



LICHENS OF ALIEN TREES AND SHRUBS OF BIAŁYSTOK (NORTH-EASTERN POLAND)

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ABSTRACT. The paper presents a list of 41 lichen species of alien trees found in Białystok. Among them seven species are endangered in Poland. They are: *Cetraria sepincola*, *Flavoparmelia caperata*, *Evernia prunastri*, *Hypogymnia tubulosa*, *Parmelina tiliacea*, *Tuckermanopsis chlorophylla* and *Usnea hirta*. Lichens colonized 42 tree species of foreign origin.

KEY WORDS: lichens, diversity of species, alien tree species, Białystok, north-eastern Poland

INTRODUCTION

A significant part of Polish flora comprises species of foreign origin. Bringing species geographically alien to Poland has been taking place for at least several hundred years. Alien species have their natural habitat area outside Poland, often in areas very distant from our country. They are divided into dragged and introduced species. The former are those imported into Poland or Europe without human control whereas the introduced alien species were specially imported as ornamental forms, often for the enrichment of the species composition of forests. Some plants were brought in so long ago that we do not realize that they are of foreign origin, such e.g. walnut *Juglans regia*. However, most of them are neophytes – species imported in modern times, after the XV century. A great number of trees are North American plants, such as Douglas fir *Pseudotsuga*, locust *Robinia* and red oak *Quercus rubra*, which have long been successfully acclimatized to our conditions (HEREŹNIAK 1992). There are also species introduced from southern Europe, such as chestnut *Aesculus*, from Asia – *Metasequoia glyptostroboides*, or *Prunus cerasifera*. A widespread species in the forests and groves across Poland is lilac *Syringa vulgaris*, which came to us from the Ottoman Empire during the First Republic. Many of the plants of foreign origin appear to be settled permanently, and constitute a regular part of the natural landscape. Some plants, mainly herbaceous, were dragged by accident, but some species, mainly trees were brought deliberately. Alien species of trees and shrubs were brought mainly for forest management and as ornamental trees. Introduced species are characterised by a sometimes faster growth, greater resistance to adverse environmental conditions and lower habitat requirements than the native species. Despite undoubted economic benefits

and ornamental advantages the importation of alien species may present a risk of danger to the native flora (DANIELEWICZ and MALIŃSKI 1997). These species often spread expansively (eg. *Padus serotina*, *Robinia pseudacacia*, *Quercus rubra*), sometimes displacing native taxa.

Species of trees of foreign origin in Polish cities might be the source of satisfaction of possessing interesting dendrological objects but also the source of knowledge about the acclimatization possibilities of those trees in the specific conditions of urbanized areas.

Lichens of trees introduced in Polish cities were have not been the subject of separate studies. Lichens most frequently mentioned in the works are those few associated with only certain species of trees, mainly *Aesculus hippocastanum*, *Juglans regia*, *Robinia pseudoacacia* (eg. TOBOROWICZ 1976, WILKOŃ-MICHALSKA et AL. 1988, PUSTELNIAK 1991, MATWIEJUK 2007).

The aim of this paper is to discuss the occurrence of alien species of trees and lichens growing on their bark in Białystok.

STUDY AREA

Białystok is located in north-eastern Poland, Białystok Upland, North Podlasie Lowland, on the River Biała. The city area comprises 102.12 ha. It is the capital of Podlaskie Province (KONDRACKI 2002). The climate of the city is clearly cooler than in other areas of Polish lowland. January average temperatures are within the range of –4 to –6°C, they are among the lowest in Poland (average annual temperature is around +7°C). The number of cold days is from 50 to 60, with frost from 110 to 138 days, and the retention time of snow cover from 90 to 110 days. Mean annual rainfall values oscillate around 550 mm, and the growing season lasts 200 to 210 days

(GÓRNIAK 2000). Approximately 32% of the city area is covered by green areas (forests, parks, squares, cemeteries, green lanes, sports facilities).

MATERIALS AND METHODS

Field studies were carried out on the territory of Białystok in 2009-2011, on 122 stands. Based on the field research the list of alien species in Białystok was compiled (Table 1). The object of the study excluded trees growing on private estates. Species of trees were named according to MIREK et AL. (2002). The origin of the trees and their affinities to the family were given according to SENETA and DOLATOWSKI (2008).

At each stand an inventory of all lichen species growing on the bark of trees was made. The laboratory work used the methods of morphological-anatomical and

chemotaxonomic analysis (ORANGE et AL. 2001). Lichens were developed by methods adopted in lichenology. An alphabetical list of lichen species listed on the test site was compiled. For each taxon a tree species and numbers of posts are given.

The terminology of lichen species was given according to SANTESSON et AL. (2004), genus *Melanelia* according to BLANCO et AL. (2004).

RESULTS

In the area of Białystok 42 species of foreign origin were found (Table 1). The amount of species of these trees outnumber native species (MATWIEJUK 2007). The most widely represented are the representatives of the Pinaceae family – 10 species, Cupressaceae – 4, Aceraceae and Oleaceae – 3 each (Table 1).

TABLE 1. List of alien tree species found on the territory of Białystok

Latin name	English name	Origin
1	2	3
Familia: Pinaceae (Pine family)		
<i>Abies concolor</i> (Gordon & Glend.) Lindl. ex Hildebr.	White fir	North America
<i>Abies koreana</i> E.H. Wilson	Korean fir	South Korea
<i>Picea glauca</i> (Moench) Voss	White spruce	North America
<i>Picea omorika</i> (Pančić) Purk.	Serbian spruce	Serbia, Bosnia
<i>Picea pungens</i> Engelm.	Blue spruce	North America
<i>Pinus nigra</i> J.F. Arnold	Black pine	Asia Minor, Southern Europe
<i>Pinus strobus</i> L.	Weymouth pine	North America
<i>Pinus wallichiana</i> A.B. Jacks	Himalaya pine	Himalajas
<i>Pseudotsuga menziesii</i> (Mirb.) Franco	Douglas fir	western part of North America
<i>Tsuga canadensis</i> (L.) Carrière	Canada hemlock	North America
Familia: Cupressaceae (Cypress family)		
<i>Chamaecyparis lawsoniana</i> (A. Murray) Parl.	Lawson false cypress	North America
<i>Chamaecyparis pisifera</i> (Siebold. & Zucc.) Endl.	Pea-fruited cypress	Japan
<i>Juniperus scopulorum</i> Sarg.	Rocky Mountain juniper	North America
<i>Thuja occidentalis</i> L.	Eastern arborvitae	North America
Familia: Taxodiaceae (The bald cypress family)		
<i>Metasequoia glyptostroboides</i> Hu & W.C. Cheng	Dawn redwood	China
Familia: Aceraceae (Maple family)		
<i>Acer negundo</i> L.	Box elder	North America
<i>Acer saccharinum</i> L.	Silver maple	North America
<i>Acer tataricum</i> L.	Tatarian maple	South-East Europe, South-West Asia
<i>Acer tataricum</i> L. subsp. <i>ginnala</i> (Maxim.) Wesm.	Amur maple	China
Familia: Anacardiaceae (Sumac family)		
<i>Rhus typhina</i> L.	Staghorn sumac, Vinegar-tree	North America

TABLE 1 – cont.

