	1	Ap	G	3	–	
<i>Gaillardia pulchella</i>	0.1 culB	0.1 culB	ErG	T	20	K	
<i>Galanthus nivalis</i>	0.4 culA	0.4 culA	HAp	G	1	K	+
<i>Galeobdolon argentatum</i>	0.2 culB		ErW	H	20	P, L	
<i>Galeopsis pubescens</i>		0.4	Ap	T	2	–	
<i>Galeopsis tetrahit</i>		0.1	Ap	T	2	–	

Species	PC in Junikowo	PC in Miłos-towo	GH	LF	SE	Reason for intro- duction	Protected species
<i>Galinsoga ciliata</i>	0.1	0.1	Kn	T	16	–	
<i>Galinsoga parviflora</i>	0.1	0.1	Kn	T	16	–	
<i>Galium aparine</i>	0.4	0.2	Ap	T	3	–	
<i>Galium mollugo</i>	0.4	0.2	Ap	H	9	–	
<i>Galium spurium</i>	0.2		Ar	T	17	–	
<i>Galium verum</i>	0.1	0.1	Ap	H	9	–	
<i>Gazania rigens</i>	0.1 culB		ErO	H	20	P, K	
<i>Geranium macrorrhizum</i>	0.2 culA		ErW	H	20	P, L, K	
<i>Geranium ×magnificum</i>	0.1 culB		ErW	H	20	P, K	
<i>Geranium molle</i>		0.1	Kn	T	14	–	
<i>Geranium pusillum</i>	0.1	0.1	Ar	T	16	–	
<i>Geranium pyreanicum</i>	0.1 culA		Kn	H	14	P, K	
<i>Geranium robertianum</i>	0.4	0.4	Ap	T	3	–	
<i>Geum coccineum</i>	0.1 culB	0.1 culB	ErW	H	20	P, K	
<i>Geum urbanum</i>	0.4	0.4	Ap	H	3	–	
<i>Gilia achilleifolia</i>	0.1 culB		ErG	T	20	K	
<i>Glechoma hederacea</i>	0.4	0.4	Ap	H	3	–	
<i>Glechoma hederacea</i> ‘Variegata’	0.1 culB	0.1 culB	ErW	H	20	P, L	
<i>Gladiolus ×hybridus</i>		0.1 culB	ErO	G	20	P, K	
<i>Gypsophila paniculata</i>	0.1 culB	0.1 culB	HAp	C	5	P, K	+
<i>Hebe ochracea</i>	0.1 culB		ErO	N	20	P, L	
<i>Hedera helix</i>	0.1 culA	0.1 culA	Kn	Ch	1	P, L	
<i>Helianthus tuberosus</i>	0.1 culA	0.2 culA	Kn	G	13	P, K	
<i>Helichrysum arenarium</i>	0.2	0.1	Ap	H	5	–	
<i>Heliopsis scabra</i>	0.1 culB	0.1 culB	ErW	H	20	P, K	
<i>Heliotropium arborescens</i>		0.1 culB	ErO	H	20	P, L, K	
<i>Helleborus niger</i>	0.1 culA		ErW	H	20	P, K	
<i>Hemerocallis flava</i>		0.1 culB	ErW	H	20	P, K	
<i>Hemerocallis fulva</i>	0.1 culA	0.1 culA	ErW	H	20	P, K	
<i>Hepatica nobilis</i>	0.1 culB		HAp	H	1	K, L	
<i>Heracleum sphondylium</i>	0.1	0.1	Ap	H	9	–	
<i>Herniaria glabra</i>		0.1	Ap	H	5	–	
<i>Heuchera ×brizoides</i>		0.1 culB	ErW	H	20	P, L	
<i>Heuchera micrantha</i>		0.1 culB	ErW	H	20	P, L	
<i>Hieracium murorum</i>		0.1	Sp	H	2	–	
<i>Hieracium pilosella</i>	0.2	0.4	Ap	H	5	–	
<i>Holosteum umbellatum</i>	0.1	0.1	Ap	T	5	–	
<i>Hordeum jubatum</i>		0.1 culB	ErG	T	20	K, D	
<i>Hosta fortunei</i>	0.1 culB		ErW	H	20	P, L	
<i>Hosta sieboldiana</i>	0.1 culB	0.1 culB	ErW	H	20	P, L	
<i>Hyacinthus orientalis</i>	0.1 culB	0.1 culB	ErW	G	20	K	
<i>Hypericum perforatum</i>	0.2	0.1	Ap	H	2	–	
<i>Hypochaeris radicata</i>	0.1	0.1	Ap	H	5	–	
<i>Iberis sempervirens</i>	0.1 culB	0.1 culB	ErW	Ch	20	P, K	
<i>Impatiens balsamina</i>		0.1 culB	ErG	T	20	K, O	
<i>Impatiens</i> ‘New Guinea’	0.1 culB	0.1 culB	ErO	T	20	P, K	
<i>Impatiens parviflora</i>	0.2	0.2	Kn	T	3	–	
<i>Iris germanica</i>	0.1 culA	0.1 culA	ErW	H	20	K	
<i>Iris sibirica</i>	0.1 culA	0.1 culA	HAp	H	8	P, K	+
<i>Jasione montana</i>	0.1	0.1	Ap	H	5	–	
<i>Jovibarba sobolifera</i>	0.1 culA	0.1 culA	HAp	H	5	P	+
<i>Knautia arvensis</i>	0.1	0.1	Ap	H	2	–	
<i>Kochia scoparia</i>	0.1 culB	0.1 culB	Kn	T	15	P	
<i>Lactuca serriola</i>	0.1	0.1	Ar	H	15	–	
<i>Lamium album</i>	0.1 culA	0.1 culA	Ar	H	3	P, K	
<i>Lamium purpureum</i>	0.1	0.1	Ar	T	16	–	
<i>Lampranthus aurantiacus</i>	0.1 culB		ErO	H	20	P, K	

Species	PC in Junikowo	PC in Miłos-towo	GH	LF	SE	Reason for intro- duction	Protected species
<i>Lapsana communis</i>	0.1		Ap	T	3		
<i>Lathyrus latifolius</i>		0.1 culB	HAp	H	4	P, K	+
<i>Lavandula angustifolia</i>	0.1 culB	0.1 culB	ErW	H	20	P, K	
<i>Lavatera trimestris</i>		0.1 culB	ErO	T	20	P, K	
<i>Leontodon autumnalis</i>	0.1	0.1	Ap	H	10	–	
<i>Leonurus cardiaca</i>		0.1	Ar	H	14	–	
<i>Lepidium densiflorum</i>	0.1	0.1	Kn	T	15	D	
<i>Lepidium ruderales</i>	0.2	0.1	Ar	T	15	–	
<i>Lepidium virginicum</i>		0.1	Kn	T	15	D	
<i>Leucium vernum</i>	0.1 culB		HAp	G	1	K	
<i>Leymus arenarius</i>	0.1 culA		Kn	G	5	P, K	
<i>Limonium sinuatum</i>	0.1 culB		ErW	H	20	P, K	
<i>Linaria vulgaris</i>	0.1	0.2	Ap	G	2	–	
<i>Lobelia erinus</i>	0.1 culB	0.1 culB	ErO	T	20	K	
<i>Lobularia maritima</i>	0.1 culB	0.2 culB	ErGi	T	20	K	
<i>Lolium perenne</i>	0.4	0.2	Ap	H	10	–	
<i>Lotus corniculatus</i>	0.1	0.1	Ap	H	9	–	
<i>Lunaria annua</i>	0.1 culA		ErG	H	20	K, O	
<i>Lupinus polyphyllus</i>	0.1 culA	0.1 culA	Kn	H	20	P, K	
<i>Lysimachia congestiflora</i>	0.1 culB		ErO	T	20	P, K	
<i>Lysimachia nummularia</i>	0.1 culA	0.1 culA	Ap	H	1	P, K	
<i>Matteucia struthiopteris</i>	0.2 culA	0.1 culA	HAp	H	1	P, L	+
<i>Matthiola incana</i>	0.1 culB		ErO	T	20	K	
<i>Medicago falcata</i>	0.1	0.1	Ap	H	4	–	
<i>Medicago lupulina</i>	0.1	0.1	Ap	H	9	–	
<i>Medicago sativa</i>	0.1	0.1	Kn	H	20	–	
<i>Medicago × varia</i>	0.1	0.1	KnxAp	H	10	–	
<i>Melandrium album</i>	0.1	0.1	Ap	H	14j	–	
<i>Melanopodium paludosum</i>	0.1 culB		ErO	T	20	K	
<i>Melilotus alba</i>	0.2	0.1	Ap	H	15	–	
<i>Melilotus officinalis</i>	0.1		Ap	H	15	–	
<i>Mirabilis jalapa</i>	0.1 culB		ErO	T	20	K	
<i>Molinia coerulea</i> ‘Variegata’		0.1 culB	ErW	H	20	P, L	
<i>Moluccella laevis</i>	0.1 culB		ErO	T	20	P, K	
<i>Myosotis sylvatica</i>	0.1 culA	0.1 culA	HAp	H	1	K	
<i>Muscari azureum</i>	0.1 culB		ErW	G	20	K	
<i>Muscari botryoides</i>	0.1 culA	0.1 culA	ErW	G	20	K	
<i>Muscari neglectum</i>		0.1 culA	ErW	G	20	K	
<i>Narcissus cyclamineus</i>	0.1 culB	0.1 culB	ErW	G	20	K	
<i>Narcissus poëticus</i>	0.1 culA	0.1 culA	ErW	G	20	K	
<i>Narcissus pseudonarcissus</i>	0.1 culB	0.1 culB	ErW	G	20	K	
<i>Nemophila menziesii</i>	0.1 culB		ErO	T	20	K	
<i>Nepeta × faassenii</i>	0.1 culB	0.1 culB	ErW	H	20	P, K	
<i>Nicotiana × sanderae</i>		0.1 culB	ErG	T	20	K	
<i>Nierembergia hippomanica</i>		0.1 culB	ErO	T	20	K	
<i>Nigella damascena</i>	0.1		ErG	T	20	O, D	
<i>Oenothera biennis</i>	0.2	0.2	Ap	H	14	–	
<i>Oenothera biennis</i> × <i>O. rubricaulis</i>		0.1	ApxAp	H	14	–	
<i>Oenothera fruticosa</i>	0.1 culA	0.1 culA	ErW	H	20	P, K	
<i>Oenothera missouriensis</i>	0.1 culB		ErW	H	20	P, K	
<i>Oenothera rubricaulis</i>		0.1	Ap	H	14	–	
<i>Omphalodes verna</i>		0.1 culA	ErW	H	20	P, K	
<i>Origanum vulgare</i>	0.1 culB	0.1 culB	Ap	H	2	P, L	
<i>Ornithogalum umbellatum</i>	0.2 culA	0.2 culA	Kn	G	20	P, K	
<i>Ostrospermum ecklonis</i>	0.1 culB		ErO	T	20	K	
<i>Oxalis corniculata</i>	0.1	0.1	Kn	H	16	–	
<i>Oxalis corniculata</i> × <i>O. dillenii</i>	0.1		Kn×Kn	H	16	–	

