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## **DISTRIBUTION OF CARABID BEETLES (*COLEOPTERA*, *CARABIDAE*) IN THE URBAN AREA OF LUBLIN**

### **ROZMIESZCZENIE BIEGACZOWATYCH (*COLEOPTERA*, *CARABIDAE*) NA TERENACH ZURBANIZOWANYCH MIASTA LUBLIN**

**Abstract:** The composition and distribution of ground beetles species in the different urban green areas of the Lublin city, Eastern Poland was studied. Carabids were collected since the end of April till the late July 2011 using pitfall traps. In total 67 carabid species were found during of the study period. The number of species varies from 54 in valley of Bystrzyca to 5 on the lawns along street. The highest species richness (5.94) had the studied floodplain of river Bystrzyca in comparison with other green territories. All studied green areas were distinguished by considerable individuality. Our results support the thesis that despite of the sizeable areas of the lawns and flowerbeds, their role in the diversity maintenance and preservation is minimal.

**Keywords:** species richness, urban green areas, *Carabidae*

The populated areas extension and transformation of the landscapes are important characteristics of second half of the 20<sup>th</sup> century. The expansion of cities is accompanied by a reduction of proportion between green and residential zones.

In view of this many publications appeared that deal with diversity of insects in urban landscapes [1-13]. It was showed that considerable moving of urban green areas (parks, squares, flowerbeds, grass spots and water bodies) away from the surrounding cities of ecosystems leads to reduction of biodiversity [14]. The building-up of river valleys that perform the function of migration tracks becomes an obstacle for animals and plants penetration into the green zones of towns.

According to the modern trends the townspeople become isolated from the nature most of the time. The citizens' isolation from nature in megalopolises has been accompanied by psychological discomfort [15]. This is why nowadays the importance of green areas as places with relaxing action is obvious. Present development projects aim more and more at combining the residential functional areas with green areas. However this task can be fulfilled in two ways: by construction of artificial green zones on place of natural ones or by conservation of native landscapes fragments amidst buildings. What type of green areas is able to keep up the sufficiently high level of biodiversity is still the question, which requires detailed research.

In this article the results of studies of the ground beetles species composition and distribution in various types the green areas of the Lublin city are presented.

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## Material and methods

Four urban green areas of different types, within the city of Lublin, were selected for study. The valley of river Bystrzyca (around Lublin University of Technology), the valley of drained tributary (region of T. Zana Street), the Saski Park (city centre) and a number of lawns were studied. All studied territories are under considerable human impact. The section of the valley of river Bystrzyca and Park Saski were characterized by wide variety of habitats.

In the valley of the Bystrzyca were studied the floodplain meadows on both riversides (stations B1-B3), plot of land with ruderal vegetation (B5) and small lake (B4), bank of floodplain lake (B7) situated on the Bystrzyca left side, old park (B8), and also tree-shrub brushwood (B9). In the Saski Park the samples were taken on six various stations situated on the slopes of an artificial stream (S1-S4), in shrubs (S5, S7) and on the grass-plots (S6). In the valley of dried tributary were studied bottom of the ravine overgrown with herbaceous vegetation (T1) and the shrubs on the ravine slopes (T2). Also the objects of investigation were lawns with single trees and shrubs located along the Nadbystrzycka Street.

The survey was conducted since April till July 2011. From five to nine pitfall traps (plastic containers with 90 mm in diameter and 130 millimeters of height) per station were installed depending on the size of study object. No preservation liquid was added to the traps. Sampling was conducted every day.

Average activity density of carabid species (individuals per trap and day) was used in statistical analyzing. The index of species richness by Margalef was used. The degree of difference between the studied urban greenery was evaluated using cluster analysis (on the Ochiai index similarity as distance measure and single linkage as method) based on the quantitative data of the ground beetles and also calculation of the index of similarity by Sørensen based on the qualitative data of the ground beetles. Calculations were conducted with the Diversity 3.0 and PAST 1.81 packages [16].

