FOLIA OECOLOGICA – vol. 40, no. 2 (2013). ISSN 1336-5266

Influence of vegetation on microclimate in the urban environment

Monika Strelková[1], Zuzana Hečková[1], Zdenka Rózová[1], Anna Tirpáková[1], Dagmar Markechová[1]

[1]Department of Ecology and Environmental Science, Faculty of Natural Sciences, Constantine the Philosopher University in Nitra, Tr. A. Hlinku 1, 949 74 Nitra, Slovak Republic, e-mail: monika.strelkova@ukf.sk, zuzana.heckova@ukf.sk, zrozova@ukf.sk, atirpakova@ukf.sk, dmarkechova@ukf.sk

Abstract

Strelková, M., Hečková, Z., Rózová, Z., Tirpáková, A., Markechová, D. 2013. Influence of vegetation on microclimate in the urban environment. *Folia oecol.*, 40: 261–265.

There are many factors in the urban environment influencing its microclimate conditions. Vegetation is one of the main components participating in this process. Our study compares microclimatic factors (the air temperature and the air humidity) of two sites with different ratio between built-up area and greenery. The measurements have been realized in the chosen areas of the built-up area of Nitra town in the spring months of 2012. The aim of the research was to compare the air temperature and the air humidity depending on the percentage of the vegetation cover in the urban environment of the built-up area of Nitra town.

Keywords

air humidity, air temperature, microclimate, vegetation

Introduction

Greenery in the urban environment is irreplaceable. The cities are being characterized by the presence of different surfaces changing the microclimatic characteristics of the environment. The presence of different surfaces is particularly reflected in the influence of the air temperature and the relative air humidity conditions of the human environment.

Greenery is a major component of the nature being involved in the treatment of this condition in the cities. It is characterized by several functions that make us a great deal in such disturbed environment as the urban settlements are. The microclimatic function of the greenery is the basic one. Microclimatic function consists of cooling of the urban environment by greenery during the warm months and avoiding of the large temperature fluctuations during the day and night. All the trees and bushes regulate the air humidity of the atmosphere. Their space capacity and biomass assimilation adapt the climate, air temperature, solar radiation and air flow (Supuka et al., 1991; Rózová and Mikulová, 2009).

The microclimatic function is being understood as the ability of greenery to influence the air humidity, shade provision, reduction of temperature fluctuations, etc., by its transpiration function. For example, the adult birch in growing season can evaporate up to 7,000 l of water, the urban parks reduce the air temperature by an average of 1 °C if compared to the temperature in the streets. The green areas increase the air humidity (the average value is 5 to 7 per cent) (Hudeková et al., 2007).

The aim of this work was to evaluate the development of the microclimatic characteristics of the areas with different ratio of built-up area and greenery in the spring of the year 2012. The relative air humidity in % and the air temperature in °C, the main indicators of the microclimatic conditions, have been the measured characteristics.

Material and methods

The research was carried out in the selected parts of Nitra town. There were selected two model areas: Site

1/Chrenová III. – parking place on Akademická Street, area with 0–50% of greenery and Site 2/Chrenová I. – place behind the Student Dormitory Nitra, area with 51–100% of greenery.

The ratio of the built-up areas and the green areas on the same size surface has been the main criteria of the selection process. The squares of 50 × 50 m have been determined within the area. Chosen squares had to include parts with different types of cover (hard surface, grassland and vegetation section). There were created two categories, 0–50% and 51–100% of greenery of the whole area. The research was carried out during the spring months (March, April and May) in 2012. Anemometer with multifunctional climate probe, VELOCICALC ® (9565) – TSI, has been used for the measurements. The relative air humidity in % and the air temperature in °C were measured simultaneously.

Data logger recorded data at weekly intervals (7 days), beginning on the second Monday of month at 7 a.m., 2 p.m. and 9 p.m. with the periodic repetition. The measurements have been realized in both localities in the middle of the selected areas with the vegetation, grass and hard surface and at the contact interfaces of these parts: grass – vegetation, vegetation – hard surface, hard surface – grass and at a distance of 2 meters from the building. The measurements have been performed at 2 m above the ground level.

