ACADEMY OF THE SOCIALIST REPUBLIC OF ROMANIA

THE RESULTS OF THE ROMANIAN RESEARCHES CARRIED OUT IN THE FRAMEWORK OF THE INTERNATIONAL BIOLOGICAL PROGRAMME

Coordinators:
NICOLAE SĂLĂGEANU and RADU CODREANU,
members of the Academy

EDITURA ACADEMIEI REPUBLICII SOCIALISTE ROMÂNIA
Bucureşti, 1979

Ecological researches in the Babadag Plateau (Dobrogea)

BY

I. POPESCU-ZELETIN, C. BÎNDIU, N. DONIȚĂ and V. MOCANU

The Babadag Plateau in which the researches were carried out between 1961 and 1966 is characterized by a synclinal relief, occurring into four erosion platforms (80—400 m altitude) on a cretaceous limestone ground partially covered with loess. The soils are disposed in strips parallel along height, and they belong to the following types : chernozem (typical and leached), brown grey forest soil, brown forest soil (typical and leached), brown chestnut-coloured xerothermic forest soil, brown podzol weathering soil, and intrazonal rendzines (typical, leached and grey ones).

The climate it typical of the afforested low hills of the Cfax-type, and is characterized by a yearly mean temperature of 9.6 to 10.8° C and by a rainfall amount ranging between 440 and 600 mm per year, with two maxima, one in spring and another in autumn.

The researches were carried out in the following plants associations : 1. *Tilio—Carpinetum (betuli)*, 2. *Nectaroscordo—Tilietum (tomentosae)*, 3. *Galantho (plicatae)—Tilietum (tomentosae)*, 4. *Fraxino* (orni)—*Quercetum (delechampii)*, 5. *Centaureo (stenolepi)—Quercetum (pedunculiflorae)*, 6. *Querco (pedunculiflorae)—Tilietum (tomentosae)*, 7. *Pasonio (peregrinae)—Carpinetum (orientalis)*, 8. *Galio (dasypodi)—Quercetum (pubescentis)*, 9. *Carici—Quercetum (frainetto)* and 10. *Festucetum (valesiacae)—Stipetum (pulcherrimae)*. Performance of a research profile on the sylvan-steppe direction was aimed at, special attention being granted to associations 1, 4, 5, 8 and 10.

Studies bearing on the environmental conditions, ecological factors, ecophysiological process and biomass production led to the following main results :

1. THE THERMIC REGIME

A differentiated data analysis shows that the associations studied belong, from the thermic point of view, to the following fields : a) the thermophytic one (yearly average 10.5—10.6°C ; average of maxima 15.1—15.5°C ; average of minima 6.5—7.0°C ; amplitude of averages 29.8—33.7°C ; absolute amplitude 51.6—53.3°C ; b) subthermophytic (respectively with 9.6—10.0°C ; 5.8—6.2°C ; 14.0—15.1°C ; 31.7—32.2°C ; 52.6—55.5°C) ; c) subthermophytic-thermophytic (respectively with 10.2°C, 14.9°C, 4.6°C, 34.3°C and 60.7°C). To the above mentioned fields the following associations correspond : a) 8, 9, 10 sub-Mediterranean pubescent oak forests : *Cotinus coggygria* forests ; meadows with *Festuca-Stipa* ; b) 1, 2, 3, 4, 5 (typical Dobrogean mixed foliage forests, those with plenty of hornbeam or sessile oak or those of the sub-Mediterranean type) and c) 6 (greyish oak forests with Tartarian maple) (Fig. 1). It seems that the forest department, the sub-Mediterranean forests included, enters