## Results and discussion

In general during of the research period 868 individuals were captured, belonging to 67 species (29 genera). The number of species found in four of Lublin urban green zones varied from 54 (in Bystrzyca river valley) to 5 (on the lawns) (Fig. 1). Alone 36 species from 16 genera were registered in the Bystrzyca floodplain: *Acupalpus meridianus* L., *Agonum fuliginosus* Panz., *A. marginatum* L., *A. versutum* Sturm, *A. viduum* Panz., *Amara aenea* Deg., *A. communis* Panz., *A. plebeja* Gyll., *A. tibialis* Payk., *Anisodactylus binotatus* F., *A. signatus* Panz., *Badister dorsiger* Duft., *Bembidion articulatum* Panz., *B. dentellum* Thunb., *B. doris* Panz., *B. quadrimaculatum* L., *B. quadripustulatum* Aud.-Serv., *B. semipunctatum* Don., *B. tetracolum* Say, *B. varium* Ol., *Carabus granulatus* L., *Chlaenius nigricornis* F., *C. nitidulus* Schrnk., *Clivina collaris* Hbst., *C. fossor* L., *Dyschirius aeneus* Dej., *Dyschirius tristis* Steph., *Elaphrus riparius* L., *Oodes helopioides* F., *Patrobus atrorufus* Stroem, *Pterostichus anthracinus* Ill., *P. nigrita* Payk., *P. oblongopunctatus* F., *P. strenuus* Panz., *Stenolophus mixtus* Hbst., *Trechoblemus micros* Hbst. Also exclusively in the Saski Park 6 species from 5 genera were found: *Amara familiaris* Duft., *A. littorea* Thoms., *Badister unipustulatus* Bon., *Calathus erratus* Sahlb., *Poecilus lepidus* Leske,

*Stomis pumicatus* Panz. The species *Calathus mollis* Marsh., *Harpalus progrediens* Schaub., *H. xanthopus winkleri* Schaub. were exclusively detected in the valley of drained tributary. Whereas *Badister bullatus* Schrnk. and *Harpalus rubripes* Duft. were not registered anywhere except of the lawns along the street.

Such species richness is quite high for the urbanized territory. This confirms the comparison with other city researches data. For example, in the studied of green zones of Warsaw - parks, green plots of land around the houses, forestry - 64, 55 and 54 species were found, respectively [1, 2]. 68 species from 26 genera were registered in the two riverbanks in the town of Sumy (Ukraine) [6]. The similar quantity - 55 species from 19 genera were found on the shores of lakes and artificial water reservoirs in the Kyiv (Ukraine) [10]. On the territories of three parks in the Donetsk (Ukraine) there were 77 species [17], and in two woodland parks of the town Lviv (Ukraine) - 48 species has been found [18]. In the reserve and woodland park in the territory of Olsztyn were found 37 and 48 species respectively [19]. Also on the territory of three woodlands of the Debrecen city (Hungary) a 50 species of carabid beetles were found [20], and 26 species - in the forests of Helsinki (Finland) [21]. According to described studies the general environmental tendency of increasing the number of species with the growth of the studied areas which is inherent in the natural biogenesis still persists on the urban territories. Despite the uniformity of conditions in green areas the homogenization of species composition is not observed in urban areas [22].

Our study showed that highest value of Margalef species richness index was in the section of the Bystrzyca river valley (5.94) and the lowest value of index (0.83) on the lawns in the city center (Fig. 1). The species richness in the valley of drained tributary and the Saski Park reached the level of the 2.01 and 2.07 respectively (Fig. 1).

The investigated sites of urban areas are located in the Bystrzyca river valley and its two tributaries. This suggests that in the past the populations of ground beetles of this area were similar according to species composition and level of diversity. Based on Sorensen's similarity coefficient we can estimate the degree of impact of territory development on the diversity of carabid assemblages of the studied green areas by the results of their comparison. The species composition similarity between all studied green areas is quite low (Fig. 2), which indicates significant changes taken place in their communities' structures.

All studied green areas were distinguished by a considerable individuality, which is proved with the results of the cluster analysis (Fig. 3). The cluster analysis shows considerable differences between the green areas in the city center, united into a one cluster, and the floodplain of the Bystrzyca, the river valley which is a corridor linking the urban green areas with the natural habitats outside the city. The results showed that the most of the habitats have a low level of similarity; this indicates the high structuring of Lublin city environment.

