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DENDROFLORA OF OPALENICA

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ABSTRACT. The study presents the results of investigations on the current state of dendroflora in the town of Opalenica within its administrative limits. A total of 140 taxa were recorded, including 95 species and 45 varieties belonging to 67 genera and 33 families (Rosaceae being the most numerous). A vast majority of plants are alien species, of which over 57% are planted diaphytes. Over 59% are species, for which no natural or anthropogenic plant communities may be found in Poland and 27.8% species characteristic for fertile deciduous forests and shrub communities. Within the pool of trees and shrubs the biggest numbers are very rare species, which may be considered floristic curiosities of the town, e.g. *Chamaecyperis nootkatensis*, *Ginkgo biloba*, *Liriodendron tulipifera*, *Metasequoia glyptostroboides*, etc. The general condition of dendroflora is good. Currently three monuments of nature are found within the city limits and three specimens of *Salix* × *sepulcralis* 'Chrysocoma' reached the dimensions of monument trees.

KEY WORDS: dendroflora, trees, shrubs, Opalenica, Wielkopolska Region

INTRODUCTION

Opalenica is a town lying in the Opalenica Plain (52° 12' of northern latitude and 16° 25' of eastern longitude) in the south-western part of the Poznań Lakeland being part of the Wielkopolska-Kuyavia Lake District (Kondracki 2001). This plain occupies a vast area of ground moraine surrounded from the western side by Lwówek–Rakoniewice Embankment, from the northern side by a belt of Buszewko–Pniewy hummocks and from the eastern side by a gully of the Niepruszewo Lake. In the south, the plain borders with the edge of Obra valley (Macyra 1993).

Along the axis of Opalenica plain (being a flat syncline), there flows the Mogilnica river in the southern direction. There, we find a typical agricultural land with not very numerous forests and a high density of population (Kondracki 2001).

The geological structure of the plain consists of three basic landscape elements. The first one represents a ground moraine in the central and southern part of the Mogilnica river-basin built mainly of boulder clay or of sands with numerous rocks of different sizes. The second element is represented by terminal moraine in the northern part of the Mogilnica river-basin. It is created by a strongly differentiated rocky material such as sands, gravels and boulder clay. The third element consists of alluvial formations occurring in the river valley and its tributaries including peats, alluvial soils and river sands (Macyra 1993).

The climate of the Opalenica Plain, similarly as that of the total Wielkopolska represents a type of transitory climate formed under the influence of oceanic and continental air masses.

Soils of the Opalenica Plain belong to four soil types. In river valleys and stream valleys as well as on lower terrains, there occur peat soils developed from peats and characterized by a high water capacity. From boulder clay, there developed soils of black turf type which ages ago were overgrown by forests and actually they are agriculturally used. The western and northern parts of the Plain are occupied by brown soils which were created of decomposed forest litter. Until present, the majority of soils is overgrown by forest communities with the participation of beech, oak and hornbeam. The last type of encountered soils are podzolic soils which occupy the smallest area of the Opalenica Plain. They are distinguished by a poor vegetation and a high level of underground waters (Macyra 1993).

The objective of the present work was the presentation of an inventory of trees and shrubs of Opalenica and an attempt to show connections between the composition of dendroflora and different methods of urban area use.

MATERIAL AND METHODS

The presented studies covered the area of Opalenica town. Documentation material was collected during the vegetation season of 2005. The cartographic basis was the town map in 1 : 20 000 scale. The town area of 6.4 km^2 was divided into 179 squares (basic plots) (Fig. 1).

On the area of the town, six complexes of spatial use were separated defined as research grounds (Fig. 2)

