

CREATION OF AN ECOLOGICAL BASIS FOR SUSTAINABLE FOREST MANAGEMENT IN ROMANIA

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ABSTRACT

In the 70-years history of the present Forest Research and Management Institute, the constant concern for promoting the researches to substantiate the forestry in Romania on natural realities of the environment and forest biocoenoses is most obvious.

In this respect, even from the very beginning of the Institute, ample researches have been conducted on:

- forest environment (soils, sites, hydrological processes);
- ecological behaviour of most of the local or cultivated exotic tree species and of the ecologically indicating grass and undershrub species;
- biology and ecological behaviour of animal species (especially game species) and fungi;
- forest and site typology and their ecological zoning;
- ecological forest disasters (massive defoliations, oaks die-back, industrial pollution, damages caused by game, etc.);
- conservation of biological and ecological diversity of species;
- forest monitoring.

The multiple results of these researches have ecologically substantiated the forest management planning, implementation of operations, seed harvesting, production of seedlings, afforestations, prognosis and control of defoliating species, establishing the productivity of the hunting area and the optimal game populations and collonisation, establishing measures for avoiding the degradation of forest ecosystems and rehabilitation of degraded forests, improvement of degraded lands and regulation of torrential watersheds, etc.

Future researches will have to be oriented towards the complex study of the representative forest ecosystems which are still natural, to find out their evolution laws as ecological models for sustainable forest management.

Keywords: ecological researches, sustainable forest management, ecological forestry basis, Romanian forestry, Forest Research and Management Institute.

INTRODUCTION

The main condition to ensure the durability of production and protection functions of the forests, which nowadays it is called “*sustainable management*”, is definitely their stability, the highest resistance possible against more and more numerous negative impacts and the high ability to restore their balance after such impacts. This stability depends on some important ecological parameters:

- climate and edaphic stability of forest sites;
- harmony between the ecological requirements of tree species and site quality;
- ecological compatibility of tree species in mixed stands;
- biodiversity and complex structure of forest biocoenoses which provide an efficient ecological self-control for harmful populations, a complex circuit of organic matter and abiotic nutritional substances and preservation of the features favorable for climate and forest soil.

In forests with a natural stand composition these parameters need to be maintained or restored; in the ones with artificial stands they must be created with a high financial and technical effort.

For sustainable forest management, these parameters have to be well known, and a large database with autoecologic and sinecologic scientific information on forests in each geographic region must be created taking into account the regional ecological differences.

BRIEF HISTORY

The contribution of forestry research to the creation of the ecological basis for sustainable forest management in Romania will be presented in the following paragraphs. We talk about the researches carried out in the 70 years since the Forest Research and Experimentation Institute (nowadays Forest Research and Management Institute) was established.

The need to have knowledge on the ecological particularities of the Romanian forests was felt even in the beginnings of forestry in the Carpathian-Danube area, that is in the second half of the 19th century. The first scientific researches in this respect have been carried out by illustrious professors in Branesti Higher Forestry School and Forestry Faculty within the Bucharest Polytechnics. For example, we can mention here the researches on virgin forest structure in the Carpathians by Professor Petre Antonescu. These ecological researches have been continuously carried out in the higher forestry teaching institutions in the entire 20th century, with many invaluable contributions.

But forestry research, as a distinct preoccupation, started to organize only in 1922, when the first research station was established in Sinaia; it was developed in 1930 when, 3 research laboratories (Botanics, Soils and Entomology) were set up in the

Autonomous House of State Forests (CAPS) and it was intensified in 1933 when the Forest Research and Experimentation Institute was set up. One of the 5 research departments (3rd Department) dealt with the study of the natural production factors (with dendrology, genetics and seed control, botanic, forest pedology and forest phytopathology) and 1st Department also included a forest protection laboratory.

The fact that the research laboratories set up in CAPS and then the department for “Natural Production Factors” and Forest Protection Laboratory within the new institute had an ecological orientation is very significant. It reflected the strong need for knowledge on the environment, the forest species and forest biocoenoses as natural production components of the Romanian forests.

Important autoecology works on forest species have been written within these research units even in the first years. Such examples are the works on the behavior of the chestnut tree (Chirita, Balanica and Munteanu 1934), of a few exotic species (Georgescu and Moldovan 1935 / 1936, Chirita 1938) and local species (Radulescu 1938, Pascovschi 1941, 1942, 1946 / 1947), of sessile oak (Chirita 1942), of the pedunculate oak (Georgescu 1946 / 1947) and the works on the most important pests of tree species (*Tortrix viridana*, *Cossus cossus*, *Zeuzera pyrina*, *Galerucella luteola*, *Saperda populnea*, *Hylesinus fraxini*, *Ips typographus*, *Pityogenes chalcographus*, *Melolontha melolontha aso.*). All the autoecology papers show the appropriate attention to the climate and soil conditions.

