GROWTH AND STABILITY OF THE BEECH TREES FORESTS IN DRAGOMIRNA RESERVATION

Seghedin Georgeta Silvia*, Timofte Adrian Ioan**

* National Forest Administration Romsilva, Bd. Magheru 31 sectorul 1 Bucuresti, Romania,
Doctoral student of "Stefan cel Mare" University Suceava, e-mail: georgetaseghedin@gmail.com
* University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048, Oradea, Romania, e-mail: adi_timofte@yahoo.com

Abstract

The paper shows that the given ecosystem has a low diversity, thus a low stability in time, as shown by the high percentage of cracks, by the presence of rot and scars. An analysis must be conducted regarding the opportunity of the ecological reconstruction of the given ecosystem using adequate treatments. The possible afforestation works must be done using local material so that the valuable gene fund of the reservation can be inherited unchanged by the generations to come.

Key words: stability, statistical analysis, defects, monitoring, natural reservation, beech tree.

INTRODUCTION

By stability we understand the capacity of the forestry biocoenoses to preserve or restore their structure and functions in the case of disturbances which don't exceed a specific level.

This depends on the level of internal organisation and on the self-regulating capacity of the biocoenoses (Institute of Biology, 2010, Bodnariuc, 1981). Having a high level of organisation and a high capacity of self-regulation, the natural forest biocoenoses are generally characterized by a stronger stability than other categories of biocoenoses. These observations are valid for the natural forest. In the forest where man intervenes, things change: the natural forest biocoenoses which are generally very stable become very vulnerable, because the modifying interventions of the man usually affect other mechanisms of biocoenotic regulation (Donita, 1977).

The ecological surveys have developed several basic axioms regarding ecosystems' stability. The main axiom says that between biodiversity and stability there is a strong correlation. According to the theory of Svirezhev and Elizarov (1972): the more complex is the structure of an ecosystem, the more stable this ecosystem is (basic axiom). This axiom can be divided in other two axioms: one which defines strictly the process of self-regulation (diversity generates diversity) and another one which defines the process of heteroregulation (complexity generates stability).

All these axioms, corroborated and generalized, produce a fourth axiom: the stability of an ecosystem is generated by the synergic effect of the biodiversity and complexity, or the main result of ecosystem biodiversity and complexity is its very stability (Giurgiu, 2004).

In conclusion, the stability is materialized in the resistance of a supraindividual heterogeneous biosystem to the fluctuating actions of the natural or anthropic factors (Studies and communications for nature preservations, Suceava 1981).

MATHERIAL AND METHOD

The investigations were conducted within the Forestry Directorate of Suceava County, UPV Dragomirna, u.a. 14 B (ICAS, 2005). For the accomplishment of the proposed objectives, a permanent trial plot of one hectare was determined. The forest trees are of the same age.

The location of the areas, the delimitation and inventory of the trees from the experimental plots was done in agreement with the established methodology for the study of forestry ecosystems, using horizontal and vertical phytocoenotic profiles (Cenusa, 1992) (Fig.1).

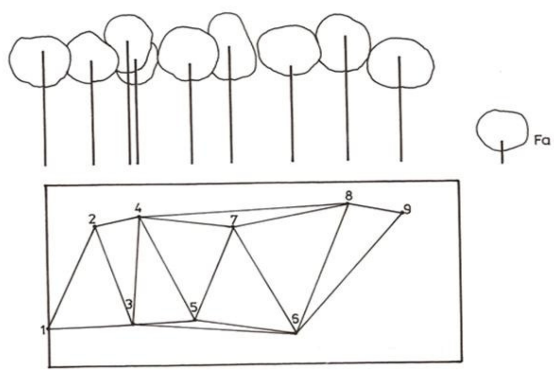

Fig. 1 Example of horizontal and vertical structure of the beech stands from Dragomirna reservation

The experimental plots have been delimited by stakes at their corners and divided in 10 × 10 quadrates using poles.

Each tree within the experimental plot, having a basal diameter larger of 4 cm was marked with a number in dye and was recorded in the field log: species, diameter at 130 cm, total height (m) on two 10 × 20 bands, Kraft class, quality class, canopy diameter (m), Cartesian coordinates (x, y) for each tree, the health state (growth defects, cracks in the wood, rotten parts, scratches, knots, Chinese tendrils). Growth samples were collected with the Pressler drill in order to determine the radial growth, the correlation between the radial growth and tree diameter and the growth in volume of the trees (Giurgiu, 1972, 1979). The health state of the trees included in the monitoring network was calculated using 25 × 4 Prodan areas.

The data were recorded and processed statistically using the methods used in forestry research.

