

## Occurrence of brambles (*Rubus* L.) in young forest plantations on the Kolbuszowa Plateau

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**Abstract.** In forests of the Kolbuszowa Plateau, bramble thickets are common mainly in young forest plantations and clear-cut areas. 11 bramble species were found in 20 plantations visited during the field study. The most frequent bramble species in young forest plantations include: *Rubus plicatus*, *R. nessensis*, *R. hirtus*, *R. idaeus*, while less frequent are: *R. gracilis*, *R. ambrosius* and *R. apricus*. The largest patches of brambles were found in plantations established on sites of mixed pine-oak forest, subcontinental lime-oak-hornbeam forest and dried alder carrs. *Rubus* thickets in young forest plantations occur together with numerous species characteristic of communities classified into the following classes: *Vaccinio-Piceetea*, *Quercio-Fagetea*, *Epilobietea angustifolii*, *Molinio-Arrhenatheretea* and *Nardo-Callunetea*. Brambles growing in young forest plantations can be roughly divided into three groups: I – species with thin, prostrate and rooting stems (*R. hirtus*, *R. apricus*, *R. pedemontanus*), which may significantly affect the growth of tree seedlings if bramble specimens or diaspores are present at the time of tree planting; II – species with strong, poorly branched and arcuate stems (*R. plicatus*, *R. gracilis*, *R. ambrosius*, *R. glivicensis*), whose negative effect on tree seedlings depends on the potential of a tree species to produce quickly a high and dense thicket thereby overshadowing the lower vegetation; III – species with erect and relatively sparsely growing stems (*R. idaeus*), which do not pose any threat to young forest plantations. Species with intermediate biological traits (e.g. *R. nessensis*) may have a negative impact on young plantations, as they generate large and dense bush, however, in most cases, their populations grow rather sparsely and do not hinder the development of tree seedlings.

**Keywords:** genus *Rubus*, forests, south-eastern Poland

### 1. Introduction

The research on bramble taxonomy, chorology and ecology in Poland has been underway for nearly 100 years. According to the latest data, the number of species occurring in Poland is 105 (Maliński 2001, Kosiński, Bednorz 2003, Zieliński 2004, Zieliński, Trávníček 2004, Zieliński et al. 2004 a, b; Trávníček, Zázvorka 2005, Trávníček et al. 2005, Kosiński 2006, 2010, Oklejewicz 2006, Kosiński, Oklejewicz 2006, Kosiński, Zieliński 2013, Oklejewicz et al. 2013, Kosiński et al. 2014, Maliński et al. 2014, 2015, Wolanin 2015, Wolanin et al. 2016). Bramble species are usually found in woods, in ecotones and in open habitats. If the individual bramble species differ to some extent in terms of habitat preferences, one can frequently come across bramble thickets composed of several bramble species growing together within small areas (Maliński 2001, Oklejewicz 2006,

Wolanin 2015). In forests of the Kolbuszowa Plateau, large patches of brambles most often occupy heavily disturbed sites. Brambles spread particularly vigorously in young forest plantations and in clear-cut areas (Wolanin 2015).

Since they can have adverse competitive effects on cultivated tree species, in view of aggressive propagation and specific characteristics of cans, such as spikes, thorns and tendency to entangle, brambles in young forest plantations are regarded as nuisance, and foresters try to control them with various results (Gazda 2001, Łukaszewicz 2013). The later may be justified from the stand point of economics. However, no information was available in the literature on the research to assess the negative impact of brambles on young forest plantations. So far, only a series of information has been published regarding the impact of various factors (including gaps in the stand) on the behavior of specimens in the populations of *Rubus hirtus* Waldst & Kit. agg. (e.g.

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Pancer-Kotejowa 1991, Pancer-Koteja et al. 1998, Gazda et al. 2007, Gazda, Kochmańska-Bednarz 2010, Gazda, Janas 2011, Gazda and Szywacz 2011).

The study carried out in forest areas of the Kolbuszowa Plateau aimed at preparing a list of bramble species as well as estimating the frequency with which individual species penetrate into young forest plantations. Habitat conditions which favor the occurrence of brambles in young plantations were generally characterized. Based on the knowledge on bramble species biology, an attempt was made to determine species possible behavior and possible negative impact on young forest plantations.