In the same time, large scale surveys on the forest soils started in the pedology laboratory, with the first contributions in this field (Chirita 1938, 1941 a, b, c) and for studying the edaphic traits important for forestry (physical traits, nutritive substances, acidity, humidity, humus) (Chirita 1940, 1941). The first researches on soils by forest types were carried out together with the ones on the structuring of forest sites classification (Chirita 1937, 1938 a, b).

The first sinecology researches were carried out, including description of forest associations or types (Georgescu 1941, Georgescu and Constantinescu 1945, Pascovschi 1943, 1945, Vlad 1945).

Also in this period, researches started on the characteristics of tree populations by setting up of 32 permanent plots and the establishment of the first local volume and yield tables and tree trunk form factor.

Even in the first years of forest research, an important action was launched for conservation of biological and ecological diversity by setting up 59 forest reserves and nature monuments.

MAIN DEVELOPMENT TRENDS IN ECOLOGICAL RESEARCHES AND RESULTS

Thus, even then the ecological approach was well defined, this approach was directed, after the reorganizing of the Institute in 1947, towards the following big objectives:

- developing the knowledge on the abiotic forest environment through researches on

the forest soil and climate, on forest sites and on degraded lands;

- more detailed knowledge on the ecological behaviour of forest indigenous and exotic tree species (especially tree species, forest pests and game), under normal conditions and ecological stress conditions, through autoecologic, ecophysiological, dendrometrical and auxologic researches;

- intensification of sinecological researches on forests (by systematic study of forest types and ecological processes in natural and managed forests);

- ecological differentiation of forests in relation to geographic zones and regions;

- investigation of ecological forest disasters, caused by insects, game, wind, snow, drought, pollutants, through complex ecological researches;

- forest functional zoning;

- forest biodiversity conservation by developing a network of protected areas;

- forest health monitoring.

The following paragraphs will be dealing with the most important contributions of the institute in the autoecologic and sinecologic knowledge on forests, under the specific geographic and ecological conditions in the Carpathian-Danube region, resulting in the creation of a large and sound ecological basis for their sustainable management.

Developing the knowledge on the abiotic forest environment

The first researches on forest soils, launched before 1948, were highly developed in the following decades, on the investigation of soil genesis processes, their genetic classification, ecological description of forest soils by establishing the humidity, acidity and trophicity indexes.

The results of the many and various researches were included in large synthesis works: General and Forest Pedology (Chirita 1953), General Pedology (Chirita 1955), Ecopedology (Chirita 1974). It must be emphasized the deeply ecological thinking which was the basis for these works. The soil is presented not only as a natural phenomenon; a special emphasis is put on its ecological values and on its productive potential.

The forest climate related researches were intensified. The researches focused on soil temperature in nurseries (Balanica 1940, 1956, 1957, Rubtov 1963, 1964, Papadopol 1970), influence of the forest shelterbelts on the climate factors (Lupe 1952, 1954, 1974, Catrina 1955, 1964, Marcu si Ionescu 1959), correlation between climate factors and physiological processes in trees (Catrina 1964, Marcu 1965, Bândiu 1973, Blujdea 2000), microclimate in the stands with regeneration felling (Vlad 1943, Constantinescu et al. 1962), microclimate in stands affected by die-back (Marcu et al. 1966), microclimate in natural ecosystems (Popescu-Zeletin et al. 1973, Bândiu 1973, Bândiu and Donita 1988, Cenusă 1991 etc.).

Many researches on rainfalls, infiltrations and run-offs were carried out in the framework of the forest hydrology field (Arghiriade et al. 1960, Abagiu 1972, 1973, Abagiu

et al. 1973, 1980 etc.).

There were also used data from the national meteorological network in the interpretation of different phenomena occurring in trees and forest biocoenoses: wind felling (Dissescu et al. 1962), correlation between the climate factors and tree growth (Giurgiu 1977, Tisescu 1988, 1991, 2000, Tisescu et al. 1991, Ianculescu et al. 1991), oak die-back, conifer expansion (Georgescu and Badea 1952, Marcu 1965, Marcu et al. 1966, 1967, 1969, 1980, Purcelean 1966, Stoica et al. 1968), distribution by ecological regions (Giurgiu et al. 1968, Domnita et al. 1980), behavior of certain exotic species (Dumitru-Tataranu 1988), various methodological items (Stanciu 1973, Dumitru-Tataranu 1973, 1979, 1985, 1986, 1987), other researches (Tomescu 1960, 1964, Mihalache 1976).

