FACTORS AFFECTING EPIPHYTIC BRYOPHYTES SPECIES DIVERSITY IN THE CENTRAL PART OF THE KATOWICE CONURBATION

Many factors contribute to the diversity and abundance of epiphytes. The observed diversity is shaped by the features of the environment, including climate, and the properties of the habitat in which epiphytes directly grow. Until recently, high air pollution was perceived as the main reason for the limited occurrence of epiphytes in cities. Economic transformation that took place in Europe at the end of the 20th century resulted in a general decrease in the level of air pollution. The effect of this was the dynamic spread of some epiphytic bryophytes, both in Europe and in Poland.

The central part of the Katowice conurbation was selected as suitable research area. It is a compact urban-industrial area, the most densely populated and most industrialized region in Poland. The field research was carried out in 2019-2020, from June to October. The sampling plots were established in four different types of urban area: urban forests, parks, discontinuous dense development (housing estates buildings zona) and compact development (city centre zona). There were totally 200 plots designated, 50 in each of the four types listed above. The plots differed significantly in terms of their structure - the degree of development and tree cover (density of the tree stand on the plot, as well as the number and species diversity of trees).

The most frequently recorded tree species on the plots were *Betula pendula* and *Robinia pseudoacacia*. More than half of the trees were native taxa, but the portion of non-native species was significant in all types of plots. The share of alien species was growing along the increasing urbanization gradient of the area. The trees differed as well in their characteristics, e.g. size (age), degree of inclination of the trunk and a texture of the bark. Trees of large size were generally rarely recorded. In general, trees of the *Populus* genus reached the largest sizes, regardless of the type of urban area. In terms of size measured by DBH value, the highest average values were recorded in compact urban development and the lowest in urban forests. Over a half of all trees were leaning trees, most often found in compact urban fabric. The characteristics of the bark texture, although dependent on the tree species, changed with the age of the tree (cracks were deeper in older trees). The largest portion of trees with strongly cracked bark was found in the plots in compact urban development.

Totally during the observation of 3 632 trees, 88 species of bryophytes were found (including 81 mosses and 7 liverworts). The sum of records of all species on all trees was 11 844. Most records belonged to mosses from the families Orthotrichaceae, Hypnaceae and Brachytheciaceae. Liverworts were definitely less numerous than mosses. The most common

species were *Hypnum cupressiforme*, *Lewinskya affinis* and *Brachythecium salebrosum*. Moreover, rare and endangered species were also recorded e.g. *Orthotrichum schimperi*, *Zygodon dentatus* and *Z. rupestris*.

Compared to the literature data, it can be noted that many species of epiphytic mosses have increased their number of stations in the region. In total, the largest number of species were found in urban forests (76), and the smallest in continuous urban fabric (39). The average number of species per plot was also the highest in forests and the lowest in compact urban development. Urban forests were characterized by the largest group of exclusive species, including regionally rare natural forest indicator species e.g. *Anomodon viticulosus*, *Homalia trichomanoides* or *Porella platyphylla*. However, these species occurred in low abundance and that is why they should not be considered as indicators. In terms of the average number of species on a single tree and the average value of the epiphyte coverage index, the highest values were recorded on trees in parks. The average number of species per tree was the lowest in urban forests, and the average value of the cover index in compact urban development. The plots were diversified in terms of species composition and frequency of moss epiphytes according to the urbanization gradient of the area. On the basis of the frequency of species occurrence, those the indicator species for the selected types of urban land use were determined.

The occurrence of epiphytes on tree bark was high. More than half of the analyzed trees were observed as colonized by epiphytes. The portion of trees overgrown by epiphytes was the highest in discontinuous dense urban fabric and the lowest in urban forests. Among the dendrometric features positively related with the probability of epiphytes occurrence were: DBH of the tree, trunk inclination and bark texture. On the contrary, negative correlation occurred in the case of coverage of a canopy. These features, as well as the diameter of the tree crown, were also correlated with the total number of species and the value of the epiphytic bryophyte abundance index recorded on the trees. In the analysis of factors affecting particular species of epiphytes, a significant group of species did not show close relation to the analyzed factors. The canopy, as well as features related to the size of the tree (DBH, crown diameter), trunk inclination and exposure on the tree trunk, linked some of the more frequently recorded species. The weighted mean of Ellenberg indicator value for moisture (F) grouped mainly forest species. In addition to tree dendrometric parameters, the frequency of occurrence, the general diversity and abundance of epiphytes was also affected by the species diversity of dendroflora. Coniferous were assessed as trees with extremely poor epiphytic bryoflora. Among the trees more frequently recorded on plots, the largest portion of colonized trees, as well as the highest abundance (coverage) by epiphytes, was found in genera *Populus* and *Salix*. The highest

diversity of epiphytic species was found on trees of genus *Populus*, *Fraxinus* and *Acer* (the largest number of species was recorded on the bark of *Fraxinus pennsylvanica*, *Populus nigra* and *Fraxinus excelsior*). Epiphytes generally were not associated with a specific tree taxon, but they were frequently observed on several trees, such as acidophilic bryophytes on the bark of *Betula pendula*.

A large portion of non-native trees is characteristic for urban areas. Some of these species were relatively often and abundantly colonised by epiphytic bryophytes. Among species recorded only on the bark of non-native trees, there were also bryophytes considered as regionally rare, e.g. *Anomodon viticulosus*, *Homalia trichomanoides*, *Leucodon sciuroides*, *Porella platyphylla* and *Zygodon dentatus*.

Despite the continuous high level of air pollution in the region of the Katowice conurbation, the conducted research showed the progressive recolonization of urban areas by epiphytic bryophytes. The diversity of tree species, which differ in various type of urban area, is important for the diversity and distribution pattern of epiphytes in the urban space. General variability of epiphytic bryoflora in relation to the analyzed gradient of habitat variability (degree of urbanization) was observed. It concerned the total number of species on selected types of plots, the number of epiphytes records and the portion of species with different habitat requirements or growth forms. In general, the largest number of species was recorded on forest plots, as well as the average number of species on the plot was the highest in urban forests. Parks were distinguished by the highest average number of species per one tree and the highest coverage of epiphytes on colonized trees. This confirms the importance of both urban forests and parks for the overall diversity of epiphytic bryophytes in urbanized areas.