

NATURAL SUPERIOR LIMIT OF THE FOREST IN THE GUTÂI MOUNTAINS

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ABSTRACT. The object of this paper is to broaden and deepen the knowledge referring to the notion of superior limit of the forests, of the types of superior limits, the analysis of the manner in which the limit beech forests from the Gutâi Mountains represent the superior limit of the forest. Another objective was a description of the main characteristics of this brush. The forests from the Oaş – Gutâi – Țibleș Mountains are almost entirely represented by natural mountainous beech forests which held the majority in the forest massifs from this zone and cover an area of about 65.000 hectares. The aim of the article is to make an analysis substantiated ecologically referring to the aspects connected with establishing the notion of superior limit of the forest, of the types of superior limits, of the measure in which the limit beech woods from the Gutâi Mountains represent the superior limit of the forest and the description of the main particularities of these brushes. The mountain beech woods belong from an administrative point of view to the Baia Mare Forestry Direction and represent about 80% of the total of the woods from the zone of the Gutâi Mountains. The superior limit of the forest is defined by the line that connects the points of maximum altitude, in which the forest achieves a consistency of minimum 0.5, the trees are at least 5 m tall, and the minimum accepted area is at least 250m². The limit brush from the Gutâi Mountains represents the **superior natural climatic limit** of the beech woods, conditioned by the dominant winds from the vegetation season, as the brushes meet the conditions of minimum area (250m²), of minimum 0.5 consistency and have the minimum average heights of above 5m (between 7.19 m and 7.94 m). Besides the dominant winds, the superior limit of the beech woods is also conditioned, but to a lesser extent, by the geomorphology of the land, very large slopes and by reasons of climatic and edaphic reasons.

Keywords: Gutâi Mountains, natural mountain beech forests, altitudinal limit, superior climatic limit

INTRODUCTION

The forests from the chain of the Oaş – Gutâi – Țibleș mountains are almost entirely represented by the natural mountainous beech forests. The Gutâi Mountains have been chosen because they are the most representative ones in the volcanic chain Oaş – Gutâi – Țibleș. The Gutâi Mountains are individualized as a geographical, hydrographical and even ethnographical barrier between the Baia Mare depression and the Maramureș depression. Here, the beech forests held most of the zone and spread over an area of about 65.000 hectares.

The forests and the forests grounds from the Gutâi Mountains are situated in the Maramureș County and are administered by the Ministry of Agriculture, Forests and Rural Administration, by the forests departments Baia Sprie and Mara within the Maramureș Forest Direction. In the Gutâi Mountains the mountainous beech forests held a compact and extensive strip, with an area of more than 9300 hectares (about 80% of the actual area of the forests). The mountainous beech forests from this massif spread over the Someș side, with a predominant southern orientation, covering a large part of the hydrographical basins of the rivers Săsar and Cavnic. Most of them belong to the Forest Department Baia Sprie (U.P. II

Șuioar, U.P. III Cavnic and U.P. IV Dunbrăvița.. On the Maramureș side of the massif, with a generally northern orientation, the mountainous beech forests cover the hydrographical basin of the Mara river and are administered by the Forest Department Mara (U.P. Budești and U.P. IV Gutin).

Under specific edaphic, relief and climatic conditions for the mountainous chain of the Gutâi massif, the natural mountainous beech woods ascend altitudinally up to the altitudinal limit of the forest. As it is known, the superior altitudinal limit of the forest in our region is mainly artificial (determined antropically), but also natural (climatic or orographic) in certain zones, making up the limit forest strip between forest and sup-alpine glades (Doniță et al., 1992; Florescu, Nicolescu, 1996; Geanana, 1975; Negulescu, Ciumac, 1959; Negulescu et al., 1973; Rob, 2003).

In most parts, the superior limit of the forest in the Carpathians is situated between the boreal level (that of the spruce fir forests), being made up of the limit spruce fir forests, limit spruce- larch in the centers where the larch is spread; sometimes, in the limit forests where the arolla pine also appears, and also the Scots pine in the Retezat massif (Stănescu in Negulescu et al., 1973). The author points out that,

quite exceptionally, in the mountains from the North West Oltenia, on the southern and western slopes, with a rather milder climate, somehow exposed to the moderating Mediterranean influences, there are also some beech glades with green alder and dwarf juniper tree, above the superior altitudinal limit of the forest made up of the limit beech woods. Their presence is tightly connected with the southern climatic influences benefactor to the beech and which are manifested up to very high altitudes.