An essential contribution for substantiating forest management according to the realities of the abiotic forest environment in Romania was represented by the defining, description and classification of sites on degraded lands (Chirita 1949, Chirita and Ceuca 1953, Ceuca 1954, Mihai 1960, 1963, Traci 1970) then of the unaltered forest sites (Chirita 1949, 1953, 1955, 1956, Ivanschii 1966, 1972, Ionescu 1965, Stanciu 1966, Popa et al. 1973 etc.). Two synthesizing works (Chirita et al. 1964, Chirita et al. 1977) include the description and classification of most of the forest site types in the country.

Many applicative researches on forest sites were performed during time (Ceuca 1958, Popa et al. 1959, Mihai et al. 1961, Chirita et al. 1961, Rosu et al. 1964, 1986, Geambasu et al. 1987, Geambasu 1989 etc.), and a series of naturalistic studies, by forest districts (Ceuca, Stan, Ciuc, Galinescu, Munteanu) were carried out between 1973 - 1980, works which are unfortunately unpublished.

Lately, the researches focused on the changes in the forest sites due to some negative impacts (decrease in the ground water levels in floodplains, aridization, soil pollution, etc).

Researches on forest soils and sites resulted in enough data to ecologically substantiate the forest management planning, to establish forestation formulas and designs, by using, in a correlated manner, autoecological data on wood species and data on the features of site potentiality.

Knowledge on the ecological behaviour of indigenous and exotic tree species

As a continuation and intensification of the researches on the ecological behavior of tree species, which had started even since the establishment of the Institute, many researches were carried out and detailed papers were published, especially monographic syntheses, on many local species - spruce (Vlad 1957, Marcu et al. 1974, Vlad and Petrescu 1977), Scots pine (Alexe 1964), Hungarian oak (Marcu 1965), pedunculate oak (Marcu et al. 1966), beech (Milescu et al. 1967), poplars and willows (Clonaru

1967), larch (Beldie et al. 1968, Rubtov 1971), lime tree (Ivanescu et al. 1966, Anca 1974), fir (Bândiu 1973, Marcu et al. 1980), European aspen (Ivanescu), but also for exotic species - locust (Costea et al. 1961), Eastern white pine (Radu 1974) and other brought in species (Dumitriu - Tataranu si col. 1988 etc.).

Specific issues on the ecology of tree seedlings and shrubs produced in nurseries and from natural regenerations were included in many researches, among which some synthesis works (Rubtov 1961, Papadopol et al. 1966, Constantinescu 1963, 1975, Badea 1964, Purcelean and Ciumac 1965, Grobnic et al. 1967, Ciumac 1967, Bândiu 1973, Damaceanu et al. 1975, Ciobanu et al. 1975, Geambasu et al. 1986, Barbu and Cenusa 2002 etc.).

Ecophysiological researches on trees were developed and the first dendroclimatic researches were initiated; thus many aspects on relationships among tree species and important ecological factors were clarified (Giurgiu 1967, 1974, Dissescu 1962, Tissescu 1989, Popa 2002).

A large autoecological database was thus created allowing, together with the results of pedological and site researches, the establishment of forestation formulas and designs, of methods for producing forestation material and substantiated ecological system.

The correlated study on the forest ground flora and on soil acidity, humidity and trophicity lead to the establishment of requirements and tolerance degree for many forest grass and undershrub species, of ecological groups and types of grass-undershrub layers (Beldie si Chirita 1960, 1967). The needed instrument was thus created for the indirect and rapid assessment of soil and site features, with a broad utility in forest management planning, in the implementation of silvicultural systems.

A summarizing paper on the phenology of 29 tree and shrub species, which were studied for 10 years, in 78 plots, was issued in 1967 (Tomescu et al. 1967).

The ecological behavior of local trees under the specific environment conditions in Romania, was also shown by the fundamental researches on their natural populations, summarized in yield and volume tables (Popescu-Zeletin et al. 1957, Giurgiu et al. 1972). This behavior was researched also in long-term plots, located in the whole country, under conditions of natural evolution and different management methods.

These significant contributions have made up the database with dendrometric and auxologic data highly needed in forest management planning, wood harvesting, and realistic assessment of the allowable cuts.