## 2. Material and methods

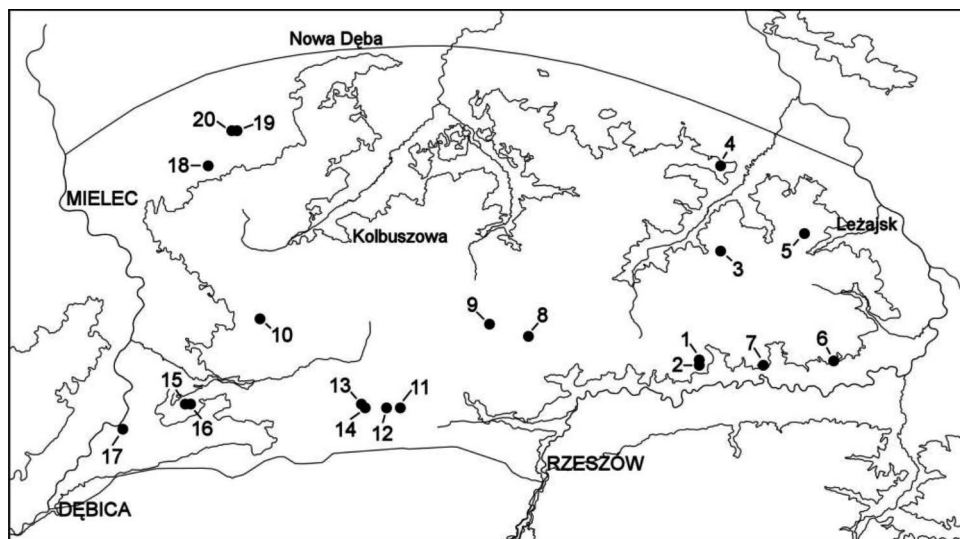
The study was carried out in young plantations situated in forest tracts of the Kolbuszowa Plateau, within the limits adopted in the study by Wolanin (2015). Field observations took place in July and August 2014. The observations were made in all forest plantations where the presence of brambles was noted. Twenty young forest plantations with compact bramble thickets and tree coverage not exceeding 50% were selected for further research (Fig. 1).

Floristic lists were made for sites dominated by brambles (species register was limited to the areas overgrown by brambles). In addition, non-measurable features were noted in the field, including, e.g. the condition of tree seedlings overgrown by brambles, which was later used to assess the impact of individual bramble species on young plantations. The collected data were summarized in a working table, which was used for

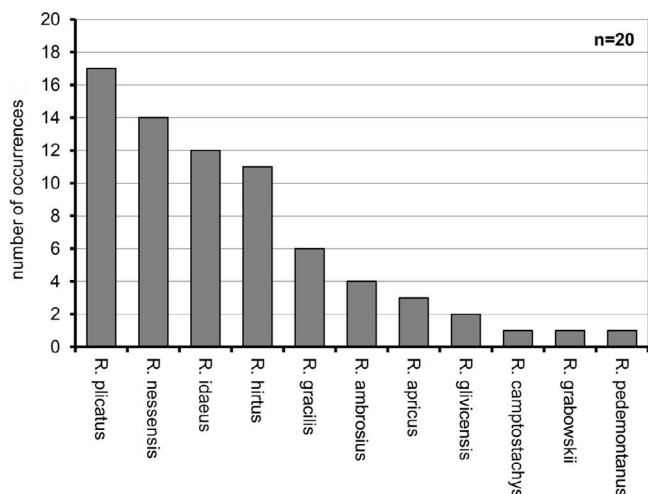
further analyses; the frequency of occurrence was determined for the individual bramble species in the plantations examined, while the accompanying plant species were grouped taking into account their syntaxonomic position according to Matuszkiewicz (2007) and Zając and Zając (2009). In view of the variability in the site colonization pattern, bramble species found in plantations were divided into three groups: I - brambles with thin, strongly branched, creeping and rooted stems, forming a mesh of shoots, and under conditions of increased light access producing a large number of branched long canes, usually covering the entire area with a dense sheet; II - brambles with strong, arcuate, weakly branched long canes, which expand their acreage under conditions of improved light access by producing successive canes, with concurrent mass concentration in the central part of the population, suppressing the growth of all plants growing under their canopy; III - brambles with ascending and loosely arranged shoots, which did not show any differences in colonizing pattern, regardless whether the light intensity was moderate or increased. Based on the above analyses and field observations as concerns the pattern of site colonization, the assessment was made of the possible negative effect of the individual bramble species on young plantations.

## 3. Results

There were found 11 bramble species in the examined forest plantations (Fig. 2), which constitutes 1/3 of the total number of bramble species registered in the Kolbuszowa Plateau (Wolanin

