THE METHODOLOGY OF ELABORATION RESEARCHES REGARDING TYPOLOGY STUDIES AND TYPOLOGICAL MAPPING OF FOREST ECOSYSTEMS IN CRISUL NEGRU PLAIN AND TASADULUI HILLS

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Abstract

The existent GIS data structures, the creation of maps usingGISs tools, are quite usefull in typological research representing the scientific base for a sustainable forestry.

Key words: forest typology, forest ecosystems, GIS, sustainable forestry

INTRODUCTION

Forest typology and forestry are sciences with a strong geographic character which must rely on local realities (Paşcovschi S., Leandru V., 1958);

The typology of the forests as ecosystems and of forest stations must have a strong regional aspect.

Starting from the understanding of forest stations as a system with integrity which represents either a geotop and ecotop features, all the components must be used as clasiffication criteria.

In order to achieve this homogeneity either at geotop and ecopot level is absolutely necessary to have as a study base natural regions, as geographic theories reletively homogeneous in terms of geological, geomorphological, climatic conditions.

As the climatic homogeneity cannot be obtained directly analyzing the recorded climatic elements recorded at meteorological observation stations because of the low density of them in terms of forest typology, the typing studies were made on climatic zones and stage taking also in consideration the general and particulat features of the relief. and, in case of steep relief forms, the exposition, the inclination of the slope.

The delimitation criteria of the types based on living conditions (stationary conditions) reflects the homogeneity of these conditions. But just if among the used criteria one could find the natural vegetation, the designated units could have a ecological homogeneity. The establishment

of typological units (types of ecosystems) was made using the method of synthetic systemic indicators evaluating phytocesosises, climate indicator forest plants and edaphic conditions: acidity, humidity, humus content, compactness. The use of phytoindicators is based on the principles of modern ecology according to which the plants, as primary producers and the phytocenosises which they make up, exactly reflects not only the complex abiotic ecological factors, decisive for forest biocoenosis but also the nature and the functionality of these biocoenosises which finally represents the productivity of the forest ecosystem

In case of the forests in which the compozition and the structure of the forests are totally or partially altered because of the human intervention, the main criterion in type identification remains the station which represents the steadiness of the ecosystem (Doniță N. et. al. 1990; Târziu, 2004). It is absolutely necessary the determination of types of forest stations on the basis of researches of inner features in order to identify the ecological feature, of phytoceonosis features and productive potential (evaluation) (Târziu, 2004).

Determining the type of station is usefull also for classification of artificial ecosystems, resulted after the introduction of alien species. These could become units of the natural type of ecosystem (Târziu, 2004).

STUDY AREA

The reseaches were made in Crisul Negru Plain and Tasadului Hills, the forests belonging to Tinca Forest Office. The area is situatead in the south-western part of Bihor county and the relief in characterised by plains and small hills (up to 35o m)

From geomorphological point of view tle plain area could be divided into two types: the low plain and the high plain.

The low plain is the western prolongation of the Western Plain, situated on the terraces of the Crisul Repede and Crisul Negru Rivers, with an average altitude between 93-110 m, with a horisontal aspect.

The eastern part is consisted of some prolongations of the Western Hills with an average altitude between 210-290 m.

MATHERIAL AND METHOD

A preliminary survey was made in order to describe the stands according to vegetation stages and phytoceonosis using Braun-Blanquet scale.

a. **The preparatory phase**

Consisted of the following steps:

- **the selection of the study area.** In order to create a data base necessary for analysis different types of maps are requared for the study area (Crisul Negru Plain, Tasadului Hills, forest maps from Tinca Forest Office). The paper maps served as primary data source and after digizitation a set of base maps resulted which were processed using ArcGIS software. The scale of the used paper maps was 1:20.000, the maps which belongs to Tinca Forest Office.

- **the analysis of the existing bibliography** related to geomorphological, geological, soil, hydrological, climatic, vegetation cover conditions, which were introduced as EXCEL files and then used with ArcGIS tools.

- **updating** the knowledges related to methodology, the scheme of the steps which must be done in case of a typology study of forest ecosystems with the establishing of the surveying points.

- **preparation and checking** of techunical devices necessary for field investigation: maps, field files, dendrometer, photo camera.