Twenty entries were recorded at the specific time in each area for the purpose of the statistic evaluation. Collected data have been processed to the tables in Excel 2010 program and evaluated by two-factor analysis of variance by Statistical Program.

Results and discussion

The measurements were realized in spring during the months of March, April and May in 2012. Change in the development of the air temperature was observed in the selected months in the monitored areas. We assumed that the air temperature would be higher in the areas with the higher ratio of the built-up area to the greenery. Such assumption was confirmed in March (Fig. 1). The air temperature during the monitored week was higher at Site 2 than at Site 1 with the higher ratio of the greenery coverage. If sub-sites were considered, the biggest differences in temperature were recorded at sub-site with the hard surface and the smallest differences were at the contact interface of the grass-vegetation.

In April (Fig. 2) the air temperatures became the equal at both sites. A significant difference is visible at the sub-sites with the grass coverage. The minimal differences were observed at the sub-sites with the hard surface and the contact areas with grass and vegetation.

The measurements in May (Fig. 3) showed differences in the air temperature values at the selected sites. The greatest difference in temperature was observed at the sub-site grass – vegetation. The higher temperatures in May were measured at Site 1, in March at Site 2. Our assumption that the air temperature is higher at site with

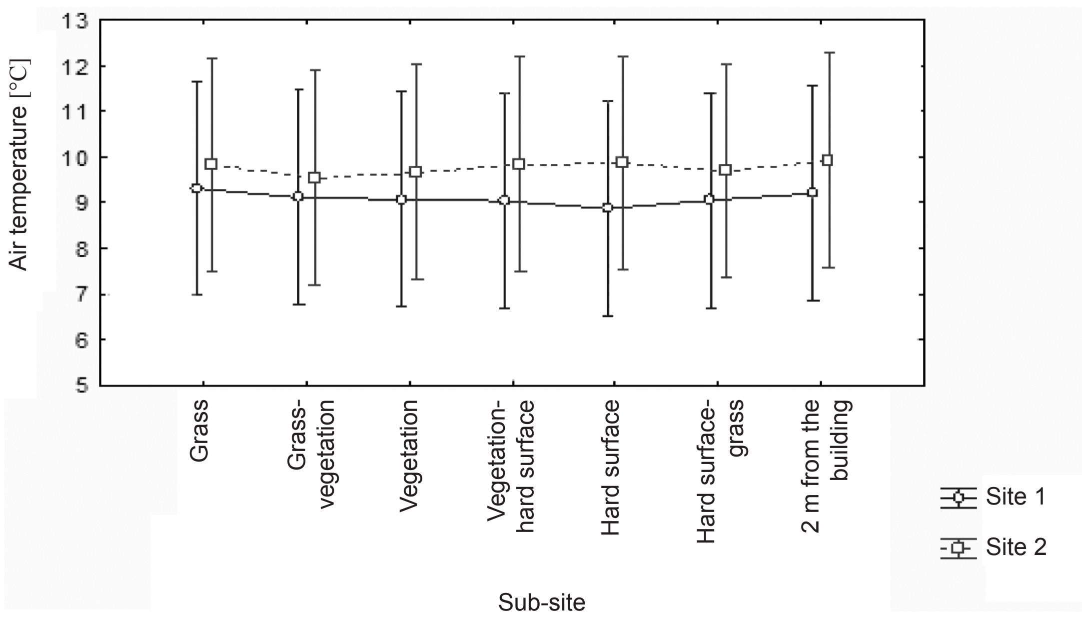

Fig. 1. Comparison of mean air temperatures measured during one week at sub-sites of sites 1 and 2 in March 2012. Site*Sub-site; LS Means. Current effect: F (6.280) = 0.01259, p = 0.99999. Effect hypothesis decomposition. Vertical bars denote 0.95 confidence intervals.

