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FLORA STRUCTURE IN RURAL PARKS ON EXAMPLE OF SANDOMIERSKA VALLEY

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Abstract. The paper presents analysis of flora structure in rural parks on the example of the Sandomierska Valley. The research was done in 51 rural parks, (landscape historic style). Parks were established in XVIII-XIX centuries (landscape historic style) on oak-hornbeam site ver. małopolska. Parks were divided into groups including area and antropic pressure.

Key words: flora*, flora structure, rural park, oak-hornbeam sites, Sandomierska Valley

INTRODUCTION

Flora of rural parks which are created or adopted by human is an integral biotic element of nature [Wysocki and Sikorski 2002]. Rural parks are also seen as a 'forest islands' [Dąbrowska-Prot 1995, Wójcik 1991] in agricultural landscape. The process was observed of changing shade trees planted by human into forest/wood [Olaczek 1976]. Plant species are modified by natural factors, for example single trees grow or die out [Olaczek 1976], and anthropogenic factors [Wysocki and Sikorski 2002].

The general aim of the article is to present analysis of the flora structure in rural parks on the example of the Sandomierska Valley including areas of research objects and antropic pressure.

METHODOLOGY

The research was done in 51 rural parks. Parks were established in XVIII and XIX centuries (landscape historic style) on oak-hornbeam site variety małopolska on the

* Flora – plants which occur on the the surface of the Earth [Matuszkiewicz 1999]. Flora – plants which occur on the the surface of the rural parks in present article.

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minimum area of 2 ha on the example of the Sandomierska Valley (14.5 thousand km^2 area) according to geobotanical division of Matuszkiewicz [1993].

Rural parks were divided based on the area and antropic pressure (Table 1 and 2). The following 51 rural parks were identified: big parks (25 objects) on area above 6 ha, medium parks (14 objects) on area of 4.1-6 ha and small parks (12 objects) on area of 2.1-4 ha.

Table 1. Number of rural parks – division based on area
Tabela 1. Liczba parków wiejskich – podział ze względu na powierzchnię

Typ of rural park Rodzaj parku wiejskiego	Area, ha Powierzchnia, ha	Number of rural parks Liczba parków
Big parks Parki duże	> 6.0	25
Medium parks Parki średnie	4.1-6.0	12
Small parks Parki małe	2.0-4.0	14

Table 2. Number of rural parks – division based on antropic pressure
Tabela 2. Liczba parków – podział ze względu na stopień intensywności pielęgnacji

Division based on antropic pressure Podział ze względu na pielęgnację	With antropic pressure Pielęgnowne	Without antropic pressure Niepielęgnowane
Number of objects Liczba obiektów	29	22

The methodology included two research stages: field research and indoor studies. Flora research assumed syntaxonomic and structure analysis. The field research was done in years 2004-2005, including 101 phytosociological records on the area 500 m^2 (1-3 phytosociological records on each park) according Braun-Blanquet method [Braun--Blanquet 1964]. Date base of phytosociological records was built using JUICE 6.2.85 programme [Tichỳ 2002] and numerical analysis using TWINSPAN program [Hill 1979]. Percentage covers of species in syntaxonomical unites were done for tree layer (A), shrub layer (B) and herb layer (C) [Wysocki and Sikorski 2002]. Plant species were grouped based on phytosociological syntaxonomic division according by Matuszkiewicz [2001].

RESULTS

Flora structure in rural parks has three layers: tree layer (A), shrub layer (B) and herb layer (C). Percentage covers of plant species in syntaxonomical unites were diffrent in each flora layers in rural parks.

Flora diversity in rural parks by TWINSPAN method

Two oak-hornbeam types were distinguished following by 101 phytosociological records dychotomocal division in parks (Fig. 1). The first type was *Tilio-Carpinetum* with low cover of different plant species*, and the other type *Tilio-Carpinetum* with *Sambucus nigra* and *Aegopodium podagraria*. *Tilio-Carpinetum* type with *Sambucus nigra* and *Aegopodium podagraria* were divided into two kinds of communities: *Tilio--Carpinetum* with *Prunus padus* and *Tilio-Carpinetum* with wellrenewable *Carpinus betulus*.