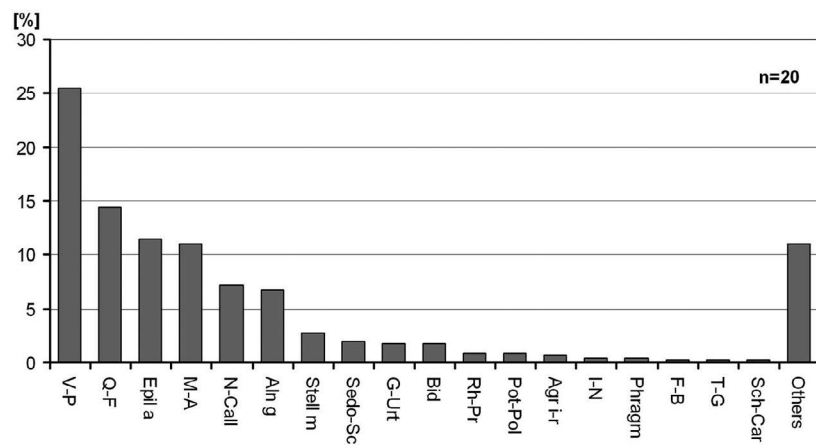


**Figure 1.** The localization of the studied forest plantations in the Kolbuszowa Plateau: 1, 2 – Dąbrówki, 3 – between Julin and Wydrze, 4 – Wola Zarczycka, 5 – between Wilkowyja and Podbór, 6 – Opaleniska, 7 – Smolarzyny, 8 – Wysoka Głogowska, 9 – Głogów Małopolski, 10 – Leszcze, 11, 12 – Dąbry, 13, 14 – between Dąbry and Krzywa, 15 – Pustków, 16 – between Podlesie Skrzyszowskie and Kochanówka, 17 – Brzeźnica, 18 – Toporów, 19, 20 – Ostrowy Baranowskie



**Figure 2.** Bramble species presence in the studied forest plantations

2015). The most common were: *Rubus plicatus*, *R. nessensis*, *R. hirtus* and *R. idaeus*; far less frequent - *R. gracilis*, *R. ambrosius* and *R. apricus*, and the remaining species were observed only sporadically (Fig. 2). In addition, 140 other vascular plant species were found in young plantations, while in the individual sites examined their number ranged from 14 to 33 (full floristic lists are included in the Annex to this paper, in line with the numbering shown in Figure 1). In addition to bramble species, in the analyzed sites there were species characteristic of various syngenetic groups (Fig. 3). The most numerous among them were forest species (characteristic of classes: *Vaccinio-Piceetea*, *Quercus-Fagetea* and *Alnetea glutinosae*) and species of open habitats (characteristic of classes: *Epilobietea angustifolii*, *Molinio-Arrhenatheretea* and *Nardo-Callunetea*).



**Figure 3.** Participation of the syngenetic groups in studied bramble aggregations

V-P – *Vaccinio-Piceetea*, Q-F – *Quercus-Fagetea*, Epil a – *Epilobietea angustifolii*, M-A – *Molinio-Arrhenatheretea*, N-Call – *Nardo-Callunetea*, Aln g – *Alnetea glutinosae*, Stell m – *Stellarietea mediae*, Sedo-Scl – *Sedo-Scleranthetea*, G-Urt – *Galio-Urticenea*, Bid – *Bidentetea tripartiti*, Rh-Pr – *Rhamno-Prunetea*, Pot-Pol – *Potentillo-Polygonetea*, Agr i-r – *Agropyretea intermedio-repentis*, I-N – *Isoëto-Nanojuncetea*, Phragm – *Phragmitetea australis*, F-B – *Festuco-Brometea*, T-G – *Trifolio-Geranietea sanguinei*, Sch-Car – *Scheuchzerio-Caricetea nigrae*

Considering the proposed division of brambles into groups, depending on the way they propagate, the following detailed characteristics of individual bramble species found in the examined plantations may be presented with respect to their general occurrence on the Kolbuszowa Plateau:

### Group I

#### *Rubus hirtus* Waldst. et Kit. agg.

Frequency of occurrence – 11

A very common species in the Kolbuszowa Plateau. Usually found in the undergrowth of various loose woodlands, in clear-cut sites as well as in scrub fringing forest stands; in both fertile and poor habitats, usually in semi-shaded places (Wolanin 2015). Produces large and dense patches, especially in moist places. Due to its creeping habit and long canes, it can form a dense mesh that hinders the forest care work and limits the development of tree seedlings.

#### *Rubus apricus* Wimm.

Frequency of occurrence – 3

An uncommon species in the Kolbuszowa Plateau. Attached to woodland communities; most often found in the thinned pine-oak, pine-beech-fir and pine stands, in dried alder carrs and in scrub communities at the edge of the above mentioned woods; mostly in temperate, moderately moist and relatively fertile habitats (Wolanin 2015). In forest plantations, the species occurs sparsely and as single, poorly developed specimens. The populations found will most likely increase in numbers with an increase in overshadowing.

#### *Rubus pedemontanus* Pinkwart

Frequency of occurrence – 1

A rare species in the Kolbuszowa Plateau, associated mainly with forest communities, most often found in pine-oak and beech woods and at their margins, mostly on moderately sunlit places, on substrates moderately moist and rich in mineral nitrogen compounds (Wolanin 2015). A small patch (an area of approximately 15 m<sup>2</sup>) of the bramble was found in the plantation examined, in a close proximity to a larger patch at the edge of the pine-oak wood. The species does not pose any threat to the plantation, as the bramble is of a low stature; however, in the future, it may create larger patches and hinder the nursing work.

## Group II

### *Rubus plicatus* Weihe et Nees

Frequency of occurrence – 17

A common species throughout the Kolbuszowa Plateau, with a very wide spectrum of suitable habitats. Occurs in both open areas (roadsides, field margins, set aside land) and woods – especially on the side of forest tracks, at edges of roadside ditches, in fringes of scrub and woods; usually in intensively sunlit places, on moderately moist and relatively fertile substrates (Wolanin 2015). The largest patches of the bramble were found in sites of mixed coniferous forests, dried alder carrs, beech forests and oak-hornbeam woods, although, as one of the few bramble species, it also occurred in plantations on poor and dry podzolic soils (but in that case, most often as a sparse single-shoot individuals). The species may hinder nursing treatment in young plantations; however, it quickly gives way with the increase in the shade.