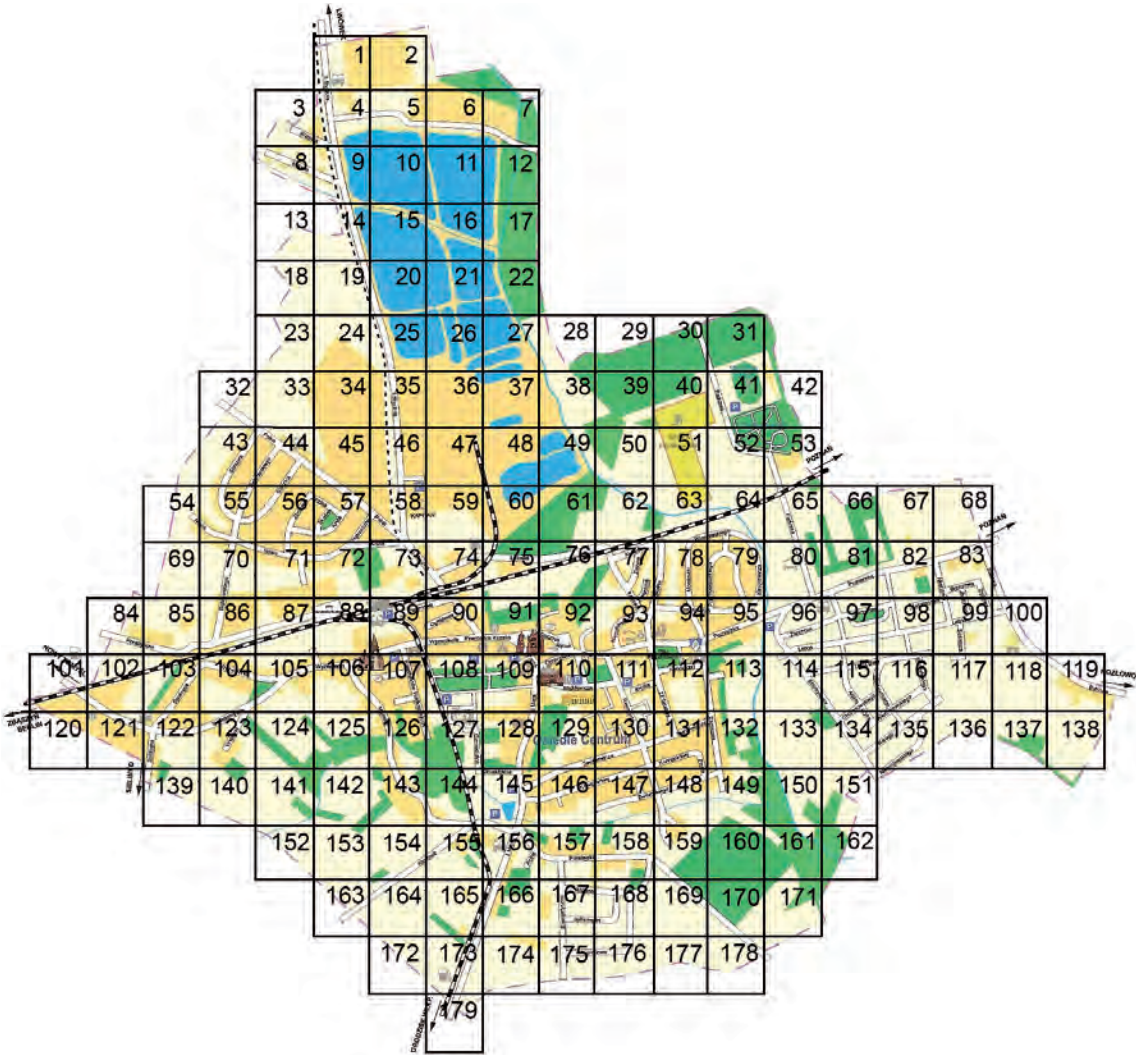

Fig. 1. Network of numbered basic plots against the background of Opalenica town map

whose localization and shape decide about the use of the area, the density of buildings distribution and their form (Jackowiak 1998).

Research ground PB1 – covers the oldest part of the town including a square market and fragments of streets branching out from it. Here, the oldest buildings are concentrated, they originated in the majority in the 19th century. The majority of buildings are situated with the longer wall facing the street, they are one-storey buildings built of brick and covered with roofing tiles. At streets branching out from the market, there are also two-storey buildings and the oldest one originated in 1860 (house no. 1, actually it is entered into the register of monumental buildings). The market is crossed along its diagonal line by a road leading in the directions: north-west – south-east. On both sides of this road, there are parking spaces surrounded by a rich set of trees supplemented by seasonal flower-bed plants. The western, northern and eastern walls of the market are planted with about 80-year old small-leaved lime-trees (*Tilia cordata*).

