THE HISTORY OF DACIA'S FORESTS IN THE ORĂȘTIE MOUNTAINS REGION

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Abstract: The paper contributes to the knowledge of forest history during the Dacian Civilization, focusing on the mountainous region where the Dacian fortresses of the Orăștie Mountains were located. Some historical and archaeological evidence has been reviewed regarding the use of trees by the Dacians. Emphasis was laid on the analysis of the papers that present indirect evidence in this respect, namely the palynological sequences from the region, belonging to the period of interest, the Subatlantic. On the basis of these, it was possible to reconstruct the natural environment and especially the forest dynamics in the studied region. The palynological analyses performed demonstrate the millennial age of the forests in the area, and aim at further comparisons with the current situation of forests in the region.

Key words: Dacian Civilization, Dacian Fortresses, Trajan's Column, Pollen analysis, Vegetation dynamics, Subatlantic period

Introduction

The history of Dacia and its inhabitants, the Geto-Dacians, has been and still is intensively studied. During the time of King Burebista, the Dacian kingdom reached its largest expansion [25]. Burebista built a new capital at Sarmizegetusa, instead of the former one based in Argedava [20]. Moreover, between the 1st century BC and the 1st century AD, the so-called "Dacian fortresses" of the Orăștie Mountains were built, which were intended to form King Decebal's defensive system against Roman aggression.

The current vegetation in the region of these fortresses, respectively of the Orăștie Mountains, has also been the subject of studies, some of them very recent [47]. In this context, it has become necessary to reconstruct the vegetation history of the region, especially with regard to the forests during the Dacian period of antiquity, in order to allow further and more comprehensive comparisons with the present forest situation in the region.

Material and Methods

The reconstruction of the vegetation around the Dacian fortresses in the Orăștie Mountains was carried out based on pollen analyses available in the literature. Since palynological studies from the neighbourhood were not available, several palynological papers from relatively close mountain massifs have been reviewed to assess the state of the forests during the time of ancient Dacia. Palynological sites situated within a radius of c. 100 km from

the Dacian fortress Sarmizegetusa Regia have been selected, from the mountains Poiana Ruscă, Retezat, Țarcu and Nedeia, Parâng, Gîlcescu, Șureanu, Sebeșului, Semenici, and from the Făgăraș and Hațeg basins (Fig. 1). The chronology of these sequences was studied, selecting the period of interest, namely the Subatlantic. The composition of the forests, respectively the presence of the main tree species within the vegetation (as inferred from pollen abundance) was analyzed in each case, considering the altitudinal characteristics of the sites analyzed. Particular attention was given to the presence of beech in the composition of these forests.

Results and Discussions

The flora and vegetation of the Orăștie Mountains during ancient Dacia can be reconstructed on the basis of historical data (the images on Trajan's Column, the Dacian plant names from the works of Dioscorides and Pseudo-Apuleius, the Romanian plant names of Dacian origin, etc.), but the most useful evidence are the vegetal macrorests (wood, leaves, fruits and seeds) found *in situ* and the palynological analyses carried out in the neighboring peat bogs.

Archaeological information on the provenance of the wood used by the Dacians for various purposes is not at all frequent. Our literature review offered indications about the use of the wood of oak (*Quercus petraea*) [13, 23, 27, 43], fir – *Abies* [23, 27, 43] and larch – *Larix* [22, 27, 43]. Lime – *Tilia* and hornbeam – *Carpinus* [43], ash – *Fraxinus* and elder – *Sambucus* [34], spruce – *Picea* [27] and beech – *Fagus* [27] were also mentioned to be used.

Few Dacian wood objects and structures have been preserved, either because of anthropogenic factors or natural causes. The best-preserved ones have allowed specialists to identify the tree species of origin. Thus, for the tank below the Blidaru fortification oak planks and beams were used [13]. Within the Sarmizegetusa site, a special facility for water catchment, decanting and distribution was discovered at "La Tău". The decanter barrel was made of fir wood, while the tubes were placed in fir tree trunks covered with fir planks [23]; after other authors all these pieces were made of spruce [27]. Also, in the Dacian capital, archaeologists found the remains of a cistern whose walls were lined with larch and also charred fragments of beech or fir planks [27]. The wooden beams embedded in the "*murus dacicus*" (Dacian wall) were of oak. Other sources show that a well lined with larch planks was found near Costești [22, 23], similar to the cistern from Sarmizegetusa Regia.

