Universitatea Transilvania din Brașov

HABILITATION THESIS

SUMMARY

Title: Forest dynamics - structure, production, growth - under the influence of environmental conditions, adapting forest planning and management

Domain: Silviculture

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SUMMARY

The habilitation thesis summarizes my main scientific achievements which focus on forest dynamics and management planning actions to increase the functional efficiency of stands. Forests are continually changing their structure as a result of development and management measures. However, radical changes in forest composition and structure also occur as a consequence of changing environmental conditions. In Romania, the most affected by these changes are the coniferous stands, which are located outside their natural range, the stands located at the lower altitudinal limit of the species range, and the stands located in the growing area of the species that deviate from the composition and structure of natural ecosystems. Thus, a continuous monitoring of these stands is required, on the basis of which the decisions regarding management planning can be adapted.

The management of risks to forests is grounded in the dynamics of stand and forest composition and structure. The objective of the thesis was to determine the indicators that characterise forest dynamics and stand structural diversity in order to establish, by forest planning, management measures which can lead to improved biodiversity and increased stand stability.

The second chapter of this research was aimed at analysing the dynamics of stand and forest composition and structure over the last five decades and estimating forest composition in the near future. The results show that in mixed beech-coniferous stands, the area of beech has increased by 38% in the last five decades, while the area of conifers has decreased, fir by 31% and spruce by 5%. Nevertheless, based on seedling dynamics, climate scenarios, and planned cutting, in the near future the proportion of fir is expected to increase from 15 to 33%, and beech to decrease from 49 to 45%.

Forest planning and management relies on knowledge of the actual condition of the stands. The third chapter discusses the possibility of using digital satellite imagery and Unmanned Aerial Vehicle imagery to monitor stand composition and structure. By applying mathematical models developed from variables measured on digital models, tree dendrometric characteristics (i.e., tree crown diameter, tree height, and tree volume) were estimated with a root mean square error ranging from 8.70 to 18.37%). The accuracy of the determinations depends on the structural complexity of the stands and on the quality of the digital models.

An analysis of the growth dynamics of fir stands of lower latitudinal limit could predict its condition. Thus, the study of the biometric relationships between different growths is useful in both scientific and practical terms for the silviculture of silver fir. The study of fir growth was carried out in the fourth chapter of the thesis. The research revealed that in even-aged stands, the mean current volume increment tree is a hypothetical tree that could have the mean basal area of all the trees and the form-height of the stand.

The fifth chapter discusses black pine stands, which are considered in Romania outside the natural distribution of the species. The behaviour of black pine is similar to that of the lower elevation limit fir. The results displayed an increase in the percentage of tree defoliation and dead trees over the last decade. Models generated from the temperature-defoliation-radial growth relationship estimated a significant continuous reduction in radial tree growth of 0.5-0.6% for each increase in defoliation by 1%. Under the site conditions of the investigated pine stands, an increase in basal area and stand density, respectively, could significantly amplify stand defoliation.

Due to their aesthetic qualities, forests near large urban centres have huge recreational potential and are in great demand. Given their multiple functions, their management must take into account the requirements of all the functions. Hence, the research in the sixth chapter was aimed at determining the main indicators that characterise the diversity of stands, which can be used to monitor structural and species diversity, as well as recreational forests. The structure of the stands that comprise the forest was investigated and the Shannon (H) diversity index was applied to the variables that characterise the structure of the stands.

The last chapter of the thesis deals with spruce monocultures that expand outside the areas where they naturally occur and are frequently exposed to environmental factors. Against the background of the potential threats caused by climate change, destabilising phenomena are likely to amplify. For this reason, the aim was to adapt forest planning and management provisions with a view to improve the stability of the forests. Management measures taken into account were directed at restoring the natural ecosystems that were converted into monocultures. The research is applicable to the management of spruce forests artificially planted on the

site of former beech forests and beech-coniferous mixed forests, which are vulnerable to environmental factors.

The final part of the thesis presents the development directions for my career in terms of didactic and scientific activity.