The same author very suggestively mentions that in the Parâng mountains, the limit beech woods form real climatical woods, with all characteristic attributes: the position at the natural altitudinal limit of the forest towards the alpine gap, the brush of lower productivity, rather thinned out, with irregular structure; trees grouped in bunches, with basic curved trunks, the bark with moss and lichen bark, etc. (Stănescu from Negulescu et al., 1973).

The aim of this paper is to bring extra information and details about the existence of the superior natural altitudinal limit of the beech in the Gutâi Mountains. As Geanana stated (1975), we consider that the superior natural altitudinal (climatic) limit joins the points where the height of the bushes exceeds 5 -6 m, and the consistency of the forest is of minimum 0.5. (Rob, 2003; Rob, Tăut, 2007).

MATERIAL AND METHODS

The ground works consisted in placing and materializing some sample areas, out of which some data about the characterization of the stationary and vegetal conditions have been drawn (Rob, 2003).

In order to find out the particularities of the limit beech forests 4 test zones have been laid out in the points of maximum altitude, as follows: S.P.1, at the altitude of 1375 m over western exposition, S.P.3 at altitude of 1415 m over eastern exposition, S.P.5 at altitude of 1370 m over southern exposition and S.P.7 at altitude of 1390 m over northern exposition.

In order to find out the variation of the structural and hypsometrical characteristics of the brushes existing at the altitudinal limit of the beech forests, 4 research zones have been laid at an altitude of about 50 m lower than those of maximum altitude, as follows: S.P. 2 at the altitude of 1325 m over western exposition, S.P.4 at the altitude of 1475 m over eastern exposition, S.P. 6 at the altitude of 1350 m over southern exposition and S.P. 8 at the altitude of 1340 m over northern exposition.

The elementary test zones as stripes with an area of 500 m² (50 x 10 m) have been preferred, in order to find arborescent populations in each place, similar to the even-aged or almost even-aged ones (Popescu - Zeletin, 1964), although the structure of the natural limit beech trees is obviously heterogeneous, closer to the relatively irregular one.

The ground investigations consisted in gathering data about the conditions of the relief characteristic to the zone (altitude in meters with the altimeter, category of the display with the hand level, the slope with the pendulum hypsometer) as well as the conditions of soil and vegetation.

Outside works

The outside investigations consisting in collecting data concerning the relief characteristic to the zone (altitude in meters with the altimeter, the category of the zone with the clizimetru, the slope with the dendrometer with pendulum), as well as the soil and vegetation conditions.

In the sample area measurements have been carried out and data are presented about the species, the diameter in centimeters, the total height in meters, the pruned height in meters and, the diameter of the crown and the quality of the trees (estimated visually).

Inside works

Based on the documentation obtained, by using the data gathered during the outside works, one has carried out the stratification, the processing and the interpretation of the data concerning: the pruning coefficient, which is the percentage expression of the ration between the pruned height and the total height; the slenderness coefficient which is given by the ration between the total height and the diameter, both expressed in centimeters; the dominant height

which represents the average total height of the thickest trees from the brush, which, in statistical terms corresponds to the height of the trees thicker than $d + S_d$ (Armășescu et al., 1967; Leahu, 1994).

Consecrated methods from biometric and statistics have been used for all the determinations (basic area, unitary volume, dimensional and primary sorting). (Giurgiu et al., 1972; Giurgiu, 1979; Leahu, 1994).

Since most of the brushes are irregular, the analysis of some parameters in relation with the absolute value or with the arithmetic mean is not relevant, and that is why one has resorted to the statistical analysis and interpretation in relation with the values relative to these parameters (medians, variation coefficients, percentages).

RESULTS AND DISCUSSIONS

The superior altitudinal limit of the forest has been defined by the line that connects the points of maximum altitude, in which the closed forest achieves a consistency of minimum 0.5, the trees reach the height of at least 5 m (Florescu, Nicolescu, 1996; Geanana, 1975), and the minimum accepted area is of 250 m² (Plesnic, from Geanana, 1975; O.U.G. no.139 from 05.10.2005).

The superior altitudinal limit of the forest can be:

- natural, which appears as a resultant of the interaction of the physical and geographical factors, without man's direct or indirect intervention. Depending on the factors that have mainly contributed to the establishment of the superior natural limit, the following types of limits can be differentiated: the superior climatic limit, the superior geo-morphological (orographical) limit and the superior edaphic limit;

- artificial, which appears as a result of man's more or less cautious intervention (extension of the alpine pastures, clearings, arrangements, irrational constructions and exploitations, fires, etc.).

