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Influence of light on flora in herb layer of country parks

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Abstract: *Influence of light on flora in herb layer of country parks.* In Poland country parks are mostly abandoned, so tree canopies could increased because of stopped any pressure by human. Moreover, light is very important abiotic factor to grow species in herb layer. The main purpose of the article is influence of light on flora in herb layer of country parks on example Sandomierska Basin.

Key words: light, flora, herb layer, country parks.

INTRODUCTION

In disturbaned landscape country parks are called relicts of the past in natural aspects (Rylke, 1987; Majdecki, 1993) and they are often the last places with rare forest plant species (Olaczek, 1970, 1972; Hermy and Cornelis, 2000; Sikorski, 2002; Sikorski and Wysocki, 2003; Fabiańska, 2004). Country parks are mostly abandoned, so tree canopies could increased because of stopped any pressure by human. Moreover, light is very important abiotic factor to grow species in herb layer. The main purpose of the article was influence of light on flora in herb layer of country parks on example Sandomierska Basin.

MATERIAL AND METHODS

Researches were done in 51 country parks of Sandomierska Basin located on south-east part of Poland[1]. Parks were identified big parks on area above 6 ha, medium parks on area from 4.1 ha to 6 ha and small parks on area from 2.0 ha to 4 ha. Light was measured on two types of tree-covered: one with no mowing herb layer and the other objects with mowing herb layer, where stand density[2] was no lower than 40% (Scamoni, 1967). Light measurements were made during spring and summer in 2005 and 2006. Researches were done on 101 plots (500 m^2) under tree canopies. These plots were located on the same areas where phytosociological records were done[3]. Light was measured on 5 points on each

[1] Fornal-Pieniak B., Wysocki Cz., 2007: Country parks as 'green islands' in agricultural landscape. Annals of Warsaw University of Life Sciences – SGGW, No 28: 179–188.

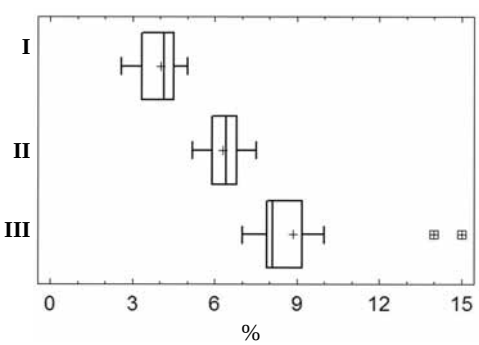
[2] Stand density – it's a space of tree canopies (Obmiński, 1978). According to Obmiński (1978) it was distinguished 5 types of stand density: 1 – tree canopies without any gaps (stand density index 100%), 2 – full stand density (stand density index: from 85.1 to 99.9%), 3 – small tree gaps are between tree canopies (stand density index: from 65.1 to 85%), 4 – tree gaps are bigger than in stand density no 3 (stand density index from 40 to 65%), 5 – without stand density (stand density index is lower than 40%).

[3] Fornal-Pieniak B., Wysocki Cz., 2007: Country parks as 'green islands' in agricultural landscape. Annals of Warsaw. University of Life Sciences – SGGW, No 28: 179–188.

plot above one meter on the ground using photometer. Species were classified according to ecological indicator values of vascular plants of Ellenberg (1991). The data were subjected to ANOVA 1 using STATGRAPHICS (version 4.1) and differences between the means were compared with the Tukey test.

RESULTS AND DISCUSSION

Quantify of light was changed in deeper vegetation layers as herb layer. Results showed that plant species in herb layer depend on variation of light intensity. Three types of stand density (one type – density index: from 85.1 to 95%, second type – density index: from 65.1 to 85% and third type – density index from 40 to 65%) were distinguished in tree canopies of country parks. Less light was receiving to herb layer in country parks where stand density index was 9.06%. Differences between three types of stand density were statistically valid in full leafy trees (Fig. 1).



I – stand density index from 85.1 to 95%,
II – stand density index from 65.1 to 85%,
III – stand density index from 40 to 65%

FIGURE 1. Percentage of received light in different type of stand density in herb layer of country parks

All three types of stand density were identified in big parks with human pressure and small, medium parks without human pressure. Full stand density and stand density with small tree gaps were in the others country parks. Average stand density was 81% in big parks without human pressure and 74% in small and medium one. Moreover, it was observed that stand density was lower in objects with human pressure (for example stand density index for big parks – 66%) than in parks without human pressure (Fig. 2).