Species	PC in Junikowo	PC in Miłos-towo	GH	LF	SE	Reason for intro- duction	Protected species
<i>Oxalis dillenii</i>	0.1	0.1	Kn	H	16	–	
<i>Oxalis fontana</i>	0.1	0.1	Kn	G	16	–	
<i>Oxalis fontana</i> × <i>O. corniculata</i>		0.1	Kn×Kn	H	16	–	
<i>Oxalis tetraphylla</i>	0.1 culB	0.1 culB	ErO	H	20	L, K	
<i>Pachysandra terminalis</i>	0.1 culB	0.1 culB	ErW	Ch	20	P, L, K	
<i>Paeonia officinalis</i>	0.1 culA		ErW	H	20	P, K	
<i>Panicum virgatum</i>		0.1 culB	ErW	H	20	P, K	
<i>Papaver argemone</i>	0.1	0.1	Ar	T	17	–	
<i>Papaver dubium</i>	0.1	0.1	Ar	T	17	–	
<i>Papaver somniferum</i>	0.1		ErG	T	20	O, D	
<i>Papaver rhoeas</i>	0.2	0.1	Ar	T	17	–	
<i>Pelargonium peltatum</i>	0.1 culB	0.1 culB	ErO	H	20	P, K	
<i>Pelargonium zonale</i>	0.2 culB	0.1 culB	ErO	H	20	P, K	
<i>Pennisetum alopecuroides</i>	0.1 culB	0.1 culB	ErW	H	20	P, K	
<i>Petunia ×atkinsiana</i>	0.1 culB	0.1 culB	ErG	T	20	P, K	
<i>Phacelia campanularia</i>	0.1 culB		ErO	T	20	P, K	
<i>Phalaris arundinacea</i> 'Picta'	0.2 culB	0.2 culB	ErW	H	20	P, L	
<i>Phlox subulata</i>	0.2 culA	0.1 culA	ErW	H	20	P, K	
<i>Phragmites australis</i>	0.1		Ap	Hel	7	–	
<i>Picris hieracioides</i>	0.1	0.1	Ap	H	14	–	
<i>Pimpinella nigra</i>	0.1	0.1	Ap	H	9	–	
<i>Pimpinella saxifraga</i>	0.1	0.1	Ap	H	9	–	
<i>Plantago arenaria</i>	0.1	0.1	Ap	T	5	–	
<i>Plantago lanceolata</i>	0.1	0.1	Ap	H	10	–	
<i>Plantago major</i>	0.2	0.2	Ap	H	10	–	
<i>Platycodon grandiflorus</i>	0.1 culB	0.1 culB	ErW	H	20	K	
<i>Plectranthus forsteri</i>	0.1 culB		ErO	T	20	P, L	
<i>Poa annua</i>	0.2	0.2	Ap	T	19	–	
<i>Poa chaixii</i>	0.1 culB		HAp	H	1	P	
<i>Poa compressa</i>	0.1	0.1	Ap	H	14	–	
<i>Poa nemoralis</i>	0.4	0.2	Sp	H	2	–	
<i>Poa pratensis</i>	0.2	0.2	Ap	H	9	–	
<i>Poa subcaerulea</i>	0.1	0.1	Ap	H	10	–	
<i>Polemonium caeruleum</i>		0.1 culB	HAp	H	2	P, K	+
<i>Polygonatum multiflorum</i>	0.1 culA		HAp	G	1	P	
<i>Polygonum aviculare</i>	0.2	0.2	Ap	T	10	–	
<i>Polygonum bistorta</i>	0.1 culB		Sp	H	8	P, K	
<i>Polygonum persicaria</i>	0.1	0.1	Ap	T	16	–	
<i>Portulaca grandiflora</i>	0.1 culB		ErG	T	20	P, K	
<i>Portulaca oleracea</i>	0.1	0.1	Kn	T	15	–	
<i>Potentilla anserina</i>		0.1	Ap	H	10	–	
<i>Potentilla arenaria</i>	0.1	0.1	Ap	H	5	–	
<i>Potentilla argentea</i>	0.1	0.1	Ap	H	14	–	
<i>Potentilla collina</i>	0.1	0.1	Ap	H	4	–	
<i>Primula juliae</i>	0.1 culA	0.1 culA	ErW	H	20	P, K	
<i>Primula vulgaris</i>	0.1 culB	0.1 culB	ErG	H	2	P, K	
<i>Pteridium aquilinum</i>		0.2	Sp	G	2	–	
<i>Pulsatilla vulgaris</i>	0.1 culA	0.1 culA	ErG	H	20	K	
<i>Puschkinia scilloides</i>		0.1 culB	ErG	G	20	K	
<i>Quercus robur</i>	0.1	0.1	Ap	M	1	–	
<i>Quercus rubra</i>	0.1	0.1	Kn	M	2	–	
<i>Ranunculus acris</i>	0.1	0.1	Ap	H	9	–	
<i>Ranunculus asiaticus</i>	0.1 culB	0.1 culB	ErO	H	20	K	
<i>Ranunculus repens</i>	0.1	1	Ap	H	10	–	
<i>Ricinus communis</i>		0.1 culB	ErO	T	20	P, L, K	
<i>Robinia pseudoacacia</i>	0.1	0.1	Kn	M	14	–	
<i>Rosmarinus officinalis</i>		0.1 culB	ErW	N	20	P, K	

Species	PC in Junikowo	PC in Miłos-towo	GH	LF	SE	Reason for intro-duction	Protected species
<i>Rudbeckia hirta</i>	0.1 culB	0.1 culB	ErG	T	20	K	
<i>Rubus caesius</i>	0.2	0.2	Ap	Ch	13	–	
<i>Rumex acetosella</i>	0.1	0.1	Ap	G	5	–	
<i>Rumex crispus</i>	0.1	0.1	Ap	H	10	–	
<i>Rumex thysiflorus</i>	0.4	0.4	Ap	H	14	–	
<i>Sagina procumbens</i>	0.1	0.1	Ap	H	12	–	
<i>Salvia nemorosa</i>	0.1 culB		HAp	H	4	P, K	
<i>Salvia splendens</i>	0.1 culB	0.1 culB	ErO	T	20	K	
<i>Sanvitalia procumbens</i>	0.1 culB		ErO	T	20	P, K	
<i>Saponaria officinalis</i>	2 culA	0.2 culA	Ar	H	14	K	
<i>Saxifraga ×arendsii</i>	0.1 culA	0.1 culA	ErW	H	20	P, K	
<i>Scilla sibirica</i>	0.2 culA	0.2 culA	ErG	G	20	K	
<i>Scleranthus annuus</i>	0.1	0.1	Ar	T	17	–	
<i>Scleranthus perennis</i>		0.1	Ap	H	5	–	
<i>Sedum acre</i>	0.2	0.2	Ap	H	5	–	
<i>Sedum album</i>	0.2 culA	0.1 culA	ErW	H	20	P, K	
<i>Sedum middendorffianum</i>	0.1 culB	0.1 culB	ErW	H	20	P, K	
<i>Sedum reflexum</i>	0.2 culA	0.1 culA	Sp	H	5	P, K	
<i>Sedum sexangulare</i>	0.1	0.1	Sp	H	5	–	
<i>Sedum spectabile</i>	0.2 culA	0.2 culA	ErW	H	20	P, K	
<i>Sedum spurium</i>	0.4 culA	0.4 culA	ErW	H	20	P, K	
<i>Sempervivum tectorum</i>	0.1 culA	0.1 culA	ErW	H	20	P	
<i>Senecio cineraria</i>	0.1 culB	0.1 culB	ErO	T	20	L	
<i>Senecio jacobea</i>	0.1	0.1	Ap	H	4	–	
<i>Setaria glauca</i>	0.1	0.1	Ar	T	16	–	
<i>Setaria viridis</i>	0.2	0.2	Ar	T	16	–	
<i>Silene armeria</i>	0.1 culB		Kn	T	5	K	
<i>Silene glabra</i>		0.1	Sp	H	2	–	
<i>Silene nutans</i>		0.1	Sp	H	2	–	
<i>Silene vulgaris</i>	0.1	0.1	Ap	H	14	–	
<i>Sisymbrium loeselii</i>	0.1	0.2	Kn	T	15	–	
<i>Solidago canadensis</i>	1 culA	0.4 culA	Kn	H	13	K	
<i>Solidago gigantea</i>		0.2 culA	Kn	H	13	K	
<i>Sonchus asper</i>	0.1		Ar	T	16	–	
<i>Sonchus oleraceus</i>	0.2	0.2	Ar	T	16	–	
<i>Spergula arvensis</i>	0.1		Ar	T	16	–	
<i>Spergularia rubra</i>	0.1	0.2	Ap	T	5	–	
<i>Stachys bizantica</i>	0.1 culA	0.1 culA	ErW	H	20	P, L	
<i>Stellaria graminea</i>	0.1		Ap	H	2	–	
<i>Stellaria media</i>	0.4	0.4	Ap	T	16	–	
<i>Stellaria pallida</i>	1	1	Ap	T	16	–	
<i>Sutera cordata</i>	0.1 culB	0.1 culB	ErO	T	20	P, K	
<i>Tagetes erecta</i>	0.2 culB	0.2 culB	ErO	T	20	K	
<i>Tagetes patula</i>	0.1 culB	0.1 culB	ErO	T	20	K	
<i>Tagetes tenuifolia</i>	0.1 culB	0.1 culB	ErO	T	20	K	
<i>Tanacetum parthenium</i>		0.1 culA	ErG	H	20	K	
<i>Tanacetum vulgare</i>	0.1	0.1	Ap	H	13	–	
<i>Taraxacum officinale</i>	2	2	Ap	H	9	–	
<i>Thunbergia alata</i>	0.1 culB		ErO	H	20	P, K	
<i>Thymus praecox</i>		0.1 culB	HAp	Ch	4	P	
<i>Thymus serpyllum</i>	0.1 culB		Ap	Ch	5	P	
<i>Torilis japonica</i>	0.1	0.1	Ap	T	3	–	
<i>Tradescantia ×andersoniana</i>	0.1 culB		ErW	H	20	P, L	
<i>Tragopogon dubius</i>	0.1		Ap	H	14	–	
<i>Tragopogon orientalis</i>		0.1	Ap	H	4	–	
<i>Tragopogon pratensis</i>	0.1	0.1	Ap	H	9	–	
<i>Trifolium arvense</i>	0.2	0.1	Ap	T	5	–	