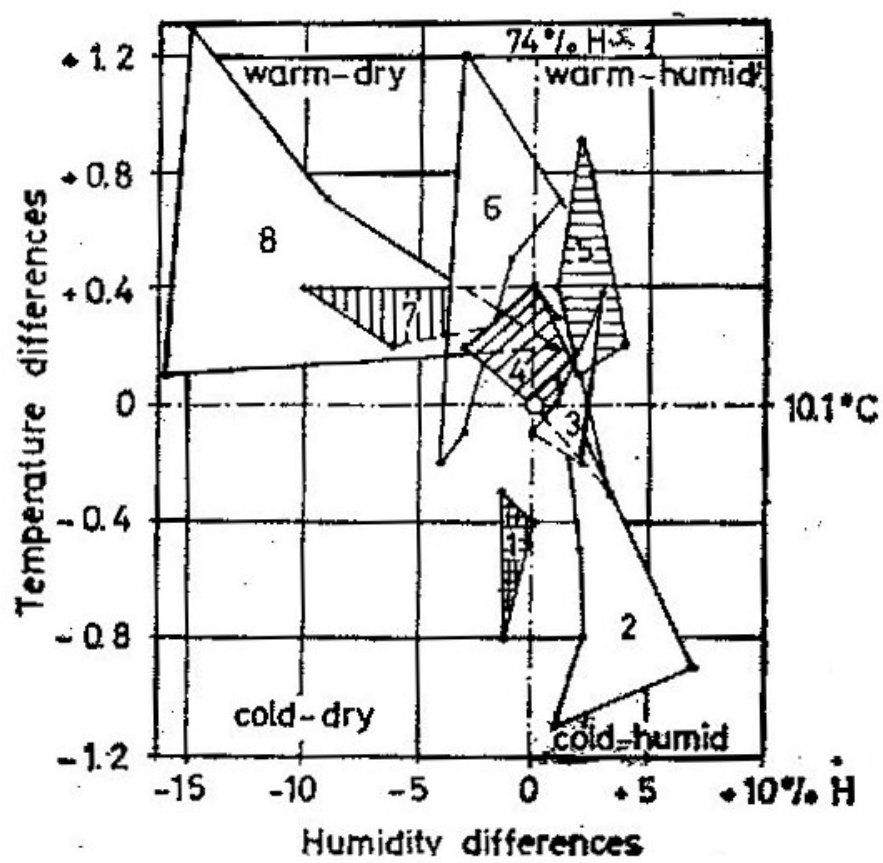

Fig. 1. — The microclimatic polygones and their areas (Azzi's system) ; *1—9* plant associations. *H*, humidity.

the area defined by an Emberger factor smaller than 7 (moderate continentalism) while for sylvan steppe the 7—9 range is available.

Another limit important to the spatial distribution of vegetation is the yearly 10°C isotherm (17°C in the growth season and 3°C during winter). It separates the areas with Central-European species (sessile oak, sub. hornbeam etc.) from those with Mediterranean-Balkanic-Pontic ones (greyish oak, pubescent oak, Oriental hornbeam, *Cotinus coggygria* etc.). The first category occurs towards the southern limit of the area, while the second one is northward.

2. THE HYDRIC REGIME

In the forest associations, the relative air humidity shows three levels of values, depending on the dominant forms of the relief, namely : a) the highest humidity (more than 75% yearly) in the valleys ; b) the lowest humidity (below 73% yearly) caused by the air currents and occuring on the hill tops ; c) intermediate (mean) humidity specific of the slopes and plateaus. Within the same relief form, humidity does not vary much from an association to another.

The humidity (xerophytism) index *H* calculated by reffering the variation amplitude of the monthly average to the yearly average shows that the forests cover an ecological field with $H < 36$, while the steppe is characterized by $H > 40$. A general differentiation of the studied phytocenose from the hydrothermic view point is presented in figure 1.

It results from researching the pluvial regime that the potential grought periods are, according to Gaussen's climate diagram, longstanding in the whole plateau (more than 100 days a year). The duration of the autumnal droughts (62 to 88 days on the whole) is by 22 to 27 days greater than that of the spring droughts. The yearly amount of rainfalls diminishes gradually from the sessile oak sub-tier (600 mm) to 500–550 mm in xerothermica forests, and under 500 mm in the sylvan steppe and steppe. The water amount reaching yearly the ground is of 435 to 554 mm depending on the retaining coefficient of the canopy.