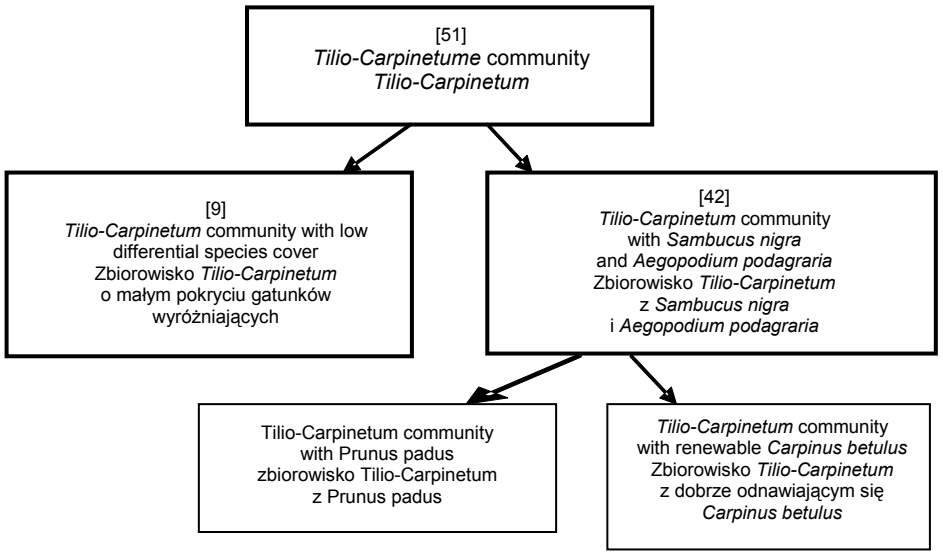

Fig. 1. Dychotomical division of *Tilio-Carpinetum* in rural parks according TWINSPAN program [51], [9], [42] – number of rural parks
Rys. 1. Podział dychotomiczny zbiorowiska *Tilio-Carpinetum* w parkach wiejskich według programu TWINSPAN: [51], [9], [42] – liczba parków wiejskich

Syntaxonomic structure analysis of flora in rural parks

Plant species which grew in rural parks were represented by 12 plant communites (Fig. 2): eutrophic forest community (*Querco-Fagetea*), riparian forest and brush of river valley (*Salicetea purpureae*) coniferous forest communities (*Vaccinio-Piceetea*), cut-over communities (*Epilobietea angustifolii*), bushes communities (*Rhamno--Prunetea*), meadow and pasture communities (*Molinio-Arrhenatheretea*), margin communities (*Trifolio-Geranietea sanguinei*), grass and heath communities (*Nardo-Callunetea*), pioneer xerothermic communities (*Agropyretea*), ruderal communities (*Artemisietea vulgaris*), segetal communities (*Stellarietea mediae*) and companion plant species. Percentage cover of plant species *Querco-Fagetea* class was the highest in rural parks (Fig. 2).

* Different species – taxons with high frequency in each set > 80%.

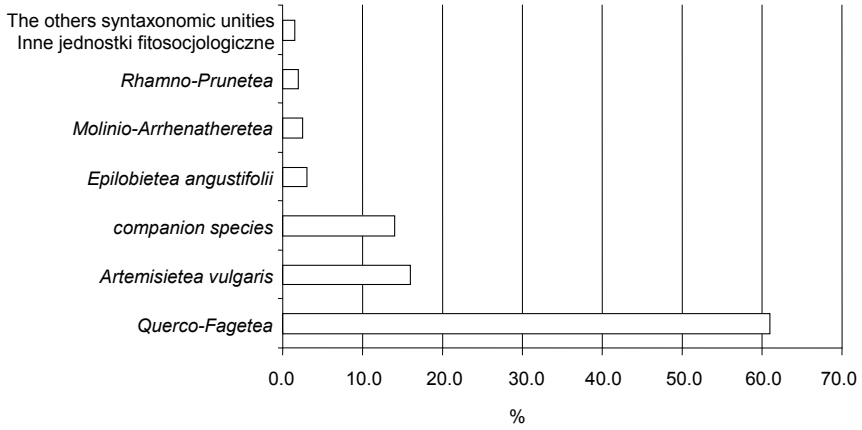

Fig. 2. Percentage cover of plant species in different syntaxonomic unities in rural parks
Rys. 2. Udział gatunków różnych jednostek syntaksonomicznych w pokryciu szaty roślinnej parków wiejskich