1	2	3
Familia: Bignoniaceae (Trumpet Creeper family)		
<i>Catalpa bignonioides</i> Walter	Bean-tree	North America
Familia: Caesalpiniaceae		
<i>Gleditsia triacanthos</i> L.	Honey-locust, Sweet locust	North America
Familia: Cornaceae (Dogwood family)		
<i>Cornus mas</i> L.	Cornelian cherry	Western Asia
Familia: Eleagnaceae (Oleaster family)		
<i>Elaeagnus angustifolia</i> L.	Aleaster	Asia
Familia: Fabaceae (Legume family, pea family, bean family or pulse family)		
<i>Robinia pseudoacacia</i> L.	Locust	North America
<i>Robinia viscosa</i> Vent.	Plummy locust	North America
Familia: Fagaceae (Beech family)		
<i>Quercus palustris</i> Münchh.	Swamp oak	North America
<i>Quercus rubra</i> L.	Red oak	central and eastern part of North America
Familia: Hippocastanaceae (Horse-chestnut family)		
<i>Aesculus × carnea</i> Hayne	Red horse chestnut	? (hybrid)
<i>Aesculus hippocastanum</i> L.	Common horse chestnut	Balkan Peninsula, Asia Minor
Familia: Juglandaceae (Walnut family)		
<i>Juglans regia</i> L.	Persian Walnut	Balkans
Familia: Moraceae (Mulberry family or Fig family)		
<i>Morus alba</i> L.	White mulberry	East Asia
Familia: Oleaceae (Olive family)		
<i>Fraxinus latifolia</i> Benth.	Oregon ash	North America
<i>Fraxinus pennsylvanica</i> Marshall	Red ash	North America
<i>Syringa vulgaris</i> L.	Common lilac	Balkan Peninsula
Familia: Platanaceae (Plane-tree family)		
<i>Platanus × acerifolia</i> (Aiton) Willd.	Plane tree	? (hybrid) North America, Asia
Familia: Rosaceae (Rose family)		
<i>Malus × purpurea</i> Rehder	Purple crab	? (hybrid)
<i>Padus serotina</i> (Ehrh.) Borkh.	Black cherry	North America
<i>Prunus cerasifera</i> Ehrh.	Myrobalan, Cherry plum	Asia
Familia: Rutaceae (Rue family)		
<i>Phellodendron amurense</i> Rupr.	Cork tree	northern part of China
<i>Ptelea trifoliata</i> L.	Wafer-ash, Hoptree, Woolly common hoptree	North America
Familia: Salicaceae (Willow family)		
<i>Salix matsudana</i> Koidzumi	Chinese Willow	China, Korea
Familia: Tiliaceae (Linden family)		
<i>Tilia tomentosa</i> Moench	Silver linden	south-eastern part of Europe and south-western part of Asia

Alien species in the city are mostly ornamental trees, growing in the parks (such as *Abies concolor*, *Aesculus × carnea*, *A. hippocastanum*, *Fraxinus latifolia*, *F. pennsylvanica*, *Metasequoia glyptostroboides*, *Phellodendron amurense*, *Picea pungens*, *Pinus nigra*, *Ptelea trifoliata*, *Quercus rubra*, *Thuja occidentalis*, *Tsuga canadensis*), in the cemeteries (eg. *Aesculus hippocastanum*, *Chamaecyparis lawsoniana*, *C. pisifera*, *Juniperus scopulorum*, *Robinia pseudoacacia*, *Thuja occidentalis*), in the squares (eg. *Abies koreana*, *Catalpa bignonioides*, *Elaeagnus angustifolia*, *Juglans regia*, *Rhus typhina*, *Syringa vulgaris*), roadside trees (e.g. *Acer negundo*, *A. saccharinum*, *Aesculus hippocastanum*, *Robinia pseudoacacia*, *Pseudotsuga menziesii*, *Tilia tomentosa*), fruit trees (eg. *Juglans regia*, *Malus × purpurea*) and forest trees (*Padus serotina*, *Pinus nigra*, *Robinia pseudoacacia*). Few trees of foreign origin occur frequently and en masse. These are mainly: *Aesculus hippocastanum*, *Robinia pseudoacacia*, *Acer negundo*, *Fraxinus pennsylvanica*, *Thuja occidentalis*. Many belong to a group of rare plants and in Białystok they are found in few places (*Gleditsia triacanthos*, *Metasequoia glyptostroboides*, *Phellodendron amurense*, *Ptelea trifoliata*, *Tsuga canadensis*, and others).

The origin of Białystok trees is very diverse and in addition to national specimens one can find trees from North America, Asia, Southern and Western Europe. Most trees are North American species (Table 1).

In recent years, particularly in new housing estates, as well as green belts along the roads, new trees have been planted (*Catalpa bignonioides*, *Malus × purpurea*, *Platanus × acerifolia*, *Prunus cerasifera*, and others).

The oldest tree is probably a specimen of *Metasequoia glyptostroboides*, remembering the times of the Crown Hetman Jan Klemens Branicki (1689-1771), which grows in the park at the Branicki Palace.

Bark of trees of foreign origin is a substrate for 41 lichen species from 26 genera. The most abundant numbers of species represented here are those of genera *Lecanora* (7), *Physcia* (5), *Cladonia* (3), *Hypogymnia* and *Xanthoria* (2 each). Lichens are represented by all morphological forms. The most dominant lichens are those with foliose thalli. They make up 49% of the overall number of the species. The second largest group consists of crustose lichens (32%). The participation of lichens with fruticose thalli is about 15% and squamulose – 4%.