As Borza [2] mentioned (p. 656), „*of the usual objects, even nowadays the dishes are made of wood in the mountain areas, being less prone to breaking... all the more so they would have been exclusively made of wood in the 5th century BC until the end of the 1st century BC. The Dacians actually lived in the wood age, although the rich and the headmost people used, with scantiness, bronze or iron tools*”. Pârvan [35] also stated (p. 140) that: “*the common dishes were made of wood. Even the cups that were served at the Gets king's table were made of wood*”.

The spiritual life of the Dacians was active and complex. Their superstitions were connected to their environment. The Dacians burned wood and lit fires during feasts as a gift to the gods, demanding more light and warmth during the cold season [26]. Various plants had a magical connotation; *Pinus* was considered to attract happiness and guarantee eternal life. Thus, pine branches were mounted on the roofs of the houses under construction, but also at the gates of the houses at a wedding. The funeral ceremonies were accompanied by the ritual of burning pine “nuggets” that produced fragrant smoke [26].

In the archaic Dacian and Dacio-Roman mythology, the feeling of communion between

plant and man or the myth of the forests and sacred trees is frequent [48]. In the Romanian language some words of Dacian origin relating to the forest have been preserved. Thus survive the generic terms "*copac*" (tree), "*codru*" (forest), "*buturugă*" (snag) and "*bunget*", the latter having the meaning of big and dense forest; also the words "*brad*" (*Abies alba*) and "*gorun*" (*Quercus petraea*) have Dacian origin [24].

One of the most eloquent proofs of the existence of forests in ancient Dacia is Trajan's Column. It stands in the centre of Rome, built in 113 AD as a tribute to Emperor Trajan's successful campaign in Dacia. Of the 224 trees visible on the sculpted relief, 222 are native to Dacia. These trees are evident on the entire Column. We can mention *Quercus* of different species (scenes: VII, IX, XII, XV, XX-XXVI, XL-XLII, LVI, LVIII-LIX, LXII, LXIV, LXVII, LXIX, LXXII-LXXIII, XCII, CXI, CXII, CXVII, CXXIII, CXLII-CXLVI, CXLVIII-CL, CLI-CLIII), *Pinus* or *Larix* (XVIII, XIX, XXI, XXII, XXVIII, XXX, LXVIII, LXXIV), *Acer* (XLI, LXVIII, LXIX, LXXII-LXXIII, CXI, CXII, CXVII, CXXIII, CXXXIX-CXL, CXLII-CXLVI, CXLVIII-CL), *Populus* (CXXVIII, CXXXIII-CXXXVIII), and so on. These trees have often been considered as simple scene dividers, but this is only one of their many functions in the Column's narrative [21].

One of the best documented papers discussing these issues is that of Stoiculescu [44], whose interpretations and conclusions were cited by Fox [21]. The main division drawn by Stoiculescu is between resinous and deciduous trees. Stoiculescu identified 7 distinct groups of subspecies, which are further split into 37 different leaf varieties. Depictions of the beech (*Fagus*) are unusual, since the tree appears in one form (Type G.37), and is only seen once on the column. The reason for this, in Stoiculescu's opinion [44], is that "*the beech was much too common*" while Trajan intended to impress his audience with a conquest of a foreign, exotic land, with strange and fascinating trees.

Nature plays an important role in the representations from the Column and is crucial in communicating the message of Roman domination and superiority over a foreign enemy and their land. The trees are prominent on the column and are carved in complex detail from the base to the top. These trees represent with remarkable precision the trees from Dacia. The abundance and detail of the trees on the column are combined with the theme of war on the landscape (expressed through the numerous deforestation scenes on the column) and the distinction between an urban emperor, Trajan and a shepherd king, Decebal. Thus, the main purpose of the tree engravings becomes clear: to prove that the war and victory shown on the Column was not only against the Dacians but against the country of Dacia [21].

In his 1976 work [24], C. Giurescu wondered (p.11): "*What do we know about the Carpathian-Danubian forest during the obscure prehistoric times, then in the time of the Dacians and of the Roman Dacia? One thing is certain: it was much more extensive than today, covering not only the mountains, but also the hills and much of the Transylvanian plain, whose very name implies the existence of large forests*".

The study of the palynological data from 25 sites from the region (Fig. 1, Tab. 1) situated at different altitudes, has revealed the presence of forests, more or less extensive, from ancient times.