For a more objective description of the altitudinal limit of the forest in Gutâi Mountains, the data collected from the eight monitoring sites (see the table 1) was processed.

By analyzing the data gathered from the eight test areas, the following things can be noticed:

- the maximum average altitudinal limit in which the research zones have been placed is of 1387,5 m and corresponds to the maximum altitude occupied by the limit beech forests from the Gutâi Mountains;

- for all the bushes from the researched zones analyzed above, the actual character of the type of forest is naturally fundamental of inferior productivity, the general structure is relatively irregular and the vitality weak;

- all bushes are pure, with the exception of the one from S.P.4, in which the mountain sycamore maple appears disseminated in the composition, but it is more weakly conformed than the beech;

- all bushes situated at the maximum altitudinal limit have the 5th production class, and those situated 50 m lower are in the 4th production class;

- the bushes situated at the maximum altitude have the consistency 0.4 - 0.6, and those situated maximum 50 m lower have the consistency of 0.5 - 0.7;

- the average values from the bushes situated at maximum height have lesser values than those specific to the inferior altitudinal level, for the following variables: median diameter, crown diameter, total

median height, dominant height, median slenderness coefficient, pruning coefficient, basic area, total volume, proportion of the thick wood in the total volume and proportion of the working wood from the total volume, which is explained by the severe worsening of the biotope conditions, whose consequence is the specific decrease of the processes of growth, development and regeneration of the bushes;

- the average values of some dendrometric characteristics of the bushes situated at maximum heights are bigger than the averages of the inferior altitude level, because of some reasons similar to those presented above. This is explained by the clear worsening over 50 m altitude of the biotope conditions, especially of the climatic ones, which affect the processes of growth, development and regeneration of the bushes, their consistency decreases suddenly, the trees being organized in bio-groups of resistance, and the production class of the brush decreases;

- in the bushes situated at maximum altitudes one has often noticed that the trees frequently present the phenomenon of saber butt at the bottom of the trunk (figure 1) or have creeping and ill-formed trunks with obvious flaws, the crowns have a tube or flag form, with rare foliage (figure 2) and in most cases the tip is dry (figure 3), and the trees that advance in altitude above these limits have bushes habit (figure 2), aspects similar to the beech glade, also ascertained by Stănescu and Târziu in the Godeanu Mountains (Negulescu et al., 1973);

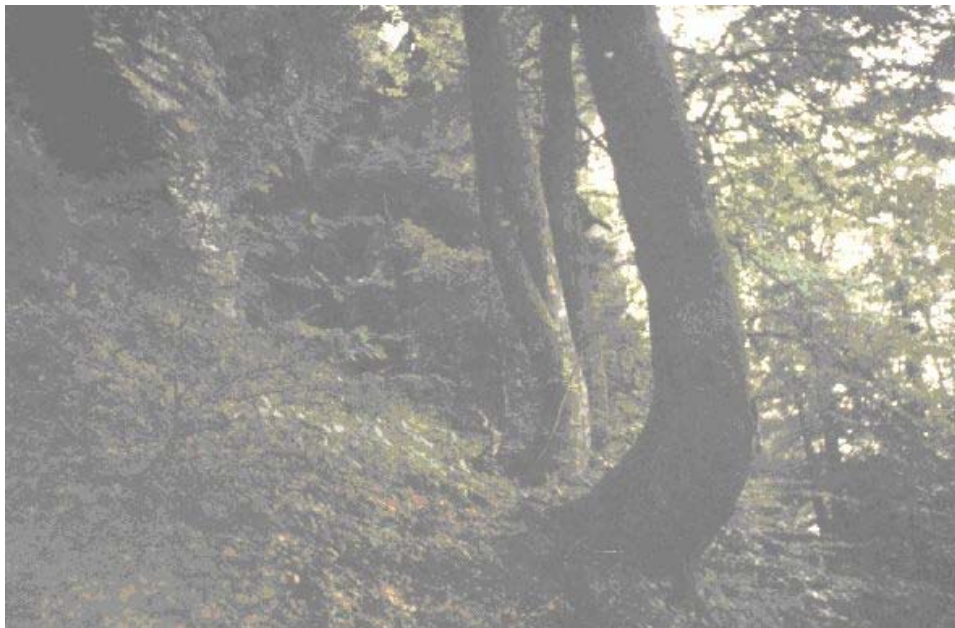


Fig. 1 Trunks with bend phenomenon

- in the bushes existing towards the altitudinal limit, in the direction of the dominant winds and in which they are bordered by rocks and steep slopes upstream, the trees have the height of the respective rocks (figure 4), and the trunks are well formed, which can be explained by the fact that the wind, like in the previous case, represents the main limitative factor which diminishes the upward growth and the general development of the trees and bushes;