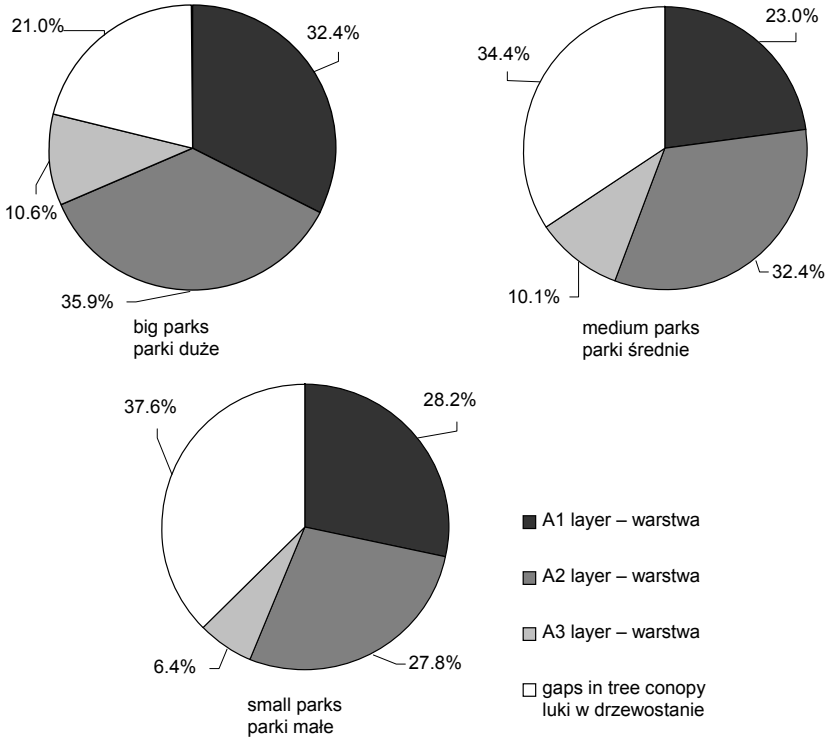

Fig. 3. Percentage cover of plant species in tree layer in rural parks with antropic pressure
Rys. 3. Udział gatunków w pokryciu w warstwie drzewostanu w parkach pielęgnowanych

Syntaxonomic analysis of plant species in tree layer (A) in parks with antropic pressure

Percentage of plant species in tree layer was the highest in big parks with antropic pressure. Moreover gaps took up 21% in tree conopy. Plant species constituted the lowest cover of tree layer and tree conopy in small parks (Fig. 3).

The highest percentage cover of plant species from *Querco-Fagetea* was in tree layer in big parks with antropic pressure. These were represented by: *Tilia cordata* – 5.7%, *Carpinus betulus* – 5.6% i *Acer platanoides* – 4.2%, *Fraxinus excelsior* – 3.5%. The others plant species had lower percentage cover in tree layer. These were: *Quercus robur, Robinia pseudoacacia, Alnus glutinosa, Ulmus leavis, Fagus sylvatica, Aesculus hippocastanum, Acer campestre, Populus alba, Betula pendula, Larix decidua, Pinus sylvestris* and *Corylus avellana* (Fig. 4).

Species from *Querco-Fagetea* also dominated in A layer in medium parks with antropic pressure. The highest cover of species in tree layer was represented by *Carpinus betulus* – 7.9%, *Acer platanoides* – 5.2% and *Tilia cordata* – 3.2% (Fig. 5).

Plant species like *Acer platanoides* – 5.2%, *Tilia cordata* – 4.7% i *Carpinus betulus* – 4,5% had got the highest cover in A layer in small parks with antropic pressure (Fig. 6).

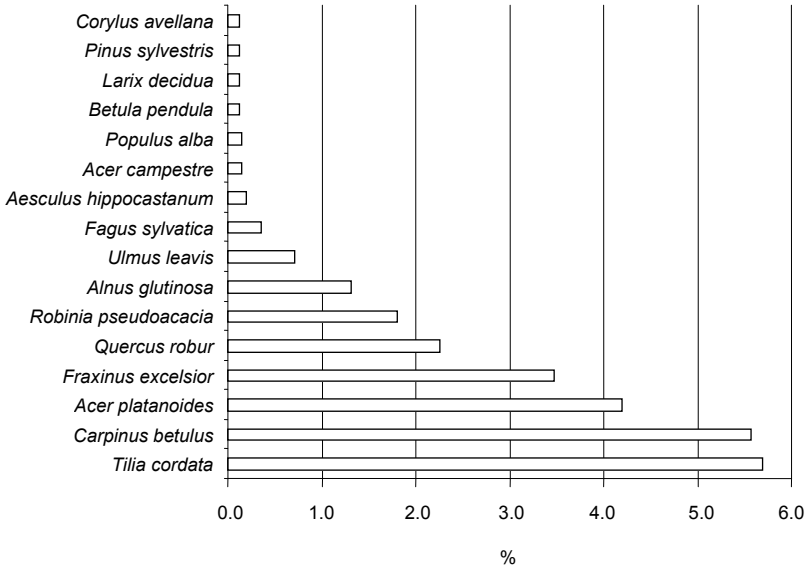

Fig. 4. Percentage cover of plant species in tree layer in big rural parks with antropic pressure
Rys. 4. Udział gatunków w pokryciu w warstwie drzewostanu w parkach dużych pielęgnowanych

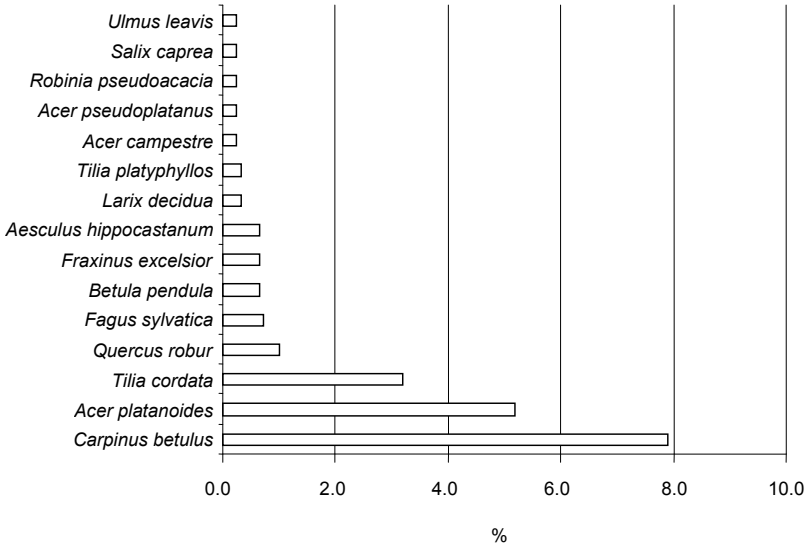

Fig. 5. Percentage cover of plant species in tree layer in medium rural parks with antropic pressure
Rys. 5. Udział gatunków w pokryciu w warstwie drzewostanu w parkach średnich pielęgnowanych