Many dendrometric and auxologic researches on virgin forests in the Carpathians (the most important contributions in this respect were made by Predescu 1953, Dissescu 1958, 1961, 1987, Giurgiu 1974) resulted in knowledge on the natural structure of stands, on their increment and production, representing starting points for creating the most adequate structure in artificial forests, through management works.

A large research program dealt with the autoecologic study on harmful insect populations. It involved the study of harmful insect life cycles, damages to stands, trophic basis, their natural enemies, influence of climate on their development. Based on these researches, an original prognosis system for insect attacks was designed, with thresh-

olds for interventions to reduce the populations, integrated and biological control methods were formulated, which to affect forest biocoenoses the least possible. The prognosis and control methods for harmful insects have been and are used at present in forest protection.

Many researches have dealt with the knowledge on the populations of the most important game species, of their trophic basis, of their diseases and pests.

These researches were highly applicable in sustainable game management in assessing the potentiality of the hunting areas, in establishing the optimal populations, the culture methods, protection and harvesting of game species, reintroduction of some species in areas where they had been extinct etc.

Also many researches were carried out on the productivity and ecology of forest biocoenoses (mushrooms, fruit shrubs, herbs, etc.) with many applications in their use.

A highly important role in the ecological substantiation of sustainable forest management in Romania was played by the researches on the distribution of tree species and forest biocoenoses. There are worth mentioning, in this respect, many contributions on trees species distribution in Romania (Georgescu 1934, 1942, Pascovshi 1935 / 1936, Haralamb 1938, 1939, 1941), The Map of the Wood Species (Beldie et al. 1960) at the scale 1 : 200000, which unfortunately exists only as a manuscript; Vegetation Map 1 : 1000000 published in the Atlas of Romania (Donita and Roman 1976) which includes the distribution of forest biocoenosis complexes and Romanian Forest Map which presents the main forest formations included in the large European forest units and the most important forest ecosystem types (Donita, Bândiu, Biris, Stan 1997, in manuscript).

Intensification of sinecological researches on forests

The set up in 1947 of a Laboratory for forest typology stimulated the development of the researches on forest types in Romania, which were started even in the 4th decade.

In a short time, only 10 years, most of the forest types in Romania were studied and described (Pascovschi 1951 a, b, 1952, 1956, Pascovschi et al. 1954, Pascovschi et al. 1955, Pascovschi et al. 1956, Purcelean et al. 1953, Leandru and Mehedinti 1953, Leandru 1957 etc.). A summarizing paper was also written (Pascovschi and Leandru 1958), as well as a decimal classification of forest types (Purcelean and Pascovschi 1968). Beech stand associations in the Southern Carpathians were described by A. Beldie (1951). The typological researches continued in the following years and other important papers were developed (Leandru et al. 1960, Leandru 1964, Alexe 1964, Marcu 1965, Clonaru 1967, Purcelean 1960, 1968 etc.).

The forest types established by these researches are used in forest management planning; the forest type is established corresponding to the forest planning units and they are used in establishing the forest activities to be applied, the goal compositions, intensity of tending works, the stand structure (Pascovschi et al. 1964 etc.).

Subsequent researches have established the forest ecosystem types (Donita et al. 1990), and the data were used in identifying the forest habitats.

After launching the research program on ecosystems in Babadag area, starting with 1970, complex researches were developed in the Institute, in the Ecology team which later became a laboratory; the researches dealt with the structure of forest biocoenoses and ecosystem processes. Different ecosystems were studied: spruce stand, spruce-Swiss stone pine stands (Bândiu and Donita 1988, Cenusa 1991), beech-oak stands (Popescu-Zeletin et al. 1973, 1975), beech stands (Bândiu 1988), sessile oak stands, pedunculate oak stands (Bândiu 1988). A part of these researches was integrated with the International Biologic Program.

These researches brought many new elements in the knowledge on the structuring of biocoenoses, their productivity, development stages, bio-geochemical processes highly useful for enlarging the ecological foundation for management measures.

An inventory of virgin forests was started for organizing the ecosystem researches in natural forests. A first presentation of the most important virgin forests was done in the framework of international programs (Giurgiu et al. 2001, Biris 1999, 2002).

Ecological differentiation of forests in relation with geographic zones and regions

Considering the zonal and regional variation of forest biocoenoses, generated by the climate, relief, geological conditions, large researches were carried out for establishing the forest zones and regions.

The first summarizing paper, which aimed at zoning the forest production, was issued in 1968 (Giurgiu et al. 1968).