Species	PC in Junikowo	PC in Miłostowo	GH	LF	SE	Reason for introduction	Protected species
<i>Trifolium campestre</i>		0.1	Ap	T	9	–	
<i>Trifolium dubium</i>	0.1		Ap	T	9	–	
<i>Trifolium pratense</i>	0.2	0.2	Ap	H	9	–	
<i>Trifolium repens</i>	0.2	0.4	Ap	H	10	–	
<i>Trollius europaeus</i>	0.1 culB		HAp	H	8	P, K	
<i>Tropaeolum majus</i>	0.1 culB		Er0	T	20	P, K	
<i>Tropaeolum peregrinum</i>	0.1 culB		Er0	T	20	P, K	
<i>Tulipa gesneriana</i>	0.1 culA	0.1 culA	ErW	G	20	K	
<i>Tulipa tarda</i>	0.1culB	0.1 culB	ErW	G	20	K	
<i>Tussilago farfara</i>	0.1	0.2	Ap	H	10	–	
<i>Urtica dioica</i>	0.2	0.2	Ap	H	3	–	
<i>Verbascum lychnitis</i>		0.1	Ap	H	5	–	
<i>Verbascum phlomoides</i>	0.1		Ap	H	14	–	
<i>Verbascum thapsiforme</i>	0.1		Ap	H	14	–	
<i>Verbena ×hybrida</i>	0.1 culB	0.1 culB	Er0	H	20	K	
<i>Veronica agrestis</i>		0.1	Ar	T	16	–	
<i>Veronica arvensis</i>	0.1	0.1	Ar	T	17	–	
<i>Veronica chamaedrys</i>	0.2	0.2	Ap	H	9	–	
<i>Veronica hederifolia</i>	0.1	0.1	Kn	T	17	–	
<i>Veronica longifolia</i>	0.1 culB		Sp	H	8	–	
<i>Veronica opaca</i>		0.1	Ar	T	16	–	
<i>Veronica plicata</i>	0.1		Ar	T	16	–	
<i>Veronica spicata</i> subsp. <i>incana</i>	0.1 culB		ErW	H	20	P, K, L	
<i>Veronica sublobata</i>	1	1	Ap	T	3	–	
<i>Veronica triphyllos</i>	1	1	Ar	T	17	–	
<i>Vicia cassubica</i>		0.1	Sp	H	2	–	
<i>Vicia cracca</i>	0.2	0.1	Ap	H	8	–	
<i>Vicia dasycarpa</i>	0.1		Kn	T	14	–	
<i>Vicia lathyroides</i>	0.1	0.2	Sp	H	5	–	
<i>Vicia tenuifolia</i>	0.1		Sp	H	4	–	
<i>Vinca major</i>	0.1 culB		ErW	Ch	20	P, L, K	
<i>Vinca minor</i>	1 culA	1 culA	ErW	Ch	20	P, L, K	
<i>Viola arvensis</i>	1	1	Ar	T	17	–	
<i>Viola odorata</i>	0.4 culA	0.2culA	Kn	H	3	P, K	
<i>Viola ×witrockiana</i>	0.2 culB	0.2 culB	ErG	T	20	K	
<i>Waldsteinia ternata</i>	0.1 culB		ErW	H	20	P	
<i>Yucca filamentosa</i>	0.1 culB	0.2 culB	ErW	H	20	P, K	

PC (plant cover classes): 0.1 – <1%; 0.2 – 1–3%; 0.4 – 3–5%; 1 – 5–15%; 2 – 15–25%; 3 – 25–35%; 4 – 35–45%; 5 – 45–55%; 6 – 55–65%; 7 – 65–75%; 8 – 75–85%; 9 – 85–95%; 10 – 95–100%; culA – cultivated introduced before 2000; culB – cultivated introduced after 2000. GH (geographical-historical groups): Ap – apophytes; Sp – spontaneophytes; Ap/Sp – semi-synanthropic spontaneophytes; HAp – hemiapophytes; Ar – archaeophytes; Kn – kenophytes; Ef – ephemeroophytes; ErW – vegetatively spreading ergasiophytes; ErT – persistent non-spreading ergasiophytes; Er0 – non-wintering ergasiophytes; ErG (= ErFi) – generatively spreading ergasiophytes (= ergasiofigofity).

LF (life-forms): M – megaphanerophytes; N – nanophanerophytes; Ch – chamaephytes; G – geophytes; H – hemicryptophytes; Hel – helophytes; T – therophytes (annuals).

SE (socio-ecological 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 (*Quercionrobori-petraeae*; *Quercion petraeae*; *Epilobion*; *Nardetalia*); 3 – nitrophilous shrub or herb communities (*Sambuco-Salicion*; *Alliarion*); 4 – xerothermic herb or grassland communities (*Trifolio-Geranietaea*; *Festuco-Brometetaea*); 5 – pine forests or sandy grassland (*Dicrano-Pinion*; *Sedo-Scleranthetetaea*; *Corynephorretetaea*); 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*; *Potamogetonetetaea*; *Lemnetetaea*; *Utricularietetaea*); 8 – humid meadows and tall herb communities (*Molinietalia*); 9 – fresh and moderately humid meadows (*Arrhenatheretalia*); 10 – nitrophilous floodplains and treaded communities (*Plantaginetaea*); 11 – salt marshes and halophilous grasslands (*Thero-Salicornietetaea*; *Asteretetaea trifolium*); 12 – therophyte communities on wet and humid sites (*Bidentetetaea*; *Nanocyperion*); 13 – mesophilous communities of tall perennials (*Arction*); 14 – xerothermic; perennial ruderal communities (*Onopordon*); 15 – short-term; pioneer ruderal communities (*Sisymbriion*; *Eragrostion*); 16 – weed communities of gardens and root crop fields (*Polygono-Chenopodietaea*); 17 – weed communities of cereal fields (*Aperetalia*); 18 – epilithic communities (*Asplenietetaea*); 19 – other garden weed communities; *Poo-Oxalidetum corniculatae*; *Portulacetum oleraceae*; *Panicum-Eragrostietum*; 20 – species of unknown phytosociological affiliation.

Reason for introduction: P – plant habit; K – flowers or inflorescences; L – leaves; O – fruits; D – dried specimens (used in funeral wreaths).

“0.4”), and a hemicryptophyte (“0.4”). In Miłostowo this layer contained 11 megaphanerophytes (mostly “0.4”), 10 nanophanerophytes (also mostly “0.4”), a chamaephyte (“0.4”), and a hemicryptophyte (“1”; Table 6).

In the herb layer, group culA included primarily hemicryptophytes (46 in Junikowo and 40 in Miłostowo), mostly representing the lowest plant cover class (“0.1”). In both cemeteries, this layer contained also 4 nanophanerophytes (mostly plant cover class “0.1”), a herbaceous chamaephyte (also “0.1”), and 2 woody chamaephytes (representing classes “0.1” and “1”). Besides, 4 therophytes in Junikowo were recorded and 2 therophytes in Miłostowo, all of them representing the lowest plant cover class (Table 6).

Among recently introduced herbs (culB), hemicryptophytes are represented most numerous (60 in Junikowo and 40 in Miłostowo), followed by therophytes (41 and 31, respectively), both

mostly in the lowest plant cover class. In Junikowo the lowest plant cover class included 3 herbaceous chamaephytes, 6 woody chamaephytes, and a nanophanerophyte, while in Miłostowo, a herbaceous chamaephyte, 4 woody chamaephytes, and a nanophanerophyte. Additionally, in Junikowo a woody chamaephyte reached plant cover class “0.4”, and in Miłostowo “0.2” (Table 6).

Among spontaneous plants in the herb layer, very much like among culB plants, hemicryptophytes are represented most numerous (104 in Junikowo and 103 in Miłostowo), followed by therophytes (78 in Junikowo and 72 in Miłostowo), both mostly representing plant cover class “0.1”. Besides, in Junikowo this layer contains 6 megaphanerophytes (most of them in the lowest plant cover class “0.1”), a chamaephyte (“0.2”), and a helophyte (“0.1”), while in Miłostowo, 4 megaphanerophytes (mostly “0.1”) and a chamaephyte (“0.2”; Table 6).

Interestingly, the proportion of geophytes is relatively high (36 species in Junikowo and 31 in Miłostowo). Plants from this group can survive in unfavourable conditions thanks to deeply hidden buds, protected from drought and low temperature, which increases their chance to survive in well-kept cemeteries. This group comprises chiefly bulb plants flowering in spring, e.g. *Allium moly*, *Chionodoxa forbesii*, *Ch. lucillae*, *Colchicum autumnale* (flowering in autumn), *Corydalis solida*, *Crocus vernus*, *C. chrysanthus*, *Eranthis hyemalis*, *Fritillaria meleagris*, *Galanthus nivalis*, *Leucoium vernalis*, *Muscari azureum*, *M. botryoides*, *M. neglectum*, *Narcissus cyclamineus*, *N. poëticus*, *N. pseudonarcissus*, *Ornithogalum umbellatum*, *Puschkinia scilloides*, *Scilla sibirica*, *Tulipa gesneriana*, and *T. tarda*. Among geophytes recorded in Junikowo, 11 species were spontaneous, 10 were introduced before the year 2000, and 15 after 2000. In Miłostowo, those groups were represented by 13 spontaneous species, 9 species introduced earlier, and 9 species introduced after 2000. In both investigated cemeteries, geophytes were included primarily in the lowest plant cover class and either class “0.4” (in Junikowo) or “0.2” (in Miłostowo), but in each cemetery 2 spontaneous species represented plant cover class “1” (the highest one among geophytes; Table 6). Cultivated geophytes (culA and culB) were mostly in the lowest plant cover class in both cemeteries or in class “0.2” (in Miłostowo; Table 6).

Among the species recorded in this study, native ones (apophytes and spontaneophytes) account for about 40% of the total number of species in each cemetery (Table 4). In both cemeteries they were represented by the following planted herbs: *Aegopodium podagraria*, *Armeria elongata*, *Campanula rapunculoides*, *Dryopteris filix-mas*, *Lysimachia nummularia*, *Origanum vulgare*, and *Sedum reflexum*. An important group of native species are hemiapophytes (4.8% of the total number of taxa in Junikowo and 3.6% in Miłostowo).

Table 2. Numbers of species included in plant cover classes in communal cemeteries in Poznań, with subdivision into spontaneous species and cultivated ones introduced before 2000 (culA) and after 2000 (culB)

Plant cover class	Junikowo	Miłostowo
0.1	120	121
0.1 culA	46	42
0.1 culB	115	78
0.2	40	49
0.2 culA	16	19
0.2 culB	17	13
0.4	49	33
0.4 culA	44	23
0.4 culB	9	7
1	14	15
1 culA	32	19
1 culB	1	1
2	4	2
2 culA	9	6
2 culB	0	0
3	0	0
3 culA	0	3
3 culB	0	0
Total	516	430

Table 3. Numbers of species included in plant life-form categories in communal cemeteries in Poznań

LF	Junikowo	Miłostowo
M	61	50
N	65	45
Ch	13	13
C	4	2
G	36	31
H	212	184
Hel	1	0
T	124	105
Total	516	430

See Table 1 for explanation of abbreviations.

