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COMPARATIVE DETERMINATION BETWEEN HEALTHY AND DECLINE OAK STANDS REGARDING GROWTH LOSSES

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Abstract
Age and health are the intrinsic characteristics of each individual plant, but depending on the environmental conditions, the entire population will be affected. In the case of injury to the stands containing species of Quercus genus, the symptoms are also manifested by the reduction in height and stand basal area, crown scarring, discoloration of the leaves and an abnormal grouping on the top of the lures, followed shortly by the appearance of epicormic branch.
Sustainable management of forests viewed from the perspective of the unconscious economy without maintaining the state of health and good vegetation, obtained through management at the intersection of economic requirements and what can produce biologically and physically a forest ecosystem under certain given conditions. This concept can be expressed by a series of qualitative or quantitative indicators.
In the present paper analyses the increase losses, expressed from the perspective of wood biomass accumulations, were determined on the radial section for 5 years period, using the method of couples applied to stands situated in similar conditions of vegetation but with major differences in status health and vegetation. The differences between the situations considered normal and those with declining phenomena show that these losses are between 14 and 22% in the affected stands compared control stands.

Keywords: decline, increases, losses, oak, sessile oak, stands.

1. INTRODUCTION

Knowledge of the forest ecosystems and especially of their development, for a period equal to at least one production cycle, is essential for the sustainable management of forests.
But in order to achieve this, it is necessary to know and maintain the state of equilibrium of forest ecosystems in relation to the harmful factors and application of silvicultural measures which seek to counteract their action.
The passage to the condition of decline of a stand is a gradual process, which implies an intermediate state which may be reversible to the healthy state, if the factors which have imposed it disappear or are reduced, but remains affected its capacity to produce biomass, registering important economic damage (Delatour, 1983; Marcu, 1986).

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Since the first observations on the decline and dieback phenomena and installation of the abnormal phenomenon generically called "the decline of forests", the problem of determination of biomass losses recorded according to the degree of damage of these stands was posed, in order to make possible the estimation of these losses from an economic perspective, and to help forest managers to make an accurate prognosis of income from the sell of wood biomass or to take management decisions.

2. MATERIALS AND METHODS

For the determination of growth losses in affected stands due to dieback, the method based on a single inventory and on samples of radial growth extracted from instead trees was used.

This procedure implies carrying out inventories in sampling areas, and investigations shall be carried out on cores (which are extracted with the Pressler drill) from average trees on those stands (Badea, 2003; Ianculescu, 2005; Leca, 2014).

They must contain a sufficient number of annual rings to ensure the determination of the real radial growth curve.

The annual rings of trees register a large quantity of information. Hence, it is possible to make a retrospective review of the growth dynamics by eliminating the influence exercised by age and climate, which constitute a collective response of trees at a certain signal (in our case, the phenomenon of the dieback in mass).

The principle of the method of determination for the abnormal loss consists in determining the average curves of growth of the healthy trees and the ones affected by the phenomenon of decline and obtaining the values of the losses incurred as the difference between the two situations.

When choosing and locating these stands, it has been taken into account the condition of vegetation and health for capturing the effect of various biotic factors involved in the phenomenon of *Quercus sp.* dieback, together with the climate stress under which they are found.

The studies were carried out for stands in which the principal species is the oak (*Quercus robur*) or sessile oak (*Quercus petraea*).

For oak stands, two stands of Forest Plain located in the North-West region of the country (Someş Plain) were included in the study, among which there are many similarities in terms of site conditions and environment, age, composition and the culture regime.

For study, it was selected a stand that had pronounced decline phenomena due to repeated defoliation, attacks by pathogens or fluctuating the groundwater level (in this case - Nisipeni Forest), whose growth was compared to that of a stand located nearby and had good conditions of vegetation (Pădurea Mare Forest), both belonging to Satu Mare Forest District.

For the sessile oak zone two stands on the same criteria as above were identified, Nicula Forest (located in Gherla Forest District), where is the state of vegetation and health were good, and Bungăr Forest (located in Dej Forest District), where decline and dieback phenomena were recorded, respectively.

