

Summary

Mining involves significant transformation of the environment and can lead to the formation of new landforms such as post-mining dumps (also called spoil tips or heaps). Usually they are subject to a process called mine reclamation, which allows their restoration and further utilization. Sometimes, however, they cover with vegetation spontaneously. Taking into account the dependence of human well-being on ecosystem services and, consequently, on the condition of ecosystems, an evaluation of how forest ecosystems developed on mine dumps help mitigate climate change was attempted. The study identified a number of research goals to verify hypotheses on the characteristics of heap tree vegetation in relation to the physicochemical conditions of the soil and its ability to provide regulatory ecosystem services.

The results of the field research revealed that the studied specimens of trees and shrubs on the heaps differ in species composition and dendrometric parameters from those found in natural forest communities (control). Studied plots differed in the number of occurrences of specimens at distinguished development stages (seedlings, low and tall undergrowth, trees). The tree-covered heaps came out to be characterized by a higher richness of species and a higher proportion of invasive alien species when compared to the control plots.

Conducted analyses made it possible to determine the average metric parameters of trees and shrubs growing on the studied heaps (height, circumference and diameter at the base and at breast height, crown spread) and occurring in various growth forms. The physicochemical conditions of the soil of the heaps and control were also determined. Concerning the total vegetation, six habitat factors (content of: magnesium, calcium, total nitrogen and organic carbon in soil, pH and site age) were shown to influence the formation of species compositions on the heaps. Statistical analyses identified significant differences in the number of specimens per plot for development stages such as tall undergrowth and trees. Moreover, it was noted that the median of the dendrometric parameters considered in the study was lower for specimens on the heaps than in the control. Furthermore, the trees in the control demonstrated better health compared to those on the heaps. Analyses using statistical linear and generalized linear mixed-effects models made it possible to determine the effects of physicochemical variables and site age on the number of tree stems classified as development stage II, III and IV, the number of seedlings, the number of species, indicators of taxonomic diversity and stand volume in the study plots.

The data gathered on post-mining dumps were used in the assessment of two regulatory ecosystem services (carbon sequestration and temperature regulation). For specimens for which diameter at breast height were available, carbon content (in kg) was calculated based on various allometric equations for biomass or tree volume and percentage of carbon in wood. Studies of carbon sequestration on heaps showed that trees and shrubs do participate in carbon sequestration, although the obtained figures are lower in comparison with the control specimens. The analysis showed that physicochemical parameters such as calcium, total nitrogen, organic carbon content in soil and water holding capacity (WHC) significantly affect the carbon content in dendromass.

On the other hand, the results of land surface temperature (LST) obtained from August 2019 and 2023 for the studied forested heaps, selected non-forested heaps (without vegetation cover or with marginal cover) and control plots enable evaluation of the influence of vegetation on temperature regulation. Plots on heaps with established vegetation achieved lower temperature values than those unforested and similar to the control. The study confirmed that heap vegetation has the potential to reduce the urban heat island.

According to the data collected during the field research and the obtained results, the research hypotheses formulated in the paper were confirmed and conclusions were drawn. In addition, issues that may require further research in the context of post-mining areas were indicated.