After subsequent works mapping the forest vegetation (Donita and Roman 1976), for a correlated study of geographic conditions, and of forest species and biocoenoses distribution, the second summarizing paper on forest zones and regions in Romanian was published (Donita et al. 1980).

It is used for the transfer of forestation material (Enescu et al. 1976), to differentiate management measures in accordance with the regional features of ecosystem types, to establish the protected area network that should include the real regional variation of forests.

Investigation of ecological disasters caused by different factors

In the last 60 years, the Romanian forests were strongly affected by disturbing factors. The Institute had the task to investigate the causes and impact of these disasters and to develop measures for reducing or eliminating the destructive impacts but also for preventing them in the future.

Detailed researches were developed on wind felling, especially in spruce stands (Dissescu et al. 1962, Barbu 1985, Popa 1999), on felling caused by snow in spruce stands and mixtures of fir, spruce and beech.

A large and complex research program dealt with the dieback of *Quercus* species (Alexe 1996, Blujdea 2000).

The more and more intense damages to forests due to air pollution, in industrial areas, resulted in the development of researches on pollution impact on forest bio-coenoses and soils (Smejkal 1985, Cristescu 1974, Ivanschii 1989, Ianculescu and Tisescu 1992).

The disasters generated by the explosive insect multiplication (especially defoliators, bark beetles and carpophage) have led to the development of special research programs for biological and integrated control, based on autoecological researches on those insects (Ceianu and Mihalache 1961, Ceianu and Balinschi 1963, Ceianu et al. 1966, Mihalache and Simionescu 1980, 1987, Ceianu and Olenici 1991, Olenici 2002 etc.).

Many researches dealt with the problem of damages caused by game in cultures and natural regenerations, as a reflection of inter-population relationships in forest bio-coenosis (Ichim 1964, 1971, 1989, Ichim et al. 1971, Barbu and Cenusă 1988, 1987, Vlad 1994, 2002).

The results of the researches were completed with the development of measures for eliminating the impacts and for preventing these phenomena in the future.

Forest functional zoning

Researches have been carried out on the ecoprotective functions of forests and their functional zoning was developed in order to be able to use these functions (Popescu - Zeletin et al. 1954).

This quite detailed system was afterwards improved (Giurgiu 1988, 1993) and it has been used in forest management planning since 1954.

Conservation of forest biological and ecological diversity

The conservation of forest species and ecosystems in protected areas, which was initiated even since the establishment of the Institute, continued through the involvement of the forest researchers in the activity of the Nature Monument Commission for identifying, describing and protecting some reserves and nature monuments. A special contribution is the respect was brought by A. Beldie, A. Haralamb, etc.

An important process in which the Institute had a contribution was the demarcation of the national and natural parks, which started after 1989. This process was completed with the legalization of these parks (Stoiculescu 1990, 1996).

The Institute's researchers were also involved in the development of management

plans for the administrations of these parks and play an important role in their scientific councils.

In the last decade, researches have been started on the assessment of forest biocoenoses biodiversity and on the impact of different management measures on it (Donita et al. 1997, Biris 2001). Also, researches have been carried out for identifying the endemic, rare and endangered species in the forest ecosystems or associated to them (Radu 1996); a series of recommendations have been developed for their conservation and management.

At present, researches are being carried out for identifying the types of forest natural habitats whose conservation needs the establishment of special conservation areas, for implementing the NATURA 2000 network in Romania.

Ecological forest monitoring

Starting with 1983, the development of the national system for forest monitoring has been discussed and, afterwards, a methodology for ecological forest monitoring was developed (Patrascoiu et al. 1985, 1987, 1990, Badea and Patrascoiu 1993, Badea et al. 1998 etc.).

CONCLUSIONS

In the 70 years of institutional forest research, a large ecological database was created with knowledge on forest environment, local and exotic tree species, cultivated in forest areas, many animal species and fungi, game species, forest types, site types and forest ecosystem types.

This large database was used for ecologically substantiating the forest management planning, silvicultural techniques, tree amelioration, pest control, prevention of disasters, improvement of degraded lands and watershed management, creation of forest shelterbelts, game management.

Founded on this database, a local forestry was developed, directed on the ecologic specific characteristics of the Romanian forest, by adjusting the European technologies for forest management to these characteristics.

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in the paper „Publicatii ICAS - seriile I, II si III, 1933 - 1993”. A selective bibliography is presented in the following paragraphs, but, of course, it can reflect only a small part of the many results obtained during the 70 years of ecological forest research.

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