From each stand included in the study of 30 samples of growth from trees that have diameters nearer to that of the average diameter have been taken.

Due to growth in homogeneity, the comparability has been achieved through the usage of growth indices.

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Figure 1. Sample plot for the loss on increment determination in the Nisipeni Forest (F.D. Satu Mare)

They express in relative values the oscillation ofthe curve of the annual rings, compared with an ideal growthcurve and can be determined on the basis of the ratio between the actual value of the growths and the offset value of the curve of growth.

In order to compensate for the actual growths, a development curve was used, whichwas obtained by using the function $y = a\ x^b\ e^{-c}$ *(Hughersforf type*), where: y - represents radial annual average increment; x - the age of the annual ring; a,b,c - the coefficients of the regression equation, experimentally determined.

The obtained distributions were compared with the χ^2 test for determining the differences in growth evolution.

If any differences between the two distributions were found, the calculation of the average indices of growth for periods of 5 years was performed.

After the calculation of relative growth indices for control and affected stands, the calculation losses of growth in diameter represents the next operation.

In the literature it is estimated that between the losses in diameter and losses in the base area or volume difference is approximatively -2% for short periods of time (Ianculescu, 1975; Leca 2014). Therefore, on the basis of such relations, the loss of the current growth in volume for stands affected by various factors may be estimated later.

3. RESULTS AND DISCUSSIONS

Age and health state are intrinsic characteristics of each individual, but depending on the environmental conditions, the entire population will be affected

In the case of damage to the stands containing species of *Quercus* genus, the symptoms are also manifested by the reduction in height and stand basal area, crown scarring, discoloration of the leaves and an abnormal grouping on the top of the lures, followed shortly by the appearance of epicormic branches.

The annual radial increases and adjusted for periods of five years are given below:

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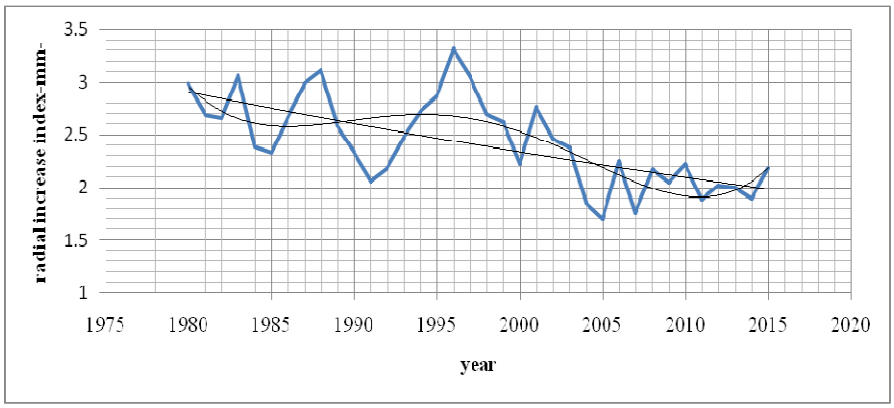

Figure 2 Medium curve of annual rings and compensated curve for Pădurea Mare forest, Satu Mare, F.D., unafected by decline

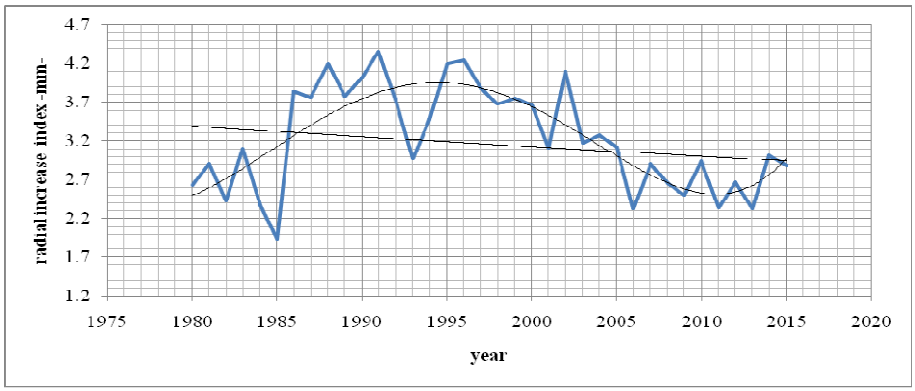

Figure 3 Medium curve of annual rings and compensated curve for Nisipeni forest, Satu Mare F.D., afected by decline

