Due to accelerated and profound human-caused changes in the environment in recent decades, new previously unknown types of habitats are present on the landscape. Such new mineral habitats occur especially on post-coal mining sites. Previous attempts at reclamation (e.g. afforestation) of anthropogenically altered habitats have not always been successful.

However, regardless of any action, natural biogeochemical process take place on such places, and if undisturbed, lead to ecosystem development that differs from all others present in the surrounding habitats. Such undisturbed situations allow the new emergent habitats to develop in the most efficient way according to natural processes. Along with spontaneous succession and development, the biological ecosystem functioning of post-coal mining habitats starts to build systems of interdependent relationships between the unknown mineral habitat and the colonising organisms. The previous research on unconstrained development of vegetation revealed that some of the ecosystem function developed on the new habitats (so-called 'novel ecosystems') are of high importance for the environment at the landscape scale. There are also papers presenting ecosystem services provided by the biological ecosystem functioning of post-coal mining habitats that are enriching the environmental network in the urban-industrial landscape. However, the detailed nature of those newly emergent ecosystem functional relationships and processes are very poorly studied.

For efficient global change mitigation it is important to recognize and understand the differences in ecosystem functioning between such novel ecosystems and old, well-developed natural ecosystems (e.g. old forests). Therefore, we would like to examine (i) the extent to which spontaneously created post-mining ecosystems resemble natural ecosystem functioning, (ii) how long it takes to reach levels of ecosystem functioning similar to natural ecosystems in terms of biodiversity and biogeochemical cycles and (iii) how these depend on and influence the surrounding landscape. The answers to these questions will enable more effective management of post-industrial sites to help mitigate processes of global change. We will assess this using a set of coal mine spoil heaps differing in age, size, and conditions in the post-industrial landscape of the Upper Silesia region with a long tradition of the mining industry.

Prior to the fieldwork on 60 spoil heaps, remote sensing tools will provide information representing various criteria and aims of the studies. On these objects the biodiversity will be sampled including plants, lichens, invertebrates and birds. Soil mites, fungi and microbes will also be sampled. Soil samples will be collected and soil enzymes, chemical and physical composition, soil respiration and root exudation will be measured. Plant biomass, decomposition rate and carbon and nitrogen pools will also be assessed. The data will be analysed in terms of seeking linkages between substrata and biodiversity at various scales, from levels of soil to landscape. Among others we want to test hypotheses that early stages of vegetation development are poorly-developed due to low levels of soil nutrients and lack of biological activity, however, during the course of time conditions become more favourable for living organisms, although responses will differ among species groups. We expect that relationships among organisms become more strict and permanent at later phases of succession. The living conditions on spoil heaps depend on landscape context but species typical for well-developed and mature vegetation will be more abundant in late-successional spoil heaps. Our study will significantly increase the knowledge about spontaneous ecosystem development in post-mining areas. We will especially fulfill the gap in knowledge about linkages between biodiversity and ecosystem functioning, describing its dynamics along a successional gradient. Such results will comprise an excellent framework for further studies aimed at applications of ecosystem restoration and biodiversity conservation. We will also develop methods allowing for estimation of biodiversity and ecosystem functioning using remote sensing. This will provide a novel approach for remote sensing in post-mining ecosystems. We will publish the results in the most relevant scientific journals, the scope of which includes problems of restoration ecology, ecological engineering and soil biology.