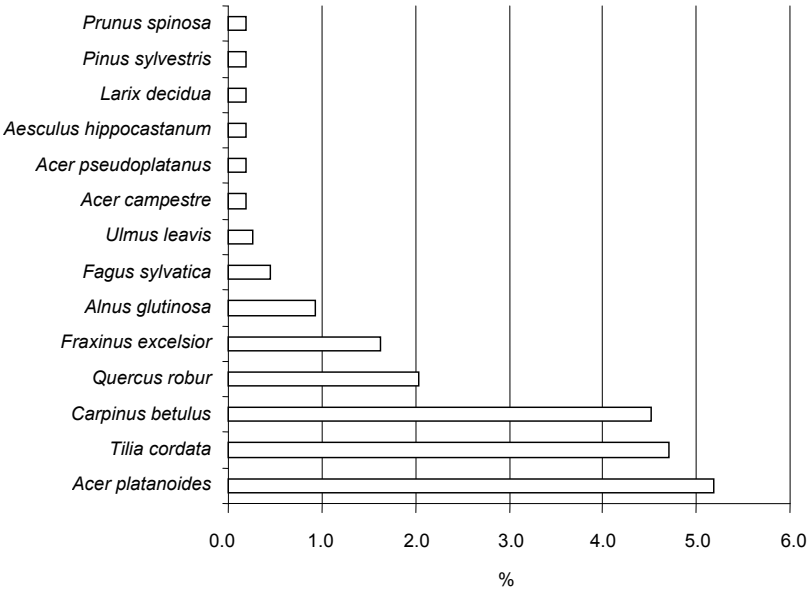

Fig. 6. Percentage cover of plant species in tree layer in small rural parks with antropic pressure
Rys. 6. Udział gatunków w pokryciu w warstwie drzewostanu w parkach małych pielęgnowanych

Syntaxonomic analysis of plant species in tree layer (A) in parks without antropic pressure

Plant species had the highest cover – (95.2%) in tree layer (A) in big parks without antropic pressure. It concerned all layers of tree stand (A1, A2 and A3). Gaps were the lowest (4.8%) in tree conopy in big rural parks, too. Percentage cover of species in A layer was lower in small (75%) and medium parks (76.4%) than in big ones (Fig. 7).

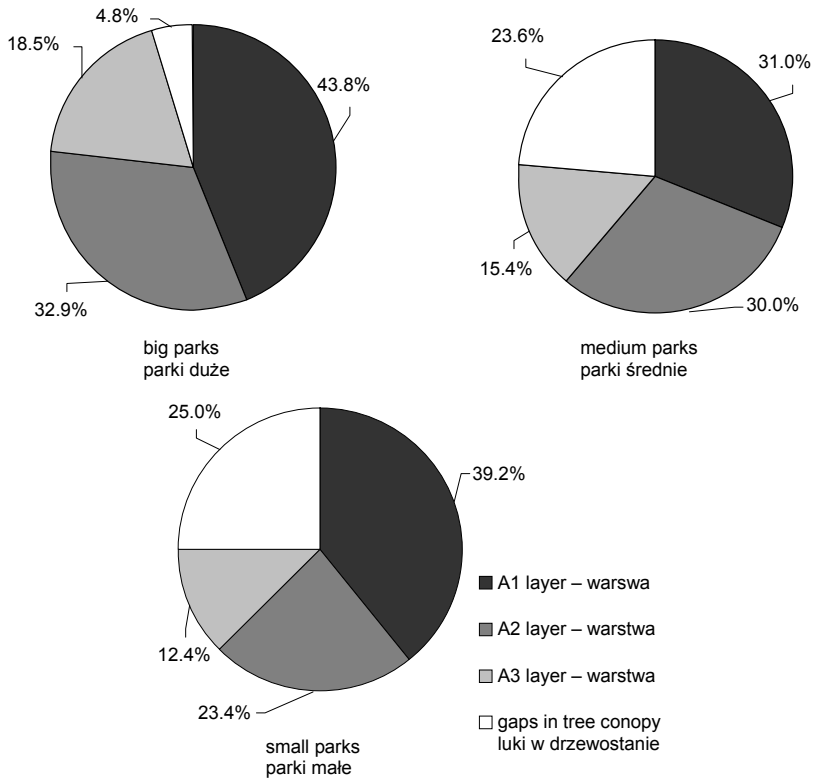

Fig. 7. Percentage cover of plant species in tree layer in rural parks without antropic pressure
Rys. 7. Udział gatunków w pokryciu w warstwie drzewostanu w parkach niepielęgnowanych

Plant species which represented *Querco-Fagetea* like: *Carpinus betulus, Tilia cordata, Fraxinus excelsior* and *Acer platanoides* were dominated in all rural parks without antropic pressure. *Carpinus betulus* had the highest cover in tree layer in big parks. It was 10.8%.