Plant species were represented by shadow plants (ecological indicator values of vascular plants from 1 to 3 numbers according to Ellenberg et al., 1991), half shadow plants (ecological indicator values of vascular plants from 4 to 5 numbers according to Ellenberg et al., 1991) and half light plants (ecological indicator values of vascular plants form 6 to 7 numbers according to Ellenberg et al., 1991) in herb layer of country parks. Shadow plants like *Gagea lutea*, *Galeobdolon luteum*, *Mercurialis perennis*, *Asarum europaeum*, *Corydalis cava* were growing in parks where stand density index was from 85.1 to 95%. There were statistically valid differences between shadow plant cover and type of stand density of tree canopies (Fig. 3). Homogenic groups were distinguished in parks with full stand density of tree canopies and with small tree gaps in stand density (Tab. 1). It was observed that more half light plant species (ecological indicator values of plants numbers 6 and 7) were occurred in herb layer of country parks where tree gaps were big (Figs 3 and 5).

There were statistically valid differences between half light plants cover and

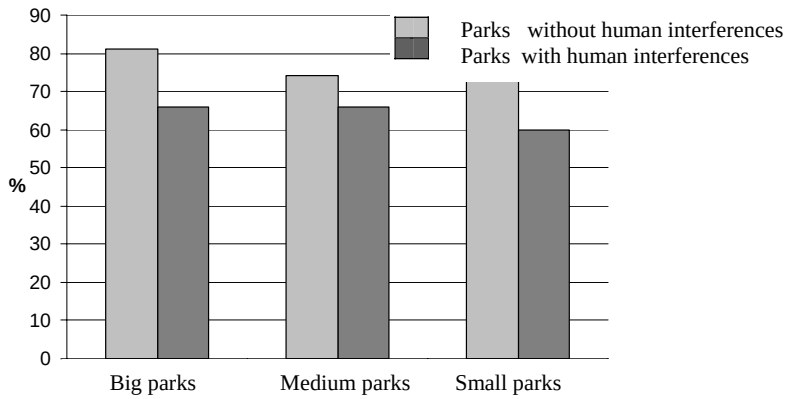


FIGURE 2. Percentage of stand density in country parks

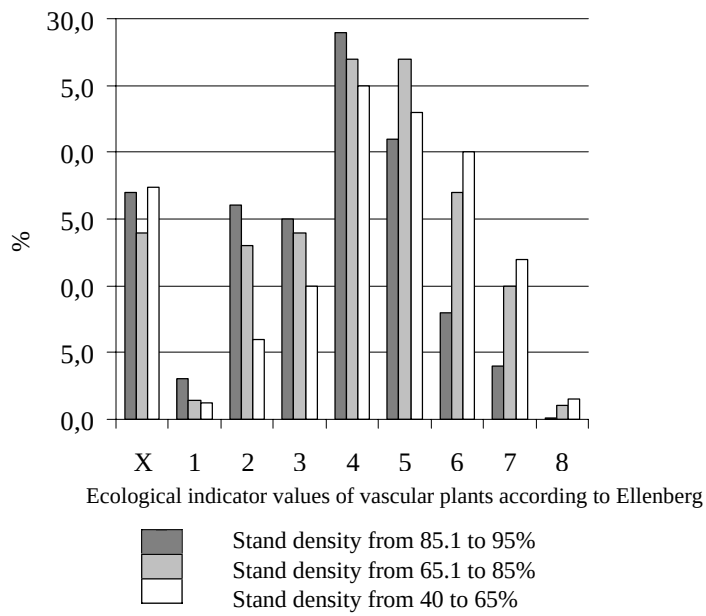
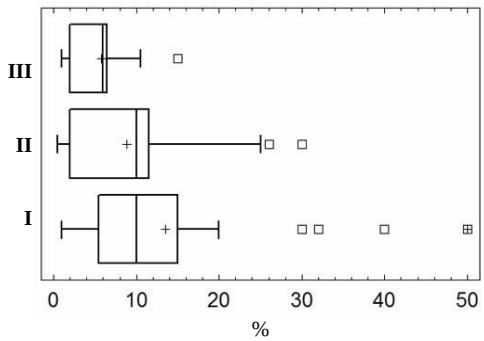


FIGURE 3. Percentage cover of plant species in herb layer depend on different types of trees stand density