Both the moisture content and the available water reserve of the soils diminish progressively from spring to autumn, according to an exponential curve. The same moisture diminution type also occurs with depth especially in the desuction zone, followed however by a zone of partial restoration of the reserves. As far as the pedohydrical equilibrium is concerned, the following regime types were differentiated : a) an exceeding type with a maximum in early summertime (mesophyte and submesophyte forests); b) exceeding with its maximum in the second part of the summer (submesophyte and sub-Mediterranean forests); c) in equilibrium (subxerophyte forests); d) poor with a maximum in early summer (xeromesophyte forests); e) poor with the maximum in late summer-time (xerophyte forests and steppe lawns). To these types there are a consumption index Q * equal respectively to : a) < 2 ; b) and c) 1.5–2 ; d) 1–1.5 ; e) < 1 ; and an accessible water reserve of respectively : > 300, 275–300, 225–275 and 175–225 mm a year which correspond. Observation should be made that in the first three regime types, the yearly water balance is positive (7–76 mm a year), while in the last two ones it is negative (between 3 and 20 mm a year).

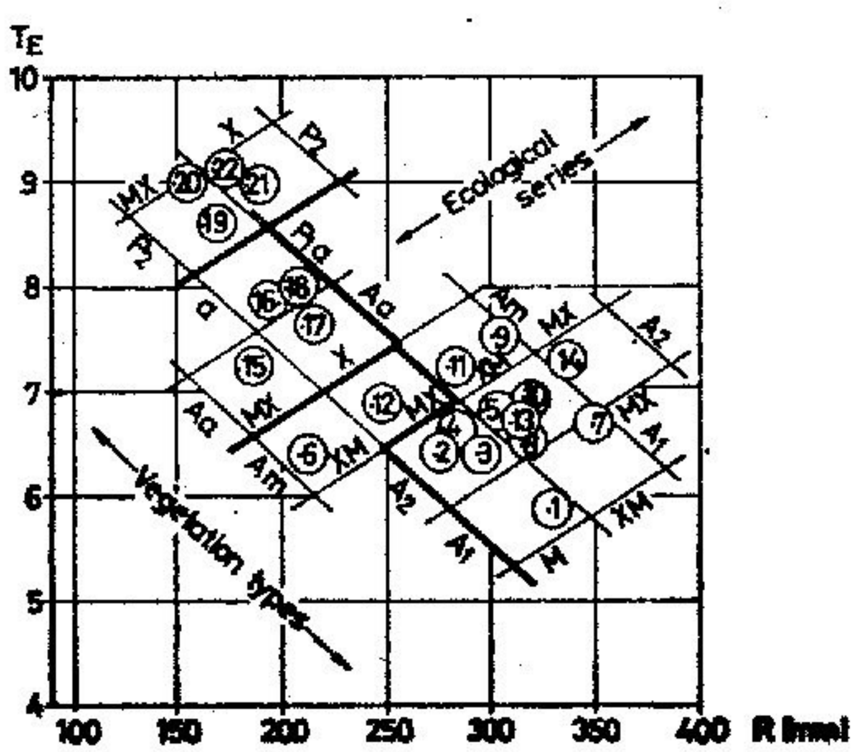

Fig. 2. – Ecological series and regions (ecological parallelism) in the Babadag Plateau forest. T_E, temperature index ; R, soil water reserve ; M, XM, X, ecological series ; P, meadow types ; A, forest types.

Studies carried out in meadows have shown that these latter occur in a state of relative equilibrium with the water supply possibilities of the biotopes they occupy and that this equilibrium rapidly breaks in case the way of exploiting the meadow changes (e.g. plant culture).

* Q = *consumed reserve* × *per cent consumption in the first half of summer* 10,000

Taking into account the water demand of various plant communities, several parallel ecological series were found which were similar with respect to both hygrophily and vegetal biomass production (Fig. 2). Evidence was brought that as the water amount available in the soil goes decreasing the species occurring in the dominant tier are either gradually replaced by dryness-resistent species or they slow their growth rate in contrast with the species occurring in the dominated tier which are able to longer resist dryness without essentially changing their structure or growth type.