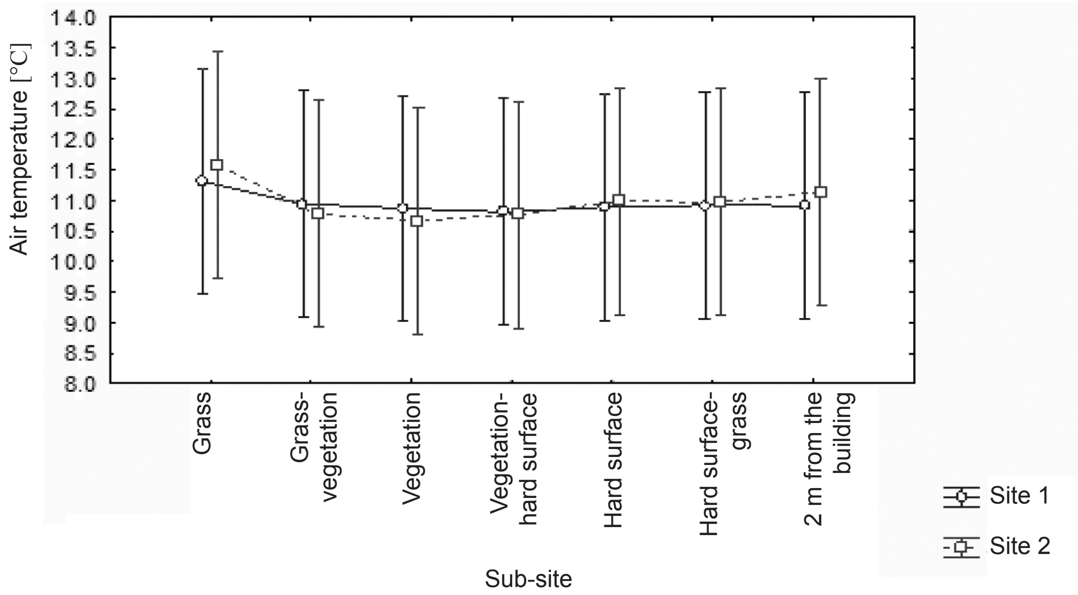

Fig. 2. Comparison of mean air temperatures measured during one week at sub-sites of sites 1 and 2 in April 2012. Site*Sub-site; LS Means. Current effect: F (6.266) = 0.01815, p = 0.99997. Effect hypothesis decomposition. Vertical bars denote 0.95 confidence intervals.

the higher ratio of the built-up area to the countryside has not been confirmed. This situation might be caused by the consequence of the fact that the measurements were taken at the beginning of the growing season of the trees. The vegetation in our latitude is without leaves in March. The leaves start to grow during April and the full foliage of trees occurs in May. The growing season of trees in Slovakia lasts from April 1 to September 30.

The relative air humidity and the air temperature were measured at the same time and at the same places. The research was performed in spring of 2012. The higher values of the air humidity were measured in all