### *Rubus gracilis* J. Presl et C. Presl

Frequency of occurrence – 6

A very common species in the Kolbuszowa Plateau. Found most often within forest tracts, mainly on roadsides, at stand margins, in scrub, on clear-cut sites and in monocultures. It is less often encountered on overgrowing open areas; typically on humid and relatively fertile soils (Wolanin 2015). In young plantations, the species was primarily occurring as single specimens or small patches. It can withstand a partial shade, so it may be growing under the stand canopy for quite a long time (the species is to be found fairly often in older plantations and disturbed pine monocultures). Considering the robustness of its canes and thorns, a larger patches of this bramble may hinder the nursing work in plantations.

### *Rubus ambrosius* Trávníček et Oklejewicz

Frequency of occurrence – 4

A common species in the Kolbuszowa Plateau. Most often found on overgrowing open areas, roadsides, railway tracks, while unquestionably more rarely in woods, where it grows mainly at forest stand margins and on disturbed plac-

es at road sides; it prefers moderately moist and relatively fertile soils, in intensively sunlit places (Wolanin 2015). It was noted only sporadically in young plantations, usually growing as single specimens or in small patches, in a well-sunlit places. The species has strong, long and heavily thorny canes, which may hinder forest works, but it recedes fairly quickly as the shade increases.

### *Rubus glivicensis* (Sprib. ex Sudre) Sprib.

Frequency of occurrence – 2

A species rather uncommon in the Kolbuszowa Plateau, most often found at forest and scrub margins, on overgrowing set aside grounds and in artificial monocultures; usually in well-exposed, well-sunlit places, on slightly moist and relatively fertile soils (Wolanin 2015). Sporadically encountered in both young plantations examined, and only as single specimens. Considering the light requirements of the species, it can be assumed that the specimens found in the plantation will withdraw with the increase in the shade, or will survive only at the edge of the stand.

### *Rubus grabowskii* Weihe ex Günther et al.

Frequency of occurrence – 1

A species not very common in the Kolbuszowa Plateau, found mainly in ecotone habitats – at forest roadsides, forest and scrub margins, in roadside ditches; for the most part in highly sunlit areas, on moderately moist soils, abundant in mineral nitrogen compounds (Wolanin 2015). The bramble grew at the edge of the plantation examined, where it is likely to persist for a longer time. The increase in the shade will most likely reduce its penetration into the forest thicket.

## Group III

### *Rubus idaeus* L.

Frequency of occurrences – 12

A common species in the Kolbuszowa Plateau, growing in open areas (field margins, roadsides, set aside grounds) and in woods – forest edges, glades, clear-cut areas, dried alder carrs, in ditches; mainly in sunny places, on medium-moist and relatively fertile grounds (Wolanin 2015). In forest plantations, it usually grows as single specimens or in loose patches. The raspberry may limit the light access to tree seedlings in a plantation, in the case of high density of shoots.

## Bramble species with intermediate growth traits

### *Rubus nessensis* W. Hall

Frequency of occurrence – 14

A very common species in the Kolbuszowa Plateau, occurring mainly in forest areas (along roads, in forest glades and in scrubs at the stand margins), it is also encountered (though

much less frequently) in overgrowing open sites; mainly on sunny or slightly shady places, on moist substrates, moderately abundant in mineral nitrogen compounds (Wolanin 2015). In young forest plantations, the species usually occurred as single bushes, and less frequently, in small patches. As a species of semi-shaded sites, it can persist over long time in young plantations and hinder forest nursing work.

#### ***Rubus camptostachys* G. Braun**

Frequency of occurrence – 1

A rare species in the Kolbuszowa Plateau, encountered mainly in overgrowing open areas, rarely in sunny edges of forests; mostly in well-sunlit places, on moderately moist substrates, relatively rich in mineral nitrogen compounds (Wolanin 2015). In the plantation examined, there were several sparsely growing bramble shoots. As a low-stature species, this bramble will not pose any threat to the plantation under study; it will most likely recede quite quickly as the shade increases.

### **4. Summary and discussion of results**

The largest thickets of brambles could be found in young forest plantations situated on the mixed coniferous, oak-hornbeam or dry alder carr habitats, while on loose, dry, sandy soils, mainly poorly developed specimens of *R. plicatus*, and rarely *R. gracilis* were encountered. Similar habitat preferences of brambles were reported from southern Wielkopolska by Maliński (2001), although bramble presence in young forest plantations was mentioned only in the case of several species.