However, species like *Populus alba* from *Salicetea purpureae* (Fig. 8, 9, 10) and *Aesculus hippocastanum* (Fig. 10, 11, 12) or *Alnus glutinosa* (Fig. 8) from companion plant species were occurred in tree layer in all types of parks, too.

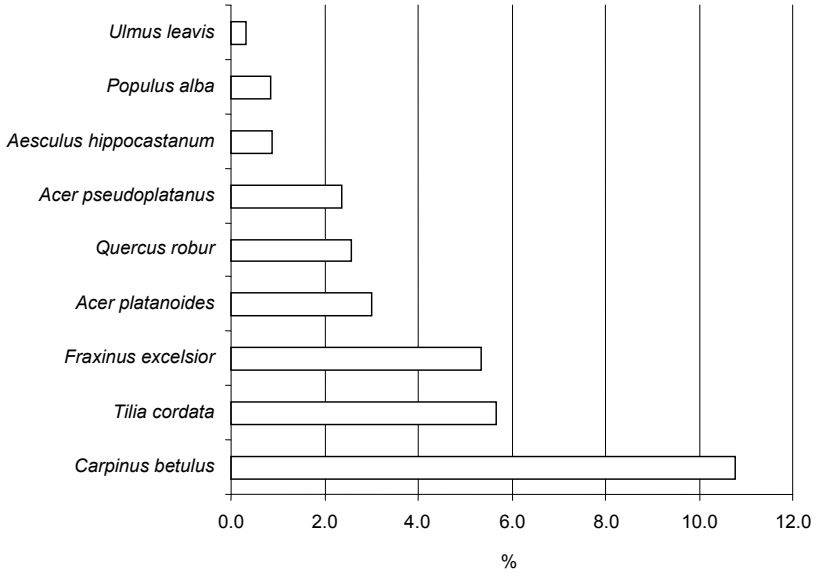

Fig. 8. Percentage cover of plant species in tree layer in big rural parks without antropic pressure
Rys. 8. Udział gatunków w pokryciu w warstwie drzewostanu w parkach dużych niepielęgnowanych

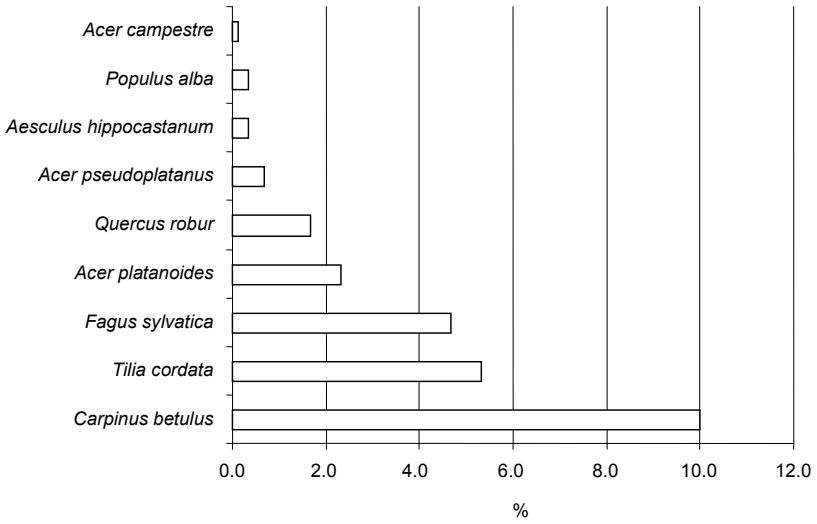

Fig. 9. Percentage cover of plant species in tree layer in medium rural parks without antropic pressure
Rys. 9. Udział gatunków w pokryciu w warstwie drzewostanu w parkach średnich niepielęgnowanych