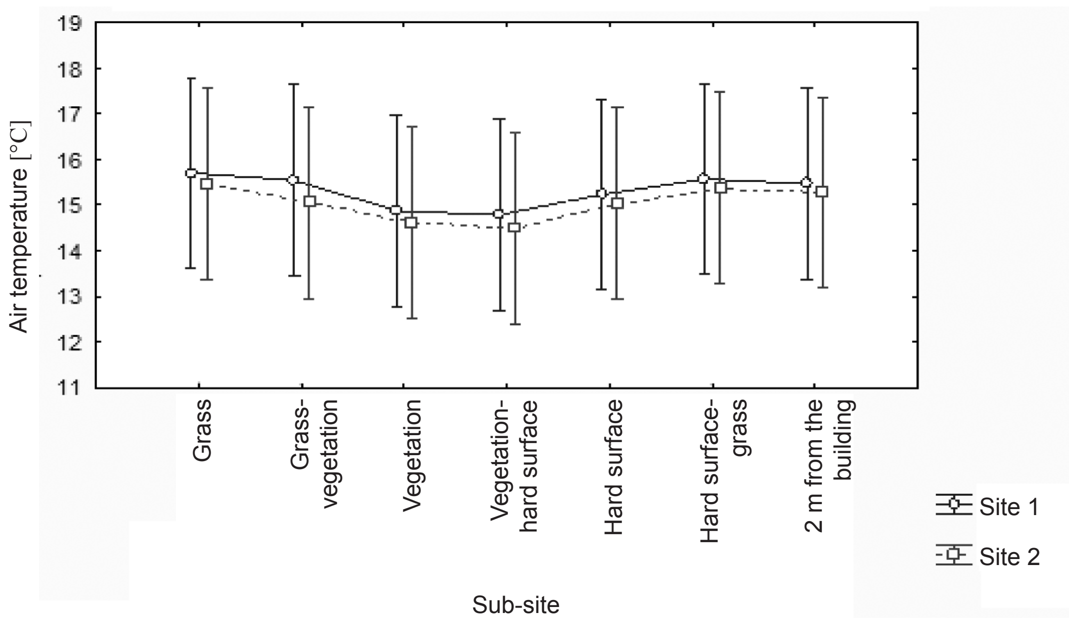

Fig. 3. Comparison of mean air temperatures measured during one week at sub-sites of Sites 1 and 2 in May 2012. Site*Sub-site; LS Means. Current effect: F (6.280) = 0.00496, p = 1.0000. Effect hypothesis decomposition. Vertical bars denote 0.95 confidence intervals.

months at Site 1, where the greenery dominates over the built-up area.

Figures 4–6 show the changes in the air humidity at the sub-site with the hard surface. In March, there was the biggest difference in values of the air humidity between the monitored sites. The difference in the following month, in April, was smaller one. In May, the values of the humidity became equal at sites 1 and 2.

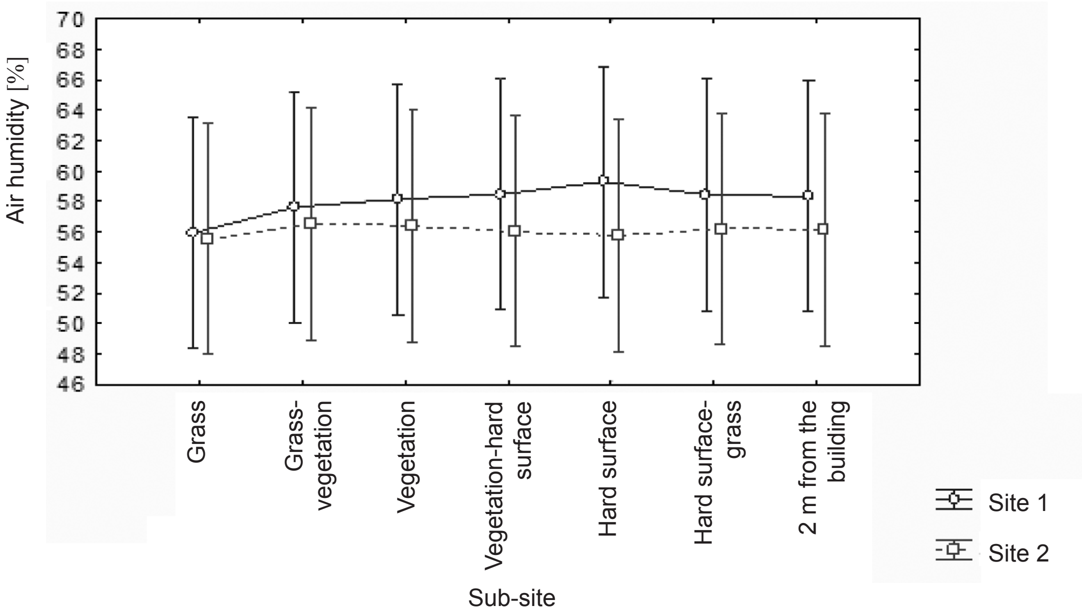

Fig. 4. Comparison of values of mean relative air humidity measured during one week at sub-sites of Sites 1 and 2 in March 2012. Site*Sub-site; LS Means. Current effect: F (6.280) = 0.03431, p = 0.99983. Effect hypothesis decomposition. Vertical bars denote 0.95 confidence intervals.