Research ground PB2 – it covers an area built over with multi-family houses. This area includes the following settlements: Centrum, Reymonta, Niegolewskich, houses at Mickiewicza, Spokojna and Poprzeczna streets. Housing blocks occur singly and they create walls consisting of two or less frequently three buildings connected with each other. Numerous free areas between the buildings are designed for play grounds for children, parks, alleys for walking or communication and parking spaces. These areas are characterized by a rich ornamentation with trees and shrubs.

Research ground PB3 – consists of green belts at street borders. These plantations refer particularly to the exit streets from the town. Buildings at the streets: Poznańska, Wyzwolenia and 3 Maja include in the majority ground-floor and one-storey houses. The street named 5 Stycznia street has no housing buildings at all (there is a sugar factory and along the street, there are sugar factory ponds). The green belts in the town along the streets include both trees and shrubs. There dominates the tendency to use trees which do not grow too high, with round tree crowns (new plantations) and the crowns of the older trees are also ball shaped. It is worthy of attention that there are frequent hedge plantations in two colours with *Berberis thunbergii* 'Atropurpurea' and 'Aurea', which connect by colour and form the tree plantations at roads leading out of the town. Older streets have no plantations of trees because of insufficient free space left there.

Research ground PB4 – it covers industrial complexes lying in the northern part of the town, at town