At the territories of green areas genetically connected with natural landscapes (residual fragments of natural landscapes) much higher level of biological diversity was preserved in comparison with artificial greenery. However it cannot be denied that artificial green areas supplement the diversity of ecological niches, and this favors the increase of overall diversity level of urban territory. In confirmation of the importance of preserving in the towns the landscape elements which have genetic relation with original natural landscape, one can cite the fact that protected species - *Carabus granulatus* L. and *C nemoralis* Müll.

together with species from the Red List [23] - *Oodes helopioides* F. were found in the valley of Bystrzyca. It should be noted that *C. nemoralis* Müll. also occurs in the Saski Park.

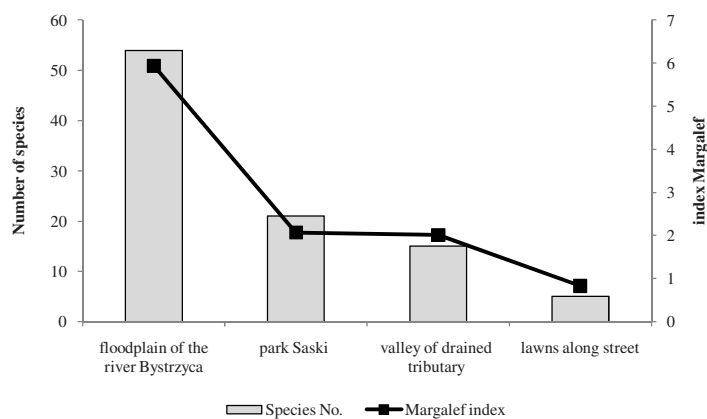


Fig. 1. The Margalef's species richness index calculated for urban green areas of the Lublin city

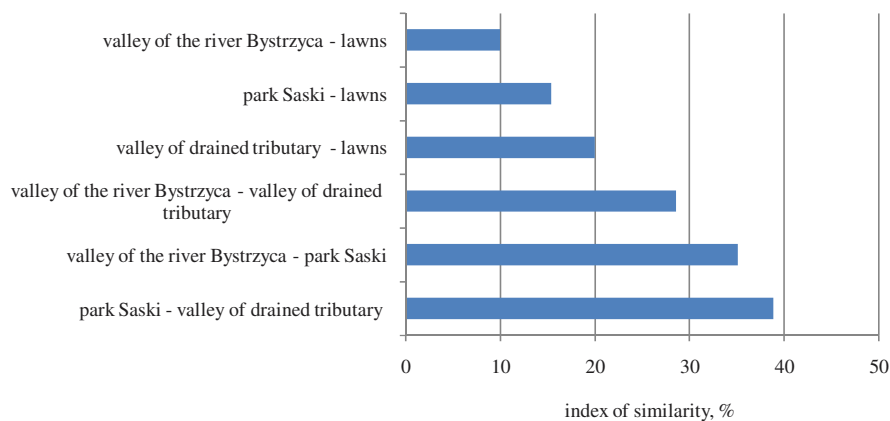


Fig. 2. Species composition similarities (Sørensen index) between the studied green areas of the Lublin city

However, for the preservation of biological diversity on the urban territories not only the conservation of residual natural complexes is important, but also the development of the infrastructure of artificial green zones, which are often represented by open habitats. The both habitat types (open and closed) are represented in our research. The floodplain meadows and ruderal vegetation in the Bystrzyca valley belong to the open habitats; the Saski Park and wooden vegetation in the floodplain of Bystrzyca belong to closed habitats.

The importance of preservation of exactly open habitats for maintenance of high level of the species richness and conserve of indigenous carabid beetles is confirmed by a number of researchers [24].