From the previous figures, it can be noted that the trend curve of development and periodic variations in the growth evolution in the 2 forests follows the same pattern, due to the characteristics of the local climate

In order to highlight the recorded differences with regard to the radial growth, both adjusted growth distributions were compared using the χ^2test, obtaining $\chi^2 = 67{,}02^{***} > \chi^2_{0,001}$ ($\chi^2_{0,05} = 42{,}60$; $\chi^2_{0,01}=49{,}60$; $\chi^2_{0,001}=58{,}30$, for 29 degrees of freedom).

Between the two stands, significant differences in the growth evolution exist, so the growth losses can be determined from the trees of Nisipeni Forest, compared with values deemed normal in the Pădurea Mare Forest (considered 100%).

From the plot of radial increases for both forest, the time of entry into the decline the Nisipeni Forest can be established (the period between 1995 and 2000) .

The losses of growth determined for periods of 5 years had the values of 14 % in the period 1980-1985, after which the growth evolution in the two stands has been similar, registering a decrease of 7% in the period 1996-2000 and an aggravation for the period 2005-2013, when the difference between the two stands exceeded 20% (Table 1), which confirms the advanced state of decline of the Nisipeni Forest. For the last two seasons of vegetation analyzed, a tendency for amelioration has been recorded, correlated with the absence of major defoliation in that period, or during the previous years.

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Table 1. The average indicators of diameter increment on 5 year terms and relative value of the diametrical increment due to the medium indicators of affected stands

period	Pădurea Mare Forest (control plot)		Nisipeni Forest (afected by decline)					
	IC_M(~ Ir)	%	IC_M(~ Ir)	%	1-Ir=ΔPid	Iv (mc^3/year/ha)	ΔPiv (mc^3/year/ha)	%
1980-1985	95.98	100	82.57	86.03	13.97	6.50	0.91	13.16
1986-1990	101.16	100	101.07	99.91	0.09	7.30	0.01	-
1991-1995	97.49	100	117.49	120.51	0.00	8.70	0.00	-
1996-2000	117.70	100	109.43	92.97	7.03	9.10	0.64	7.03
2001-2005	97.30	100	102.60	105.45	0.00	9.60	0.00	-
2005-2010	92.42	100	73.41	79.43	20.57	10.10	2.08	20.59
2010-2015	96.77	100	77.12	81.33	15.24	9.24	1.97	21.32

IC_M - The average indices of growth in diameter
Ir - Relative value for growth in diameter
ΔPid- Relative increases losses in diameter
Iv- Curent volume growths for control stand
ΔPiv –The loss of relative growth in volume for affected stand

These values expressed only losses of the current growth, but in the economy of the forest to these are added the volume of dead, dying or extracted trees, so that the total losses of wood mass are much higher, but in fact they are higher than 50 % of the amount per hectare recorded in an unaffected stand.

The large fluctuations observed in the current growth rates in Nisipeni Forest for the analyzed period overlap with the total or partial defoliations that occurred in these stands, which amid the physiological weakening of the trees due to abiotic causes have become more frequent and with higher intensities.

Another factor which has contributed to this phenomenon have been the chemical control against defoliators insects, applied with a high frequency in the Nisipeni Forest compared to the Pădurea Mare Forest.

The same procedure has been followed for the sessile oak stands chosen for the study.