RESULTS AND CONCLUSIONS

Tree growth

The regression equations for the correlation between the radial growth in 1, 2, ... 7 years and tree diameter were determined. The following results were obtained (Figs 2 and 3):

- for 1 year, the equation is: $y=0.0236x+0.1729$; $R^2=0.2718$;
- for 2 years, the equation is: $y=0.0451x+0.215$; $R^2=0.4097$;
- for 3 years, the equation is: $y=0.0699x+0.1474$; $R^2=0.4653$;
- for 4 years, the equation is: $y=0.09776x+0.0625$; $R^2=0.4691$;
- for 5 years, the equation is: $y=0.12086x+0.259$; $R^2=0.4486$;
- for 6 years, the equation is: $y=0.1749x+0.3225$; $R^2=0.475$;
- for 7 years, the equation is: $y=0.2093x+0.2522$; $R^2=0.5029$;

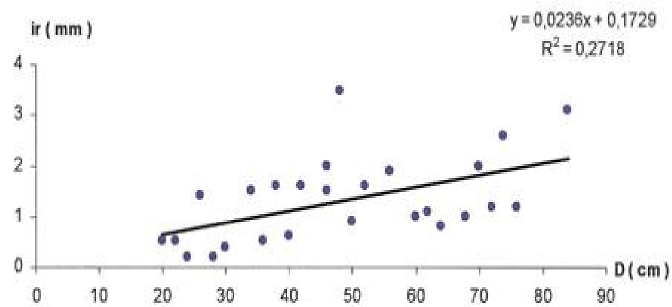

Fig. 2 Relation between the radial growth in one year and tree diameter

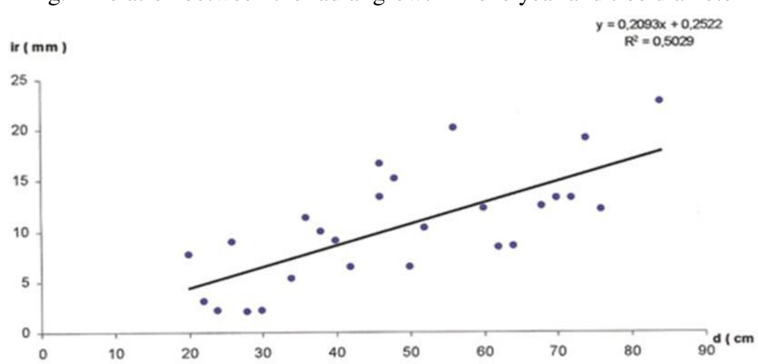

Fig. 3 Relation between the radial growth in seven years and tree diameter

The charts show a normal relation for the trees of the same age between ir and d. The regression coefficient a_1 increases with the period taken into consideration (n), while the free term a_0 displays a poor trend of growth in relation with the same variable n (Seghedin, 1998).

The increase of the relation coefficient R^2 with the considered period was also noticed, as shown by the following regression equation:

$R^2=0.0763 \ln x + 0.5597$

The relation is very strong and is characterised, in turn, by another coefficient of relation $R^2= 0.8102$ which is very significant.

Graphically, the correlation between the number of years for which the growth was measured and R^2 is shown in the subsequent figures by a parabolic correlation, which can be reduced to linearity using a logarithm (Fig. 4).

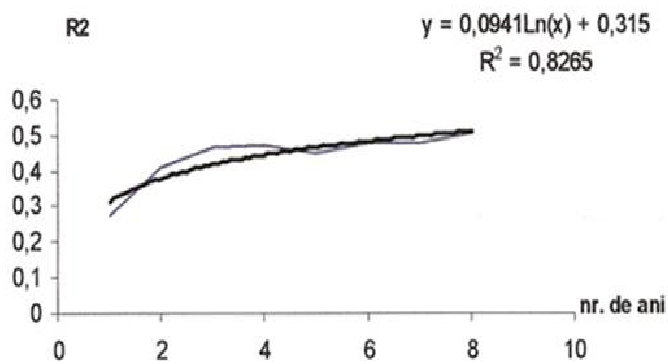

Fig. 4. Correlation between the correlation coefficient R^2 and the number of years for which the growth was measured (linear correlation)

Statistical processing was also done regarding the health state of the trees subsequent to the monitoring activities. The overall health state is good, with a small proportion of the trees included in the lower health classes. On the entire area, there are 88% healthy trees, 10% slightly affected trees, 1% medium affected trees, 0.5% seriously affected and 0.5% dead trees. Although 88% of the trees are healthy, the phenomenon of abnormal drying of the beech trees is noticed locally, even at the trees from the upper level, accompanied by the phenomenon of insolation. This can be explained by the previous prolonged draughts, by the stress produced by climactic factors (thermal and hydric extremes), by the chemical pollution of the air and soil, the global decline of the forests being felt progressively. Another cause, are the late freezes which occur in spring (Giurgiu, 1995).

We also determined the number of trees with cracks, which are in quite a high proportion (39%); this is explained by the fact that the beech tree is a species characteristic to the rather warm areas, there forests being at the N-NE limit of its areal. Following the Poisson distribution and making the correlation between the category of diameters and the cracks, we noticed that the highest proportion of affected trees appears in the category of the higher diameters by 17%.