Table 4. Numbers of species included in geographical-historical groups in communal cemeteries in Poznań

GH	Junikowo	Miostowo
Sp	17	18
Ap	172	163
HAp	25	15
Ar	34	30
Kn	64	56
Ef	1	0
ErW	94	71
ErG	29	20
ErO	44	32
ErT	33	22
Ap × Ap	0	1
Kn × Ap	1	1
Kn × Kn	2	1
Total	516	430

See Table 1 for explanation of abbreviations.

Among alien plants, the largest number of species belonged to the group of ergasiophytes (178 species in Junikowo and 145 in Miostowo), followed by kenophytes (63 species in Junikowo and 54 in Miostowo). Four groups of ergasiophytes were distinguished: non-wintering ergasiophytes (ErO), persistent non-spreading ergasiophytes (ErT), vegetatively spreading ergasiophytes (ErW), and generatively spreading ergasiophytes (ErG). The third group (ErW) is the most numerous. Many kenophytes are present in both cemeteries: *Amaranthus retroflexus*, *Aster novi-belgii*, *Bidens frondosa*, *Chenopodium strictum*, *Conyza canadensis*, *Diplotaxis muralis*, *Epilobium ciliatum*, *Eragrostis minor*, *Erigeron annuus*, *E. ramosus*, *Galinsoga ciliata*, *G. parviflora*, *Helianthus tuberosus*, *Impatiens parviflora*, *Kochia scoparia*, *Lepidium densiflorum*, *Lupinus polyphyllus*, *Mahonia aquifolium*, *Ornithogalum umbellatum*, *Oxalis corniculata*, *O. dillenii*, *O. fontana*, *Portulaca oleracea*, *Prunus cerasifera*, *Rosa multiflora*, *Solidago canadensis*, *Veronica hederifolia* s.s., *Viola odorata*, and *Viscum album*.

In the tree layer, among the earlier introduced species (i.e. before the year 2000, culA) apophytes are the most numerous (12 in Junikowo and 10 in Miostowo). In the former cemetery, plant cover classes "1" and "2" included 6 species each, while in the latter cemetery, plant cover classes "1", "2", and "3" included 3 species each, and an apophyte represented class "0.4". Besides, in Junikowo 5 persistent non-spreading ergasiophytes, 2 kenophytes and a spontaneophyte represented plant cover class "0.4", whereas a persistent non-spreading ergasiophyte and 7 kenophytes reached class "1". In Miostowo, 3 kenophytes and 2 persistent non-spreading ergasiophytes reached plant cover class "1", while 2 kenophytes represented plant cover class "0.4" (Table 7). The tree layer included only one spontaneous species in Junikowo (apophyte, plant cover class "2"), while 2 in Miostowo (apophytes representing classes "0.4" and "2").

In Junikowo in the shrub layer, the group of earlier introduced species (culA) was composed of 21 vegetatively spreading ergasiophytes (mostly representing plant cover classes "0.4" and "1"), 16 persistent non-spreading ergasiophytes (mostly "0.4"), 6 kenophytes ("0.4" and "1"), 4 apophytes ("0.4" and "1"), 4 hemiapophytes ("0.4" and "1"), and a spontaneophyte ("0.4"). In Miostowo, this group consisted of 12 persistent non-spreading ergasiophytes (mostly "0.4"), 11 vegetatively spreading ergasiophytes (mostly "0.4" and "1"), 4 apophytes (mostly "1"), 4 kenophytes (mostly "0.2"), 3 hemiapophytes (mostly "0.4"), and a spontaneophyte ("0.4"; Table 7). In Junikowo in the shrub layer, the group of recently introduced species (culB) included 8 persistent non-spreading ergasiophytes (mostly class "0.2"), 2 apophytes ("0.2"), and 3 vegetatively spreading ergasiophytes ("0.4"). In Miostowo, this group comprised 4 persistent non-spreading ergasiophytes (mostly "0.4"), 4 vegetatively spreading ergasiophytes (mostly "0.2"), 2 kenophytes ("0.4" and "1"), an apophyte ("0.1"), and a spontaneophyte ("0.2") (Table 7).

Among spontaneous plants in the shrub layer, apophytes are the most numerous (14 in Junikowo and 13 in Miostowo), followed by kenophytes (9 and 6, respectively), mostly representing class "0.4", but 4 apophytes and 2 kenophytes reached class "1", while one apophyte was in class "2". In Miostowo, 5 apophytes, 4 kenophytes, and 2 spontaneophytes reached class "0.4", and 5 apophytes represented class "1" (Table 7).

In Junikowo in the herb layer, the group of earlier introduced species (culA) included 26 vegetatively spreading ergasiophytes (mostly class "0.1"), 11 kenophytes (mostly "0.1"), 10 apophytes (mostly "0.1" but one reached class "2"), 7 ergasiophytes (mostly "0.1"), 5 hemiapophytes (mostly "0.1" or "0.2"), 4 spontaneophytes (mostly "0.2"), 3 persistent non-spreading ergasiophytes ("0.1"), and an archaeophyte ("0.1"). In Miostowo, this group was composed of 23 vegetatively spreading ergasiophytes (mostly "0.1"), 11 kenophytes (mostly "0.1" or "0.2"), 8 apophytes (mostly "0.1"), 5 ergasiophytes (mostly "0.1"), 4 hemiapophytes (mostly "0.1"), 3 persistent non-spreading ergasiophytes ("0.1"), 3 spontaneophytes (mostly "0.1"), and an archaeophyte ("0.1"; Table 7).

Among recently introduced herbs (culB), the most numerous are non-wintering ergasiophytes (44 in Junikowo and 32 in Miostowo) and vegetatively spreading ergasiophytes (43 and 32, respectively). In Junikowo this group includes also 9 hemiapophytes, 19 ergasiophytes, 5 spontaneophytes, 4 apophytes, 2 kenophytes, and an ephemeroophyte, while in Miostowo, 15 ergasiophytes, 5 hemiapophytes, an apophyte, a kenophyte, and a spontaneophyte. Most of them were in the lowest plant cover class ("0.1").

Table 5. Numbers of species included in socio-ecological groups in communal cemeteries in Poznań

SE	Junikowo	Miostowo
1	37	31
2	28	29
3	21	20
4	19	14
5	38	38
6	1	1
7	4	4
8	7	3
9	24	24
10	16	15
11	0	0
12	4	3
13	9	9
14	24	23
15	16	15
16	33	29
17	13	10
18	0	0
19	3	3
20	219	159
Total	516	430

See Table 1 for explanation of abbreviations.

Class “0.4” included a non-wintering ergasiophyte and a vegetatively spreading ergasiophyte in both cemeteries, as well as an ergasiophyte and a spontaneophyte found in Junikowo. Only one non-wintering ergasiophyte in Junikowo reached plant cover class “1” (Table 7).

Among spontaneous species in the herb layer, apophytes are the most numerous (131 in Junikowo and 130 in Miostowo), followed by archaeophytes (31 and 28, respectively), and kenophytes (27 and 24, respectively). Most of them as well as spontaneophytes, all ergasiophytes (3 in Junikowo), Kn × Kn (2 in Junikowo and 1 in Miostowo), one Kn × Ap (in both cemeteries), and one Ap × Ap (in Miostowo) were in the lowest plant cover class. Plant cover class “1” included 6 apophytes and 2 archaeophytes in Junikowo as well as 8 apophytes and 2 archaeophytes in Miostowo. Two apophytes in Junikowo and one in Miostowo reached class “2” (Table 7).

Among socio-ecological groups, the largest number of species belong to the group with undefined phytosociological affiliation, which in Junikowo and Miostowo account for about 40% (Table 5), because all cultivated species were taken into account. Several groups are represented by about 30 species each: fertile deciduous forests and shrub communities, acidophilous oak forests, open oak forests, mixed coniferous forests and their substitute communities in cleared plots as well as pine forests and sandy grasslands, weed communities of gardens and root crop fields. About 20 species represented nitrophilous shrub communities and forest edges, xerothermic

grasslands and forest edge communities, fresh, moderately moist meadows, thermophilous, perennial ruderal communities, and short-term, pioneer ruderal communities.

Many interesting and rare native ornamentals were recorded in the studied cemeteries, e.g. *Alyssum saxatile*, *Aquilegia vulgaris*, *Asarum europaeum*, *Aster alpinus*, *Colchicum autumnale*, *Corydalis solida*, *Dianthus gratianopolitanus*, *Erica tetralix*, *Fritillaria meleagris*, *Galanthus nivalis*, *Gypsophila paniculata*, *Hepatica nobilis*, *Iris sibirica*, *Jovibarba sobolifera*, *Lathyrus latifolius*, *Leucoium vernum*, *Matteucia struthiopteris*, *Myosotis sylvatica*, *Poa chaixii*, *Polemonium coeruleum*, *Polygonatum multiflorum*, *Salvia nemorosa*, *Thymus praecox*, and *Trollius europaeus*. Their cultivation in cemeteries contributes to their protection *ex situ*.

In the cemeteries, species protected by law are another important group, comprising 19 species: *Anemone sylvestris*, *Aquilegia vulgaris*, *Asarum europaeum*, *Colchicum autumnale*, *Dianthus gratianopolitanus*, *Epipactis helleborine*, *Erica tetralix*, *Fritillaria meleagris*, *Galanthus nivalis*, *Gypsophila paniculata*, *Iris sibirica*, *Jovibarba sobolifera*, *Lathyrus latifolius*, *Matteucia struthiopteris*, *Pinus mugo*, *Polemonium coeruleum*, *Rosa gallica*, and *Taxus baccata*. Nearly all of them have been planted there, except for *Epipactis helleborine*, which appeared spontaneously in the cemetery in Miostowo.

Very unusual species planted recently in those cemeteries enrich the pre-existent groups of synanthropic plants. Some of them are overwintering ergasiophytes: *Achillea filipendulina*, *Allium moly*, *Anaphalis margaritacea*, *Arabis ferdinandi-coburgii*, *Artemisia ludoviciana*, *Brunnera macrophylla*, *Eupatorium purpureum*, *Euphorbia myrsinites*, *Geranium × magnificum*, *Geum coccineum*, *Limonium sinuatum*, *Muscari azureum*, *Panicum virgatum*, *Pennisetum alopecuroides*, *Platycodon grandiflorus*, *Sedum middendorffianum*, *Tulipa tarda*, *Waldsteinia ternata*; while others are non-wintering ergasiophytes: *Anemone coronaria*, *Aptenia cordifolia*, *Argyranthemum frutescens*, *Asteriscus maritimus*, *Bidens feruifolius*, *Clarkia amoena*, *Coleus blumei*, *Crocsmia masoniorum*, *Dimorphotheca sinuata*, *Dorotheanthus bellidiformis*, *Erica gracillis*, *Hebe ochracea*, *Heliotropium arborescens*, *Lampranthus aurantiacus*, *Lavatera trimes-tris*, *Lysimachia congestiflora*, *Melaniopodium paludosum*, *Mirabilis jalapa*, *Molucella laevis*, *Nemophila menziesii*, *Nierembergia lippomanica*, *Osteospermum ecklonis*, *Oxalis tetraphylla*, *Phacelia campanularia*, *Plectranthus forsteri*, *Ranunculus asiaticus*, *Ricinus communis*, *Salvia splendens*, *Sanvitalia procumbens*, *Sutera cordata*, *Thunbergia alata*, and *Tropaeolum peregrinum*.