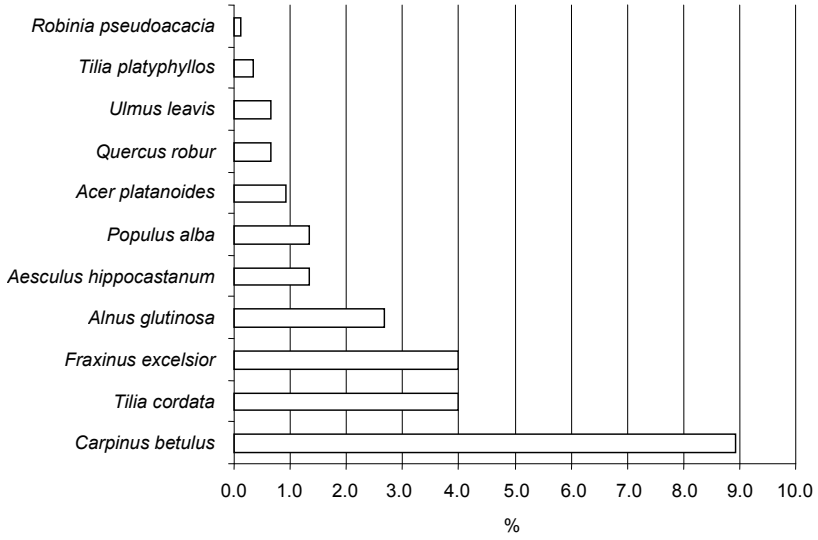

Fig. 10. Percentage cover of plant species in tree layer in small rural parks without antropic pressure
Rys. 10. Udział gatunków w pokryciu w warstwie drzewostanu w parkach małych niepielęgnowanych

The plant cover which grew in A layer was dominated by *Carpinus betulus* in medium parks without antropic pressure, but it was lower than in big objects. Apart from *Carpinus betulu*s, *Fagus sylvatica* occurred in tree layer – 4.7% of cover (Fig. 11).

Syntaxonomic analysis of plant species in shrub layer (B) in parks without antropic pressure

Plant species from *Querco-Fagetea* had the highest percentage cover of plants (19.4%) in shrub layer in parks without antropic pressure. These were: *Euonymus verrucosus, Acer platanoides* and *Carpinus betulus*. Percentage cover of plant species from *Querco-Fagetea* was the highest in B layer of big parks without antropic pressure. However, species cover from *Epilobietea angustifolii* was the highest 1.35% in B layer in parks without antropic pressure compared with parks with human interferences. The percentage of plant species from *Rhamno-Prunetea* and *Vaccinio-Piceetea* was only 0.7% i 0.1% in shrub layer (Fig. 11).

Syntaxonomic analysis of plant species in shrub layer (B) in parks with antropic pressure

Plant species belonged to 5 syntaxonomical classes like *Querco-Fagetea, Epilobietea angustifolii, Rhamno-Prunetea, Salicetea purpureae, Galio-Urticeuea* and companion species in shrub layer in rural parks with antropic pressure. However, plant species from *Ouerco-Fagetea* had the highest percentage cover of plants (7.3%) in shrub layer. Percentage cover of plants from *Epilobietea angustifolii* was 3.15% in B layer (Fig. 12).

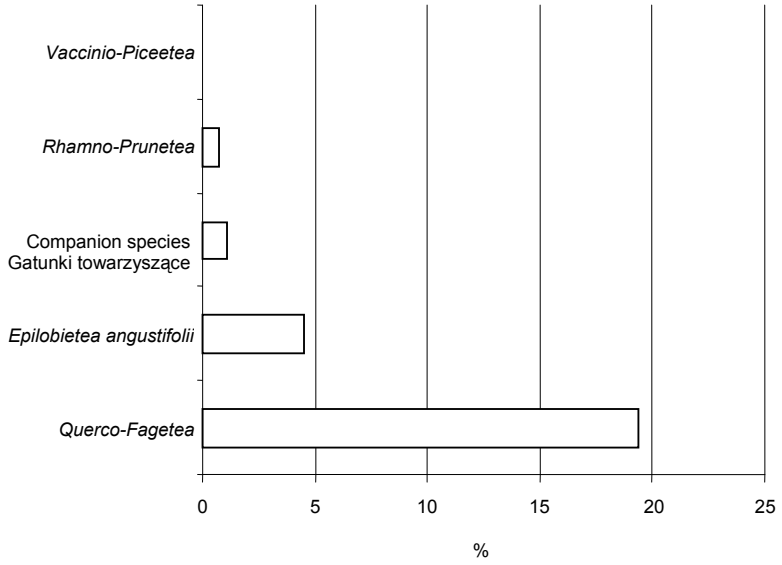

Fig. 11. Percentage cover of plant species in different syntaxonomic unities in shrub layer (B) in rural parks without antropic pressure
Rys. 11. Udział gatunków różnych jednostek syntaksonomicznych w pokryciu w warstwie B w parkach niepielęgnowanych