It seems that the presence of individual bramble species, and of other plants accompanying the cultivated seedlings, depends on their success in colonizing the plantation. There were found, with a high constancy, both the species with highly branched and expanding underground organs, growing in the immediate vicinity (such as e.g. *Calamagrostis epigejos*, *Frangula alnus*, *Pteridium aquilinum*, or *Vaccinium myrtillus*) and the species whose diaspores come from the close- (*Quercus robur*, *Sorbus aucuparia*) or long-distance- transport (e.g. *Betula pendula*, *Conyza canadensis* or *Solidago gigantea*). On the soil exposed (at the time of establishing forest plantation), there were also species of alien origin, including those now considered invasive, including: *Solidago gigantea*, *Impatiens parviflora*, *Erechtites hieraciifolia*, *Quercus rubra* or *Padus serotina*. In the Kolbuszowa Plateau, almost all of the above-mentioned species were found growing together with a well-developed bramble patches, also outside forest plantations (Wolanin 2015). In Wielkopolska, brambles were found mainly in disturbed communities, with dominating *Calamagrostis epigejos* or *Padus serotina* (Maliński 2001). It seems that the conditions prevailing in young forest plantations resemble, to a great extent, those in disturbed forests or abandoned farmland.

Taking into account the brambles included into the first group (*R. hirtus*, *R. apricus*, *R. pedemontanus*), only the behaviour of *R. hirtus* was on multiple occasions studied under conditions of changing light intensity, and Gazda (1992) considers it an expansive species. Its negative impact on tree seedlings was estimated to be considerable, in particular, when its diaspores or specimens were already present during establishment of a forest plantation. This is also confirmed by Gazda (2001), who reports that seedlings show a higher light demand than adult plants, and that bramble specimens generated from rooting of the terminal parts of long canes can additionally take up nutrients from parental organisms, which favours spreading and faster control of the area. The role of this group of brambles decreases with the time passing from the establishment of plantation to the emergence of first bramble specimens. The second group of brambles is represented, among others, by: *R. plicatus*, *R. gracilis*, *R. ambrosius*, *R. glivicensis* and *R. grabowskii*. Two of the above species: *R. plicatus* and *R. ambrosius* produce the highest arches and, at the same time, form the most dense thickets, thus they can affect the growth of tree seedlings for a particularly long time. After establishing plantation, the negative impact of the above bramble species depends on the ability to quickly produce a large, compact thicket and declines with the increase in the shade. The third group represented by raspberry *R. idaeus* does not pose too much threat to young forest plantations. Species with intermediate growth traits (e.g. *R. nessensis*) can have a negative effect when they form a large and compact bush, although in most cases their populations are loose and do not hinder the growth of seedlings; in reverse, in the first stages of patch formation, they can even contribute to an increase in the number of species, similarly as it happens under the tree canopy in managed forests (Chmura et al. 2013).

### **Conflict of interest**

The authors declare the lack of potential conflicts.

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## Author's contribution

M.M.W. – concept, field work, data compilation, result interpretation, manuscript writing – 40%; M.N.W. – field work, data compilation, interpretation of results, manuscript writing – 30%; K. O. – interpretation of results, manuscript writing – 30%.

## Annex

1. Dąbrówki, N50°07'58.7", E22°13'13.7", 16.07.2014. Young plantation *Pinus sylvestris*. List of species: *Agrostis capillaris*, *Betula pendula*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carex ovalis*, *Carex pallescens*, *Carex pilulifera*,

*Cerastium holosteoides*, *Chamaenerion angustifolium*, *Conyza canadensis*, *Erechtites hieracifolia*, *Festuca rubra*, *Frangula alnus*, *Hieracium pilosella*, *Hieracium sabaudum*, *Hypericum perforatum*, *Juncus effusus*, *Lactuca serriola*, *Luzula pilosa*, *Moehringia trinervia*, *Pinus sylvestris*, *Poa pratensis*, *Populus tremula*, *Pteridium aquilinum*, *Quercus rubra*, *Rubus ambrosius*, *Rubus grabowskii*, *Rubus gracilis*, *Rubus idaeus*, *Rubus nessensis*, *Rubus plicatus*, *Rumex acetosella*, *Salix caprea*, *Sambucus racemosa*, *Sarothamnus scoparius*, *Solidago gigantea*, *Sorbus aucuparia*, *Vaccinium myrtillus*, *Veronica officinalis*;

2. Dąbrówka, N50°07'38.5", E22°13'24.2", 16.07.2014. Young plantation *Quercus robur*–*Pinus sylvestris*. List of species: *Alnus glutinosa*, *Athyrium filix-femina*, *Betula pendula*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carex pilulifera*, *Dryopteris carthusiana*, *Frangula alnus*, *Galeopsis speciosa*, *Juncus effusus*, *Luzula multiflora*, *Luzula pilosa*, *Maianthemum bifolium*, *Oxalis acetosella*, *Pinus sylvestris*, *Pteridium aquilinum*, *Quercus robur*, *Quercus rubra*, *Rubus hirtus*, *Rubus idaeus*, *Rubus plicatus*, *Solidago gigantea*, *Sorbus aucuparia*, *Tilia cordata*, *Urtica dioica*, *Vaccinium myrtillus*;