Funeral herbaceous species in the studied communal cemeteries include:

- A. *Aegopodium podagraria* ‘Variegata’, *Ajuga reptans* ‘Atropurpurea’, *Amaranthus caudatus*, *A. paniculatus*, *Aster novae-angliae*, *A. novi-belgii*, *Aubrieta × cultorum*;

- B. *Begonia semperflorens*, *B. ×tuberhybrida*, *Bellis perennis* 'Plena', *Bergenia cordifolia*;
 C. *Calluna vulgaris*, *Celosia argentata*, *Cerastium bibersteinii*, *Chrysanthemum ×grandiflorum*, *Coleus blumei*, *Consolida ajacis*, *C. orientalis*, *Convallaria majalis*, *Cosmos bipinnatus*;
 D. *Dahlia ×hortensis*, *Dianthus chinensis*, *D. gratianopolitanus*, *Dipsacus sylvestris*;
 E. *Erica gracillis*, *E. tetralix*, *Euphorbia marginata*;
 F. *Festuca cinerea*;
 G. *Galanthus nivalis*, *Gazania rigens*, *Geum coccineum*, *Glechoma hederacea* 'Variegata';
 H. *Hebe ochracea*, *Hedera helix*, *Hemerocallis fulva*, *Hosta fortunei*, *H. sieboldiana*;
 I. *Impatiens* 'New Guinea', *Iris germanica*;
 J. *Jovibarba sobolifera*;
 K. *Kochia scoparia*;
 L. *Lavandula angustifolia*, *Lobelia erinus*, *Lysimachia nummularia*;
 M. *Matteucia struthiopteris*, *Myosotis sylvatica*;
 N. *Narcissus pseudonarcissus*;
 O. *Oenothera fruticosa*, *Ornithogalum umbellatum*;
 P. *Petunia ×atkinsiana*, *Phlox subulata*, *Polygonatum multiflorum*, *Primula juliae*, *P. vulgaris*;
 R. *Rudbeckia hirta*;
 S. *Saponaria officinalis*, *Saxifraga ×arendsii*, *Scilla sibirica*, *Sedum album*, *S. reflexum*, *S. spectabile*, *S. spurium*, *Sempervivum tectorum*, *Senecio cineraria*, *Stachys bizantica*, *Sutera cordata*;
 T. *Tagetes erecta*, *T. patula*, *T. tenuifolia*, *Tulipa gesneriana*;
 V. *Verbena ×hybrida*, *Vinca minor*, *Viola odorata*, *V. ×wittrockiana*.

A special group are plants self-sown from dried specimens used in funeral wreaths: *Agropyron cristatum*, *Camelina microcarpa*, *C. sativa*, *Dipsacus sylvestris*, *Lepidium densiflorum*, *Nigella damascena* and *Papaver somniferum*.

DISCUSSION

In 1843, an influential architect John Loudon wrote a book entitled „On the Laying Out, Planting and Management of Cemeteries, and on the Improvement of Churchyards”. He stated there that to enhance their sentimental character, cemeteries should be similar to parks and gardens. This contributed to the veneration of the dead. Cemeteries started to be perceived as gardens, parks, places for meditation, reminiscences, and reflections (KOLBUSZEWSKI 1996).

Comparisons of woody vegetation of cemeteries show that trees are present in all of them. Planted in lines along paths, they form characteristic alleys in cemeteries, e.g. composed of lindens (*Tilia cordata* and *T. platyphyllos*) in the communal cemetery in Olsztyn (STYPIŃSKI 1978), and of *Aesculus hippocastanum* in Koźmin (CZARNA 2001).

ZIELONKO (1973) distinguished two types of green areas of special use: accessible (open) and with limited access. He classified cemeteries as areas with limited access. Their importance for landscape is emphasized by NIEMIRSKI (1973): the cemeteries where the proportion of tall vegetation is high are important links in the system of urban green areas. Such extensive green areas undoubtedly affect the microclimate of urban districts, and can also play a remarkable visual role in urban landscape. A similar classification of green areas, with controlled accessibility, was used by ŁUKASIEWICZ & ŁUKASIEWICZ (2006). The cited authors noted the importance of well-planned communal cemeteries, where inhabitants of nearby housing estates frequently go for a walk.

Wrote that to enhance their sentimental character, cemeteries should be very much like parks and gardens. Cemeteries have started to be perceived as gardens, parks, places for meditation, reminiscences, and reflections (KOLBUSZEWSKI 1996).

Table 6. Numbers of plant species representing various life-forms in communal cemeteries in Poznań

		Tree layer					
LF	FC	Junikowo			Miłostowo		
		culA	culB	natural	culA	culB	natural
	0.2	0	0	0	2	0	0
	0.4	6	0	0	2	0	0
M	1	14	0	0	8	0	0
	2	6	0	0	3	0	0
	3	0	0	0	3	0	0
N	0.4	1	0	0	1	0	0
Ch	0.4	1	0	0	0	0	0
		Shrub layer					
LF	FC	Junikowo			Miłostowo		
		culA	culB	natural	culA	culB	natural
	0.1	0	0	0	0	1	1
	0.2	0	4	2	1	2	2
M	0.4	5	2	5	5	4	5
	1	4	0	5	2	0	3
	2	1	0	1	1	0	0

Herb layer							
LF	FC	Junikowo			Miłostowo		
		culA	culB	natural	culA	culB	natural
N	0.1	1	0	0	2	1	2
	0.2	4	4	3	1	2	2
	0.4	24	3	7	12	1	5
	1	11	0	1	8	1	1
	2	1	0	0	2	0	0
Ch	0.2	0	0	0	1	0	0
	0.4	0	0	0	0	0	4
	1	1	0	0	0	0	0
H	0.4	0	0	1	0	0	0
	1	0	0	0	0	0	1
M	0.1	0	0	0	0	0	1
	0.2	0	0	2	0	0	2
	0.4	0	0	5	0	0	5
	1	0	0	5	0	0	3
	2	0	0	1	0	0	0
N	0.1	3	1	0	3	1	2
	0.2	1	0	3	1	0	2
	0.4	0	0	7	0	0	5
	1	0	0	1	0	0	1
Ch	0.1	1	6	0	1	4	0
	0.2	0	0	0	0	1	0
	0.4	0	1	0	0	0	1
	1	1	0	0	1	0	0
C	0.1	1	3	0	1	1	0
	0.1	6	15	0	4	9	0
G	0.2	2	0	0	4	0	0
	0.4	2	0	0	1	0	0
	0.1	30	51	0	29	35	0
H	0.2	9	6	0	9	4	0
	0.4	5	3	1	2	1	0
	1	1	0	0	0	0	1
	2	1	0	0	0	0	0
T	0.1	4	37	0	4	26	0
	0.2	0	3	0	0	4	0
	0.4	0	0	0	0	1	0
	1	0	1	0	0	0	0

Table 7. Numbers of plant species representing various geographical-historical groups in communal cemeteries in Poznań

Tree layer							
GH	FC	Junikowo			Miłostowo		
		culA	culB	natural	culA	culB	natural
Sp	0.1	0	0	0	0	0	0
	0.2	0	0	0	0	0	0
	0.4	1	0	0	0	0	0
	0.4	0	0	0	1	0	0
Ap	1	6	0	0	3	0	0
	2	6	0	0	3	0	0
	3	0	0	0	3	0	0
Kn	0.2	0	0	0	1	0	0
	0.4	2	0	0	2	0	0
	1	7	0	0	3	0	0
ErT	0.2	0	0	0	1	0	0
	0.4	5	0	0	0	0	0
	1	1	0	0	2	0	0

Shrub layer							
GH	FC	Junikowo			Miłostowo		
		culA	culB	natural	culA	culB	natural
Sp	0.1	0	0	0	0	0	1
	0.2	0	0	0	0	1	1
	0.4	1	0	2	1	0	2
	1	0	0	0	1	1	1
Ap	0.2	0	2	2	0	0	2
	0.4	2	0	7	1	0	5
	1	2	0	4	2	0	5
HAp	2	0	0	1	0	0	0
	0.4	2	0	0	2	0	0
	1	2	0	0	1	0	0
Kn	0.1	0	0	0	0	0	1
	0.2	0	0	3	3	0	1
	0.4	4	0	4	1	1	4
ErW	1	2	0	2	0	1	0
	0.1	1	0	0	1	1	0
	0.2	4	0	0	0	2	0
	0.4	10	3	0	4	1	0
	1	6	0	0	5	0	0
ErT	2	0	0	0	1	0	0
	0.2	0	6	0	0	1	0
	0.4	10	2	0	8	3	0
	1	4	0	0	2	0	0
	2	2	0	0	2	0	0
Herb layer							
GH	FC	Junikowo			Miłostowo		
		culA	culB	natural	culA	culB	natural
Sp	0.1	1	4	5	2	0	5
	0.2	2	0	0	1	1	3
	0.4	1	1	1	0	0	0
	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
Ap	0.1	8	4	64	6	1	69
	0.2	0	0	27	2	0	32
	0.4	1	0	32	0	0	19
	1	0	0	6	0	0	8
	2	1	0	2	0	0	1
HAp	0.1	2	9	0	2	5	0
	0.2	2	0	0	1	0	0
	0.4	1	0	0	1	0	0
	1	0	0	0	0	0	0
Ar	2	0	0	0	0	0	0
	0.1	1	0	20	1	0	19
	0.2	0	0	7	0	0	6
	0.4	0	0	2	0	0	1
	1	0	0	2	0	0	2
Kn	2	0	0	0	0	0	0
	0.1	7	2	25	5	1	20
	0.2	2	0	1	5	0	4
	0.4	1	0	1	1	0	0
Ef	1	1	0	0	0	0	0
	2	0	0	0	0	0	0
	0.1	0	1	0	0	0	0
ErW	0.1	18	37	0	18	28	0
	0.2	5	5	0	4	3	0
	0.4	3	1	0	1	1	0
	1	0	0	0	0	0	0
	2	0	0	0	0	0	0

	0.1	5	16	3	3	12	0
	0.2	1	2	0	1	3	0
ErG	0.4	0	1	0	0	0	0
	1	1	0	0	1	0	0
	2	0	0	0	0	0	0
	0.1	0	40	0	0	29	0
ErO	0.2	0	2	0	0	2	0
	0.4	0	1	0	0	1	0
	1	0	1	0	0	0	0
	0.1	3	0	0	3	0	0
	0.2	0	0	0	0	0	0
ErT	0.4	0	0	0	0	0	0
	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
Ap × Ap	0.1	0	0	0	0	0	1
Kn × Ap	0.1	0	0	1	0	0	1
Kn × Kn	0.1	0	0	2	0	0	1

The best-kept graves, which attract attention, are located in central parts of both the studied communal cemeteries, namely near the main gates and near the cemetery chapels. On those graves, you can see living, sometimes unusual, rare plant species. It is noteworthy that many species with symbolic meanings are present. Till the 2nd World War, nearly exclusively symbolic plants were planted in cemeteries (CZARNA 2011) but currently the selection of plants is generally based on suitability for the local environmental conditions or on ornamental value.