The richest lichen biota was reported on the bark of trees – *Robinia pseudoacacia* (26), *Aesculus hippocastanum* and *Quercus rubra* (25 each), *Acer saccharinum* (14), *Rhus typhina* and *Fraxinus pennsylvanica* (13 each), *Phellodendron amurense* (12) and *Thuja occidentalis* (11). On other trees, the number of lichen species ranges from 1 to 9. Of the 42 species of trees on the bark of 10 of them (*Abies koreana*, *Acer tataricum* subsp. *ginнала*, *Chamaecyparis lawsoniana*, *C. pisifera*, *Picea glauca*, *Pinus wallitchiana*, *Pinus strobus*, *Platanus × acerifolia*, *Robinia vinosa*, *Salix matsudana*) there were no lichens recorded.

The red oak has an interesting epiphytic biota. Particularly noteworthy specimens are the ones growing along Valentine Avenue in the Planty Park, planted by Germans during World War II. On the bark of this phorophyte taxa, rare for urban areas, were found, such

species as *Evernia prunastri*, *Flavoparmelia caperata*, *Hypogymnia tubulosa*, *Parmelina tiliacea*, *Platismatia glauca*, *Pseudevernia furfuracea* and *Usnea hirta*.

On most trees a large share in lichen biota is exhibited by common, macrothallus, nitrophilous lichens of the genera *Physcia* (*P. adscendens*, *P. dubia* and *P. stellaris*, *P. tenella*), *Phaeophyscia* (*P. orbicularis*) and *Xanthoria* (*X. parietina*, *X. polycarpa*).

The largest number of positions and the highest rate of coverage is reached by the species that occur not only on the bark of trees but also on other substrates. They are also the species forming a group of lichens most commonly encountered in the lichen biota of Białystok: *Parmelia sulcata*, *Phaeophyscia orbicularis*, *Physcia adscendens*, *P. dubia*, and *Xanthoria parietina*.

Worth mentioning are the rare species of epiphytic lichens *Cetraria sepincola* (bark of *Pinus nigra*), *Flavoparmelia caperata* (bark of *Quercus rubra*), *Hypogymnia tubulosa* (bark of *Quercus rubra*, *Rhus typhina*), *Tuckermanopsis chlorophylla* (bark of *Aesculus hippocastanum*, *Robinia pseudoacacia*), and *Usnea hirta* (bark of *Quercus rubra*).

Conifers of foreign origin are represented by pine (*Pinus nigra*, *P. strobus*, *P. wallitchiana*), spruce (*Picea glauca*, *P. omorika*, *P. pungens*), fir (*Abies concolor*, *A. koreana*), douglas fir (*Pseudotsuga menziesii*), eastern arborvitae (*Thuja occidentalis*), dawn redwood (*Metasequoia glyptostroboides*), canada hemlock (*Tsuga canadensis*), and cypress (*Chamaecyparis lawsoniana*, *C. pisifera*). They are characterised by poor lichen biota, numbering a total of 14 species. These trees have acidic bark and usually a set of epiphytes poor in species. This poverty is exacerbated by other factors, such as the fact that bark of pine trees has also very low water capacity, is low in the elements needed for organisms, and peels intensively, which further aggravates the adverse conditions for lichens. As a result, few species grow on the trunks of conifers, those highly acidophilous and fast-growing, mostly *Hypogymnia physodes*, *Lecanora conizaeoides* and *Lepraria incana*.

The richest lichen biota is exhibited by *Picea pungens* and *Juniperus scopulorum*.

The noteworthy are exclusive species *Cetraria sepincola* on the bark of *Pinus nigra* and *Flavoparmelia caperata* on the bark of *Quercus rubra*.

Participation of vulnerable and protected lichens

Of the 41 lichen species identified in Białystok, seven species have been put on the Red List of extinct and vulnerable lichens of Poland (CIEŚLIŃSKI ET AL. 2006), including two species in the endangered category – EN (*Cetraria sepincola*, *Flavoparmelia caperata*), three species in the vulnerable category – VU (*Parmelina tiliacea*, *Tuckermanopsis chlorophylla*, *Usnea hirta*), two species in the category of near threatened – NT (*Evernia prunastri*, *Hypogymnia tubulosa*) and one species on the Red List of lichens vulnerable in north-east Poland (CIEŚLIŃSKI 2003), in the category EN (*Flavoparmelia caperata*).

Of all the 41 lichen species, 11 have been put under legal protection, 10 of which are totally and one of which are partially protected. *Usnea hirta* is a species which requires a protection zone to be established within a 50-metre radius from the stand border.