TABLE 1. Percentage cover of shadow plant species depend on types of trees stand density

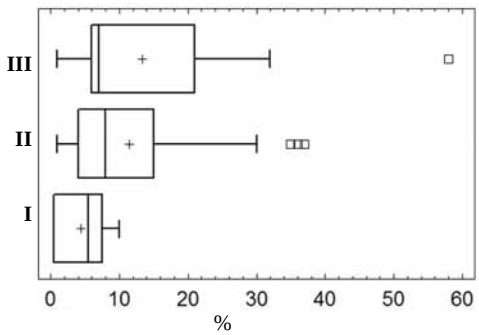
Type of stand density	Homogenic groups	Compared groups	Statistical differences
III	X	III–II	–3.03
II	X	III–I	*7.7
I		II–I	*–4.7

X – homogenic groups
*statistically valid differences.



I – stand density index from 85.1 to 95%,
II – stand density index from 65.1 to 85%,
III – stand density index from 40 to 65%

FIGURE 4. Percentage cover of shadow plant species (ecological indicator values of vascular plants from 1 to 3 numbers according to Ellenberg) in herb layer



I – stand density index from 85.1 to 95%,
II – stand density index from 65.1 to 85%,
III – stand density index from 40 to 65%

FIGURE 5. Percentage cover of half light plant species (ecological indicator values of vascular plants from 6 to 7 numbers according to Ellenberg) in herb layer

TABLE 2. Percentage cover of half light plant species depend on types of trees stand density

Type of stand density	Homogenic groups	Compared groups	Statistical differences
I		III–II	1.9
II	X	III–I	*8.9
III	X	II–I	*6.9

X – homogenic groups
*Statistically valid differences.

type of stand density of canopy trees. It was distinguished homogenic groups like parks with stand density index: from 65.1 to 85% and from 40 to 65% (Tab. 2).

Studies forested communities demonstrate that light availability on the herb layer plays an important role in growth of plant seedlings (Denslow, 1980, 1987). Light measurements were relatively done in forest canopies (Edler, 1993; Fleishman et al., 1997). All species showed a strong positive relationship between light availability and growth in country parks on example Sandomierska Basin. Stand density had got impact on cover of plants in herb layer (Bonciana, 2000). Higher percentage cover of half light plants in herb layer were noticed in tree canopies with bigger gaps (Persson et al., 1987; Eriksson, 1995; Sikorski, 2002). The same results were observed in country parks of Sandomierska Basin. Mostly forest species were very elastic for light factor, but ancient forest species are very sensitive on small light differences (Grave et al. 2006). According to Mitchell and Wooddward (1988), Sikorski (2002) most forest species were growing in full light on tree areas. Moreover in these objects, it was noticed that very stand density could be limiting factor of plant's growing (Légaré, Bergerom, Paré, 2002).

CONCLUSIONS

1. It was observed strong relationship between light factor and plant species in herb layer of country parks.
2. Higher cover of half light plant species were occurred under canopies with big tree gaps.
3. Mainly forest species were growing under canopies with higher stand density.

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Streszczenie: *Wpływ oświetlenia na kształtowanie się flory w warstwie ziół w parkach wiejskich.* W Polsce parki wiejskie często są obiektami

zaniedbanymi, pozbawionymi najprostszych zabiegów pielęgnacyjnych, np. koszenia. Istniejąca sytuacja ma wpływ na zwiększenie zwartości okapu drzew. Wówczas zmienia się m.in. ilość światła docierającego do najniższych warstw szaty roślinnej. Zwarcie okapu drzew ma nieodzowny związek z pokryciem gatunków roślin w warstwie ziół (Bonciana, 2000). Celem pracy jest określenie wpływu oświetlenia na kształtowanie się składu gatunkowego roślin w warstwie ziół w zadrzewieniach parków wiejskich Krainy Kotlina Sandomierska. Przedmiotem opracowania jest 51 parków wiejskich (XVIII/XIX w.) zlokalizowanych na obszarze Krainy Kotlina Sandomierska. Badania terenowe przeprowadzono na powierzchniach zadrzewionych, niekoszonych lub koszonych w okresie wegetacji, gdzie zwarcie drzewostanu było nie mniejsze niż 40%. Wyniki badań wykazały, iż istnieje silny związek pomiędzy czynnikiem abiotycznym, jakim jest światło, a składem florystycznym zadrzewień parków wiejskich.

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