Transilvania
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HABILITATION THESIS

Abstract

Title: Assessment of structure and dynamics of forest ecosystems, and of effects of environmental changes on their elements

Domain: Forestry

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In this thesis are included the results of research activity obtained during postdoctoral period and it is structured as follows: summary, professional and scientific achievements, carrer development plan and bibliography.

In Introdution (chapter l) are presented the general considerations regarding the necessity of sustainable development of forests, but also the importance of beech virgin forests from Romania into scientific fundamentation of various silvicultural techniques recommended to reach this goal. The increasing demand for various forest ecosystem goods and services and the uncertainties caused by climate change associated with higher temperatures and more frequent and/or severe disturbances have increased the interest in uneven-aged and close-to-nature sylviculture. But for this kind of management more information about the processes that govern the natural forests are needed.

European beech is the most important of the European and Romanian deciduous broadleaf species. It is, therefore, and will remain, one of the main species found in mixed stands in combination with other productive broadleaved and coniferous tree species. Furthermore, the study of virgin beech mixed forests of Romania, a country with a still large virgin area, might contribute subtantially to decipher and better understand natural processes that allowed the coexistence of different species in mixed stands. The species coexistence in different forest ecosystems has been explained often by different shade tolerance of participating species and by different ways to react to disturbances occured in forest.

In this habilitation thesis have been investigated two important virgin forests: Runcu Grosi forest where beech is mixed with sessile oak (two species with different shade tolerance capacity) and Sinca where beech is mixed with Silver fir (two species shade tolerant). Due to an intensive management of oak stands in Europa, mixed beech-sessile oak forests having low impact of human influence are very rare and not well investigated, although they have a great importance for biodiversity.

The mixed beech-silver fir forests have been more investigated, but there is a lack of studies at the eastern limit of the natural beech-silver fir vegetation zone.

For characterization of the two important mixed virgin forests it has been performed the spatial pattern analysis to assess tree distribution, species spatial interaction, and detect evidence of biological processes. It is based on the pattern-process relationship which allows to infer ongoing dynamics in a forest (chapter 2, 3 și 4). In the absence of long-term monitoring data, it can, however, be a very valuable tool to recognize processes that may explain species coexistence and possible spatio-temporal changes in species composition and/or dominance. Patterns of mortality and of living trees in different size strata (e.g. canopy layers) hold information on disturbances

and tree species recruitment, and the analysis of spatial relations between trees of the same or other species belonging to the same or another size strata can help to detect mechanisms of inter- and intraspecific competition or facilitation at different stages of development.

Due to the lack of traditional long-term monitoring and since forest disturbances are unpredictable and rare events it is very difficult to evaluate accurately the natural disturbance patterns. For this reason, the dendrochronological method remains one of the most efficient way to identify past disturbance patterns in temperate forests, especially through detection of growth releases. In Chapter 5 is presented the application of dendrochronological methods into historical reconstruction of natural regime of disturbances in Sinca forest.

Dead wood in its different forms (standing dead trees, fallen dead wood, stumps) is a major structural and functional component of forest ecosystems, especially in old-growth forest. By contributing to the accumulation of organic matter in the soil, and providing habitat for decomposer organisms and shelter for bacteria, fungi, bryophytes, arthropods, birds and mammals, deadwood is an important substrate for the regeneration of many tree species, and represents a capital pool of nutrients and carbon storage. From this reason in Chapter 6 is presented a detailed study of the deadwood from both analysed old-growth forests.

As a consequence of climate change, severe and recurrent droughts have been identified as a key factor in the recently accelerated rates of tree decline and mortality also in temperate forest from Europe, this phenomenon being thus not restricted to dry sites only. In the past years, extended tree mortality was observed in the temperate-continental climate region of Romania, especially in coniferous tree species stands.

This mortality event could be, therefore, the culmination of a relatively long term declining process during which trees have struggled to face accumulated water deficits, which have probably weakened their resistance and finally lead to the death of the most vulnerable ones. In Chapter 7 are presented main results of TREEMORIS project, where by an innovative and interdisciplinary approach, combining analysis of mortality dynamics based on tree rings with soil microbiome and nutrient analyses, we were able on the one hand to disentangle the driving factors of the tree mortality dynamics, and on the other hand to study the effects of tree mortality on forest functioning (trying to understand at the same time how tree mortality could affect the capacity of forest soils to capture carbon and regulate the quantity and quality of essential nutrients.

The final part of the thesis presents the development plan of the university career (in research and teaching activity) na dends with the list of bibliographic references mentioned in its content.