In burial sites, some original elements of wildlife can be preserved, and this fact has been known for more than 100 years. However, little is known about long-term changes and effects of long-term methods of cemetery management on their flora (LÖKI et al. 2020). In the investigated cemeteries some protected species grew spontaneously, e.g. *Epipactis helleborine*, or were cultivated, e.g. *Anemone sylvestris*, *Aquilegia vulgaris*, *Asarum europaeum*, *Colchium autumnale*, *Crocus vernus*, *Dianthus gratianopolitanus*, *Fritilaria meleagris*.

In currently used cemeteries of Lublin and its environs, the greatest species diversity was observed in the largest and youngest one (TRZASKOWSKA & KARZMARZ 2013). Also in the communal cemeteries in Poznań the number of species is higher than in other cemeteries in this city (CZARNA 2005, 2016a,b, 2017b, CZARNA et al. 2011). The largest number of species (516) was recorded in the communal cemetery in Junikowo, and slightly smaller, in the cemetery in Miłostowo (430). In Junikowo, 29 species were found in the tree layer, 90 in the shrub layer, and 402 in the herb layer. Among the 430 species recorded in Miłostowo, 34 were in the tree layer, 109 in the shrub layer, and 287 in the herb layer (Table 1).

Very much like GRAF'S (1986) paper concerning 42 cemeteries in Berlin and their vascular flora, GALERA et al.'s (1993) study of 24 cemeteries in Warsaw, in comparison to the flora of the city, and a subsequent study (LISOWSKA et al. 1993) focused on

selected aspects of their site conditions. Those authors reported that the relatively high floristic richness is a symptom of synanthropization of the flora of cemeteries of left-bank Warsaw. Their flora was only slightly related to their location in the city. The flora is more strongly affected by the applied methods of management, reflected in the high share of ergasiophytes. Cemeteries can also be refugia of some native species. The cited authors noted that cemetery size is related to floristic richness. It is noteworthy that the shares of various plant life-forms in cemeteries were similar in Warsaw (GALERA et al. 1993) and Berlin (GRAF 1986).

Results of our study confirm the hypothesis that there are many annual species in the currently used cemeteries. Annuals in the studied communal cemeteries in Poznań account for about 24%. Their share is only slightly lower (19%) in rural cemeteries of Lower Silesia (DĘBICZ 2012). Research in all cemeteries in the town of Jarocin (CZARNA 2004) showed that in the cemeteries that are not used for burial any more, hemicryptophytes are the dominant life-form (62%, Jewish and Protestant cemeteries), while therophytes account for about 15% of the total number of species. In contrast, in the parish cemetery in Jarocin, hemicryptophytes account for 48% and therophytes for 30%, so the difference is smaller. In the communal cemetery in the same city, contributions of both groups are nearly the same, about 45%. In all the cemeteries of Lublin and its environs studied by TRZASKOWSKA & KARZMARZ (2013), the perennial hemicryptophytes are the dominant life-form (about 40% to 49%), while therophytes account for 23% to 29%. Also in cemeteries of left-bank Warsaw, perennials prevail (49%), while annuals account for 34% (GALERA et al. 1993). In Zakopane (CZARNA & PISKORZ 2005), the share of annuals reached 66% in the old cemetery and 31% in the new one, while perennials, for 28% and 67%, respectively. This is due to very frequent visits of tourists in the old cemetery, as its

paths are very strongly affected by trampling and consequently colonized by annuals. In contrast, the new cemetery is rarely visited by tourists and local inhabitants do not remove weeds from the vicinity of graves of their relatives, so that many perennials grow there.

Cemeteries are affected by specific human activities, resulting in a continuous supply of diaspores of cultivated plants and weeds. There are many sources of the diaspores: ornamentals planted in cemeteries, funeral wreaths, bunches of flowers, garden soil, sand, gravel, and stones brought to the cemeteries (PYŠEK 1987). In our study, many plant species derived from dry specimens used in funeral wreaths brought to the cemetery on All Saints' Day and All Souls' Day (which is a common tradition in Poland). *Lepidium virginicum* originated from live specimens used in wreaths, whereas bunches of flowers placed in vases were sources of *Erigeron annuus* and *E. ramosus*. Several species were accidentally introduced to both cemeteries with ornamentals, in garden soil: *Oxalis dilleni*, *O. corniculata*, *Cardamine hirsuta*, *Cerastium glomeratum*, and *Sagina procumbens*.

In Germany, where the art of decorating cemeteries has developed for many years, mainly ready-made projects are used for grave decoration, to achieve an optimum ornamental effect. In such projects, plants are carefully selected to form interesting, long-lasting, and aesthetic compositions. Many characteristics of the plants are taken into account, e.g. flower colour, flowering time, rate of spreading, but also duration of foliage, and life size and colour (FIEDER et al. 1988, BÖCKENHÜSER 1993, BOTT 1996). In the communal cemeteries in Poznań, mostly plants with ornamental flowers were found (198 taxa), or less commonly with decorative leaves (45 taxa), but also plants having both ornamental flowers and leaves (25 species). The great diversity of leaf shape, size, texture, and colour – allowing various, often contrasting colour compositions – suggests that they should be used more frequently. Especially some of the species in the herb layer deserve to be popularized, e.g. *Cotoneaster dammeri*, *Dryas octopetala*, *Euonymus fortunei*, *Fragaria chiloensis*, *Pachysandra terminalis*, *Vinca major*, and *Hedera helix* cultivars (DIPNER 1999, HEINRICH 1999, JAMES 1999a, b, DĘBICZ 2012). Among those species, only *Euonymus fortunei* is used more and more often in cemeteries and gardens, while the other species are recommended in Polish garden catalogues.

It is noteworthy that *Viola odorata* was earlier introduced to cultivation in manor parks (LATOWSKI & ZIELIŃSKI 2001), and later it spread to nearby forests. Currently it is planted, as confirmed by research in the communal cemeteries in Poznań. It seems that the initial places of occurrence of *Ornithogalum umbellatum* were cemeteries, parks, and gardens (NOWIŃSKA et al. 2016). From those habitats this species has spread to roadsides and thickets, where now it is frequent.

It is noteworthy that in six cemeteries transformed into parks in Poznań (CZARNA 2017b), the native species *Aegopodium podagraria* was found, as it had a symbolic meaning in the past (KOSSAK 2017). It was certainly planted in cemeteries as an ornamental groundcover plant. It was also recorded as its variegated cultivar ('Variegata') in both communal cemeteries in Poznań.

The presence of segetal communities *Poo-Oxalidetum corniculatae* Pass. 1966 (GRAF 1986) and the community with *Cardamine hirsute* (BALCERKIEWICZ & PAWLAK 2011) in both cemeteries is linked with continuous planting of plant material with the root ball on graves. Specificity of their fruits strongly dehiscent, which shed seeds germinating in nearly all seasons – results in the relatively high abundance of those species in the studied cemeteries. Also small patches of *Erigeronto-Bryetum* Balcerk. 2000 were observed in both cemeteries, with *Erigeron annuus* or *E. ramosus*.

In the communal cemeteries also patches of *Poo-Oxalidetum corniculatae* were observed, covering 100% of the area of some graves. From the aesthetic standpoint, such patches can be regarded as ornamental. This could be the initial aim of appearance of *Oxalis corniculata* in nurseries, but currently it is naturalized, self-sown between pots or in pots with earth and cultivated plants. That is why it is found in cemeteries, gardens, flower beds and lawns, and has become a nuisance weed among ornamental plants.

We observed a small contribution of species which spread from graves to paths, but do not spread to other sites: *Amaranthus paniculatus*, *Cosmos bipinnatus*, *Euphorbia marginata*, *Gaillardia pulchella*, *Gilia achilleifolia*, *Myosotis sylvatica*, *Nicotiana × sanderae*, *Puschkinia scilloides*, *Rudbeckia hirta*, *Sedum album*, *Silene armeria*, *Tanacetum parthenium*, and *Viola × wittrockiana*.

Results reported by BURNECKIENĖ (2007) indicate a great popularity of *Hosta* species and cultivars in currently used cemeteries in two Lithuanian cities. In the communal cemeteries in Poznań, only two species were noted: *Hosta fortunei* and *H. sieboldiana*.

In 10 cemeteries in the town of Daugavpils, the most common alien species were *Spiraea chamaedryfolia*, *Syringa vulgaris*, and *Euphorbia cyparissias* (RUTKOVSKA et al. 2011). In the communal cemeteries in Poznań, *Syringa vulgaris* was cultivated in both, but *Euphorbia cyparissias* was planted in only one of them, and in the other one it occurred spontaneously, while *Spiraea chamaedryfolia* was absent in both.

In currently used municipal cemeteries, alien species do not commonly escape from cultivation. However, urban cemeteries can become refugia of native species, which find shelter there (GALERA et al. 1993). On the one hand, the introduction of alien species is a positive phenomenon, increasing species diversity, but at the same time it can pose a threat to the native flora (ZISENIS 1998).

In eight park-like cemeteries in Poznań, studied earlier, 334 vascular plant species were recorded: 62 in the tree layer, 91 in the shrub layer, and 181 in the herb layer (CZARNA 2017b). In contrast, in the communal cemeteries in Poznań, a total of 603 species were found: 34 in the tree layer, 109 in the shrub layer, and 460 in the herb layer.

In the eight park-like cemeteries in Poznań, the vascular flora includes 173 taxa (51.8%) introduced into cultivation. Most of them are in the shrub layer (70 species, i.e. 20.9%). Plants with symbolic meanings include 52 species 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 (CZARNA 2017b).

Cultivated plants were very numerous in the cemeteries in Junikowo (44% of the total vascular flora, 289 species) and Miłostowo (38%, 211 species). The plants introduced to cultivation recently (culB), i.e. after the year 2000, included 142 taxa in Junikowo and 99 in Miłostowo. The cultivated plants introduced earlier (culA) were represented by 147 taxa in Junikowo and 112 in Miłostowo. In comparison, on the basis of research in rural cemeteries of Lower Silesia, 672 taxa of vascular plants were recorded, including 365 herbaceous and 307 woody ones (DĘBICZ 2012).