3. Area between Julin and Wydrze, N50°13'41.9", E22°14'57.8", 16.07.2014. Young plantation *Quercus robur*–*Tilia cordata*. List of species: *Agrostis capillaris*, *Allium victorialis*, *Alnus glutinosa*, *Athyrium filix-femina*, *Betula pendula*, *Bidens frondosa*, *Carex brizoides*, *Carex remota*, *Carpinus betulus*, *Cirsium palustre*, *Conyza canadensis*, *Deschampsia caespitosa*, *Epilobium ciliatum*, *Erechtites hieracifolia*, *Erigeron annuus*, *Frangula alnus*, *Galium palustre*, *Gnaphalium uliginosum*, *Holcus lanatus*, *Impatiens noli-tangere*, *Juncus bufonius*, *Juncus effusus*, *Juncus tenuis*, *Moehringia trinervia*, *Oxalis fontana*, *Poa annua*, *Polygonum minus*, *Polygonum amphibium*, *Polygonum hydropiper*, *Ranunculus repens*, *Rubus hirtus*, *Rubus idaeus*, *Rubus nessensis*, *Rubus plicatus*, *Scutellaria galericulata*, *Solidago gigantea*, *Sorbus aucuparia*;

4. Wola Zarczycka, N50°18'04.4", E22°15'43.5", 16.07.2014. Young plantation *Pinus sylvestris*. List of species: *Agrostis capillaris*, *Anthoxanthum odoratum*, *Betula pendula*, *Calamagrostis epigejos*, *Conyza canadensis*, *Corynephorus canescens*, *Deschampsia flexuosa*, *Chamaenerion angustifolium*, *Frangula alnus*, *Hieracium pilosella*, *Hieracium umbellatum*, *Hypochoeris radicata*, *Jasione montana*, *Melampyrum pratense*, *Padus serotina*, *Pinus sylvestris*, *Populus tremula*, *Quercus robur*, *Rubus gracilis*, *Rubus idaeus*, *Rubus plicatus*, *Rumex thyrsiflorus*, *Senecio viscosus*, *Sorbus aucuparia*;

5. Area between Wilkowyja and Podbór, N50°14'01.8", E22°21'55.7", 16.07.2014. Young plantation *Pinus sylvestris*. List of species: *Betula pendula*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carex pilulifera*, *Corynephorus canescens*, *Deschampsia flexuosa*, *Fagus sylvatica*, *Frangula alnus*, *Hypochoeris radicata*, *Populus tremula*, *Pteridium aquilinum*, *Quercus robur*, *Rubus plicatus*, *Sarothamnus scoparius*, *Sorbus aucuparia*, *Vaccinium vitis-idaea*;

6. Opaleniska, N50°07'45.6", E22°24'02.1", 16.07.2014. Young plantation *Pinus sylvestris*–*Quercus robur*. List of species: *Agrostis capillaris*, *Betula pendula*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carex pilulifera*, *Carpinus betulus*, *Conyza canadensis*, *Deschampsia caespitosa*, *Echinochloa crus-galli*, *Erechtites hieracifolia*, *Fallopia convolvulus*, *Frangula alnus*, *Holcus lanatus*, *Hypericum perforatum*, *Juncus effusus*, *Luzula pilosa*, *Lysimachia vulgaris*, *Maianthemum bifolium*, *Pteridium aquilinum*, *Quercus rubra*, *Rubus gracilis*, *Rubus hirtus*, *Rubus plicatus*, *Rumex acetosella*, *Solidago gigantea*, *Sorbus aucuparia*, *Vaccinium myrtillus*, *Veronica officinalis*;

7. Smolarzyny, N50°07'35.4", E22°18'11.6", 16.07.2014. Young plantation *Pinus sylvestris*. List of species: *Agrostis capillaris*, *Betula pendula*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carex ovalis*, *Carex pilulifera*, *Conyza canadensis*, *Corynephorus canescens*, *Deschampsia caespitosa*, *Digitaria sanguinalis*, *Erechtites hieracifolia*, *Frangula alnus*, *Hieracium sabaudum*, *Juncus compressus*, *Juncus effusus*, *Lactuca serriola*, *Luzula multiflora*, *Molinia caerulea*, *Polygonum lapathifolium* subsp. *lapathifolium*, *Pteridium aquilinum*, *Rubus ambrosius*, *Rubus gracilis*, *Rubus hirtus*, *Rubus nessensis*, *Rubus plicatus*, *Sarothamnus scoparius*, *Sorbus aucuparia*, *Vaccinium myrtillus*;

8. Wysoka Głogowska, N50°09'38.6", E21°59'50.0", 06.08.2014. Young plantation *Pinus sylvestris*. List of species: *Agrostis capillaris*, *Betula pendula*, *Bidens frondosa*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carex brizoides*, *Carex echinata*, *Carex elongata*, *Carex hirta*, *Carex ovalis*, *Carex pilulifera*, *Carex remota*, *Conyza canadensis*, *Deschampsia caespitosa*, *Echinochloa crus-galli*, *Erechtites hieracifolia*, *Frangula alnus*, *Hypochoeris radicata*, *Juncus effusus*, *Lactuca serriola*, *Molinia caerulea*, *Pinus sylvestris*, *Polygonum minus*, *Pteridium aquilinum*, *Rubus hirtus*, *Rubus idaeus*, *Rubus nessensis*, *Rubus plicatus*, *Sorbus aucuparia*, *Vaccinium myrtillus*;