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- Amandinea punctata* (Hoffm.) Coppins & Scheid. – bark of *Aesculus hippocastanum*, *Malus × purpurea*; stands: 12, 48, 62, 106, 116, 118, 119.
- Candelaria concolor* (Dicks.) Stein. – bark of *Aesculus hippocastanum*, *Robinia pseudoacacia*; stands: 109, 119.
- Candelariella xanthostigma* (Ach.) Lettau – bark of *Acer saccharinum*, *A. tataricum*, *Aesculus hippocastanum*, *Elaeagnus angustifolia*, *Fraxinus latifolia*, *F. pennsylvanica*, *Malus × purpurea*, *Metasequoia glyptostroboides*, *Padus serotina*, *Phellodendron amurense*, *Picea pungens*, *Quercus rubra*, *Robinia pseudoacacia*, *Rhus typhina*, *Syringa vulgaris*, *Thuja occidentalis*; stands: 3, 4, 6, 8, 10-13, 15, 21, 30, 35, 38-42, 45, 84-86, 93, 95, 97, 104, 105, 113, 115, 116, 119.
- Cetraria sepincola* (Ehrh.) Ach. – bark of *Pinus nigra*; stand: 120.
- Cladonia coniocraea* (Flörke) Spreng., nom. cons. – bark of *Quercus rubra*, *Robinia pseudoacacia*, *Thuja occidentalis*; stands: 2, 4, 8, 11, 21, 35, 38, 118, 119.
- Cladonia fimbriata* (L.) Fr. – bark of *Quercus rubra*, *Robinia pseudoacacia*, *Syringa vulgaris*; stands: 3, 4, 11, 21, 35, 38, 89, 119.
- Cladonia glauca* Flörke – bark of *Robinia pseudoacacia*; stand: 11.
- Cladonia* sp. – bark of *Picea pungens*, *Robinia pseudoacacia*; stands: 4, 7, 11.
- Evernia prunastri* (L.) Ach. – bark of *Aesculus × carnea*, *A. hippocastanum*, *Acer saccharinum*, *Quercus rubra*, *Robinia pseudoacacia*, *Rhus typhina*; stands: 3, 4, 6, 9, 12, 35, 38, 46, 61, 86, 87, 119.
- Flavoparmelia caperata* (L.) Hale – bark of *Quercus rubra*; stand: 35.
- Hypocenomyce scalaris* (Ach.) M. Choisy – bark of *Acer saccharinum*, *Aesculus hippocastanum*, *Quercus rubra*, *Robinia pseudoacacia*; stands: 3, 4, 11, 12, 21, 35, 38, 40, 97, 101, 104, 110, 115-119.
- Hypogymnia physodes* (L.) Nyl. – bark of *Acer saccharinum*, *A. tataricum*, *Fraxinus pennsylvanica*, *Gleditsia triacanthos*, *Malus × purpurea*, *Phellodendron amurense*, *Picea pungens*, *Prunus cerasifera*, *Quercus rubra*, *Robinia pseudoacacia*, *Rhus typhina*, *Syringa vulgaris*; stands: 3, 4, 6, 7, 11, 12, 13, 17, 21, 23, 35, 38, 46, 47, 59-61, 63, 85-89, 91, 97, 99, 101, 104, 109, 111, 112, 114, 116, 118, 119.
- Hypogymnia tubulosa* (Schaer.) Hav – bark of *Quercus rubra*, *Rhus typhina*; stands: 4, 35, 38, 46, 59, 85.
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- Lecanora argentata* (Ach.) Malme – bark of *Acer negundo*; stand: 121.
- Lecanora carpinea* (L.) Vain. – bark of *Aesculus hippocastanum*, *Robinia pseudoacacia*; stands: 30, 54, 97, 116, 119.
- Lecanora conizaeoides* Nyl. ex Cromb. – bark of *Aesculus hippocastanum*, *Fraxinus pennsylvanica*, *Phellodendron amurense*, *Robinia pseudoacacia*, *Tsuga canadensis*; stands: 3, 8, 21, 48, 95, 103, 110, 111, 114-116.
- Lecanora expallens* Ach. – bark of *Aesculus hippocastanum*; stand: 97.
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- Lecanora pulicaris* (Pers.) Ach. – bark of *Aesculus hippocastanum*, *Juglans regia*, *Quercus rubra*; stands: 30, 38, 113.
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- Lepraria incana* (L.) Ach. – bark of *Acer negundo*, *A. saccharinum*, *A. tataricum*, *Aesculus hippocastanum*, *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*, *Juniperus scopulorum*, *Metasequoia glyptostroboides*, *Picea pungens*, *Quercus rubra*, *Robinia pseudoacacia*, *Thuja occidentalis*; stands: 2, 3, 4, 6, 11, 12, 21, 22, 23, 24, 26, 30, 35, 38, 40, 42, 45, 63, 86, 101, 102, 109, 110, 116, 118.
- Melanelixia fuliginosa* (Fr. ex Duby) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch – bark of *Acer saccharinum*, *A. tataricum*, *Aesculus × carnea*, *A. hippocastanum*, *Fraxinus pennsylvanica*, *F. latifolia*, *Malus × purpurea*, *Morus alba*, *Padus serotina*, *Phellodendron amurense*, *Quercus rubra*, *Robinia pseudoacacia*, *Rhus typhina*; stands: 2, 3, 4, 6, 11, 12, 13, 17, 21, 35, 46, 85, 87, 93, 97.
- Melanohalea exasperatula* (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch – bark of *Aesculus hippocastanum*, *Quercus rubra*; stands: 3, 106.
- Parmelia sulcata* Taylor – bark of *Aesculus × carnea*, *A. hippocastanum*, *Acer saccharinum*, *A. tataricum*, *Catalpa bignonioides*, *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*, *Gleditsia triacanthos*, *Juglans regia*, *Malus × purpurea*, *Phellodendron amurense*, *Picea pungens*, *Prunus cerasifera*, *Quercus rubra*, *Rhus typhina*, *Robinia pseudoacacia*, *Syringa vulgaris*, *Thuja occidentalis*; stands: 3, 4, 6, 7, 9-15, 17, 18, 21, 23, 30, 35, 38, 42, 45-47, 53, 55, 59, 61-63, 67, 84-89, 91, 93, 96, 97, 101, 104-107, 109, 110, 113, 115, 116, 118, 119.
- Parmelina tiliacea* (Hoffm.) Hale – bark of *Quercus rubra*, *Robinia pseudoacacia*; stands: 4, 11, 21.
- Phaeophyscia orbicularis* (Neck.) Moberg – bark of *Abies concolor*, *Acer negundo*, *A. saccharinum*, *A. tataricum*, *Aesculus × carnea*, *A. hippocastanum*, *Cornus mas*, *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*, *Gleditsia triacanthos*, *Juglans regia*, *Juniperus scopulorum*, *Phellodendron amurense*, *Pseudotsuga menziensis*, *Ptelea trifoliata*, *Quercus rubra*, *Rhus typhina*, *Robinia pseudoacacia*, *Syringa vulgaris*, *Thuja occidentalis*, *Tilia tomentosa*; stands: 3, 4, 6, 8-21, 23-25, 28, 30-33, 39-42, 44-49, 53, 54, 57, 59, 85-89, 91, 93, 95-98, 100, 101, 103-108, 110, 111, 113, 114, 116-118.
- Phlyctis argena* (Spreng.) Flot. – bark of *Aesculus hippocastanum*, *Acer negundo*, *Fraxinus latifolia*, *F. pennsylvanica*, *Malus × purpurea*, *Morus alba*, *Quercus rubra*, *Robinia pseudoacacia*, *Thuja occidentalis*; stands: 3, 6, 11, 21, 45, 119.
- Physcia adscendens* H. Olivier nom. cons. – bark of *Acer negundo*, *A. saccharinum*, *A. tataricum*, *Aesculus × carnea*, *A. hippocastanum*, *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*, *Gleditsia triacanthos*, *Malus × purpurea*, *Phellodendron amurense*, *Picea pungens*, *Prunus cerasifera*, *Quercus rubra*, *Robinia pseudoacacia*, *Rhus typhina*, *Syringa vulgaris*, *Thuja occidentalis*; stands: 3, 7-12, 14-17, 21, 23, 28, 30-33, 35, 39, 45-47, 52-54, 56, 57, 59, 61, 85-89, 91, 93, 95, 96, 113, 116.