Pop et al. [37] conducted a palynological study in the Peșteana peat bog (c. 480 m altitude, Poiana Ruscă Mts), relatively close to the Dacian fortresses of Luncani (at about 25 km distance), and respectively Blidaru and Costești (at about 30 km). The authors set the age of the

floating islet of the peat bog in the first half of the Subatlantic (SA IX). At the base of this Subatlantic pollen sequence, preceded by a hiatus in the sedimentation of the bog between 360 and 150 cm, there are already remarkable beech percentages of c. 50%, favouring the hypothesis that even at greater depths, corresponding to an earlier Subatlantic age, possibly even the beginning of the Subatlantic, beech (*Fagus*) was already well represented compared to spruce (*Picea*). The same sedimentary hiatus was encountered in the recent analysis of the Peșteana peat bog [16, 19], accompanied by ^{14}C dating, slightly offset because of the different drilling location, therefore the dating does not refer to the period of interest for the present work.

Fig. 1: Map of the Dacian fortresses and selected palynological sites from the studied region

The pollen spectra of the Retezat Mts provide data on the evolution of beech during the Subatlantic period at a lower latitude but higher altitude. Thus, Ciobanu [6] noted the presence of beech and fir with surprisingly high percentages, in the preliminary analyses carried out in four bogs situated between 1750 m and 1940 m altitude, in the subalpine belt (north of Lake Lia, under Lake Ana, under Retezat) and at the upper forest limit (“Tăul dintre Brazi”).

In the same mountains (Retezat Mts), Lupșa [28] performed pollen analysis of alpine soils from 7 sequences extracted from “Căldarea Șeselor” (1980 m), “Căldarea Gemenea” under the “Judele” peak (1950–2000 m), “Curmătura Bucurii” (2100–2200 m) and “Fața Retezatului” (1850 m) – the latter highlighting the regional history of vegetation from the end of the Subboreal – and thus emphasized the evolution of the beech forest during the Subatlantic. The author revealed the competition between spruce and beech during the Subatlantic, mentioning (p.

203) that the pollen of these trees was driven by upward air currents at very high altitudes, of the alpine areas, *"proportional to their quantitative participation on the forested slopes, but in reverse proportion to the specific weight of the pollen grains"*. The author refers to the correlations established by Pop et al. [38] between altitude and the representation of pollen in spectra. They showed that beech pollen was still well represented at the lower limit of spruce forests, almost unnoticed in the pollen spectra corresponding to the compact forest of the spruce belt, started to increase in value from 1700 m altitude, was well represented between 2100 and 2300 m, but has again become under-represented at higher altitudes, favouring spruce pollen with lower aquaplaning due to higher weight, thus subjected to a higher gravitational force. In the sequence of "Fața Retezatului", according to previous statements, beech pollen dominated spruce since the beginning of the Subatlantic.

At "Tăul Zănoagă" (1840 m) Pop et al. [40] pointed out an ascending evolution of beech pollen, which recorded a first maximum of c. 40% shortly after the establishment of the cold and humid climatic conditions of the Subatlantic period, following an ever-ascending evolution, in a reverse correlation with spruce, whose pollen constantly dropped until 10%. A second peak of the beech in the second part of the Subatlantic did not reach the same high value. Subsequent studies in this perimeter were resumed by Fărcaș et al. [15], in order to establish absolute chronologies using ^{14}C dating. An age of 2820 ± 70 years B.P. marks roughly the beginning of the Subatlantic and corresponds in the pollen diagram with a percentage increase of the beech, in opposition to the decrease of the spruce. The higher resolution of the analyzed levels has shown several peaks of beech presence during the Subatlantic, some corresponding to spruce minima. It should be noted that in these pollen spectra spruce minima generally do not decrease below the beech maxima.

Boșcaiu and Lupșa [5] performed the pollen analysis of the peat from the "Zănoaga" bog (1880 m), obtaining similar results to their forerunners [40]. The bimaximal curve of the Subatlantic beech had a peak at the beginning of the period, synchronous with a minimum of spruce, and another one later, in the second half of the Subatlantic, slightly offset from the further reduction in spruce percentages. The 40% beech pollen obtained reflects the certain existence of beech forests in the region, at the specific altitudes.

Resuming the analysis of the Tăul dintre Brazi site almost half a century after Ciobanu, compared to Lake Galeș, Magyari et al. [30, 31] have obtained ^{14}C dating as chronological references to the evolution of the Late-glacial and Post-glacial vegetation in the area. Beech had a fairly constant increase in the pollen spectra of the first half of the Subatlantic, being overall better represented than spruce during this period.

