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Analysis of species diversity and stand structure in managed and protected ravine forests

The aim of the study was to compare species composition and stand structure of forests that were subject to management practices of moderate intensity with forests protected in national parks and nature reserves. The studies focused on ravine forests, and this community type has been recognized as a *Phyllitido-Aceretum pseudoplatanii* Moor 1952 association. The community occurs under specific habitat conditions, such as rock ledges and steep slopes covered by rubble. Due to the low economic value and low accessibility, most stands of ravine forests have been subject to extensive management.

For the floristic analyses, 215 releves from the Carpathians were used. Of which, 83 plots were localized in protected areas (national parks and nature reserves) and 132 plots were localized in management forests. Both groups were analyzed in terms of differences in species composition. In comparison, indices of richness and diversity, cover of trees shrubs and herbs, as well the share of selected ecological groups, like species of ancient forests, species of open habitats, ruderal species and alien species, were used.

Structural analyses of ravine forests in 24 plots were studied, from the whole range of communities in Poland, including 13 plots localized in managed forests and 11 localized in unmanaged forests, mostly legally protected. The analyses of the stand structure were based on DBH measures of all living and dead trees, as well their location within the plots. In total, 12 characteristics were calculated that described the forest stand structure and were related to both living and dead trees, among others including tree density, number of large living trees, quadratic mean diameter, number of stumps, uprooted trees, broken trees and snags. Additionally analyses of the spatial patterns of trees, using Riley's function, were used.

Research has not shown an influence of forest management on plant species composition in ravine forests, in the cases of both open habitat species as well as ancient forest species. Slight, insignificant differences were identified in the case of diversity indices and Elenberg's Indicator Values. In addition, there were no differences for the case of alien species.

Structural analyses have shown significant differences between managed and unmanaged forests. Plots of ravine forests in managed forests have a simpler stand structure, while the tree density, number of large living trees (>50 cm), quadratic mean diameter and maximum diameter were lower in managed forests. Both study groups did not show significant

differences in the case of dead wood. Comparing the spatial distribution of trees in the Carpathians, it was found that in unmanaged forests the trees have a tendency to create clusters, while in managed forests the trees are distributed more regularly, which is probably a consequence of the cutting of single trees that creates multiple stems or growing in clusters. In the Kraków-Częstochowa Upland, due to the large share of linden, which creates multiple stems and clusters, extensive treatments do not impact the spatial distribution.

The findings show that traditional features considered as a good indices of management treatment or naturalness, like ground floor species composition or the amount of dead wood, in specific habitat conditions, not always reflect the influence of the forest management. In this case, other features, like DBH distribution, number of large living trees or density of living trees, are better predictors of past or current management practices.

Key words: managed forests, protected forests, ravine forests, Carpathians, Kraków-Częstochowa Upland, species composition, stand structure