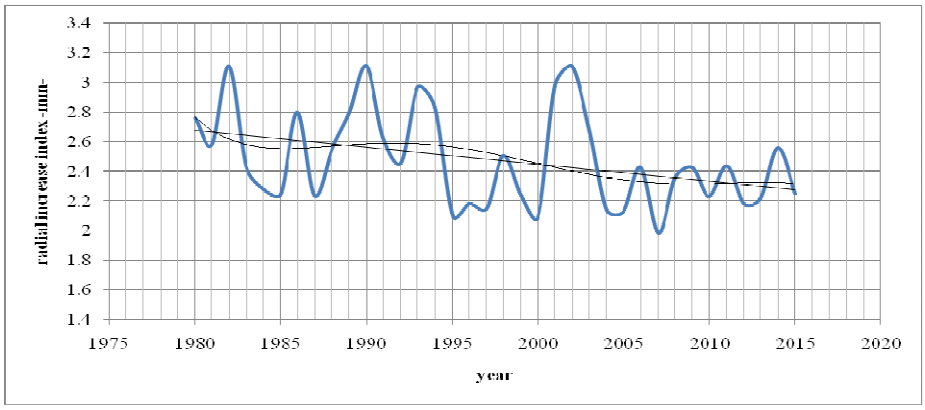

Figure 4. Medium curve of annual rings and compensated curve for Nicula forest, FD Gherla, not affected by decline

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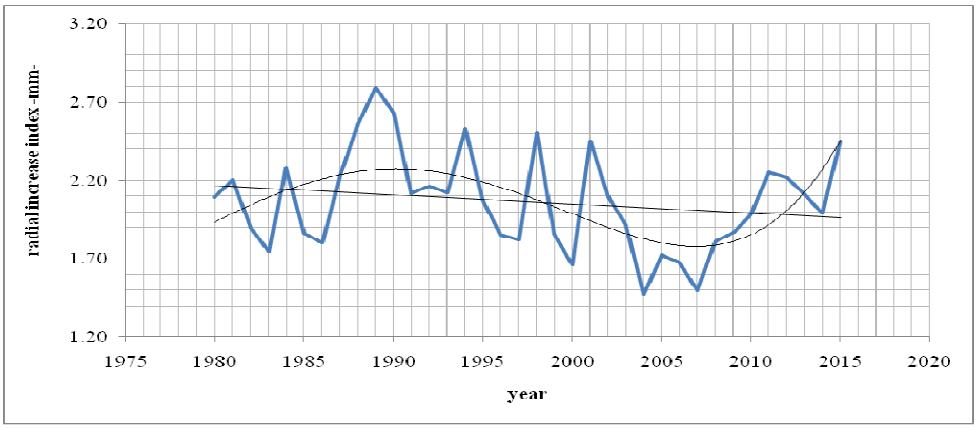

Figure 5. Medium curve of annual rings and compensated curve for Bungăr Forest, Dej F.D., affected by decline

The two adjusted distribution were compared with χ^2 test, where $\chi^2 = 29{,}32 < \chi^2_{0,05}$ ($\chi^2_{0,05} = 42{,}60$; $\chi^2_{0,01} = 4\ 9{,}60$; $\chi^2_{0,001} = 58{,}30$, for 29 degrees of freedom).
It is noted that there are no statistically ensured differences between the two forests, with regard to the annual growth evolution and this indicates that the decline here is a relatively recent date.

4. CONCLUSIONS

From the analysis of the current radial growths on cores extracted from trees near the average individual, it may be determined that the situation of the Nisipeni Forest, where a chronic decline existed, primarily due to forest site conditions and the increased frequency of defoliating insects attack and in the case of Bungar Forest forest there are specific manifestations of an acute decline, installed in the last years due to the decrease of the natural resistance and some climatic peculiarities of the last vegetation seasons (mainly - spring drought and late frosts).
The growth losses of the Nisipeni Forest, compared with the control forest have had an oscillating evolution until the 1995-2000 period, when its vegetation state began to worsen constantly. Currently, the current growth differences exceed 20%.
To these are added the volume of dead and extracted trees, the reduced number of trees per hectare, so that between the 2 stands the difference in terms of the volume per hectare is greater than 50%, which continues to increase.
This phenomenon also has direct consequences on the quality of wood, by alteration and decayed the sapwood in a very short time, which leads to the declassification of the wood.
To remedy this situation it is necessary to apply special measures for the management of the stands affected by decline, in conjunction with the measures for the integrated control of pests and diseases and in the medium and long term, realization of stands with vertical and horizontal structure, consisting of mixing species and rich underwood, since they will be able to resist the better to various injurious factors.

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