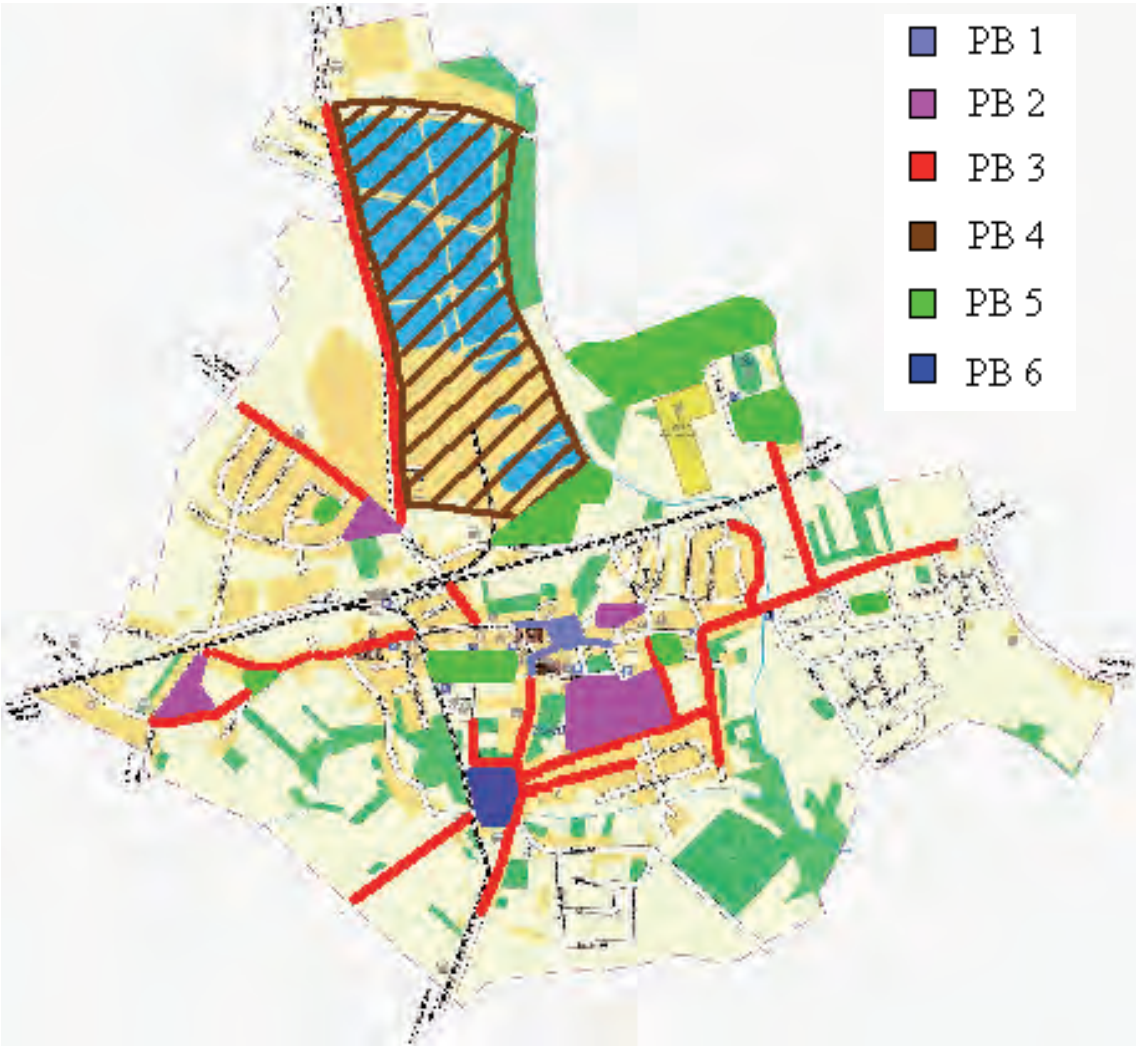

Fig. 2. Distribution of research grounds against the background of town map

outskirts. These areas include the terrain of the present sugar factory together with the ponds belonging to it which cover a significant part of this research ground. There dominate production objects and a significant part of hardened area designed for road traffic and for storage purposes. Practically, there are no trees and shrubs.

Research ground PB5 – it includes green areas for general access such as municipal park, squares and green areas, cemetery and allotment gardens. On the area of Opalenica, there are three allotment gardens, however, they are a private property of the town inhabitants and no research was carried out on them. The cemetery is localized in the centre of the town, while the squares and green areas are found at the following streets: Zarzecze, Wyzwolenia and Nowotomyska, Poznańska, Mickiewicza, Kręta and Skośna.

Research ground PB6 – it includes the zone at the liquidated pond in the southern part of the town, at the road leading in the direction of Grodzisk Wielkopolski. Originally, this terrain was covered by meadows and it started to be used for other purposes in the 1990-ies. At that time, a communication system was outlined connecting the market with Młyńska street (for this purpose, it was necessary to build two bridges permitting to cross a water course flowing to the pond) and new tree plantations were gradually introduced. Presently, the area is called 'Opalenica Plateau', it is a place where municipal picnics are celebrated every year. It is a rather vast terrain, neighbouring with a meadow, market and two streets: Młyńska and 3 Maja.

The dendroflora of Opalenica town has been characterized from the point of view of the participation of species groups distinguished by their historico-geographic origin, connections with formations and phytosociological plant units (the so called sociologico-ecological groups) and their place in the systematic system. The values of the mentioned features have been accepted after Chmiel (1993).

The names of trees and shrubs have been accepted according to the elaboration by Seneta and Dolatowski (2000) and Chojnowska (2003).

RESULTS

List of species and their localization

On the area of Opalenica, the occurrence of 95 species was found including one sub-species and two cultivars of trees and shrubs. Below, there is a list given in alphabetical order.

Explanations: 1, 2, 3, ..., 179 – numbers of squares; 110-113 – species recorded in the squares: 110, 111, 112, 113.

Spatial differentiation of dendroflora on the level of basic squares

The richness of Opalenica dendroflora referring to the basic squares is differentiated depending on the function and method of urban green areas use.

On the area of the town, there is the greatest number of terrains poor in dendroflora, where one can find up to five tree and shrub species in one square. They include industrial areas as well as streets where one- or two-species plantations are used, or where are no plantations at all. Medium rich areas (21-30 species in one square) include the oldest part of the town (the market), J. Piłsudski square, as well as plantations at the exit streets leading in the direction of Grodzisk Wielkopolski and Poznań. The richest in species are housing estates and in particular in the Centre and in Reymonta (31-40 tree species and shrubs in one square) as well as on the terrains at the pond and in the square at Wyzwolenia street (more than 41 species in one square).

Such great number of squares poor in vegetation (Table 1) is connected with the fact that dendrological researches were carried out only on the terrains of municipal green belt without the consideration of private housing estates in the town.

Table 1. Richness of dendroflora at the level of basic squares

Category	Number of species in a square	Number of squares	Percentage
Very poor	0-5	139	78
Poor	6-10	11	6
Moderately poor	11-20	8	5
Moderately rich	21-30	11	6
Rich	31-40	5	3
Very rich	> 41	4	2

Similarities and differences in the dendroflora on research grounds

The greatest reaches of species was found in the green areas of housing estates (PB2), espacially in the two biggest ones: Reymonta and in the Centre. There occur 64 taxa of trees and shrubs and 21 varieties (Table 2).