- Physcia caesia* (Hoffm.) Fűrnr. – bark of *Aesculus hippocastanum*; stand: 118.
- Physcia dubia* (Hoffm.) Lettau – bark of *Abies concolor*, *Acer negundo*, *A. saccharinum*, *A. tataricum*, *Aesculus × carnea*, *A. hippocastanum*, *Catalpa bignonioides*, *Cornus mas*, *Elaeagnus angustifolia*, *Fraxinus latifolia*, *F. pennsylvanica*, *Gleditsia triacanthos*, *Juglans regia*, *Juniperus scopulorum*, *Malus × purpurea*, *Metasequoia glyptostroboides*, *Morus alba*, *Padus serotina*, *Phellodendron amurense*, *Picea omorika*, *P. pungens*, *Pinus nigra*, *Prunus cerasifera*, *Pseudotsuga menziensii*, *Ptelea trifoliata*, *Quercus palustris*, *Q. rubra*, *Robinia pseudoacacia*, *Rhus typhina*, *Syringa vulgaris*, *Thuja occidentalis*, *Tilia tomentosa*, *Tsuga canadensis*; stands: 2-15, 17-21, 23-25, 28, 30-33, 35, 38-49, 51-54, 56, 58-61, 63, 67, 84-89, 92, 93, 95-99, 103-105, 107, 109-111, 116, 119.
- Physcia stellaris* (L.) Nyl. – bark of *Acer negundo*, *A. saccharinum*, *Aesculus × carnea*, *A. hippocastanum*, *Catalpa bignonioides*, *Fraxinus latifolia*, *F. pennsylvanica*, *Juglans regia*, *Phellodendron amurense*, *Quercus rubra*, *Rhus typhina*, *Robinia pseudoacacia*; stands: 13, 30, 35, 46, 48, 53, 54, 55, 57-61, 91.
- Physcia tenella* (Scop.) DC. – bark of *Aesculus hippocastanum*, *Rhus typhina*, *Syringa vulgaris*; stands: 3, 89, 97.
- Physconia enteroxantha* (Nyl.) Poelt – bark of *Acer saccharinum*, *Aesculus hippocastanum*, *Fraxinus latifolia*, *F. pennsylvanica*, *Robinia pseudoacacia*, *Thuja occidentalis*; stands: 7, 11, 12, 13, 45, 97.
- Physconia grisea* (Lam.) Poelt – bark of *Acer negundo*, *Robinia pseudoacacia*; stands: 11, 21.
- Platismatia glaca* (L.) W.L. Culb. & C.F. Culb. – bark of *Quercus rubra*; stand: 38.
- Pseudevernia furfuracea* (L.) Zopf. – bark of *Phellodendron amurense*, *Quercus rubra*; stands: 3, 35.
- Scoliosporum chlorococcum* (Graeve ex Stenh.) Vězda – bark of *Aesculus hippocastanum*, *A. × carnea*, *Robinia pseudoacacia*; stands: 87, 101, 111, 119.
- Tuckermanopsis chlorophylla* (Willd.) Hale – bark of *Aesculus hippocastanum*, *Robinia pseudoacacia*; stand: 11.
- Usnea hirta* (L.) Weber ex F.H. Wigg. – bark of *Quercus rubra*; stand: 35.
- Xanthoria parietina* (L.) Th. Fr. – bark of *Abies concolor*, *Acer negundo*, *A. saccharinum*, *A. tataricum*, *Aesculus × carnea*, *A. hippocastanum*, *Catalpa bignonioides*, *Cornus mas*, *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*, *Juniperus scopulorum*, *Malus × purpurea*, *Phellodendron amurense*, *Picea pungens*, *Ptelea trifoliata*, *Quercus rubra*, *Rhus typhina*, *Robinia pseudoacacia*, *Syringa vulgaris*, *Thuja occidentalis*, *Tilia tomentosa*; stands: 3, 4, 6-14, 16, 17, 19-21, 23-25, 28, 30-33, 35, 38-42, 45-49, 51, 52, 54, 56-63, 67, 84-89, 91, 93, 95, 96, 97, 100, 101, 106-108, 111-113, 116.
- Xanthoria polycarpa* (Hoffm.) Th. Fr. ex Rieber – bark of *Acer saccharinum*, *Aesculus × carnea*, *A. hippocastanum*, *Catalpa bignonioides*, *Gleditsia triacanthos*, *Phellodendron amurense*, *Picea pungens*, *Prunus cerasifera*, *Pseudotsuga menziensii*, *Quercus rubra*, *Rhus typhina*, *Robinia pseudoacacia*, *Thuja occidentalis*; stands: 3, 4, 6, 7, 9, 11, 14-18, 23, 28, 30-33, 35, 38, 40, 43, 45-48, 53-62, 67, 84, 87-89, 95, 104, 108, 111, 113, 114.

Index of stands

1. Street Podleśna 2, square at the Opera and Philharmonic – *Picea pungens*.
2. Zwierzyniecki Park (Park name of the Constitution of 3 May) – *Quercus rubra*, *Robinia pseudoacacia*.
3. Planty Park, part between the street Maria Curie-Skłodowska, street Świętojańska and street Akademicka – *Acer saccharinum*, *A. tataricum*, *Fraxinus latifolia*, *F. pennsylvanica*, *Malus × purpurea*, *Phellodendron amurense*, *Picea pungens*, *Quercus rubra*, *Rhus typhina*, *Thuja occidentalis*.
4. Planty Park, part between street Akademicka to street Adam Mickiewicz – *Picea pungens*, *Pseudotsuga menziensii*, *Quercus rubra*, *Thuja occidentalis*.
5. Planty Park, Praczkki, street Adam Mickiewicz – *Picea pungens*.
6. Lower Garden Palace Branicki – *Aesculus hippocastanum*, *Metasequoia glyptostroboides*, *Quercus rubra*, *Rhus typhina*.
7. Square, street Adam Mickiewicz at the club Herkulesy and buildings University in Białystok – *Acer saccharinum*, *Picea pungens*.
8. Prince Józef Poniatowski Park (Old Park) – *Acer rubrum*, *Aesculus hippocastanum*, *Fraxinus pennsylvanica*, *Picea pungens*, *Pinus nigra*, *Pseudotsuga menziensii*, *Robinia pseudoacacia*, *Thuja occidentalis*, *Tsuga canadensis*.
9. Wedding at the Palace Square, a square Armia Krajowa – *Abies koreana*, *Acer negundo*, *Picea omorika*, *P. pungens*, *Pseudotsuga menziensii*, *Quercus rubra*.
10. Square at the street John Paul II – *Aesculus hippocastanum*, *Fraxinus pennsylvanica*, *Picea pungens*, *Pseudotsuga menziensii*.
11. Park Constitution of 3 May (Zwierzyniecki Park) – *Acer negundo*, *A. tataricum* subsp. *ginnala*, *Padus serotina*, *Quercus rubra*, *Robinia pseudoacacia*.
12. Street November 11 at the rink and stadium city MOSiR – *Aesculus hippocastanum*, *Fraxinus pennsylvanica*, *Robinia pseudoacacia*.
13. Street Legionowa – *Acer saccharinum*, *Aesculus hippocastanum*, *Fraxinus latifolia*, *F. pennsylvanica*.
14. Square between street Legionowa and street Suraska – Blues Alley – *Acer saccharinum*, *Aesculus hippocastanum*, *Picea pungens*.
15. Square, street Rynek Kościuszki – *Aesculus hippocastanum*.
16. Street Maria Skłodowska-Curie – *Aesculus hippocastanum*.
17. Central Park – *Acer negundo*, *A. saccharinum*, *Aesculus hippocastanum*, *Cornus mas*, *Picea pungens*, *Pinus nigra*, *Pseudotsuga menziensii*, *Ptelea trifoliata*, *Thuja occidentalis*.
18. Street Krakowska – *Aesculus hippocastanum*.
19. Street St. Roch – *Aesculus hippocastanum*, *Robinia pseudoacacia*.
20. Park name Jadwiga Dziekońska – *Acer saccharinum*, *Aesculus hippocastanum*, *Elaeagnus angustifolia*.
21. Lubomirski Park – *Acer negundo*, *Aesculus hippocastanum*, *Fraxinus pennsylvanica*, *Morus alba*, *Quercus rubra*, *Robinia pseudoacacia*.
22. Street Rev. Stanisław Suchowolec – *Robinia pseudoacacia*.