- the herbaceous covering is well represented (over 0.4 -1.0 S) and is generally formed of Ericaceae and of *Luzula luzuloides*, and from the bushes, the juniper tree occurs frequently;

- a part of the trees existing towards the superior altitudinal limit present ovality on the trunk in E-W and N-S direction, which can be explained by the mechanic action of the dominant winds (the south-western wind in summer and the north wind in winter);

Table 1

Main dendrometric characteristics of the brushes from the sample areas situated at altitudes above 1.300 m

Number of the sample area	Display	Altitude (m)	Number of trees/ha	Median diameters (cm)	Crown diameter (cm)	Total median height (m)	Median pruning height (m)	Median pruning coefficient (%)	Median slenderness coefficient	Dominant height (m)	Basic area (m ² /ha)	Total volume (m ³ /ha)	Volume of the thick wood (%)	Volume of the working wood (%)
1	V	1375	700	19,7	3,52	6,2	1,3	14,2	34	13,5	31,4	150,36	9,32	14,2
2	V	1325	480	24,25	5,94	13,2	3,34	21,2	54,4	23,3	37,4	372,64	91,7	34,7
3	E	1415	580	18,5	4,3	7,5	1,6	20	39,4	10,4	17,2	77,76	0	19,7
4	E	1375	360	27,75	7,09	14,5	3,54	29,8	54,7	19,9	23,8	185,68	79,2	41,1
5	S	1370	840	16,25	3,88	7,35	1,36	9,3	47,7	10,8	22,08	99,48	0	14,9
6	S	1350	320	35,5	7,93	18,4	4,74	25	50,7	19,8	37,4	351,02	87,1	47,8
7	N	1390	360	24,8	5,11	8,05	0,89	5,76	32,9	12,3	17,4	82,88	68,7	23,2
8	N	1340	360	26,6	6,59	13,5	2,78	21,7	44,7	14,5	28,4	200,62	49,8	26,4
Media pe nivel altitudinal		1367,5	500	24,17	5,55	11,1	2,44	18,37	44,8	15,5	26,89	190,06	48,2	27,8



Fig. 2 Samples of beech with shrub shape at the superior western limit of the forest



Fig. 3 Phenomenon of drying of the crowns at the superior limit of the forest

- the mountain gap is not covered with secondary lawns, but by juniper tree and bilberry bushes, which, together with the fact that no obvious evidence of clearing or fire have been found in the limit brushes might lead to the idea that the forest limit has not been totally modified anthropically;

- the superior limit of the closed beech forests is higher on the direction of the mountain peaks and lower on the direction of the saddles between them; on the direction of the saddles, the vegetal covering formed of juniper tree and bilberry is mostly dry, without any tracks of arson, and the limits of this covering follow the forest limit rather exactly, being situated above it from the altitudinal point of view;

- what was mentioned above can be explained by the fact that the clouds ceiling is generally formed at altitudes between 800 – 1200 m, and the dominant

winds in the region are those from the south and the south west (in summer) and those from the east and north-east (in winter). As an effect of the action of the dominant winds from the vegetation season, which blow from the south, west and south-west and of the lower ceiling of the clouds than the maximum altitudes, the vegetation has deficits between absorption and perspiration, which makes the superior limit of the beech forests lower over the expositions facing the dominant winds directly, respectively western and southern, as compared to the opposite expositions, the eastern and southern ones. Therefore, the superior western limit (figure 2) is has a 40 m lower altitude as compared to the eastern one (figure 7), and the southern one (figure 6) is 20 m lower than the northern one (figure 5);