Because of the dynamic development of ornamental horticulture and importation of seeds of many alien plants, many native and naturalized ornamentals are no longer propagated; this applies especially to winter-hardy perennials.

Observations of the first author inspired her to formulate a general remark on decoration of graves, although no precise research on this topic was conducted. Certainly the graves that have an earth-filled part, pots or stone vases, are more "attractive" in respect of decoration than those composed only of tombstones. The earth-filled parts allow interesting decoration of graves.

SUMMARY AND CONCLUSIONS

Cultivation of ornamental plants in cemeteries markedly affects their spontaneous flora. Changes in grave management and plant selection are reflected both at the level of flora and plant communities.

Our results do not confirm the second hypothesis that the cemeteries are rich in species that have escaped from cultivation on graves. Only 13 such species were found among 350 species cultivated there: *Ailanthus altissima*, *Amaranthus paniculatus*, *Cosmos bipinnatus*, *Euphorbia marginata*, *Gaillardia pulchella*, *Gilia achileifolia*, *Myosotis sylvatica*, *Nicotiana × sanderae*, *Puschkinia scilloides*, *Rudbeckia hirta*, *Silene armeria*, and *Tanacetum parthenium*.

Interesting ergasiophytes (temporarily naturalized cultivated alien plants) recorded in the studied

cemeteries include: *Achillea filipendulina*, *Allium moly*, *Anaphallis margaritacea*, *Aptenia cordifolia*, *Arabis ferdinandi-coburgii*, *Argyranthemum frutescens*, *Artemisia ludoviciana*, *Asteriscus maritimus*, *Bidens feruifolius*, *Brunnera macrophylla*, *Clenica amoena*, *Coleus blumei*, *Crocsmia masonarium*, *Dimorphoteca sinuata*, *Dorotheanthus bellidiformis*, *Eupatorium purpureum*, *Euphorbia myrsinites*, *Geranium × magnificum*, *Geum coccineum*, *Hebe ochracea*, *Heliotropium arborescens*, *Lampranthus aurantiacus*, *Lavatera trimestris*, *Limonium sinuatum*, *Lysimachia congestifolia*, *Melaniopodium paludosum*, *Mirabilis jalapa*, *Molucella laevis*, *Muscari azureum*, *Nemophila menziesii*, *Nierembergia lippomanica*, *Osterospermum ecklonis*, *Oxalis tetraphylla*, *Panicum virgatum*, *Penistetum alopecuroides*, *Phacelia campanularia*, *Platocodon graniflorus*, *Plectranthus forsteri*, *Ranunculus asiaticus*, *Rycinus communis*, *Salvia splendens*, *Sanvitalia procumbens*, *Sedum middendorffianum*, *Sutera cordata*, *Thunbergia alata*, *Trapaeolum peregrinum*, *Tulipa tarda*, and *Waldsteinia ternata*.

The cemeteries are refuges of rare, threatened and protected species of native plants introduced to cultivation or occurring spontaneously. Most of them are used as ornamentals.

The studied communal cemeteries in Poznań play an important role in the cultural landscape of the Central Wielkopolska region not only for religious reasons but also as floristically valuable green areas.

REFERENCES

- AL-AKL N.M., KARAAAN E.N., AL-ZEIN M.S., ASSAAD S. (2018): The landscape of urban cemeteries in Beirut: Perceptions and preferences. *Urban Forestry and Urban Greening* 33: 66–74. <https://doi.org/10.1016/j.ufug.2018.04.011>
- BALCERKIEWICZ S., PAWLAK G. (2011): Ugrupowania chwastów w ozdobnych założeniach ogrodowych: nowe technologie – nowe zbiorowiska. *Ekologia i Technika* 19(3A): 49–59.
- BANIUKIEWICZ E. (1994): Pojęcie cmentarza. Działania konserwatorskie. *Studia i Materiały. Cmentarze* 1(4): 21–26.
- BIAŁOBOK S. (1985): Renowacja parków o skażonym środowisku. *Aura* 5: 8–10.
- BIAŁOBOK S. (1993): Dławisz na starych cmentarzach w okolicy Gorlic. *Rocznik Dendrologiczny* 41: 141–142.
- BOTT H. (1996): *Schöne Gräber – bepflanzen und pflegen*. Eugen Ulmer, Stuttgart.
- BOULY DES LESDAIN M. (1948): *Ecologie de quelques sites de Paris*. In: P. Lechevalier (ed.). *Encyclopédie biogéographique et écologique* 4: 1–88. Paul Lechevalier, Paris.
- BUCHHOLZ S., BLICK TH., HANNIG K., KOWARIK I., LEMKE A., OTTE V., SCHARON J., SCHÖNHOFER A., TEIGE T., VON DER LIPPE M., SEIT B. (2016): Biological richness of a large urban cemetery in Berlin. Results of

- a multi-taxon approach. *Biodiversity Data Journal* 4: e7057. <https://doi.org/10.3897/BDJ.4.e7057>
- BURNECKIENĖ I. (2007): Cemetery planting in Šiauliai Town (Lithuania). *Acta Biologica Universitatis Daugavpiliensis* 1: 46–53.
- CHMIEL J. (2006): Zróżnicowanie przestrzenne flory jako podstawa ochrony przyrody w krajobrazie rolniczym. *Prace Zakładu Taksonomii Roślin Uniwersytetu im. Adama Mickiewicza w Poznaniu* 14. Bogucki Wydawnictwo Naukowe, Poznań.
- CMENTARZ JUNIKOWO w Poznaniu – Wikipedia. http://pl.wikipedia.org/wiki/_na_Junikowie, dostęp: 5.02.2010.
- CMENTARZ MIŁOSTOWO w Poznaniu – Wikipedia. http://pl.wikipedia.org/wiki/Cmentarz_na_Miłostowie, dostęp: 5.02.2010.
- CZARNA A. (2001): Flora naczyniowa cmentarzy ewangelickich w Koźminie i Koźmińcu (Nizina Wielkopolska). *Roczniki Akademii Rolniczej w Poznaniu* 334, *Botanika* 4: 27–37.
- CZARNA A. (2004): Flora naczyniowa cmentarzy na terenie Jarocina. *Roczniki Akademii Rolniczej w Poznaniu* 363, *Botanika* 7: 33–45.
- CZARNA A. (2005): Flora naczyniowa starego cmentarza katolickiego na Świerczewie w Poznaniu. *Roczniki Naukowe Polskiego Towarzystwa Ochrony Przyrody „Salamandra”* 9: 61–76.
- CZARNA A. (2009): Rośliny naczyniowe środkowej Wielkopolski. Wydawnictwo Uniwersytetu Przyrodniczego w Poznaniu, Poznań.
- CZARNA A. (2011): Kulturowe rośliny naczyniowe Staromiejskiego Cmentarza Ewangelickiego we Wschowie. Muzeum Ziemi Wschowskiej, Wschowa.
- CZARNA A. (2016a): Vascular plant flora on Cytadela Cemeteries in Poznań. *Acta Agrobotanica* 69(4): 1–17.
- CZARNA A. (2016b): Vascular plants in the Cemetery of the Meritorious (Cmentarz Zasłużonych) in Poznań (Poland). *Annales Universitatis Mariae Curie-Skłodowska* 71(1): 59–73.
- CZARNA A. (2016c): Roses (*Rosa* spp.) in old cemeteries in the Wielkopolska region (W Poland). *Annales Universitatis Mariae Curie-Skłodowska* 71(1): 7–31.
- CZARNA A. (2017a): *Hedera helix* (Araliaceae) in old cemeteries in the Wielkopolska Region (in Poland). *Electronic Journal of Polish Agricultural Universities EJPAU* 20(3): #01.
- CZARNA A. (2017b): Vascular flora of old cemeteries transformed into parks in Poznań. *Steciana* 21(3): 115–125. <https://doi.org/10.12657/steciana.021.014>
- CZARNA A., ANTKOWIAK W. (2008): Vascular plants in the former old town evangelical cemetery in Wschowa (the Wielkopolska region). *Roczniki Akademii Rolniczej w Poznaniu* 387, *Botanika–Steciana* 12: 71–78.
- CZARNA A., NOWIŃSKA R. (2011): Vascular flora in cemeteries of the Roztocze Region and surrounding areas (South-East Poland). *Acta Agrobotanica* 64(2): 77–92.
- CZARNA A., PISKORZ R. (2005): Vascular flora of cemeteries in the town of Zakopane in the Tatra Mountains. *Roczniki Akademii Rolniczej w Poznaniu* 373, *Botanika–Steciana* 9: 47–58.
- CZARNA A., WOŹNICKA A., MAJ M., MOROZOWSKA M. (2011): Flora of vascular plants of selected Poznań cemeteries. *Acta Agrobotanica* 64(4): 123–140.
- DĘBICZ R. (2012): Zieleń cmentarzy w krajobrazie wsi Dolnego Śląska. Wydawnictwo Uniwersytetu Przyrodniczego we Wrocławiu, Wrocław.
- DIERSCHKE H. (1994): *Pflanzensoziologie Grundlagen und Methoden*. Eugen Ulmer, Stuttgart.
- DIPNER H. (1999): Pflanzung dem Grabmal angepasst. *Deutscher Gartenbau* 27: 18–20.
- ERHARDT W., GÖTZ E., BÖDEKER N., SEYBOID S. (2008): *Zander*. Eugen Ulmer, Stuttgart.
- FIEDLER A., JONGBAUER I., KERSTJENS K., SZUBERT I. (1988): *Zierpflanzenbau mit Staudengärtnerei Friedhofsgärtnerei*. Eugen Ulmer, Stuttgart: 217–254.
- FLAKOWA J. (1948): Materiały do planu zadrzewienia cmentarza w Junikowie. *Kronika Miasta Poznania* 21(4): 54–76.
- GALERA H., SUDNIK-WÓJCIKOWSKA B., LISOWSKA M. (1993): Flora cmentarzy lewobrzeżnej Warszawy na tle flory miasta. *Fragmenta Floristica et Geobotanica* 38(1): 237–261.
- GAWRYS W. (2008): *Słownik roślin zielnych łacińsko-polski*. Officina Botanica, Kraków.
- GRAF A. (1986): Flora und vegetation der Friedhöfe in Berlin (West) *Verhandlungen des Berliner Botanischen Vereins* 5: 1–211.
- HEINRICHS G. (1999): Frühling in Oberhausen. *Deutscher Gartenbau* 21: 15–18.
- HEWITT A. (2013): Revisiting Toby Price’s (1979) account of the native vegetation of Duck River and Rookwond Cemetery Western Sydney. *Cunninghamia* 13: 25–124.
- HUSSAIN F., HAMEE I., SHAH M., BADSHAH L., ULLAH R., DASTAGIR G. (2011): Graveyard reflect reminent vegetation of Tehsil Peshawar, Pakistan. *Pakistan Journal of Plant Sciences* 17(1): 55–63.
- JACKOWIAK B. (1990): Antropogeniczne przemiany flory roślin naczyniowych Poznania. Wydawnictwo Naukowe UAM, Poznań.
- JACKOWIAK B. (1993): Atlas of distribution of vascular plants in Poznań. Publications of the Department of Plant Taxonomy of the Adam Mickiewicz University in Poznań.
- JACKOWIAK B., CELKA Z., CHMIEL J., ŻUKOWSKI W. (2017): Checklist of the vascular flora of Wielkopolska (Poland): casual alien species. *Biodiversity Research and Conservation* 46: 35–55.