Table 2. Comparison of research grounds regarding the differentiation of taxa number, tree and shrub varieties

Research plot	Number of taxa	Number of varieties	Number of total trees and shrubs
PB 1	17	6	694
PB 2	64	21	4 103
PB 3	40	11	4 125
PB 4	3	1	48
PB 5	61	37	3 438
PB 6	36	16	519

There dominate the following tree plantations: *Ligustrum vulgare* (19% of all plants in one research ground), *Spiraea* × *vanhouttei* (12%), *Forsythia* × *intermedia* (10%). Among trees, the greatest is the participation of: *Fraxinus excelsior* (2.5%), *Tilia platyphyllos* and *Betula pendula* (1.5% each). The majority of plants occurring here are distinguished by decorative flowers, leaves or habit and they are species commonly met on housing estates.

On the terrain of green areas generally accessible (PB5), there occur 61 taxa of trees and shrubs. Most numerously represented is *Tilia platyphyllos* occurring primarily on the cemetery (making 5.2% of the total plantations in one research ground). The main species creating the afforestation of the municipal park include: *Acer platanoides*, *Fagus sylvatica*, *Fraxinus excelsior* and *Crataegus monogyna*. On the area of the research ground, there occur also numerous hedges with *Buxus sempervirens* and *Ligustrum vulgare*. These areas distinguish themselves by the greatest riches of varieties and it is exactly there where the greatest number of new ornamental forms are introduced (for example, *Fagus sylvatica* 'Purpurea Tricolor') and species not encountered so far in Opalenica (like e.g. *Liriodendron tulipifera* or *Ginkgo biloba*).

The green areas at the pond (PB6) are characterized by rich plantations. Diversity of species and ornamental varieties have appeared on this area comparatively recently. There occur 36 taxa and 15 varieties of trees and shrubs. Most numerously are represented: *Berberis thunbergii* 'Atropurpurea' (making 20% of all plantations in one research ground), *Forsythia* × *intermedia* (over 12%), *Acer platanoides* 'Globosum' (7%), *Taxodium distichum* (3%) and *Salix* × *sepulcralis* 'Erythroflexuosa' (3%).

Green belts at town streets (PB3) are represented by 40 taxa and 11 varieties. The richest are the plantations along the streets: Poznańska, 3 Maja and 5 Stycznia, where the dominating ones include: *Picea pungens*, *Malus sieversii* 'Niedzwetzkyana' and *Prunus cerasifera* 'Nigra', as well as shrubs from *Juniperus* genus. Congeneric plantations along streets are created by: *Acer platanoides* 'Globosum', *Robinia pseudoacacia* 'Umbraculifera', *Sorbus intermedia* and *Tilia cordata*. Many streets are still not bordered with trees, particularly in the centre of the town. On the other hand, the majority of streets developed in housing estates of one-family houses requires first of all the making of roads and pavements.

Tree plantations in the oldest part of the town (PB1) include the market and its adjoining streeets. There occur 17 taxa and six varieties. The most frequent ones include: *Ligustrum vulgare* (57% of all plants in the research ground), *Berberis thunbergii* 'Atropurpurea' (over 8%), *Rosa rugosa* (5%), *Crataegus* × *media* 'Paul's Scarlett' (4%), *Tilia cordata* (3%) and *Juniperus communis* 'Hibernica' (3%).

The poorest is the area of industrial plants (PB4). It is represented only by three taxa: *Populus* × *canadensis*, *Populus nigra* 'Italica' and *Corylus avellana* (Table 2). It is compensated by rich borders of tree belts along the streets at the ponds of sugar plant factory and in front of the building of the factory (counted to research ground PB3). Studies in this research ground were difficult because the production area of the factory constitutes a closed terrain.

Participation of geographico-historical groups

On the area of the town, anthropophytes make 73.6% (70 species), which confirms anew this general regularity occurring in synantropic floras and also in reference to dendroflora (Klimko et al. 2004). Particularly great is the participation of diaphytes which include the majority of trees and shrubs (55 species making 57.9% of the total pool of anthropophytes) (Fig. 3). To this group belong also among others all species of the genera *Cotoneaster*, *Berberis* and *Juniperus*. Among the planted species, the most frequent are: *Symphoricarpos orbiculatus*, *Spiraea japonica*, *Picea pungens* and *Abies concolor*.