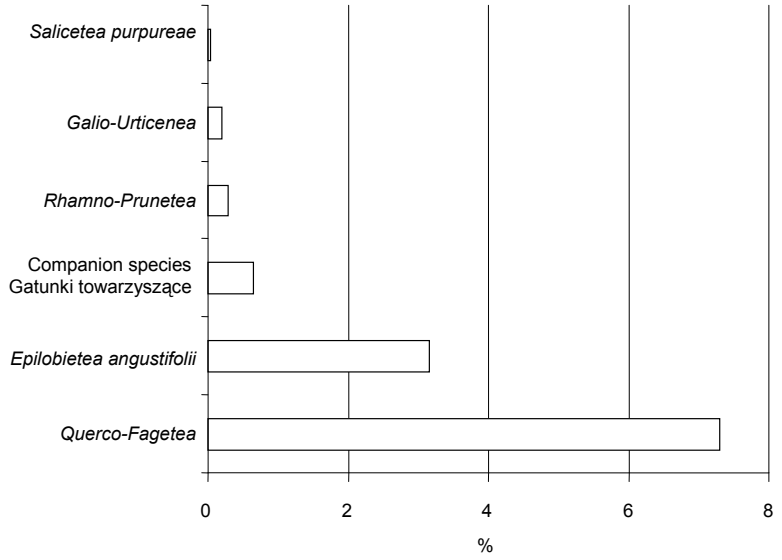

Fig. 12. Percentage cover of plant species in different syntaxonomic unities in shrub layer (B) in rural parks with antropic pressure
Rys. 12. Udział gatunków różnych jednostek syntaksonomicznych w pokryciu w warstwie B w parkach pielęgnowanych

Syntaxonomic analysis of plant species in herb layer (C) in parks without antropic pressure

Plant species from *Querco-Fageta* (64%) represented by *Anemone nemerosa*, *Aegopodium podagraria*, *Gogea lutea*, *Galeobdelon luteum*, *Corydalis cava*, *Millium effusum*, *Vinca minor* and companion species (22.9%) were dominated in herb layer in rural parks without antropic pressure. Herbaceous plants from *Epilobietea angustifolii* and *Rhamno-Prunetea* had 1.8% of cover in herb layer. The plant cover from *Artemisieta vulgaris* (7%) and *Molinio-Arrhenathereta* (1.8%) was lower in herb layer in parks without antropic pressure than in parks with antropic pressure. Percentage cover of plant species from *Trifolio-Geranietea sanguinei*, *Agropyretea*, *Stellarietea mediae* was the lowest in herb layer (0.6%; Fig. 13).

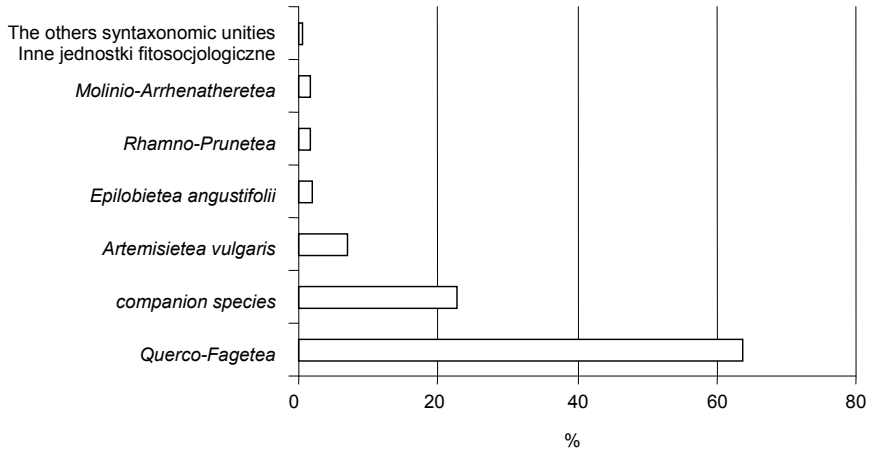

Fig. 13. Percentage cover of plant species in different syntaxonomic unities in herb layer (C) in rural parks without antropic pressure
Rys. 13. Udział gatunków różnych jednostek syntaksonomicznych w pokryciu w warstwy ziół w parkach niepielęgnowanych

Syntaxonomic analysis of plant species in herb layer (C) in parks with antropic pressure

Plant species belonged to 8 syntaxonomical classes like *Querco-Fageta*, *Epilobietea angustifolii*, *Rhamno-Prunetea*, *Molinio-Arrhenatheretea*, *Trifolio-Geranietea sanguinei*, *Agropyretea*, *Artemisieta vulgaris*, *Stellarietea mediae* and companien species in herb layer in rural parks with antropic pressure (Fig. 14). Herbaceous plants from *Querco-Fagetea* had the highest cover of plants (47%) in C layer in parks with antropic pressure Plants from *Artemisieta vulgaris* (27.2% of cover) were represented by: *Chelidonium majus*, *Impatiens parviflora*, *Urtica dioica* in herb layer. The next group of plants was companion species (17.9%). Plant cover from *Molinio-Arrhenatheretea* (3.7%), *Trifolio-Geranietea sanguinei*, *Agropyretea*, *Stellarietea mediae* (2.3%) was higher in herb layer of parks with antropic pressure than in parks without antropic pressure (*Molinio-Arrhenatheretea* – 1.8%, *Trifolio-Geranietea sanguinei*, *Agropyretea* and *Stellarietea mediae* – 0.6%).