3. THE TROPHIC FACTOR (ECOLOGICAL COMPENSATIONS)

The soils of the Babadag Plateau are very rich in alkalis (saturation degree 87—100%), but rather poor in water. As a consequence, the Dobrogean ligneous and herbaceous plant populations tolerate a smaller soil moisture, but claim in exchange increased trophycity. This phenomenon was interpreted as if the hydric factor were partly compensated by the trophic ones. Otherwise spoken of, considering the critical limits for transpiration, one could observe that in comparison with more humid regions, the values of the hydric potential appear drifted by 1/2—1 degree, so that the intensity of transpiration starts restraining at a lower pF, respectively at a higher sucking pression. At the same time, the soils in this region are characterized by an increased trophicity since the alkaline saturation degree is by 10—20% higher than in the more humid regions.

4. ECOPHYSIOLOGICAL PROCESSES IN TREES

Transpiration. Most tree species in the Babadag Plateau show a sole maximum of transpiration, namely at midday time, excepted the pubescent oak (in the sylvan steppe), the Balkan oak, the silver linden and the bigleaf linden (in pedohydric deficit periods). The decrease of transpiration in droughty periods by comparison with the normal ones is more obvious in the mixed species forests, and in the sylvan steppe: from 285—485 mg/g/h to 185—260 mg/g/h in the first case, and from 340—470 to 240—345 mg/g/h in the second case.

Besides water, temperature (Fig. 3) also plays an important part in regulating the transpiration intensity : the correlation is made in terms of moisture levels (more than 50%, 25—50% and respectively less than 25% active moisture). According to some regression equations and to the temperature curves, it was stated that the forest species in the zone consume yearly between 1,620 and 14,970 l water/mean tree, as follows : mesophilous species over 10,000 l, mesoxerophilous species 7,000—10,000 l, and xerophilous species under 7,000 l. The water consumption of shrubs is approximately 10 times smaller than that one of trees. As against the whole phytocenosis, the water consumption is the following : 371—455 mm yearly in mesophilous and submesophilous mixed forests (ass. 1—4); 288—403 mm yearly in sub-Mediterranean forests (ass. 5—7); 253—

280 mm yearly in sylvan steppe (ass. 8–9); and 174–207 mm a year in steppe meadows (ass. 10).

The radial growth. A correlated examination of the moment growth starts and of the course of temperature leads to the conclusion that the

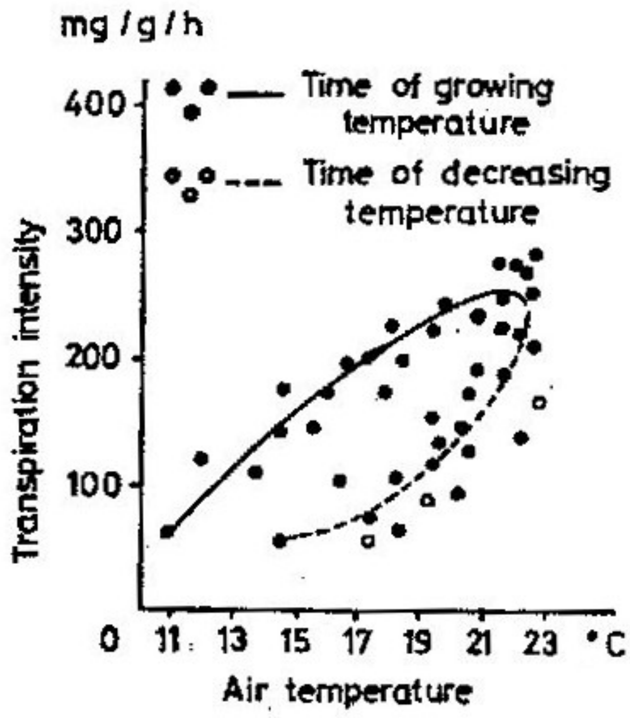

Fig. 3. – Relationship between air temperature and transpiration intensity in the Balkan oak (dryness period), with hysteresis line.