Of the category of defects which depreciate wood quality and forest health, we also considered the rot. It is present, participating as defect, in 10% of the trees, smaller than the proportion of trees affected by cracks. There is a large variability of the trees affected by rot, between 0 and 76%. The Poisson distribution (of the rare events) shows the distribution of the trees with rot. This shows that we are confronted with a random process due to a multitude of factors, but of low importance, because there is no predominant factor to destabilise it. The trees with rot are uniformly distributed on the surveyed area, the λ^2 test confirming the veracity of this distribution (λ^2_{exp}= 0.973 < $\lambda^2_{theoretic}$ = 5.59, for a probability of 5%). By category of diameter, the distribution of the rot has shown again that the most affected are the trees in the categories of medium to larger diameter, with 5% proportion of trees with rot, followed by the category of large diameter, with 3%, and by the category of trees with small diameter, with 2%.

The monitoring network also inventoried the trees with scars. These scars are local degradations of the wood tissues produced by the game, hail, tree marking, forest exploitation, resin collection, tourism, etc. The distribution of the trees with wounds shows a high variability (0 to 100%) of the percentage of wounds between the experimental plots. Of the total 709 beech trees taken into calculation, 132 (19%) trees have wounds, fact which must make us think. The repartition of the experimental plots by class of the percentage of wounded trees shows that the most frequent are the locations with a low percentage of wounded trees (0-10%), but we also noticed areas with 80-90% trees with wounds. The frequency of the number of trees by diameter category also shows that the highest proportion of the trees with wounds is in the category of trees with medium to large diameter, 6%, followed by the category of trees with small diameter, 5%, and by the category of trees with large diameter, 4%. This is explained by the fact that the trees with medium diameter were affected the most by the exploitation done before 1975.

It is also interesting to notice that the highest proportion of wounded trees is in the interval where the most valuable trees of the forest are.

The worryingly high percentage of wounded trees is due to the fact that the trees have been affected in the past by the intervention during the exploitation works.

CONCLUSIONS

The relation radial growth-diameter relation is given by a linear regression equation: $y=a_0+a_1x$. The values increase constantly and proportionally with the increase of the radial growth.

In terms of the health state, determined by the level of canopy defoliation, we observed that 88% of the trees are healthy and just 10% are medially affected. This means that the decline already started, as shown by the phenomenon of abnormal beech trees drying, even at the upper level, which brings along the phenomenon of insolation. This is explained by the previous ling periods of draught.

The examination of the percentage of defoliated trees all around Suceava County shows that Dragomirna natural reservation has a much better state of health, which explains the highly stable state of the ecosystem. We also observed that throughout the reservation, the trees are also valuable in terms of tree trunk quality, evaluated according to the proportion of wood good for work; most of the trees were included in the first class quality.

In terms of defects, the cracks have a worryingly high percentage, 45%. This is explained by the fact that the beech tree is a species characteristic to the rather warm areas, while these forests are at the N-NE limit of its area. The knots caused about 20% of the defects, followed by bifurcations, 15%, tree scars, 12% and Chinese tendrils 8%. The rot was observed in about 4% of the trees (Figure 5). We may use in this case the Poisson distribution which shows that we are witnessing a random process due to a multitude of factors which are, nevertheless of low importance. The trees with medium tree diameters are the most affected. Scratching appears due to the careless exploitation during the past period, when the forest didn't have the quality of natural reservation.

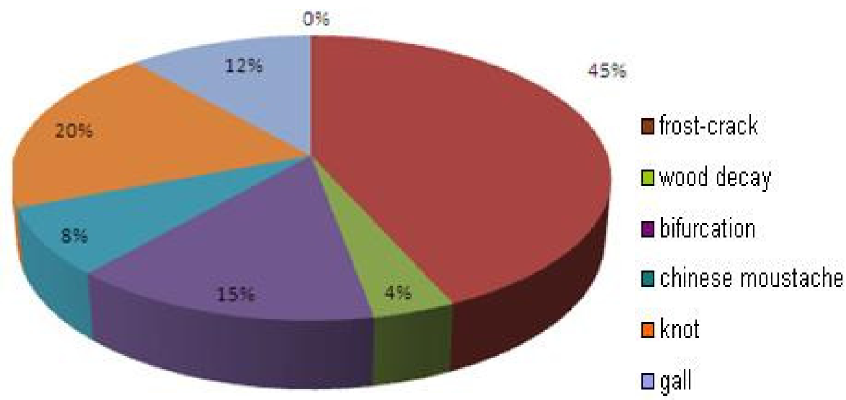

Fig.5. Percentage of defects in one of the Dragomirna surface

In conclusion, we may say that although the trees have a consistent high quality and are included in class 0 of the level of defoliation, the surveyed ecosystem has a low biodiversity; this means that it has a low stability in time, as shown by the high percentage of cracks, by the presence of rot and scars. Although the total amount of wood is sizeable, it doesn't have exceptional quality because of the technological defects that we mentioned previously.

There should be an analysis of the opportunity for ecological reconstruction of this ecosystem. The most adequate treatment must be selected: the treatment with long period of regeneration, or maybe a continuous regeneration (gardening, maybe the treatment of the gardened forest or just highly intensive conservation works); there may also be forestation works using local material so that the valuable gene fund of the reservation can be inherited unchanged by the generations to come.

The ecosystem must be monitored using a permanent monitoring network which has to be built in this reservation; this would allow supervising the health state and the structure of the ecosystem.

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