23. Roman catholic cemetery of the Immaculate Heart of Mary, street Rev. Stanisław Suchowolec – *Thuja occidentalis*.
24. Orthodox cemetery St. Holy Prophet Elias, street St. Elias – *Abies koreana*, *Juniperus scopulorum*, *Picea pungens*, *Robinia pseudoacacia*, *Thuja occidentalis*.
25. Street Rev. Stanisław Suchowolec, at the petrol station – *Robinia pseudoacacia*.
26. Street Adam Mickiewicz the intersection of street Baranowicka – *Aesculus hippocastanum*.
27. Street Dębowa, roman catholic cemetery The Holy Spirit, Zaścianki – *Thuja occidentalis*.
28. Crossing street Branicki and street Baranowicka (from Lidl) – *Aesculus hippocastanum*.
29. Street Piastowska – *Elaeagnus angustifolia*, *Robinia pseudoacacia*.
30. Street Mieszka I – *Aesculus* × *carnea*, *A. hippocastanum*, *Acer negundo*, *A. saccharinum*, *Elaeagnus angustifolia*, *Robinia pseudoacacia*, *Rhus typhina*.
31. Alley Józef Piłsudski – *Acer negundo*, *A. saccharinum*, *Aesculus hippocastanum*.
32. Street Czesława Miłosza – *Aesculus hippocastanum*.
33. Street Jana Klemensa Branickiego – *Aesculus hippocastanum*.
34. Street Wiejska – *Rhus typhina*, *Thuja occidentalis*.
35. Street Władysław Wysocki, city cemetery – *Abies concolor*, *Acer saccharinum*, *Aesculus hippocastanum*, *Chamaecyparis lawsoniana*, *Juniperus scopulorum*, *Picea omorika*, *Picea pungens*, *Quercus rubra*, *Robinia pseudoacacia*, *Thuja occidentalis*.
36. Street Władysław Wysocki, at city cemetery – *Acer negundo*, *Aesculus hippocastanum*, *Robinia pseudoacacia*.
37. Street Łącznikowa – *Acer negundo*, *Picea pungens*, *Thuja occidentalis*.
38. Street Władysław Raginis, roman catholic cemetery (Fara) the Assumption of the Blessed Virgin Mary – *Aesculus hippocastanum*, *Chamaecyparis lawsoniana*, *Picea omorika*, *Quercus rubra*, *Robinia pseudoacacia*, *Thuja occidentalis*.
39. Street Władysław Raginis – *Abies concolor*, *Acer negundo*, *Robinia pseudoacacia*, *Rhus typhina*.
40. Street Władysław Wysocki, orthodox cemetery the Assumption of the All Holly – *Juniperus scopulorum*, *Picea pungens*, *Robinia pseudoacacia*, *Thuja occidentalis*.
41. Street Wasilkowska – *Acer saccharinum*.
42. Lutheran Cemetery, street July 27 – *Aesculus hippocastanum*.
43. Square at the Pułkowa street – *Aesculus hippocastanum*, *Robinia pseudoacacia*.
44. Street Pułkowa 7 – *Acer negundo*, *A. saccharinum*, *Robinia pseudoacacia*.
45. Street 11 November, military cemetery – *Robinia pseudoacacia*, *Thuja occidentalis*.
46. Street Wiejska, university square – *Acer negundo*, *Aesculus hippocastanum*, *Juglans regia*, *Pinus strobus*, *Pseudotsuga menziensis*, *Robinia pseudoacacia*, *R. viscosa*, *Rhus typhina*, *Thuja occidentalis*.
47. Street general Józef Bem – *Aesculus hippocastanum*, *Elaeagnus angustifolia*, *Gleditsia triacanthos*, *Thuja occidentalis*.
48. Street Mikołaj Kopernik – *Aesculus hippocastanum*, *Tilia tomentosa*.
49. Street St. Andrzej Bobola, roman catholic cemetery – *Acer negundo*, *Chamaecyparis lawsoniana*, *Juniperus scopulorum*, *Robinia pseudoacacia*, *Thuja occidentalis*.
50. Street St. Andrzej Bobola, orthodox cemetery St. Eufrozyna – *Juniperus scopulorum*, *Thuja occidentalis*.
51. Forest Valley, street St. Andrzej Bobola – *Acer negundo*, *Elaeagnus angustifolia*, *Robinia pseudoacacia*.
52. Street Bataliony Chłopskie – *Chamaecyparis lawsoniana*, *Elaeagnus angustifolia*, *Juniperus scopulorum*, *Phellodendron amurense*, *Robinia pseudoacacia*.
53. Street Powstańców – *Catalpa bignonioides*, *Rhus typhina*.
54. Street Armia Krajowa – *Aesculus hippocastanum*, *Catalpa bignonioides*, *Elaeagnus angustifolia*, *Malus* × *purpurea*, *Phellodendron amurense*, *Prunus cerasifera*, *Rhus typhina*, *Syringa vulgaris*.
55. Street Wrocławska – *Catalpa bignonioides*, *Elaeagnus angustifolia*, *Prunus cerasifera*, *Rhus typhina*.
56. Street Rumiankowa – *Chamaecyparis lawsoniana*, *Fraxinus latifolia*, *Juglans regia*, *Picea pungens*, *Phellodendron amurense*, *Pinus nigra*, *P. strobus*, *Prunus cerasifera*, *Quercus palustris*, *Rhus typhina*, *Robinia pseudoacacia*, *Salix matsudana*, *Syringa vulgaris*.
57. Street Zielonogórska – *Elaeagnus angustifolia*, *Rhus typhina*, *Robinia pseudoacacia*, *Syringa vulgaris*.
58. Street Słonecznikowa – *Picea pungens*, *Pinus nigra*, *Rhus typhina*, *Robinia pseudoacacia*, *Thuja occidentalis*.
59. Street Upalna – *Acer negundo*, *Aesculus* × *carnea*, *Elaeagnus angustifolia*, *Juglans regia*, *Phellodendron amurense*, *Quercus rubra*, *Rhus typhina*, *Robinia pseudoacacia*, *Syringa vulgaris*, *Thuja occidentalis*.
60. Street general Władysław Sikorski – *Catalpa bignonioides*, *Elaeagnus angustifolia*, *Prunus cerasifera*, *Robinia pseudoacacia*, *Thuja occidentalis*.
61. Street Wincenty Witos – *Chamaecyparis lawsoniana*, *Rhus typhina*.
62. Street general Zygmunt Berling 21, square – *Malus* × *purpurea*.
63. Street general Zygmunt Berling 25 – *Aesculus hippocastanum*, *Elaeagnus angustifolia*, *Picea pungens*, *Rhus typhina*.
64. Street general Zygmunt Berling 34 – *Aesculus hippocastanum*, *Elaeagnus angustifolia*, *Robinia pseudoacacia*, *Thuja occidentalis*.
65. Street general Zygmunt Berling – *Aesculus hippocastanum*.
66. Street Leszczynowa 50 – *Aesculus hippocastanum*.
67. Street Palmowa 21 – *Aesculus hippocastanum*, *Robinia pseudoacacia*.
68. Street Gajowa 62 – *Syringa vulgaris*.
69. Square, street Gajowa 62a – *Elaeagnus angustifolia*, *Robinia pseudoacacia*, *Rhus typhina*.
70. Street Gajowa 59 – *Rhus typhina*.
71. Street Gajowa 58 – *Padus serotina*, *Rhus typhina*.
72. Street Produkcyjna – *Aesculus hippocastanum*.
73. Street Zagórna – *Robinia pseudoacacia*.
74. Street Constitution of 3 May – *Robinia pseudoacacia*.