reactivation of cambium occurs when the decade temperatures exceed a certain threshold, characteristic of each species and equal approximately to 8°C in sessile oak, greysh oak and pubescent oak, to 8–9°C in ash, and to 10°C in linden and hornbeam. It was found out that the growth starts simultaneously in all diameter categories in the case of species *Quercus* and *Tilia*, and begins earlier in ash and hornbeam in small-diameter categories. Cessation of radial growth depends on the water supply of the soil and varies according to weather and to the species. In drought years, the radial growth ceases between June 10 and July 10, while in normal years it continues till June 30–August 19. Connected to this fact there also is a short duration of growth in all ligneous species showing great variations from year to year: 90–141 days in sessile oak; 61–120 in linden; 70–91 in ash; 90–120 in greyish oak; and 50–101 days in pubescent oak. Another consequence of the pedohydric stress is the summer shrinkage phenomenon observed in the stems of all the species in the region. Versus the growth of the last year ring the phenomenon mentioned amounts to 4–29% in sessile oak, 4–11% in linden, 2–7% in hornbeam, 27–84% in ash, 6–59% in greyish oak and 8–9% in pubescent oak.

5. PRODUCTIVITY AND CLIMATIC FACTORS

In order to render evident, at the regional level, the connection between the climatic factors, the vegetation distribution and the ecosystem productivity, a new bioclimatic index (BI) was forwarded which may be calculated through the formula:

$$BI = \frac{V(10\,P + S + T)}{A(T_m \cdot 0.059)}, \text{ where}$$

V = duration of the vegetation period (months); P = mean yearly amount of rainfalls (m); S = mean useful hydrologic soil depth (m); T = yearly amount of positive temperature; A = monthly thermic amplitude (°C); T_m = mean yearly temperature (°C).

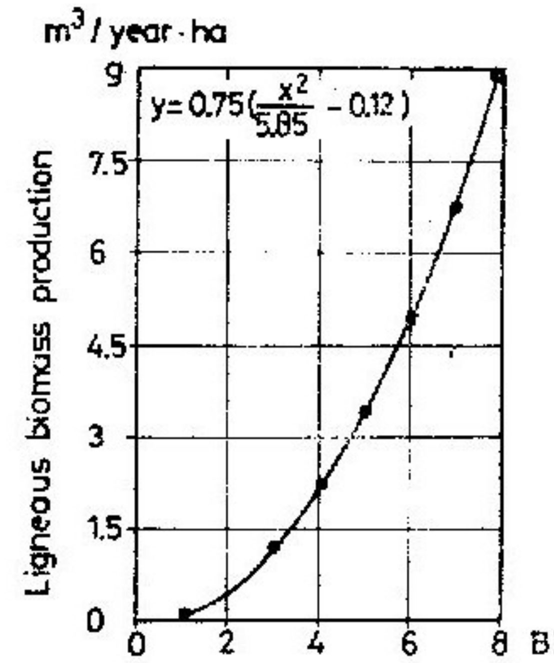

Fig. 4. — Potential productivity of vegetal cover in the Babadag Plateau (from sylvan steppe to sessile oak zone). BI, bioclimatic index.

Applied to the Babadag Plateau, this index shows values between 3.2 (steppe) and 7.0 (sessile oak forests and mixed forests) defining the following types of ecological regions : mesophytic-subthermophytic (BI 5.5—7); xeromesophytic — subthermophytic (BI 4—5); xeromesophytic-thermophytic BI = 3.5—4.5; 3 — 4 mesoxerophytic-thermophytic (BI 3 — 4); xerophytic-thermophytic (BI 3.5).

For the calculation productivity serves another formula :

$$y = 0.75\left(\frac{x^2}{5.85} - 0.12\right), \text{ where}$$

x = BI, and y = growth of the wood biomass in m^3/year/ha. It results from the formula above that the productive potential of the Babadag Plateau forests (Fig. 4), though reduced (approximately 6 m^3/year/ha) is greater than the effective productivity (under 4.5 m^3/year/ha), because of the inadequate management of the forests in the past.

The second formula helps rendering evident the ecological optimum of the species growing in this region according to potential productivity.

REFERENCES

1. DIHORU G., DONIȚĂ N., *Flora și vegetația Podișului Babadag*, Ed. Academiei, București, 1970.
2. POPESCU-ZELETIN I., BINDIU C., DIHORU G., DONIȚĂ N., DRĂGUȚ N., ELIESCU GR., HONDRU N., IONESCU M. A., MARGARIT GR., MOCANU V., NICULESCU-BURLACU F., ZAMFIRESCU A., *Cercetări ecologice în Podișul Babadag*, Ed. Academiei, București, 1971.