9. Głogów Małopolski, N50°10'11.7", E21°56'54.4", 06.08.2014. Young plantation *Pinus sylvestris*, wet place. List of species: *Betula pendula*, *Betula pubescens*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Chamaenerion angustifolium*, *Dryopteris carthusiana*, *Frangula alnus*, *Juncus effusus*, *Lysimachia vulgaris*, *Molinia caerulea*, *Pteridium aquilinum*, *Quercus petraea*, *Quercus robur*, *Quercus ×rosacea*, *Rubus hirtus*, *Rubus idaeus*, *Rubus nessensis*, *Rubus plicatus*, *Salix aurita*, *Sorbus aucuparia*, *Vaccinium myrtillus*;

10. Leszcze, N50°11'04.8", E21°39'18.3", 06.08.2014. Young plantation *Pinus sylvestris*. List of species: *Agrostis capillaris*, *Alnus glutinosa*, *Betula pendula*, *Betula pubescens*, *Calamagrostis epigejos*, *Carex digitata*, *Conyza canadensis*, *Frangula alnus*, *Juncus effusus*, *Luzula pilosa*, *Maianthemum bifolium*, *Molinia caerulea*, *Mycelis muralis*, *Oxalis acetosella*, *Padus serotina*, *Pinus sylvestris*, *Populus tremula*, *Pteridium aquilinum*, *Pyrus pyraeaster*, *Quercus robur*, *Rubus*

*idaeus*, *Rubus nessensis*, *Rubus pedemontanus*, *Salix caprea*, *Sambucus nigra*, *Sambucus racemosa*, *Solidago gigantea*, *Sorbus aucuparia*, *Vaccinium myrtillus*, *Veronica officinalis*;

11. Dąbry, N50°06'05.5", E21°49'29.6", 18.08.2014. Young plantation *Quercus robur*. List of species: *Acer pseudoplatanus*, *Athyrium filix-femina*, *Calamagrostis epigejos*, *Carex brizoides*, *Echinochloa crus-galli*, *Frangula alnus*, *Galeopsis bifida*, *Impatiens parviflora*, *Juncus effusus*, *Molinia caerulea*, *Pinus sylvestris*, *Polygonatum multiflorum*, *Pteridium aquilinum*, *Rubus hirtus*, *Rubus idaeus*, *Rubus nessensis*, *Sambucus nigra*, *Urtica dioica*;

12. Dąbry, N50°06'05.6", E21°49'07.3", 18.08.2014. Young plantation *Pinus sylvestris*. List of species: *Agrostis capillaris*, *Alnus glutinosa*, *Betula pendula*, *Calamagrostis epigejos*, *Carex brizoides*, *Carpinus betulus*, *Conyza canadensis*, *Erechtites hieracifolia*, *Frangula alnus*, *Hypericum maculatum*, *Juncus effusus*, *Luzula pilosa*, *Oxalis fontana*, *Pinus sylvestris*, *Populus tremula*, *Pteridium aquilinum*, *Quercus robur*, *Rubus hirtus*, *Rubus nessensis*, *Rubus plicatus*, *Salix caprea*, *Sambucus nigra*, *Solidago gigantea*, *Sorbus aucuparia*;

13. Area between Dąbry and Krzywa, N50°06'12.5", E21°46'50.4", 18.08.2014. Young plantation *Pinus sylvestris*. List of species: *Agrostis capillaris*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carex brizoides*, *Frangula alnus*, *Juncus effusus*, *Molinia caerulea*, *Pinus sylvestris*, *Polygonatum verticillatum*, *Populus tremula*, *Pteridium aquilinum*, *Quercus robur*, *Rubus hirtus*, *Rubus idaeus*, *Rubus nessensis*, *Rubus plicatus*, *Salix aurita*, *Salix caprea*, *Solidago gigantea*, *Sorbus aucuparia*;

14. Area between Dąbry and Krzywa, N50°06'10.7", E21°46'51.0", 18.08.2014. Young plantation *Pinus sylvestris*. List of species: *Achillea millefolium*, *Agrostis capillaris*, *Alnus glutinosa*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carex brizoides*, *Carpinus betulus*, *Chamaenerion angustifolium*, *Conyza canadensis*, *Eupatorium cannabinum*, *Frangula alnus*, *Galeopsis speciosa*, *Juncus effusus*, *Luzula pilosa*, *Lysimachia vulgaris*, *Molinia caerulea*, *Polygonum hydropiper*, *Rubus hirtus*, *Rubus idaeus*, *Rubus nessensis*, *Rubus plicatus*, *Salix aurita*, *Salix caprea*, *Sambucus nigra*, *Scrophularia nodosa*, *Solidago gigantea*, *Stellaria holostea*, *Urtica dioica*;