Not far from the Retezat Mountains, southwest from them, Pop et al. [36, 41] conducted studies at "Cucuiul Cuntului" (1460 m), in the Țarcu Mts (2190 m) and Nedeia (1750 m and 1850 m, respectively). At „Cucuiul Cuntului” (the foothill of Țarcu Mts), the palynological sequence obtained shows the vegetation evolution since the end of the Subboreal, and during the Subatlantic. The dominance of spruce pollen is obvious in the first part of the Subatlantic period, with percentages up to 70%, seconded by beech, with substantial percentages of approx. 25%, which demonstrate the presence of the beech forests in the region, at lower altitudes, within its own vegetation belt. In the pollen spectra of Țarcu, assigned by the authors to the Subatlantic age, beech is present with high percentages, but spruce pollen is almost absent, which also corresponds to the present situation of the forests on the SW slope of these mountains, the upper

limit of the forest being represented by beech, in the absence of spruce. Also, in the case of Nedeia, the same correspondence with the present reality is evident. The spruce is present in the palynological sequences of Subatlantic age, subordinated to beech, but the percentage of fir is impressive, supporting the statement of its glacial refugia in the South-Western region of the Carpathians [31].

Table 1: The selected palynological sites

Nr.	Site name	Location	Altitude (m)	Significant trees presence* (SA**)	References
1	Clopotiva	Hațeg Depression	500	<i>Fagus, Picea, Abies</i>	Boșcaiu 1971
2	Cucuiul Cuntului	Țarcu Mountains	1460	<i>Picea, Fagus</i>	Pop et al. 1966, 1967
3	Fața Retezatului	Retezat Mountains	1850	<i>Fagus, Picea</i>	Lupșa 1968
4	Gura Sălanelor	Șureanu (Sebeș) Mountains	1350	<i>Picea, Fagus, Abies</i>	Ciobanu 1970
5	Iezerul Șureanului (Șureanu Lake)	Șureanu (Sebeș) Mountains	1800	<i>Fagus, Picea</i>	Bartmus 1969
6	Lacul Ana (Ana Lake)	Retezat Mountains	1750 - 1940	<i>Fagus, Abies, Picea</i>	Ciobanu 1960
7	Lacul Câlcescu (Câlcescu/Gâlcescu Lake)	Parâng Mountains	2000	<i>Picea, Abies, Fagus</i>	Ciobanu et al. 1968
8	Lacul Galeș (Galeș Lake)	Retezat Mountains	1990	<i>Fagus, Picea</i>	Magyari et al. 2009, 2012
9	Lacul Lia (Lia Lake)	Retezat Mountains	1750 - 1940	<i>Fagus, Abies, Picea</i>	Ciobanu 1960
10	Lacul Oașa (Oașa Lake)	Șureanu (Sebeș) Mountains	1200-1210	<i>Picea, Fagus</i>	Bartmus 1969
11	Lacul sub Retezat (The lake under Retezat)	Retezat Mountains	1750 - 1940	<i>Fagus, Abies, Picea</i>	Ciobanu 1960
12	Lacul Zănoaga (Zănoaga Lake)	Retezat Mountains	1880	<i>Picea, Fagus</i>	Boșcaiu & Lupșa 1984
13	Mlaca Tătarilor – Arpaș (Tatars Peat bog - Arpaș)	Făgăraș Depression	520	<i>Fagus, Picea</i>	Fărcaș et al. 2004
14	Mlaștina Peșteana (Peșteana Peat bog)	Poiana Ruscă Mountains	480	<i>Fagus, Picea</i>	Pop et al. 1971 Fărcaș et al. 2006 Fărcaș & Tanțău 2012
15	Muntinu Mic (Muntinu Mic peak)	Parâng Mountains	1960-2372	<i>Picea, Fagus</i>	Ciobanu et al. 1967 a, b
16	Mlaștinile Semenicolui (Semenicolui Peat bogs)	Semenicolui Mountains	1400	<i>Fagus, Picea, Abies</i>	Rösch and Fisher 2000 Fărcaș et al. 2005
17	Munții Țarcu (Țarcu Mountains)	Țarcu Mountains	2190	<i>Fagus</i>	Pop et al. 1966, 1967
18	Nedeia	Nedeia Mountains	1750-1850	<i>Fagus, Picea, Abies</i>	Pop et al. 1966, 1967
19	Prigoana	Șureanu (Sebeș) Mountains	1350-1400	<i>Picea, Fagus, Abies</i>	Bartmus 1969, Ciobanu 1970
20	Sălane	Șureanu (Sebeș) Mountains	1200-1210	<i>Picea, Fagus, Abies</i>	Ciobanu 1970
21	Stâna din Ciungi	Țarcu Mountains	1600	<i>Picea, Fagus, Abies</i>	Boșcaiu 1971
22	Tăul dintre Brazi (The Lake among Firs)	Retezat Mountains	1710	<i>Fagus, Abies, Picea</i>	Ciobanu 1960, Magyari et al. 2009, 2012
23	Tăul Zănoașii (Zănoașii Lake)	Retezat Mountains	1840	<i>Picea, Fagus</i>	Pop et al. 1971 Fărcaș et al. 1999
24	Tăuri Avrig (Avrig lakes)	Făgăraș Depression	400	<i>Fagus, Picea</i>	Tanțău et al. 2006
25	Valea Frumoasă (Frumoasa Valley)	Șureanu (Sebeș) Mountains	1310-1320	<i>Picea, Fagus, Abies</i>	Ciobanu 1970

