Determination of the effects of urban climate on biota by using lichens

Prof. Dr. Ute Windisch

Cities form a local climate which differs from the surrounding areas. The urban heat island is attended by an increased concentration of air pollution. The aim of this work is to develop a method to trace the effects of urban climate on biota. The scheme is embedded in the project "KLIMPRAX Wiesbaden-Mainz" which analysis the consequences of climate change in urban systems due to temperature.

Data basis are lichen-mappings in Gießen, Wetzlar and Aschaffenburg. 46 lichen-indices were calculated which are potentially relevant to the biomonitoring of urban climate effects. These include data on the biodiversity, the occurrence and abundance of species and ecological groups of species. The lichen data were correlated with data on land use and urban climate by means of multivariate statistical methods. To visualize the results geographic maps were made showing four meaningful variants of lichen-indices in the cities studied.

There are two ecological groups of lichens which were differentiated into:
The Group A where humidity requiring fruticose lichens and a selection of large foliose lichens genera belong to. These lichens avoid the city centers.
In contrast, the group B consists of representatives that are relatively tolerant of drought and eutrophication. These species belong to the genera *Phaeophyscia* and *Hyperphyscia*. They show in the city centers higher frequencies than in the surrounding areas.

The clusters of ecological factors concerning urban climate and air pollution are closely linked in cities. Lichens are affected by both and a differentiation is difficult. If the concept of the urban climate would be defined more broadly, so that the urban-typical accumulation of air pollutants is included, the lichens represent suitable, integrating biological indicators. In moderate eutrophicated city outskirts lichen indices are available, showing the cold air areas where the water supply is ensured by the morning dew. These are the representatives of the group A.

To detect effects of small-scale land use such as urban green corridors by means of lichens is principally possible. But the available data make it difficult, because the evaluated investigations are focused to effects of air pollution. It could be shown by an example in the Ernst-Leitz-Straße in Wetzlar that trees just off the road bear a different range of lichen species than in a green area in the direct surrounding. The facts are known from the existing literature as well.
A comparison of the three analyzed cities (Gießen, Wetzlar and Aschaffenburg) shows that both of the above groups of lichens (A and B) have substantially the same distribution pattern. Thus, they are suitable for biomonitoring in other cities such as Wiesbaden and Mainz as well.

As a proposal the lichen biomonitoring should be added into the KLIMPRAX project to detect the effects of city climate related factors. Lichens react to city-related stress factors such as overheating and integrate simultaneously air hygiene factors. The recommendations for implementation in the project in Wiesbaden and Mainz concern collection and evaluation of data. Further research and investigation requirements, such as the necessity for detecting microclimatic location data, were already formulated.