15. Pustków, N50°06'56.6", E21°32'31.4", 18.08.2014. Young plantation *Pinus sylvestris*. List of species: *Agrostis capillaris*, *Betula pendula*, *Calamagrostis epigejos*, *Carex pilulifera*, *Carpinus betulus*, *Conyza canadensis*, *Danthonia decumbens*, *Fagus sylvatica*, *Juncus tenuis*, *Luzula pilosa*, *Padus serotina*, *Pinus sylvestris*, *Pteridium aquilinum*, *Quercus robur*, *Quercus rubra*, *Rubus apricus*, *Rubus glivicensis*, *Rubus gracilis*, *Rubus hirtus*, *Rumex acetosella*, *Sorbus aucuparia*, *Vaccinium myrtillus*, *Veronica officinalis*;

16. Area between Podlesie Skrzyszowskie and Kochanówka N50°06'50.8", E21°33'26.2", 18.08.2014. Young

plantation *Pinus sylvestris*. List of species: *Alnus glutinosa*, *Betula pendula*, *Carex brizoides*, *Carex pilulifera*, *Conyza canadensis*, *Frangula alnus*, *Galeopsis bifida*, *Impatiens parviflora*, *Juncus effusus*, *Lysimachia vulgaris*, *Maianthemum bifolium*, *Molinia caerulea*, *Oxalis fontana*, *Padus avium*, *Padus serotina*, *Pinus sylvestris*, *Pteridium aquilinum*, *Quercus robur*, *Quercus rubra*, *Rubus ambrosius*, *Rubus apricus*, *Rubus idaeus*, *Rubus nessensis*, *Rubus plicatus*, *Solidago gigantea*, *Sorbus aucuparia*, *Trentalis europaea*, *Urtica dioica*, *Vaccinium myrtillus*;

17. Brzeźnica, N50°05'34.4", E21°27'59.1", 18.08.2014. Young plantation *Pinus sylvestris*–*Quercus robur*. List of species: *Calamagrostis epigejos*, *Carpinus betulus*, *Conyza canadensis*, *Cornus sanguinea*, *Corylus avellana*, *Cucubalus baccifer*, *Euonymus europaea*, *Euphorbia cyparissias*, *Fallopia convolvulus*, *Hypericum perforatum*, *Padus avium*, *Padus serotina*, *Quercus robur*, *Quercus rubra*, *Rubus ambrosius*, *Rubus apricus*, *Rubus camptostachys*, *Rubus glivicensis*, *Rubus idaeus*, *Rubus nessensis*, *Rubus plicatus*, *Sambucus nigra*, *Solidago gigantea*, *Sorbus aucuparia*, *Torilis japonica*, *Urtica dioica*;

18. Toporów, N50°19'03.7", E21°35'06.1", 18.08.2014. Young plantation *Pinus sylvestris*. List of species: *Betula pendula*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carex pilulifera*, *Frangula alnus*, *Maianthemum bifolium*, *Melampyrum pratense*, *Molinia caerulea*, *Padus serotina*, *Pteridium aquilinum*, *Quercus robur*, *Quercus rubra*, *Rubus plicatus*, *Sorbus aucuparia*, *Vaccinium myrtillus*;

19. Ostrowy Baranowskie, N50°20'33.1", E21°37'35.8", 18.08.2014. Young plantation *Pinus sylvestris*. List of species: *Betula pendula*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carpinus betulus*, *Deschampsia flexuosa*, *Festuca ovina*, *Hieracium murorum*, *Luzula pilosa*, *Melampyrum pratense*, *Padus serotina*, *Polygonatum multiflorum*, *Pteridium aquilinum*, *Quercus petraea*, *Quercus robur*, *Quercus rubra*, *Rubus nessensis*, *Rubus plicatus*, *Solidago virga-aurea*, *Sorbus aucuparia*, *Taraxacum officinale*, *Vaccinium myrtillus*;

20. Ostrowy Baranowskie, N50°20'32.1", E21°37'30.2", 18.08.2014. Young plantation *Pinus sylvestris*. List of species: *Betula pendula*, *Calamagrostis epigejos*, *Calluna vulgaris*, *Carex pilulifera*, *Conyza canadensis*, *Danthonia decumbens*, *Deschampsia flexuosa*, *Dryopteris carthusiana*, *Erechtites hieracifolia*, *Euonymus verrucosa*, *Festuca ovina*, *Filago minima*, *Frangula alnus*, *Galeopsis bifida*, *Hypochoeris radicata*, *Juniperus communis*, *Lembotropis nigricans*, *Luzula pilosa*, *Mycelis muralis*, *Padus serotina*, *Peucedanum oreoselinum*, *Polygonatum multiflorum*, *Pyrus pyraister*, *Quercus robur*, *Rubus gracilis*, *Rubus nessensis*, *Rubus plicatus*, *Solidago gigantea*, *Vaccinium myrtillus*, *Vaccinium vitis-idaea*, *Veronica officinalis*, *Viola canina*, *Viola reichenbachiana*.