* In descending order of abundance; ** Subatlantic period

In 1971, Boșcaiu resumed the Holocene vegetation study in the Țarcu Mountains (along with Godeanu and Cernei Mts.) in a large monograph [4]. Several palynological sequences are presented that reflect the evolution of vegetation during the Subatlantic, including the lake near “Stâna din Ciungi” (1600 m), the marshes from Obârșia Bistricioarei (1800 m), the bog on the plateau of Poiana Nedeii mountain (2000 m), the marshes of „Obârșia Șucului” (1900 m), the one under the „Priporul Jigorii” (1400 m), from „Șcheiu” (1830 m), near „Iezerul Lucios” under „Mătania” (about 2000 m) and the marsh near Clopotiva (about 500 m). The author states (p. 248) that *"sporo-pollen analysis of sediments from relatively low altitudes has often provided the possibility of reconstituting the local picture of vegetation dynamics. Unlike these, the pollen diagrams obtained on the basis of analysis of peat sequences extracted from the alpine belt had a higher regional expressivity, which often concealed local particularities"*. The author supports the statements made by Pop et al. [36, 38] to which we have already referred and at the same time attempts to clarify the way in which the vegetation on the different slopes is reflected in the pollen spectra, finding a concordance only at the altitude of 2000 m.

At “Stâna din Ciungi”, where the marsh was invaded in the 1970s by spruce, the Subatlantic pollen spectra are dominated mostly by the spruce, due to the high altitude (1600 m), although, according to the author (p. 255) *"a large part of the Subboreal, and the entire Subatlantic period, is represented in the pollen sequence through a competition phase between spruce, beech and fir"*. The pollen diagram shows quite suggestively the existence of the four Subatlantic maximums of beech. The author (p. 256) also states that *"the first peak of the beech (F1: 41%), when spruce pollen was temporarily exceeded, coincides with a stage of forest evolution in which the beech populations reached quite close to the place where the pollen profile was extracted, up to an altitude of 1600 m"* - and, we complete, this event seems to have taken place towards the beginning of the Subatlantic, if we examine the percentages of other tree species at that time.

Near Clopotiva, at a much lower, but unspecified altitude, the author points out that the descendant air currents had the most important role in pollen transport, and the prevalence of spruce (*Picea* 24%) and fir (*Abies* 15.3%) pollen on beech pollen (*Fagus* 12%) on the basal horizon would indicate the end of the Subboreal. The increase of beech percentage that goes beyond the spruce and fir in the next horizons would indicate the beginning of the Subatlantic. According to the author, the extension of the Dacian-Roman agricultural crops would have occurred in the upper Subatlantic, respectively in the second part of the Subatlantic, being marked in the pollen diagrams by increasing the curves of *Poaceae* (including *Cerealia*), *Centaurea cyanus*, *Chenopodiaceae* and *Asteraceae*, also by the steep decrease of trees percentages, which in the case of beech have fallen to 0.6%. The author affirms (p. 279) *"It is quite plausible that these deforestations (which could have been carried out through burning), followed by the invasion of the lime, coincide with a historical stage of intense human activity in the area of Clopotiva - Sarmizegetusa,"* thus placing the peak of the Dacian period at the beginning of the upper Subatlantic.