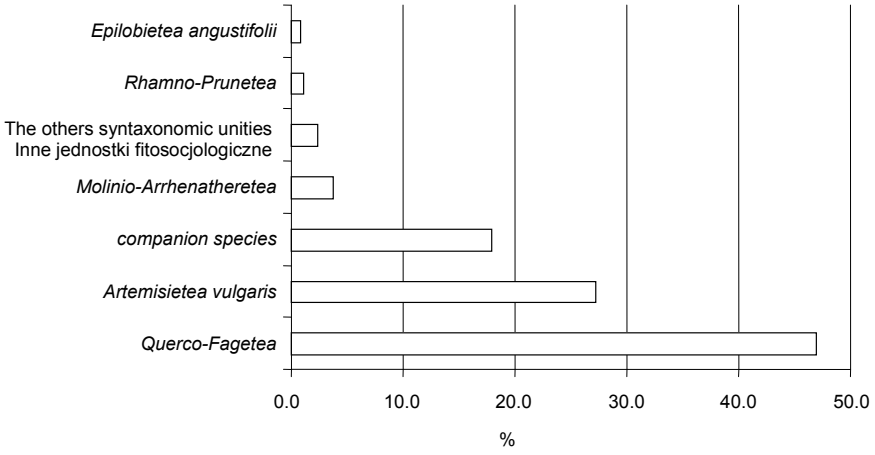

Fig. 14. Percentage cover of plant species in different syntaxonomic unities in herb layer (C) in rural parks with antropic pressure
Rys. 14. Udział gatunków różnych jednostek syntaksonomicznych w pokryciu w warstwie ziół w parkach pielęgnowanych

DISCUSSION

The following research about the diversity of flora in rural parks distinguished two types of *Tilio-Carpinetum* on the example of the Sandomieska Valley using TWINSPAN method. There were: *Tilio-Carpinetum* with fewer wooden species and *Tilio--Carpinetum* with wooden species. The similar results of the flora research was achieved by Sikorski [2002], who recognized two types of *Tilio-Carpninetum* in rural parks in the West Masurian Region.

The research done by Hermy and Stieperaere [1981], Dzwonko and Loster [2001] also confirmed wooden plant species in rural parks. Percentage cover of plant species from *Querco-Fageta* was 59% in flora layers (A, B, C) in rural parks on example of the West Masurian Region [Sikorski 2002] and 61% in flora layers in rural parks on the example of the Sandomierska Valley. Complete composition of wooden species from forest communities could be a natural regeneration only on the areas which are located nearby ancient forests [Dzwonko and Gawroński 1994, Bossuyt 2001].

Virgin nature of parks disappeared and these objects changed into an enclave of high greenery with many rare and even protected plant species [Sikorski 2003]. It process of transformation was observed of shade trees which were planted by humans into nature forest [Olaczek 1976].

Succession process impacted the transformation of shade trees into forest communities in neglected parks. Succession could have impact on regeneration of communities which were in the past on the researched area, too [Olaczek 1970]. The results concerning the flora of parks without antropic pressure were the evidence about it. High percentage was observed of cover of plants species typical for oak-hornbeam site in flora

layers (A, B, C) in the researched parks. Factors change between parks and surrounding nature in case of neglected parks or not proper human interferences.

It impacts the migration of species from the surroundings areas [Latowski and Zieliński 2001]. It was observed in parks located in the Sandomieska Valley. The herb layer included not only plants from *Querco-Fagetea* but also *Molinio-Arrhenatheretea* and *Trifolio-Geranietea sanguinei.* Ruderal vegetation has been dispersal in rural parks because of eutrophization of soil [Latowski and Zieliński 2001]. Plants species from *Artemisietea*, *Agropyretea* and *Stellarietea mediae* grow plentifully in many parks. It depends on the level of the disturbance to the site [Fijałkowski and Kseniak 1982].

According to Paczoski [1928] ruderal vegetation mostly occurs in disturbed plant communities. The highest percentage cover of ruderal plants was in parks with antropic pressure (mostly in small ones) on the example of the Sandomierska Valley. It probably depended on the disturbances to the site.

CONCLUSIONS

1. Flora diversity in rural parks on the example of the Sandomierska Valley depends on the area and antropic pressure.

2. The highest percentage of cover of plants on homogeneous oak-hornbeam site was found in parks without antropic pressure.

3. Synatropic plant species had the highest cover in the herb layer in parks with antropic pressure. It probably depended on the disturbances to the site.

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STRUKTURA SZATY ROŚLINNEJ PARKÓW WIEJSKICH NA PRZYKŁADZIE KRAINY KOTLINA SANDOMIERSKA

Streszczenie. W pracy podjęto próbę scharakteryzowania struktury szaty roślinnej parków wiejskich na przykładzie Krainy Kotlina Sandomierska. Badania przeprowadzono w 51 parkach, w stylu krajobrazowym, założonych na siedliskach grądu odmiany małopolskiej. Parki podzielono ze względu na powierzchnię i stopień intensywności pielęgnacji szaty roślinnej.

Słowa kluczowe: szata roślinna[*], struktura szaty roślinnej, park wiejski, siedliska grądowe, Kraina Kotlina Sandomierska

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[*] Szata roślinna – ogół roślin występujących na powierzchni Ziemi [Matuszkiewicz 1999], a w niniejszym artykule to ogół roślin na powierzchni parków wiejskich.