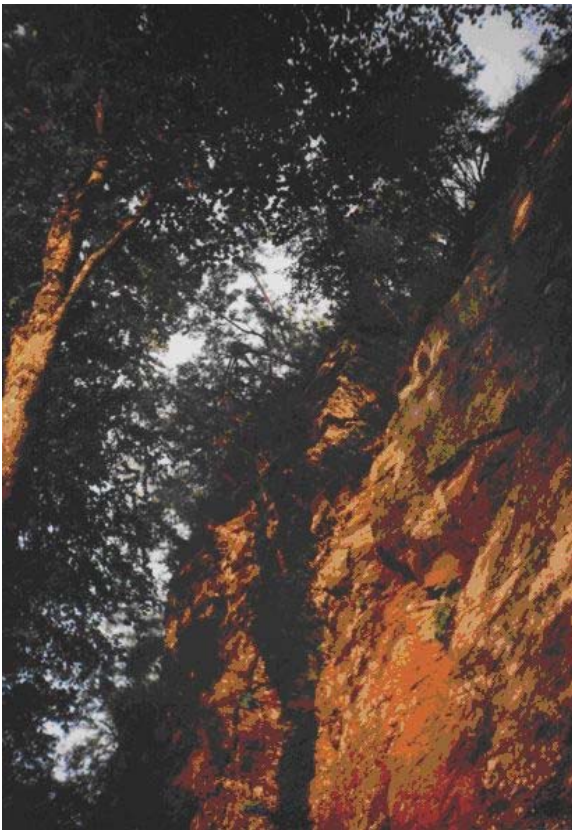


Fig. 4 Natural superior limit of geo-morphological nature



Fig. 5 Northern superior limit of the forest (Creasta Cocoşului in the background)

- the superior western limit has a higher altitude than the southern one, because the point of maximum altitude for the wood closed on the western exposition is achieved at the peak Gutâiul Mic, which has an altitude of 1420 m;

- the northern superior limit is lower than the eastern one, which might be explained by the fact that the brushes on the northern exposition are more exposed to the cold winds during winter, and the foehn effect in the vegetation season, which leads to the diminution of the precipitations has negative consequences for the vegetation;

- over all the expositions, the superior limit of the forest is higher on the direction of the mountainous peaks (Gutâi Peak – 1443 m, Gutâiul Mic Peak – 1420

- m, Secătura Peak - 1394 m, Creasta Cocoşului – 1428 m) and lower and the saddles between these peaks, because the vegetation no longer benefits from protection against the dominant winds, which cross the chain of the Gutâi mountains from south and south-west towards north and north-east, exactly through the saddles formed between these peaks, increasing their speed and, consequently, their negative effects on vegetation.

The beech forests of superior limit, as beech glades with green alder tree and dwarfish juniper tree have been noticed in the Godeanu Mountains as well, they representing characteristics similar to the limit beech forests from the Gutâi Mountains, namely (Stănescu and Târziu from Negulescu et al., 1973):



Fig. 6 Southern superior limit of the forest



Fig. 7 Eastern superior limit of the forest
- the trees are distributed in small, distinct groups;

- the isolated, stunted plants are missing, as a result of the incapacity of the young beeches to resist in a state of complete isolation;

- the trunks are very curved at the bottom, irregularly twisted, winding, having an aspect of young trees, with swellings and wounds;

- the crowns are spare, interrupted, and the leaves are small;

- the minimum heights reach 5 – 8 m, and the maximum diameters reach 30- 60 cm;

- they have reduced altitudinal extension of only 50 – 100 m level difference, and are situated, without any transition, near the limit beech forests, in the inferior parts, and here and there with associations of dwarf juniper tree or mountain alder trees clusters in the superior parts.

CONCLUSIONS

The following more important conclusions can be drawn from the analyze presented above:

- the forests from the mountainous chain Oaş – Gutâi – Țibleș are almost integrally represented by the natural mountainous beech forests which are dominant in the wood massifs from this zone and include an area of about 65.000 hectares;

- in the climatic, edafic and relief conditions, specific for the mountainous chain of the Gutâi massif, the natural mountainous beech forest climb altitudinal up to the limit of the forest;

- the superior altitudinal limit of the forest in the Gutâi mountains is represented by the superior natural climatic limit of the beech forests, conditioned by the specific climate and especially by the dominant winds from the vegetation season, because the brushes meet the requirements of minimum area (250m²), of minimum consistency of 0.5 and have minimum average heights over 5 m (between 7,19m and 7,94m);

- the superior limit of the beech trees is circumscribed on the line that unites the altitude of 1375 m on the western exposition, 1370 m on the southern display, 1415 m on the eastern exposition and 1390 m on the northern exposition, the maximum average altitude being of 1387,5 m (higher than the one in the Rodna Mountains of 1300 m, Călimani Mountains of 1250 m, Giurgeu Mountains of 1190 m and Harghita Mountains of 1270 m for the beech forests) (Stănescu from Negulescu et al., 1973);

- besides the dominant winds, the superior limit of the beech forests is also conditioned, but to a lesser extent, by the geo-morphology of the ground: rocks and steep slopes, very large slopes, detritus etc. and by reasons of edaphic order: early and late frosts, by the geographic position and by the direct or indirect influence of the anthropic factor;

- the structural, qualitative and hypsometric characteristics of the beech forests of superior altitudinal limit are very different from those situated at a lower altitude.

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