Studies conducted by Ciobanu et al. [10, 11] southeast from the Dacian fortresses, at high altitude (1960–2372 m), in the glacier cirque of Parâng Mountains and on the slopes of Muntinu Mic, showed the predominance of spruce in the first part of the Subatlantic, yet with increasing percentages of beech reflecting its presence at lower altitudes. A similar situation is found for the Gâlcescu glacier cirque [12], at an altitude of over 2000 m, where the beech on the increase even

reached a maximum of 56%, still after those of spruce and fir.

Five decades ago, in the same prolific period for the study of vegetation history in the Carpathians, two articles concerning the Sebeș zone, the eastern region of the Dacian fortresses, occurred in quick succession [1, 9], completing the knowledge on the history of vegetation from the Southern Carpathians.

Bartmus analyzed the representative peat bogs from „Oașa” (1200–1210 m), „Prigoana” (1350 m) and „Iezerul Șurianului” (1800 m), of different ages, yet all reflecting the Subatlantic period [1]. Bartmus showed that beech has no distinct lower boundary in the areas adjacent to „Oașa” while the upper one goes up to 1100–1150 m, nevertheless according to local Forestry Office quoted by Bartmus (p. 20) *"spruce is the only tree species in the Oașa basin"*. Bartmus emphasized the complete dominance of spruce (*Picea*) in the forest evolution during Subatlantic at Oașa; however, there is also a hornbeam (*Carpinus*) maximum (18%) in the first part of the period, which could justify, in the absence of ^{14}C dating, an older age of the marsh. A subphase of beech increase follows, surpassing the hornbeam, while the fir tree (*Abies*) increases in the pollen spectrum up to 14%. However, *Fagus* did not succeed in surpassing the spruce in this sequence even in the last Subatlantic period, although Bartmus stated (p. 22) that *"the beech in the neighboring massifs (the Hunedoreni and Parâng Mountains) had the upper limit at 1330 m, still forming compact populations at this altitude"*. In the much older diagram of "Prigoana" (1350 m), beech reached a peak of about 32% in its own phase, approaching the spruce percentage at that level. However, spruce dominated the entire pollen sequence. A different situation was recorded in the sequence from „Iezerul Șurianului” („Mărgila” peat bog), where beech temporarily surpassed the percentage of spruce, thus demonstrating the presence of the nearby beech forests at lower altitudes.

Ciobanu published in 1970 [9] the results of the palynological surveys carried out in 7 marshes in the upper basin of the Sebeș river, from "Frumoasa" (1310–1320 m), "Sălane" (1200–1210 m), "Gura Sălanelor" and "Prigoana" (1350–1400 m), different from those cored and published by Bartmus. In all of these sequences the author finds and describes (p. 319) *"the new spruce phase, corresponding to the Subatlantic beech phase at lower altitudes"*. Summarizing these results, the author mentions that spruce is very well represented in all sequences, but also that the beech reaches significant values in some diagrams (Sălane, Prigoana I, III, IV), as well as the fir at Prigoana II; the author also notes the simultaneous occurrence of beech and fir in pollen spectra here and that the values of beech and fir in Sebeș Mountains are higher than those in other Carpathian massifs at similar altitudes.

Although more distant from the perimeter of the Dacian fortresses (55–75 and 90 km respectively), we mention too the palynological analyses performed in the Făgăraș Depression by Fărcaș et al. [17] and Tanțău et al. [46], and by Rösch and Fischer [42] and Fărcaș et al. [18] in the Semenic Mountains, because they also provide an absolute chronology of phyto-historical events, by ^{14}C dating.

The sequence obtained from the „Mlaca Tătarilor” peat bog (520 m altitude) near Arpașul de Sus [17], reflects very high values of beech during the Subatlantic period, reaching from the beginning of the period a maximum of 45% while the spruce does not exceed 25% over the entire phase.

At Avrig (400 m altitude), C^{14} dating of 3590 ± 40 years B.P. [46] marks the beginning of the beech expansion, which at the beginning of the Subatlantic reached about 30%, on the

background of a consistent hornbeam participation of c. 20%. The beech maintained high percentages until the end of its own phase.