75. Street Antoniuk Fabryczny, roman catholic cemetery, St. Roch – *Juniperus scopulorum*, *Thuja occidentalis*.
76. Street St. Kazimierz – *Rhus typhina*, *Thuja occidentalis*.
77. Street Antoniuk Fabryczny 40 – *Thuja occidentalis*.
78. Street Antoniuk Fabryczny 19 – *Thuja occidentalis*.
79. Street Antoniuk Fabryczny 11c – *Rhus typhina*.
80. Street Antoniuk Fabryczny 7 – *Rhus typhina*.
81. Street Antoniukowska 5 – *Thuja occidentalis*.
82. Square, at the street Antoniukowska – *Catalpa bignonioides*.
83. Street Skłodowa – *Aesculus hippocastanum*, *Rhus typhina*.
84. Street Świerkowa 1 – Radio Białystok – *Abies koreana*, *Picea pungens*, *Pseudotsuga menziensii*, *Thuja occidentalis*.
85. Square, street Michał Wołodyjowski 8 – *Acer saccharinum*, *Aesculus × carnea*, *A. hippocastanum*, *Fraxinus pennsylvanica*, *Rhus typhina*, *Syringa vulgaris*.
86. Street Michał Wołodyjowski 8c – *Abies concolor*, *Acer tataricum*, *Aesculus hippocastanum*, *Catalpa bignonioides*, *Elaeagnus angustifolia*, *Rhus typhina*, *Robinia pseudoacacia*, *Syringa vulgaris*.
87. Street Wesoła – *Abies concolor*, *Acer negundo*, *A. saccharinum*, *Aesculus × carnea*, *A. hippocastanum*, *Robinia pseudoacacia*, *Thuja occidentalis*.
88. Square, between street Wesoła and street Mazowiecka – *Abies concolor*, *Acer saccharinum*, *Aesculus hippocastanum*, *Picea pungens*, *Quercus rubra*, *Syringa vulgaris*, *Thuja occidentalis*.
89. Street Mazowiecka 39 – *Aesculus hippocastanum*, *Fraxinus pennsylvanica*, *Padus serotina*, *Rhus typhina*, *Syringa vulgaris*, *Thuja occidentalis*.
90. Street Zwierzyniecka corner of street Mazowiecka – *Acer saccharinum*.
91. Street Zwierzyniecka – *Acer saccharinum*, *Aesculus hippocastanum*, *Elaeagnus angustifolia*, *Fraxinus pennsylvanica*.
92. Street Szpitalna – *Robinia pseudoacacia*.
93. Street Żelazna – *Acer negundo*, *A. saccharinum*, *Aesculus hippocastanum*.
94. Street Zachodnia – *Platanus × acerifolia*.
95. Street Hetmańska – *Aesculus hippocastanum*.
96. Street Kazimierz Pułski – *Aesculus hippocastanum*.
97. Street Wiewiórcza – *Aesculus hippocastanum*.
98. Street Jan III Sobieski, corner of street Starobojarska – *Aesculus hippocastanum*.
99. Street Ogrodowa – *Robinia pseudoacacia*.
100. Street Jagienki – *Aesculus hippocastanum*.
101. Street Józef Ignacy Kraszewski – *Aesculus hippocastanum*.
102. Street Rev. Paweł Grzybowski, roman catholic and orthodox cemetery – *Robinia pseudoacacia*.
103. Street St. Mikołaj – *Aesculus hippocastanum*.
104. Street Kawaleryjska, square opposite the petrol station – *Robinia pseudoacacia*.
105. Street Kawaleryjska, before the trade fair – *Elaeagnus angustifolia*.
106. Street Parkowa – *Aesculus hippocastanum*.
107. Street Bohaterów Monte Cassino – *Juglans regia*.
108. Street Zagórna – *Juglans regia*.
109. Street Wiejska – *Aesculus hippocastanum*.
110. Street Kaliska – *Aesculus hippocastanum*.
111. Street Cardinal Stefan Wyszyński – *Aesculus hippocastanum*.
112. Street Niedźwiedzia – *Aesculus hippocastanum*.
113. Street Wrocławska – *Juglans regia*.
114. Street Wołyńska – *Aesculus hippocastanum*.
115. Street Krucza – *Aesculus hippocastanum*.
116. Street Strzelecka – *Aesculus hippocastanum*.
117. Street Skorupska – *Aesculus hippocastanum*.
118. Street Leśna – *Robinia pseudoacacia*.
119. Krywlany airport, paving the way – *Robinia pseudoacacia*.
120. Bacieczki Forest – *Pinus nigra*.
121. Street Wysoki Stoczek – *Acer negundo*.
122. Street Konstancy Ciołkowski, church square – *Pinus wallitchiana*.