Also during this stage it is necessary to identify the forest ecosystems naturally regenerated, from seeds or from sprouts, consisted of naturally brushes regenerated according to the criterion of naturality of forest ecosystems. For this purpose were used both information collected during field trips and information provided by the forest authority. These reprezentative zones are key zones for the typology study. They are marked on the map with the help of survey points, dendrometric measurements, soil analysis (fig. 1).

b. The field research phase

The record of features of investigated phytoceonosis was obtained through inventory with the use of stratified preferential sampling (stratified is the position of the sampling areas in areas characteristic for each phytoceonosis)

During the selection of each stand necessary for the phytoceonotic analysis of forest ecosystems were taken into consideration the following criteria: compositionn, degree of naturality, structure, age, consistency of stands.

Concerning the degree of naturality priority has given priority to fundamental natural stands where the human impact generated by human activities is as reduced as possible (for ex. recent applied forestry aivities, grazing).

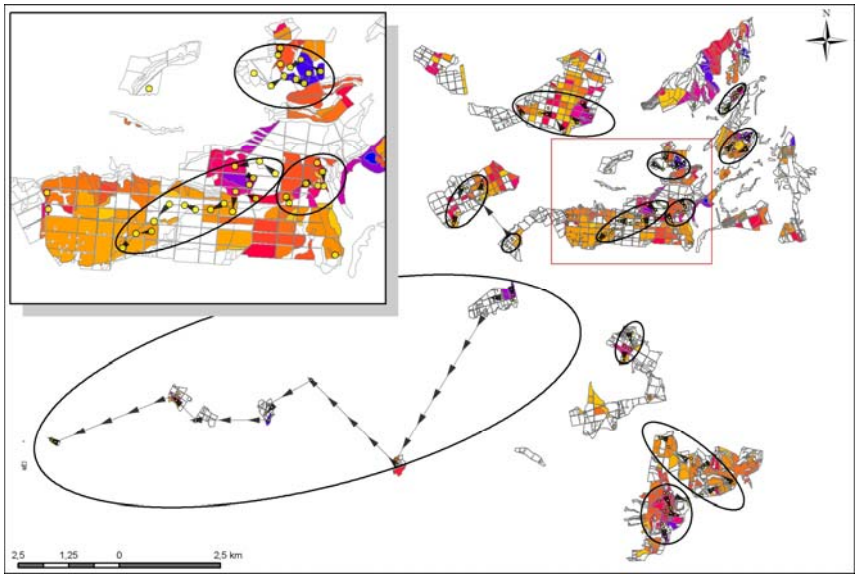

fig. 1. Key zones for the typology study

In relation to the structure were chosen stands with a relatively homogeneous or homogeneous age, these dominating the investigated areas.

An other selected criteria was the criteria of age, preffering the mature stands, where just sanitation cuts were made.

Concerning the consistency were preferred stands with a solid or relatively solid consistency (for ex. stands with an undegraded structure through illegal cuts or cut for regeneration)

For studies related to phytoceonosis diversity is recommended to use individuals with same size and they choose to separate three different layers:

-the layer of trees where all individuals had more than 4 m in diameter and 7 meter in height

-the shrub layer where were included all the shrubs more than 1 m

-the grass and sub-shrub layers where were included all grass and sub-shrub species.

For phytoceonotic and ecologic analyze of the stands within the investigated ecosystems, phytoceonotic descriptions were made for each plot of land which belongs to each ecosystem. In this respect was used J. Braun-Blanquet scale, method which was widely used in phytoceonotic analysis. This scale rely on a double character, *abundance-dominance,* meaning refers to a number of individuals and the degree of covering. Six coefficients are used:

+... little isolated individuals (sometimes just one individual on a plot) without having the possibility of appreciation the degree of coverage

1.... few individuals, de degree of coverage being under 1/20 from total area
2... relatively few individuals, with a degree of coverage between 1/20-1/4
3...pretty numerous individuals, with a degree of coverage between 1/4 -1/2
4... numerous individuals with a degree of coverage between 1/2 -3/4
5... very numerous individuals with a degree of coverage over 3/4

This scale was modified and completed by R.Tüxen and H. Ellenberg (1937) in that they explicitly stated the extreme percentage values for each stage and also the central values of abundance-dominance factor.