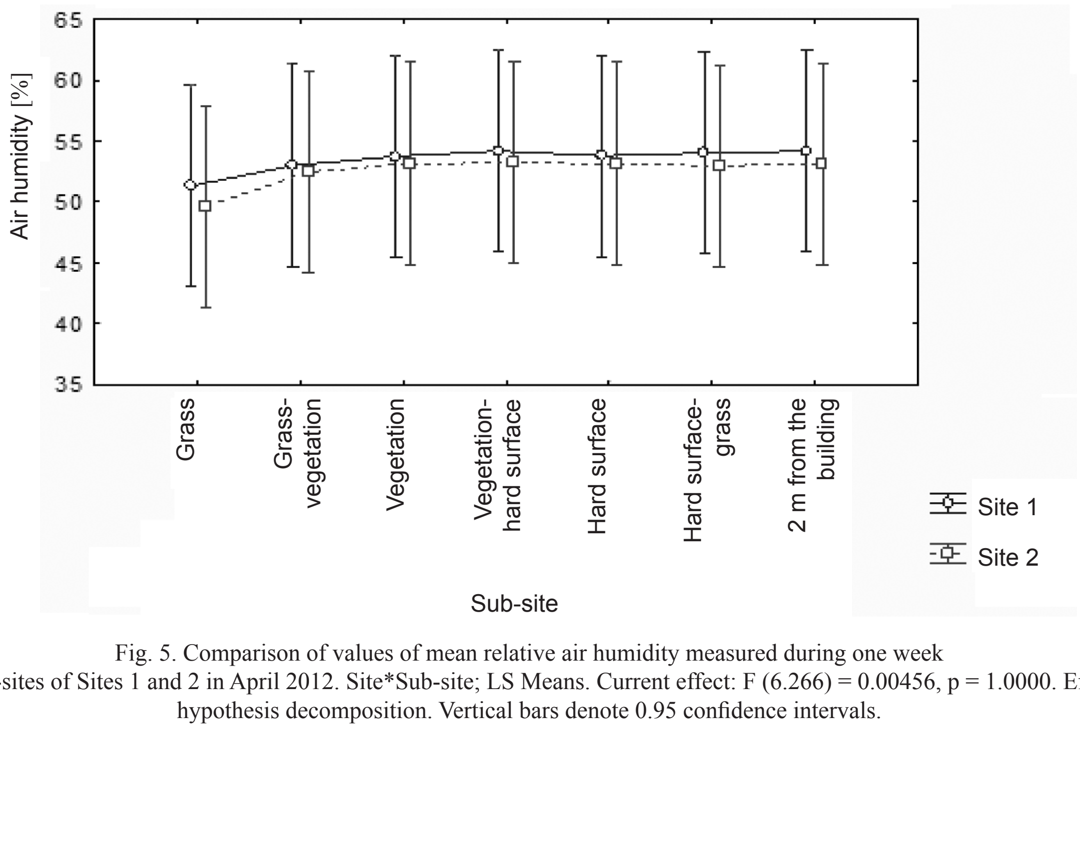

Fig. 5. Comparison of values of mean relative air humidity measured during one week at sub-sites of Sites 1 and 2 in April 2012. Site*Sub-site; LS Means. Current effect: F (6.266) = 0.00456, p = 1.0000. Effect hypothesis decomposition. Vertical bars denote 0.95 confidence intervals.