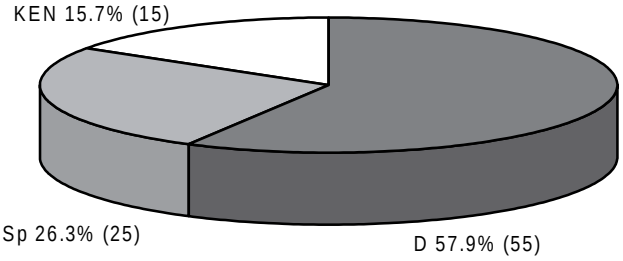

Fig. 3. Percentage participation of geographico-historical groups in Opalenica dendroflora

Native species (apophytes and spontaneophytes) make over 26% of dendroflora. Foreign species (diaphytes, kenophytes) originate mainly from Northern America and Asia.

Analysing the particular research grounds, one can state that in the majority of them, similarly as in reference to the whole area of studies, there dominate man-planted species.

A tendency to domesticate foreign species in preference of the native ones is visible in each research ground with the exception of green areas generally accessible (PB5), which are dominated by species counted to spontaneophytes: *Acer platanoides*, *Acer pseudoplatanus*, *Fagus sylvatica*, *Quercus robur*, *Fraxinus excelsior* or *Tilia cordata*. On the other hand, the greatest number of native species on the commonly accessible green areas are met in the municipal park as well as on the area of the cemetery.

It is worthy to note that native species dominate in older plantations, while at present, the newly planted plants include the ornamental forms of these species. In Opalenica, this tendency is visible, particularly in plants on street borders (for example *Acer platanoides* 'Globosum'), and also on the areas of generally accessible greens.

Sociologico-ecological grups of species

Among all tree and shrub species occurring on the area of Opalenica, the greatest participation, over 59.3%, is shown by taxa of foreign origin, among others: *Sorbus intermedia*, *Aesculus hippocastanum* and *Cotoneaster horizontalis*, for which there is no other place in the country which would indicate a similar differentiation of vegetation (Fig. 4). In the second place, there are species typical of deciduous forests. They make 27.8% of the whole pool of species. In Opalenica town, there occur five skirt species (they make 5.8%): *Rosa rugosa*, *Salix caprea*, *Salix viminalis*, *Sambucus nigra* and *Sarothamnus scoparius*. Wood species make 3.5%, while ruderal species show 1.2% each (*Robinia pseudoacacia*), species of sandy meadows (*Hippophaë rhamnoides*) and waterside and marsh species (*Salix alba)*.

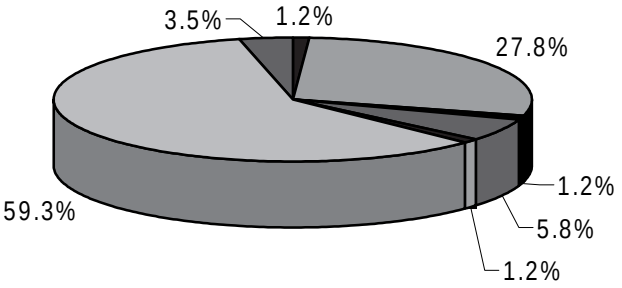

Fig. 4. Percentage participation of sociologico-ecological groups in Opalenica dendroflora

The differentiation in the particular research grounds is presented below. The greatest participation of deciduous forest species occurs on green areas at street borders (PB3). These species make over 24% of the total number of species in the research ground and they include: *Acer platanoides*, *Acer negundo*, *Fraxinus excelsior*, *Betula pendula* and *Quercus rubra*. Over 17% of deciduous forest species occurs in the oldest part of the town (PB1) and on the green areas generally accessible (PB5), where the most frequently encountered species include: *Ligustrum vulgare* and *Tilia cordata*. Deciduous forest species make almost 80% of the total number of plants occurring in the municipal park.

The greatest number of wood species occurs among the greens of housing estates and the green areas generally accessible (PB2 and PB5). They include: *Picea abies*, *Larix decidua* and *Laburnum anagyroides*.

Skirt species occur in each research ground (with the exception of the greens on the area of industrial plants), however, their greatest participation was recorded on the areas of housing estates (PB2) and at the pond (PB6). There occur: *Sambucus nigra*, *Rosa rugosa*, *Salix caprea*, *Salix viminalis* and *Sarothamnus scoparius*.