DISCUSSION AND CONCLUSIONS

The number of tree species of foreign origin of Białystok in comparison to other Polish cities, mainly located in the south, is much smaller. For example, in Wrocław the number of species of exotic trees and shrubs is estimated at 900 (DRAPELLA-HERMANSDORFER ET AL. 1996). This is mainly due to prevailing adverse weather conditions there. In the cold climate of north-eastern Poland the most important factor limiting the possibilities of cultivation of many species and varieties of trees of foreign origin are winter frosts, and early (in September) and late (even in June) frosts. Another limitation is the temperate – between the Atlantic and continental – climate, due to its variability, both in months and in years. Periodically there are “siberian” or mild winters, or atypical ones (eg. warming in January or February, and strong frosts in November and March). Especially dangerous are large diurnal temperature fluctuations in March. There are dry summers, and rainy summers are rare. Both the extreme winter temperatures and the variability of the weather during the growing season, particularly fluctuations in temperature cause disruption in the growth and development, and often serious damage to plants.

Despite the climatic conditions, in recent years the inhabitants of Białystok have planted many interesting trees of foreign origin in their gardens (e.g. *Abies nordmaniana*, *Ginkgo biloba*, *Liriodendron tulipifera*, *Magnolia* spp., *Pinus ponderosa*, *Prunus triloba*, *Thuja orientalis*).

Other factors limiting the growth of trees in urban areas are: drying of the soil and air, strong soil salinity associated with winter road de-icing, a small space restricting the development of the root system, poor structure and abnormal reaction of urban soils, lack of symbiotic microorganisms living together with trees roots, atmospheric air pollution, and strong variation of thermal conditions during the year (BOROWSKI and LATOCHA 2006).

Bark of trees of foreign origin in Białystok is colonized by 41 species of lichens. The richest lichen biota can be found on *Robinia pseudoacacia* (26 species), *Aesculus hippocastanum* and *Quercus rubra* (25 each),

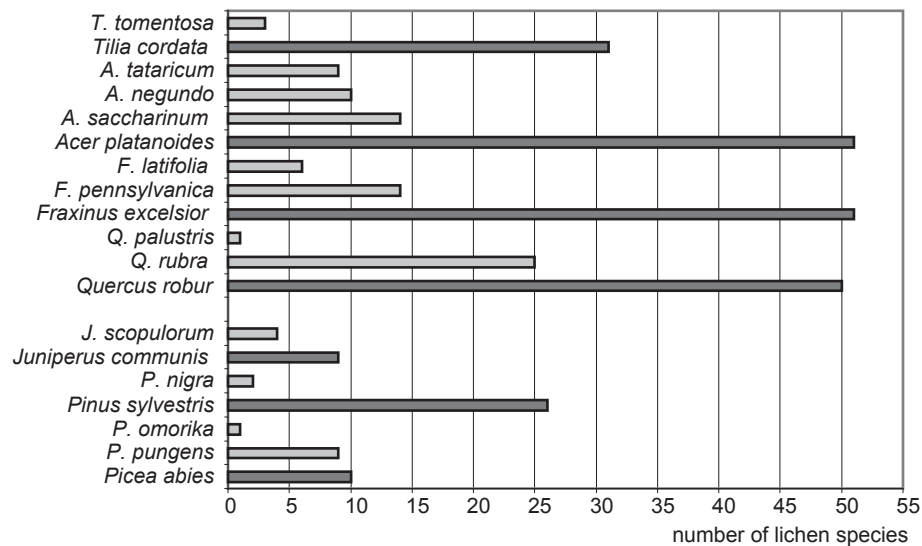


FIG. 1. Comparison of the number of lichen species colonized native and alien trees and shrubs in Białystok

the trees with the highest prevalence. Compared to the native trees and shrubs, this number is relatively small (Fig. 1), because the bark of *Fraxinus excelsior* is inhabited in Białystok by 51 species, *Acer platanoides* – 51, *Quercus robur* – 50, *Tilia cordata* – 31, *Pinus sylvestris* – 26, *Picea abies* – 10, *Juniperus communis* – 9 (MATWIEJUK 2007). This is, among others, due to the fact that these species are common, growing in different habitat conditions (built-up areas, peripherals, parks, cemeteries, forests). Many trees of foreign origin are young trees recently planted, and only few lichen thalli grow on their bark.

The lichen biota of trees of foreign origin in other Polish cities, is characterised by poorer lichen species composition. In Toruń (WILKOŃ-MICHALSKA et al. 1988) on the bark of *Aesculus hippocastanum* eight species were recorded, on the bark of *Robinia pseudoacacia* – three, in Kielce (TOBOROWICZ 1976) on the bark *Robinia pseudoacacia* – 10.

In the whole country the bark of *Quercus rubra* is inhabited by 63 species of lichens, of which 56 taxa in the forests of Olsztyn Lakeland (KUBIAK 2006). Among the lichens found on the bark of this phorophyte in Białystok there are new species, so far not reported for this tree in Poland. They are: *Candelariella xanthostigma*, *Flavoparmelia caperata*, *Hypogymnia physodes*, *Lecanora allophana*, *Melanohalea exasperatula*, *Parmelina tiliacea*, *Phaeophyscia orbicularis*, *Physcia dubia*, *P. stellaris*, *Usnea hirta* and *Xanthoria parietina*.

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