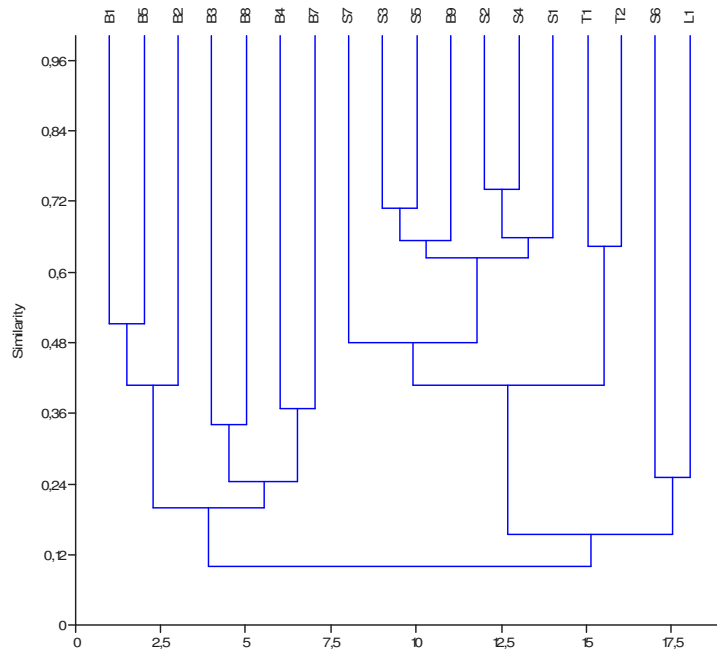


Fig. 3. Cluster analysis of the carabid species composition in the stations of the four studied green areas using Ochiai index as similarity measure and the paired group as linkage method. Code of stations (see also Material & methods): B1-B9 - the floodplain of river Bystrzyca, T1-T2 - the valley of drained tributary, S1-S6 - the park Saski, L - lawns allow street

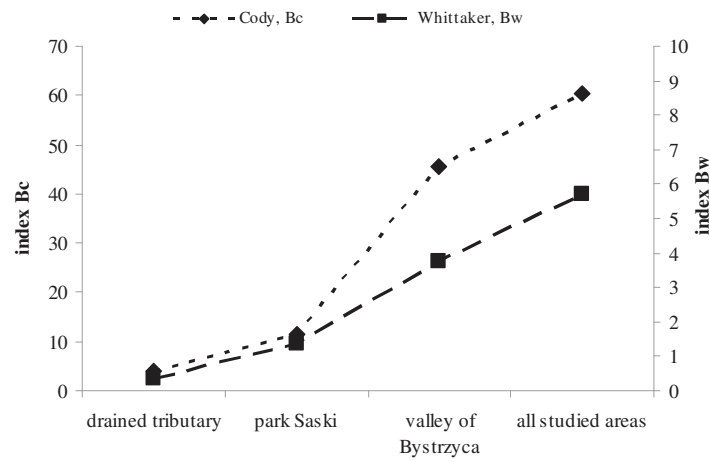


Fig. 4. The beta-diversity indices calculated for each studied green area separately and in total

The considerable increase of the total level of biodiversity in the presence of various types of green areas in the town boundaries shows the diagram in the Figure 4. Although the highest values of beta-diversity indices are registered in the Bystrzyca river valley, however the total index of diversity considerably increases due to the presence of green areas in the city center.

## Conclusion

Our studies proved the exceptional importance of the preservation of different elements of floodplain landscape within town boundaries for the conservation of the biodiversity. Quite high level of biodiversity remains in a city park and the drained tributary of Bystrzyca, despite of their location in the residential zone. Even though the lawns and flowerbeds occupy here sizable areas, their role in the diversity maintenance and preservation is minimal.

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## ROZMIESZCZENIE BIEGACZOWATYCH (*COLEOPTERA, CARABIDAE*) NA TERENACH ZURBANIZOWANYCH MIASTA LUBLIN

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**Abstrakt:** W pracy omówiono wyniki badań dotyczących składu gatunkowego zgrupowania biegaczowatych na różnych obszarach zieleni miejskiej w Lublinie (Polska). Badania prowadzone były od końca kwietnia do końca lipca 2011 roku; odłowy biegaczowatych prowadzono za pomocą pułapek naziemnych. W czasie przeprowadzonych badań odłowiono łącznie 67 gatunków biegaczowatych. Liczba gatunków stwierdzonych podczas badań kolejnych obszarów wahała się od 54 do 5. Największą wartością wskaźnika bogactwa gatunkowego Margalefa (5.94) charakteryzował się teras zalewowy rzeki Bystrzycy w porównaniu do innych obszarów zieleni miejskiej. Na podstawie składu gatunkowego poszczególnych stanowisk można stwierdzić znaczne różnice między nimi. Wyniki wskazują również, że pomimo znaczących obszarów trawników na terenie miasta Lublin ich rola w utrzymaniu i ochronie różnorodności biegaczowatych jest minimalna.

**Słowa kluczowe:** bogactwo gatunkowe, tereny zurbanizowane, *Carabidae*