Ruderal species are represented only by *Robinia pseudoacacia* occurring most numerously on the generally accessible green areas (PB5) and on housing estates (PB2). Many splendid trees of this species were cut out (before this research started) because of the danger they created for people and vehicles.

Hippophaë rhamnoides counted to the species of sandy meadows is met on the terrain of multifamily houses (PB2), while *Salix alba* – the representative of waterside and marsh species – are found among the generally accessible greens (PB5).

Species groups in systematic arrangement

In the dendroflora of Opalenica town, there are species belonging to 33 families. Gymnospermous plants are represented by 30 species belonging to five families, making 31.6% of dendroflora. Most frequent among them are the representatives of Pinaceae family (15 species) and Cupressaceae family (10 species). Angiospermous plants are represented by 65 species belonging to 28 families. The richest in species are the following families: Rosaceae (21 species), Salicaceae (eight species);

the families: Araceae, Oleaceae and Caprifoliaceae have five species each, Fabiaceae family (four species). In the studied pool of plants, l6 families were found which are represented by one species. Trees and shrubs of Opalenica can be grouped within 67 genera. The richest are the following genera: *Juniperus* (7), *Pinus* (5), *Acer* (5), *Salix* (4); *Picea*, *Prunus* and *Symphoricarpos* genera are represented by three species each.

Nature monuments on the area of Opalenica

On the area of Opalenica town, there occur trees recognized as nature monuments. The first one is represented by a 12-year old sessile oak "Mateusz Oak". It is 20 m high with 592 cm circumference. It grows on the right hand of the road from Opalenica to Kozłowo, about 500 m from the highroad Opalenica–Poznań. It was acknowledged as a nature monument in 1979 (Dz. Urz. Woj. RN No. 5 of 10.06.1979). Today, it does not have any information plate and its drying branches are a testimony of its deteriorating health.

Two other trees represent common oaks with 394 cm and 310 cm circumferences and 20 and 22 m height respectively. They grow on plot no. 118 at Rynek street 16 in Opalenica. They were acknowledged as nature monuments in 1995 (Dz. Urz. Woj. Poz. No. 1 of 20.01.1995).

Nature monuments occur numerously on the area of Opalenica commune, among others in Urbanowo, Rudniki and Porażyn.

On the area of Opalenica, there occur three trees which reached monumental dimensions. They are *Salix* × *sepulcralis* 'Chrysocoma' growing on J. Piłsudski Square.

Their circumferences measured at breast height are: 3.27 m; 3.70 m and 4.13 m, respectively.

Species (and their ornamental forms) in the flora of trees and shrubs of Opalenica town

The richness of dendroflora at the level of basic squares and research grounds is connected mainly with the presence of 345 ornamental plants. A significant number of ornamental species is present in the generally accessible green areas and in housing estates as well as at the pond; the least number is found in PB1 including the market. Below, there is a list of the particular cultivars (explanations as on page 4):