In the Semenic Mountains, the palynological analyses supported by ^{14}C dating, undertaken by Rösch and Fischer [42], and Fărcaș et al. [18] respectively, revealed the very early affirmation of beech, which in its own phase reached a maximum of over 60%; its percentage curve maintained very high levels up to the surface. A first beech peak, around 40%, appeared at the very beginning of the Subatlantic, before ^{14}C dating of 2560 ± 110 years BP [42].

Borza [2] considered (p. 659) that „the Semenic peak itself, the tallest and most beautiful of all peaks, was certainly covered with beech forests during the Dacian period, as it is today”. Also, according to Borza [3] “*The deciduous forests were dominant, in those times, in all the eastern Banat. Beech was overwhelming.... During the time of the Romans the beech forests of Banat were, certainly, as vigorous as they are now... they tend to have more and more fir (Abies alba) going towards the upper vegetation belt.... The spruce forests (Picea excelsa) ... are missing in Siminic and Poiana Rusca and naturally occur as compact woods only in the high massif of Eastern Banat: at Muntele Mic - Țarcu, further expanding to Retezat - Sebeș Mountains with an increasing massiveness, being nevertheless restricted to the upper part of the mountains*” (p. 125–126).

It is hard to say from a palynological point of view whether the forests surrounding the Dacian fortresses were, at that time, of beech, beech with fir, or spruce. It is a fact that the pollen analyses carried out in areas not very distant from the zone of the fortresses revealed the presence of spruce and beech forests, or of beech with fir, at the appropriate altitudes for these trees, depending on the local topoclimates.

The maximum extension of the beech, confirmed by the C14 dating from the Semenic Massif, the Apuseni Mountains, the Gutâi Mountains and the Căliman Mountains, took place during the Subatlantic period [14]. In the Transylvanian Plateau, the forest structures diversified during the Subatlantic period, especially up to an altitude of ± 600 m. At higher altitudes, the beech forests became more compact and monospecific, as was demonstrated by the palynological analyzes at Sălicea [29], Mohoș [39, 45], Călățele [8], Ruț [7]; at Mluha (1240 m), located at the eastern edge of the Apuseni Mountains, beech pollen recorded the absolute value of $\pm 81\%$ [14]. The competition between beech and spruce, or between the beech and the mixed oak species, arose only after the replacement of the hornbeam by beech. This is the period of *Fagus* expansion on both directions, upward and downward, during the Subatlantic. The beech forests of the Banat Mountains, and especially those of the Semenic Mts., have had the maximum extension after the establishment of fir forests, which appeared there earlier than in the rest of Romania [14]. In the Southern Carpathians, where the southern slopes are much gentler than those in the north, the same vegetation stratification on altitude has probably existed throughout the Subatlantic, as it is today. The differences consisted only in the maximum dispersion of beech forests and in the occurrence of fir forests, increasingly from west to east. Palynological research in the Southern Carpathians generally involved peat bogs situated above the present forest limit. The pollen was transported from the forest belts, which therefore occur without local overrepresentation [14].

Conclusions

The palynological analyses performed in the region demonstrate the millennial age of

forests in the area of Dacian fortresses. The Dacian civilization knew and successfully used the different species of trees, both in peacetime and during wars, when the forest constituted an "ally" of the local population, giving significant tactical advantages. Comparing the current vegetation with the past, it seems that Orăștie Mountains have not undergone far-reaching transformations since Antiquity to the present. The main human interventions have manifested closer to the present, through deforestation, shepherding, road upgrades, openings of quarries, other economic and tourist activities. The mountains remained still afforested; the main natural ecosystems have not changed much their role and structure during the last two millennia.

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ISTORIA PĂDURILOR DACIEI ÎN REGIUNEA MUNȚILOR ORĂȘTIEI

(Rezumat)

Lucrarea contribuie la cunoașterea istoriei pădurilor în timpul civilizației dacice, concentrându-se asupra regiunii muntoase în care se aflau cetățile dacice din Munții Orăștiei. Au fost trecute în revistă unele dovezi istorice și arheologice în ceea ce privește utilizarea copacilor de către daci. S-a pus însă accentul pe analiza lucrărilor care prezintă dovezi indirecte în acest sens, și anume secvențele palinologice din regiune, care aparțin perioadei de interes, Subatlanticul. Pe baza acestora a fost posibilă reconstituirea mediului natural și, în special, a dinamicii pădurilor din regiunea studiată. Analizele palinologice efectuate demonstrează vârsta milenară a pădurilor din zonă și vizează comparații ulterioare cu situația actuală a pădurilor din regiune.

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