Summary

Lichens constitute symbiotic associations central to which are a fungus (mycobiont) and an alga and/or cyanobacteria (photobiont). The influence of environmental stress factors on the physiological condition of lichens is challenging to predict, due to the potentially different effect of stressors on the fungus and phototroph, separately, and on lichens as a whole functional unit. Nowadays, urban pollution is a current problem in many countries, with excessive salinity and nitrogen emissions from human activities, being a significant environmental concern. The excessive use of plant growth stimulants and pesticides in agriculture and horticulture also has a negative impact on the environment. Additionally, extreme weather events, such as heatwaves, heavy rainfall, and prolonged droughts, are intensifying due to climate change.

The aim of my PhD project was to analyse the effect of abiotic stress factors including salinity, nitrogen pollution and their interaction, plant growth stimulator, fungicide and their interaction as well as heat stress on physiology and biochemistry of lichens. The results of my research showed that long-term salt stress led to a decrease of maximum PSII efficiency (F_V/F_M), cell membrane integrity and an increase of membrane lipid peroxidation in *Cladonia rei* and *Peltigera didactyla*, with species-specific responses associated with antioxidant defense mechanisms. However, the supply of liquid water periodically enabled photosynthesis to be reactivated and reverse the harmful effects of salt. The next study showed that combined salt-nitrogen stress caused disturbances in cell membrane integrity and chlorophyll fluorescence of *C. rei*, with membrane integrity serving as a key indicator of acute stress. We observed that short-term salt stress in a nitrogen-poor environment only temporarily affects photosynthetic efficiency. We also demonstrated that fungicides, and combined use of them with chitosan, led to the loss of cell membrane integrity, the high level of membrane lipid peroxidation, and changes in chlorophyll fluorescence parameters in *Xanthoria parietina*. We concluded that the regular use of these agents in fruit tree cultivation may cause serious ecological consequences for epiphytic lichen communities. Finally, we tested the effect of heat stress on the physiology of lichen *Cetraria aculeata*. We observed that the critical temperature for metabolically active lichen metabolism is c.a. 35 °C. Both symbiotic partners responded to stress, which was manifested by the decrease of F_V/F_M, high level of cell membrane damage, increased membrane lipid peroxidation and decreased dehydrogenase activity. Moreover, highly melanised thalli were more sensitive to heat stress, which suggests that mycobiont melanisation imposes a trade-off between protection against UV and avoidance of damage caused by high temperature. These findings contribute to a deeper understanding of lichen resilience and vulnerability under changing environmental conditions, highlighting the importance of maintaining a balance between protective mechanisms and damage caused by the stress factor.