Acer platanoides 'Crimson King' – 57, 122, 145
Acer platanoides 'Globosum' – 90, 94, 108, 113, 122, 127, 128, 145
Berberis thunbergii 'Atropurpurea' – 35, 58, 89, 92-94, 96, 103, 105, 110, 111, 122, 130, 145
Berberis thunbergii 'Aurea' – 89, 94, 95, 105, 106
Betula pendula 'Youngii' – 58, 94, 105, 108, 110
Cornus alba 'Sibirica' – 103, 122
Crataegus × *media* 'Paul's Scarlet' – 90, 91, 110
Euonymus fortunei 'Emerald'n Gold' – 58, 105, 111
Fagus sylvatica 'Pendula' – 145
Fagus sylvatica 'Purpurea Pendula' – 110
Fagus sylvatica 'Purpurea Tricolor' – 105
Fraxinus excelsior 'Heterophylla Pendula' – 105
Fraxinus excelsior 'Pendula' – 41, 105
Fraxinus excelsior 'Simplicifolia laciniata' – 145
Fraxinus pennsylvanica 'Aucubaefolia' – 145
Juniperus chinensis 'Variegata' – 58, 111
Juniperus communis 'Hibernica' – 74, 89, 92, 94, 110, 111, 130
Juniperus × *pfitzeriana* 'Old Gold' – 105
Juniperus sabina 'Tamariscifolia' – 58, 94, 96, 108, 110
Juniperus squamata 'Meyeri' – 94, 110
Juniperus virginiana 'Skyrocket' – 94, 103, 110, 111, 130, 156
Larix kaempferi 'Pendula' – 110
Malus sieversii 'Niedzwetzkyana' – 4, 9, 14, 20, 81, 82, 93, 96, 108, 111, 130, 156, 166
Physocarpus opulifolius 'Luteus' – 57, 103, 145, 156, 166
Picea glauca 'Compacta' – 105
Picea glauca 'Conica' – 110
Pinus mugo 'Mops' – 105
Populus nigra 'Italica' – 42, 88, 129
Prunus cerasifera 'Atropurpurea' – 4, 9, 14, 20, 80, 81, 92-94, 96, 105, 108-111, 130, 145, 156, 166
Prunus × *eminens* 'Umbraculifera' – 72, 73, 145
Pyracantha coccinea 'Orange Glow' – 89, 93, 108, 110, 111, 127, 130, 145
Pyracantha coccinea 'Solieil d'Or' – 89, 93, 105, 108, 110, 111, 127, 130, 145
Quercus robur 'Fastigiata' – 110
Robinia pseudoacacia 'Umbraculifera' – 57, 94, 105, 106, 109, 110, 112, 122, 123, 145
Salix babylonica 'Tortuosa' – 9, 20, 93
Salix integra 'Hakuro Nishiki' – 108, 145
Salix × *sepulcralis* 'Chrysocoma' – 75, 94, 96, 103, 108, 110-112, 130
Salix × *sepulcralis* 'Erythroflexuosa' – 58, 130, 145
Sorbus aucuparia 'Pendula' – 92, 93, 96, 110, 111, 130, 145
Spiraea japonica 'Golden Princess' – 105
Syringa vulgaris 'Maluch' – 97, 105
Taxus baccata 'Elegantissima' – 92, 93, 94
Thuja occidentalis 'Ellwangeriana Aurea' – 105
Tilia 'Euchlora' – 45, 95, 103, 122, 145
Ulmus 'Dampieri' – 110

CONCLUSIONS

1. On the area of Opalenica, there occur 140 taxa (95 species) and 45 tree and shrub varieties belonging to 33 families and 67 genera. The most numerous families include: Rosaceae (212 species) and Pinaceae (15 species). Genera most rich in species include: *Juniperus* (7), *Pinus* (5), *Acer* (5), *Salix* (4) and *Picea*, *Tilia*, *Abies*, *Symphoricarpos* (three species each).

2. Among native anglospermous trees, the most frequent ones include: *Tilia cordata, Fraxinus excelsior, Betula pendula, Acer platanoides* and *Acer pseudoplatanus*. Introduced anglospermous trees include: *Robinia pseudoacacia*, *Populus* × *canadensis* and *Aescullus hippocastanum*.

3. In the dendroflora of Opalenica, 59% consist of species which cannot be classified to any definite plant communities of Poland. They include primarily ornamental species planted by man. From the remaining ecological groups, the most frequently represented is a group of deciduous forest species. It makes almost 28% of all species. The greatest agglomeration of species characteristic of deciduous forests occurs on the area

of municipal park (almost 80%). Besides, these species occur rather numerously on the green belts on street borders (24% of all species) and in the oldest part of Opalenica town and on generally accessible green areas (17% each).

4. Species of trees and shrubs are unevenly distributed on the area of the town. There dominate areas which are very poor in dendroflora (they include areas of industrial plants as well as the majority of streets without trees planted on street borders) which results from the fact that private possessions of the inhabitants have not been covered by these studies.

5. Areas distinguished by the riches of taxa include housing estates, green areas of general access and areas at the pond. It is exactly there where the greatest number of new varieties can be found. In the oldest part of the town, there occurs every year a new plantation of trees (in the belt dividing the roadway and in containers hanging on street lanterns).

6. It was found that there is a significant majority of angiospermous plants. The gymno-spermous plants make 31.6%. Among them, there occur: *Picea pungens, Abies concolor* and taxa from the genera: *Juniperus* (particularly *Juniperus sabina* and *Juniperus × pfitzeriana).*

7. On the area of the town, there occur three trees representing nature monuments. One of them, "Mateusz Oak" requires an information plate. Three other trees *Salix × sepulcralis* 'Chrysocoma' have been selected since they have reached the dimensions of monumental trees.

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