Table 1

The evaluation scale of abundance-dominance according to Braun-Blanquet and completed by R.Tuxen şi H. Ellenberg(1937)

Stage	Coverage interval(%)	Value of AD (%)
5	75-100	87,5
4	50-75	62,5
3	25-50	37,5
2	10-25	17,5
1	1-10	5
+	0,1-1	0,5
r	0,01-0,1	0,05

The result of this complex stand-grass layer-sub-shrub research was the identification and descriprion of different types of forest ecosystems. This is the first step of the field analysis, **the identification and detailed description of forest ecosystems in key-plots**.

c. The analysis phase

The analysis phase consisted of processing and interpretting the collected data. In order to process the data EXCEL and ArcGIS softwares were used and for structures processing SVS software was used. This is the first step in analysis phase, **the development of typology schemes for plot areas.**

THE METHOD OF TYPOLOGICAL MAPPING

a. The field phase

The method of delimitation of forest ecosystems was made on the basis of typological schemes made for representative research areas – the key plots.

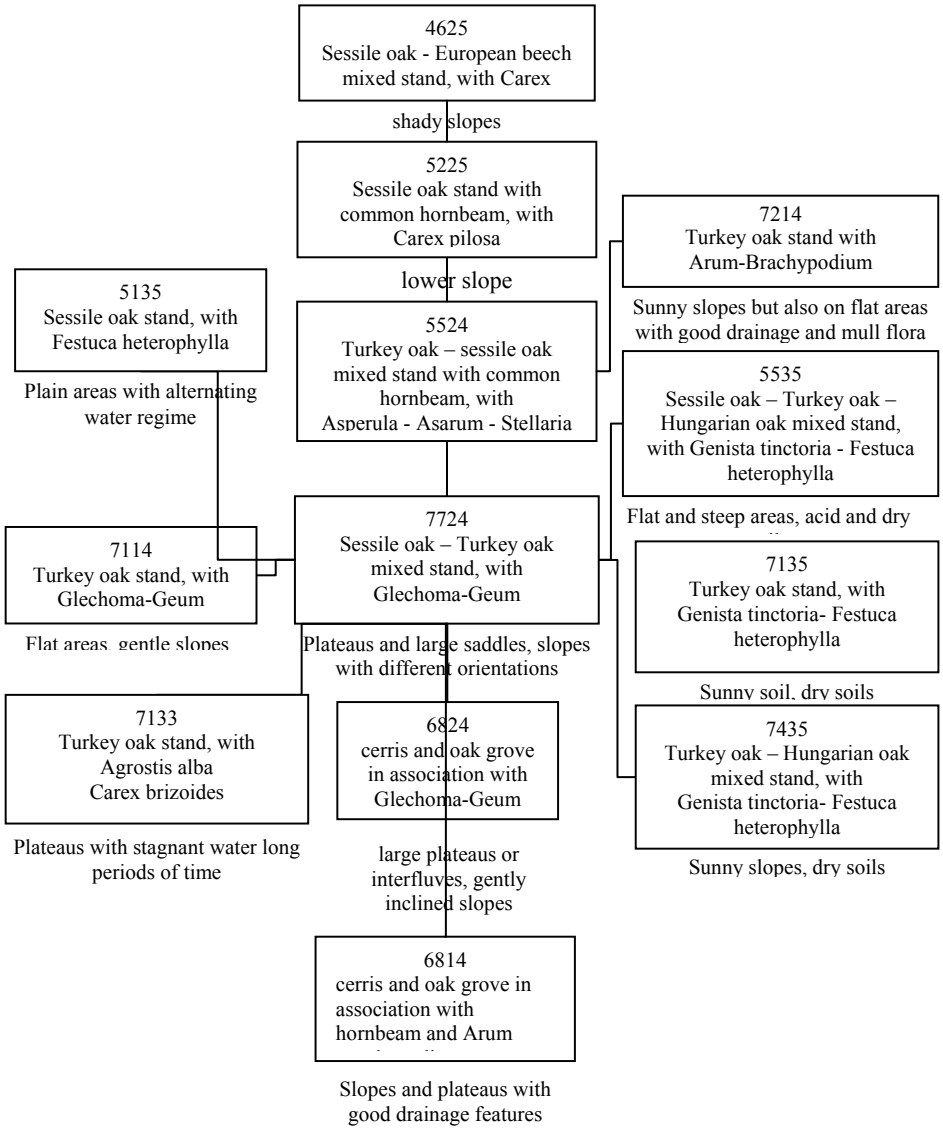

Fig. 2. Example of typological scheme in the high plain and the hilly area

Within these schemes the type of forest ecosystem in represented closely related to stationary conditions (fig. 2) which allows a better understanding of the distribution of different types on the field, helping thus the typological mapping, in cultivated forests, more or less different from the fundamental natural type. The grass and sub-shrub layer perfectly matches the the stationary conditions, even in the forest type found n the field differs from the natural, fundamental type.