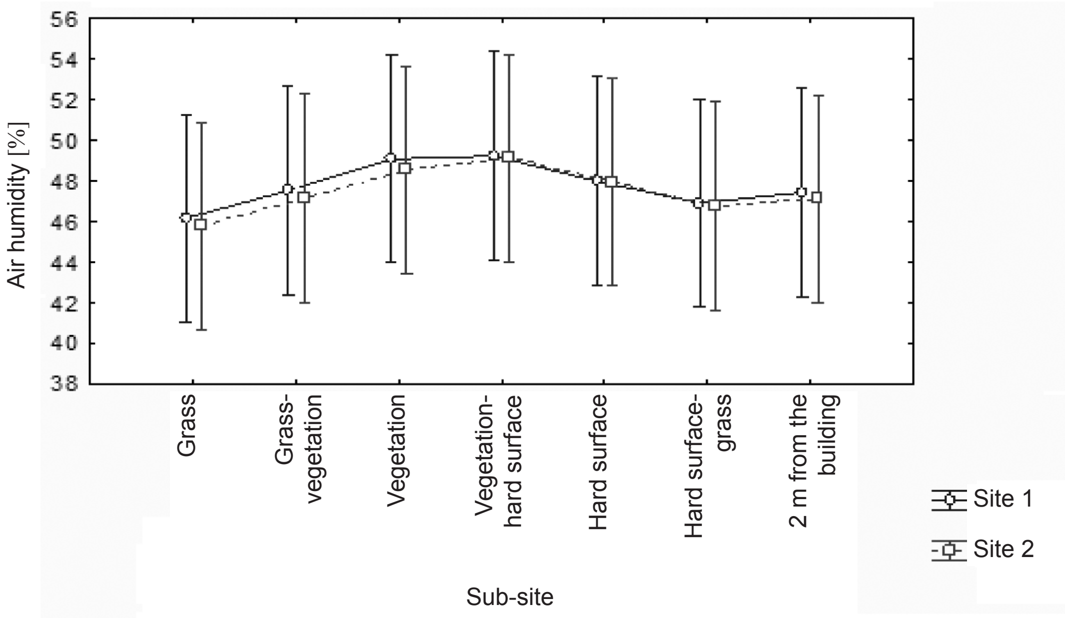

Fig. 6. Comparison of values of mean relative air humidity measured during one week at sub-sites of Sites 1 and 2 in May 2012. Site*Sub-site; LS Means. Current effect: F (6.280) = 0.00243, p = 1.0000. Effect hypothesis decomposition. Vertical bars denote 0.95 confidence intervals.

This situation is caused by the equalizing of the temperature daily routine. The air temperature is higher and its fluctuations are reduced during the day. We did not take into consideration the precipitation when evaluating data and results. In the future, the precipitation regime of Nitra town needs to be considered in comparison with the microclimatic characteristics.

Acknowledgements

This study is the result of the project implementation: Environmental Aspects of the Urbanized Environment, ITMS: 26220220110, supported by the Research & Development Operational Programme funded by the ERDF, scientific projects: Slovak Ministry of Education, project VEGA No. 1/0042/12 and Constantine the Philosopher University in Nitra, project UGA No. VII/35/2012.

References

Hudeková, Z., Krajcsovics, L., Martin, P., Pauditšová, E., Reháčková, T., Hudek, V. (eds). 2007. *Ekologická stopa, klimatické zmeny a mestá* [The ecological footprint, climatic changes and towns]. Bratislava: Regionálne environmentálne centrum. 52 p.

Rózová, Z., Mikulová, E. 2009. *Vegetačné úpravy v krajine* [Vegetation arrangement in the country]. Prírodovedec, č. 365. Nitra: Fakulta prírodných vied Univerzity Konštantína Filozofa v Nitre. 155 p.

Supuka, J., Benčať, F., Bublinec, E., Gáper, J., Hrubík, P., Juhásová, G., Maglocký, Š., Vreštiak, P., Králová, K. 1991. *Ekologické princípy tvorby a ochrany zelene* [Ecological principles of creation and protection of greenery]. Bratislava: Veda. 308 p.

Received December 6, 2012
Accepted March 8, 2013