- JAMES C. (1999a): Ein Herz für Sommerblumen. *Deutscher Gartenbau* 31: 10.
- JAMES C. (1999b): Oberhausen mit Struktur. *Deutscher Gartenbau* 29: 28.
- JĘDRZEJKO K., WALUSIAK E. (2008). Charakterystyka florystyczno-fitosocjologiczna unikatowego stanowiska rzadkich i chronionych roślin naczyniowych w Lanckoronie (Pogórze Wielickie). *Fragmenta Floristica et Geobotanica Polonica* 15(2): 239–251.
- KOLBUSZEWSKI J. (1996): Cmentarze. Wydawnictwo Dolnośląskie, Wrocław.
- KOSSAK S. (2017): O ziołach i zwierzętach. Marginesy, Warszawa.
- KOWARIK I., BUCHHOLZ S., VON DER LIPPE M., SEITZ B. (2016.): Biodiversity functions of urban cemeteries: Evidence from one of the largest Jewish cemeteries in Europe. *Urban Forestry and Urban Greening* 19: 68–78. <https://doi.org/10.1016/j.ufug.2016.06.023>
- KRAWIECOWA A., ROSTAŃSKI K. (1972): Projekt usprawnienia klasyfikacji roślin synantropijnych. *Phytocoenosis* 3: 217–222.
- KUNICK W. (1990): Zur ökologischen Bedeutung der Friedhöfe. *Deutsche Friedhöfs Kultur (DFK)* 80 H: 286–290.
- LATOWSKI K., ZIELIŃSKI J. (2001): Parki wiejskie – wybrane zagadnienia geobotaniczne i kulturowe. In: M. Wojterska (ed.). *Szata roślinna Wielkopolski i Pojezierza Południowopomorskiego. Przewodnik sesji terenowych 52. Zjazdu PTB, 24–28 września 2001*. Bogucki Wydawnictwo Naukowe, Poznań: 291–304.
- LISOWSKA M., SUDNIK-WÓJCIKOWSKA B., GALERA H. (1994): Flora cmentarzy lewobrzeżnej Warszawy – wybrane aspekty analizy. *Fragmenta Floristica et Geobotanica, Polonica* 1: 19–31.
- LÖKI V., SCHMOTZER A., TAKÁCS A., SÜVEGES K., LOVAS-KISS A., LUKÁCS B.A., TÖKÖLYI J., ANDRÁS B., MOLNÁR A. (2020): The protected flora of long-established cemeteries in Hungary: Using historical maps in biodiversity conservation. *Ecology and Evolution* 10: 7497–7508. <https://doi.org/10.1002/ece3.6476/>
- LONDO G. (1976): The decimal scale for relevés of permanent quadrats. *Vegetatio* 33: 61–64.
- ŁUKASIEWICZ A., ŁUKASIEWICZ S. (2006): Rola i kształtowanie zieleni miejskiej. Scientific Publishing House of Adam Mickiewicz University, Poznań.
- MCBARRON E.J., BENSON D.H., DOHERTY M.D. (1988): The botany of old cemeteries. *Cunninghamia* 2: 97–105.
- MIREK Z., PIĘKOŚ-MIRKOWA H., ZAJĄC A., ZAJĄC M. (2002): Flowering plants and pteridophytes of Poland. A checklist. *Biodiversity of Poland*, vol. 1. W. Szafer Institute of Botany, Polish Academy of Science, Kraków.
- NAEGELI D., THELLUNG A. (1905): Die Flora des Kantons Zürich. I Teil. Die Ruderal – und Adventivflora des Kantons Zürich. *Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich* 50: 225–305.
- NIEMIRSKI W. (1973): Założenia programowe i normatywy techniczne projektowania. In: W. Niemirski (ed.). *Kształtowanie terenów zieleni*. Wyd. Arkady, Warszawa.
- NOWIŃSKA R., CZARNA A., CZEKALSKI M., MOROZOWSKA M. (2016): Vascular flora of Selected Palaces in the Wielkopolska Region. *Steciana* 20(3): 137–157. <https://doi.org/10.12657/steciana.020.016>
- NOWIŃSKA R., CZARNA A., KOZŁOWSKA M. (2020): Cemetery types and the biodiversity of vascular plants – a case study from south-eastern Poland. *Urban Forestry and Urban Greening* 49: 1–10. <https://doi.org/10.1016/j.ufug.2020.126599>
- OTVES C., ARSENE G.G., NEACȘU A. (2016): Species diversity of the plants found in the roman-catholic and orthodox cemeteries (from the Mehala Neighbourhood) and the heroes cemetery from Timisoara. *Research Journal of Agricultural Science* 48(2): 82–93.
- PYŠEK P. (1987): Floristisch- und Vegetationsverhältnisse des Zentralen Friedhofs in der Stadt Plezen. *Folia Musei rerum naturalium Bohemiae occidentalis – Botania* 25: 5–46.
- RAHMONOV O., JĘDRZEJKO K., MAJGIER R. (2010): The secondary succession in the area of abandoned cemeteries in northern Poland. In: M. Barančková, I. Krajčí, J. Kollár, I. Belčáková (eds). *Landscape ecology – methods applications and interdisciplinary approach*. Institute of Landscape Ecology, Slovak Academy of Sciences, Bratislava: 647–657.
- RAK J. (1998): Ogrody pamięci – dekorowanie grobów roślinami. Multico Oficyna Wydawnicza, Warszawa.
- ROJECKA N. (1932): Flora starego cmentarza karaimskiego w Trokach. *PTPN w Wilnie, Wydział Nauk Matematycznych i Przyrodniczych* 8: 1–11.
- ROSTAŃSKI K., SOWA R. (1986–1987): Alfabetyczny wykaz efemerofitów Polski. *Fragmenta Floristica et Geobotanica* 32–32(1–2): 151–205.
- ROZPORZĄDZENIE Ministra Środowiska z dnia 9 października 2014 r. w sprawie ochrony gatunkowej roślin. *Dz.U.* 2014, poz. 1409.
- RUTKOWSKA S., PUČKA I., NOVICKÁ I. (2011): Analysis of invasive flora in cemetery territories of the city of Daugavpils. *Environment. Technology. Resources. Proceeding of the 8th International Scientific and Practical Conference*. Vol. 11. Rēzeknes Augstskola, Rēzekne, RA Izdevniecība: 344–351.
- RUTKOWSKI L. (1998): Klucz do oznaczania roślin naczyniowych Polski niżowej. Wydawnictwo Naukowe PWN, Warszawa.

- SCIPIŃSKI J.T. (1989): Zieleń łódzkich cmentarzy. In: R. Olaczek, G. Ojrzyńska (eds). *W obronie zieleni miasta*. Wydawnictwo Uniwersytetu Łódzkiego, Łódź.
- STACHAK A., GRINN U. (1993): Drzewa i krzewy cmentarza centralnego Szczecina. *Zeszyty Naukowe Akademii Rolniczej w Szczecinie, Rolnictwo* 53(153): 11–27.
- STACHAK A., ZIELIŃSKI J. (1995): Drzewa i krzewy cmentarza w Szczecinie-Goleńcinie. *Zeszyty Naukowe Akademii Rolniczej w Szczecinie* 60(167): 97–101.
- STYPIŃSKI P. (1978): Drzewa i krzewy cmentarzy Olsztyna. *Rocznik Dendrologiczny* 31: 153–161.
- SUKOPP H. (1990): Freidhöfe. In: H. Sukopp (ed.). *Stadtökologie. Das Beispiel Berlin*. Dietrich Reimer Verlag, Berlin: 274–281.
- TOKARSKA-GUZIŁ B. (2005): The establishment and spread of alien plant species (kenophytes) in the flora of Poland. *Wydawnictwo Uniwersytetu Śląskiego, Katowice*.
- TRZASKOWSKA E., KARCZMARZ K. (2013): Spontaneous vascular flora of selected cemeteries in Lublin and the surrounding area. *Acta Agrobotanica* 66(2): 107–122.
- URBISZ A. (2012): Occurrence of temporarily-introduced alien plant species (ephemerophytes) in Poland – scale and assessment of the phenomenon. *Prace Naukowe Uniwersytetu Śląskiego w Katowicach* 2897: 1–200.
- WIELKA ENCYKLOPEDIA roślin. (1993). Muza S.A., Warszawa.
- WITTIG R., SUKOPP H., KLAUSNITZER B. (1993): Die ökologische Gliederung der Stadt. In: H. Sukopp, R. Wittig (eds). *Stadtökologie*. Springer, Stuttgart: 299–302.
- YILMAZA H., KUŞAKB B., AKKEMIKC U. (2018): The role of Aşyan Cemetery (İstanbul) as a green urban space from an ecological perspective and its importance in urban plant diversity. *Urban Forestry and Urban Greening* 33: 92–98. <https://doi.org/10.1016/j.ufug.2017.10.011>
- ZAJĄC A. (1979): Pochodzenie archeofitów występujących w Polsce. *Rozprawy Habilitacyjne Uniwersytetu Jagiellońskiego* 29: 1–213.
- ZAJĄC A., ZAJĄC M., TOKARSKA-GUZIŁ B. (1998): Kenophytes in the flora of Poland: list, status and origin. *Phytocoenosis* 10 (N.S.), Supplementum *Cartographiae Geobotanicae* 9: 107–116.
- ZAJĄC M., ZAJĄC A. (2014): Survival problems of archaeophytes in the Polish flora. *Biodiversity Research and Conservation* 35: 47–56. <https://doi.org/10.2478/biorc-2014-0015>
- ZARZYCKI K., TRZCIŃSKA-TACIK H., RÓŻAŃSKA W., SZELĄG Z., WOŁEK J., KORZENIAK U. (2002): Ecological indicator of vascular plants of Poland. *Władysław Szafer Institute of Botany, Polish Academy of Science, Kraków*.
- ZIELONKO A. (1973): Planowanie terenów zieleni. In: W. Niemirski (ed.). *Kształtowanie terenów zieleni*. Wydawnictwo Arkady, Warszawa.
- ZISENIS M. (1998): Secondary woodland on Nunhead Cemetery, London, UK. *Landschaftsentwicklung und Umweltforschung* 104: 73–79.