The result is mapping through extrapolation in similar areas in the vicinity of key plots.

This is the second phase of the field investigation, respectively in expansion area, **the description and mapping of forest ecosystems**.

b. The analysis phase

During this phase of the study will be the made of some preliminary analisys in terms of the distribution of different forest ecosystems, location within the three main relief units: the relief form, altitude category, slope exposition categories, slope inclination categories, correletion with different forest types, forest units types, forest habitats (Doniță N. şi colab., 2005/2006), types and subtypes of soils; the spread within different types of forest ecosystems of tree species, the association of tree species and the proportion of forest composition, the classes of made productions.

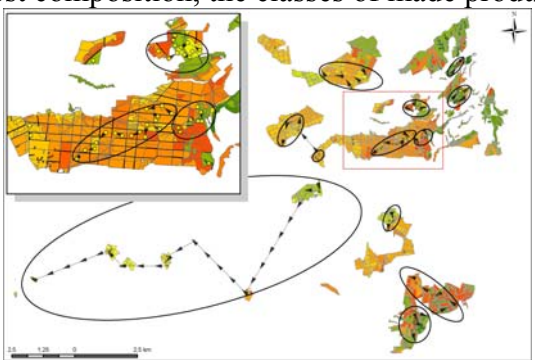

fig. 3 - the field distribution of forest ecosystems in corelation with key zones for the typology study

By overlapping the soil maps, types of stations, types of forests and different forest ecosystems and the analysis of the new layers correlation has been followed of different forest ecosystems with different forest stations, types of forests and types and subtypes of soil, the field distribution of forest ecosystems (fig. 3)

RESULTS AND DISSCUSIONS

The result was a combined research method, field-office method, a double method, in which the field-office analysis is repeated after field **investigation phase and the description of types of forest ecosystems** followed by a second phase, of **typological mapping.**

The study was made according to the following steps: 1. The field investigation phase on key plot areas – the identification and detailed description of types of forest ecosystems. 2. The office phase – the elaboration of typological schemes. 3. The second field investigation phase, in the extension area – the primary description and typological mapping. 4. The second office phase – the detalied analysis of the field investigation results and the map making process. During the second field investigation

phase a feed-back is obtained thus checking the accuracy of the typlogical schemes and their correction, if necessary.

The result is a combined method between classical data processing methods and the modern methods, using EXCEL and ArcGIS tools.

The development of forest ecosystem typology respond to current concerns in modern forestry in order to promote valuable native species, the complex forest structure for a rational use of forest resources. The introduction of forest typology in the field of forest management and in forest research will create the basis for introduction the ecological forestry oriented either to wood production or environmental protection (Doniță et al., 1990).

CONCLUSIONS

The result of this study was an accurate data base for the Tinca Forest Office, data which were checked in the field and filled with typological, phytosociologic and soil data; the researches were filled with the sudy of 96 soil profiles. The analysis of soils was made in the laboratory and it fills the previous knowledge related to humus, nitrogen, phosphorus, potassium, the sum of change basis, total change capacity, degree of saturation in basis, the acidity, a.s.o.

The created data base allows an easy access to information related to forest and stands. The typlogical research using GIS tools is a usefull tool in practical forestry baing the base for a sustainable forestry.

The typological substantiation of forestry is the ecological base for a efficient management of forests providing the forest the complex condition for preserving healthy environment.

It is considered that for the study of forest ecosystems two different approaches could be used, not opposite but complementary approaches: *analytical approach and the systemic approach*. The analytical approach start from the premise that the properties of the forest ecosystem is the sum of the properties of each component, isolates the elements in order to be studied, emphasising the accurate identification of details. The systemic approach take into account the interaction among components emphasising the global perception (as a whole).

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