

## GUIDELINES FOR THE FOREST SITE DIAGNOSIS IN HUNGARY

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The forest is the highestly organized plant community; the result of complicated interactions between numerous ecological factors and the living world. Its very existence as well as the natural processes taking part in it can be understood only in the totality of these factors and never separately and independently from each other. The conception of the forest as life community has been rather slowly acknowledged by practical foresters, as mostly mechanical considerations prevailed which regarded the forest as a mere tree stand. It took several decades till a more up-to-date management system paying attention to natural processes was accepted in Hungary, too.

#### 1. Tree stand types

In the period prior to Second World War forest management was mostly based on the so-called forest stand types determined by prevailing tree species. Beech stands, hornbeam-oak, Scotch pine, Robinia stands etc. were dealt with separately; regeneration, tending and other methods of management mostly followed practical experiences without any special attention to locations, site and ecology of these stands.

It was a step forward when forests composed of the same tree species were divided according to their location above sea level, that is, forests grown on the plain, in hilly and in mountainous regions were considered as different ones. The division, however, was still too rough to allow proper up-to-date forest management.

#### 2. Forest regions

A decisive change was introduced by an eminent scientist of the Hungarian silviculture, I. BABOS, who divided Hungary into forest regions in 1954 and established the principal directives of forest management according to regional, ecological factors.

He marked out 50 regions. The main points of the delimitation were:

1. More or less identical site factors in respect to soil and climate.

2. Under more or less identical climatic conditions and varied soil quality identical soil types on the areas intended for afforestation.
3. Geographical regions irrespective of soil and climate differences.
4. In case of varying soil and climate conditions the combination of such areas to avoid parcelling up.
5. The joining of shelter belt afforestation areas on arable lands.

Based on above points forest management regions were defined as "areas of varied size with geographically continuous, definite features (mountains, hills, plains) and macro-climate (abundant or poor precipitation), where on sites of more or less identical parent rocks (eruptive, sedimentary, metamorphic) the forest stands and growth of typical tree species allow uniform management practices. Within these regions the arrangement of sites is always mosaic-like with areas of sometimes typical size".

By means of above principles and definitions BABOS determined the concrete limits between regions with the cooperation of numerous forestry experts working in the practice. They indicated to the most important soil and climate figures related to certain regions and determined the agrotechnical methods, the choice of tree species depending on site and the preparation of soil, the ratio of tree species mixture, the stand establishment, the ways of natural regeneration and the proper felling age of forest stands.

### 3. Forest types

The introduction of regional forest management systems awoke interest in a more thorough knowledge of site conditions and relations between site factors and the natural regeneration. Attention was turned to the forest type system of A. MAJER. In MAJER's definition forest types are characterized by "the identical total effect of site factors and by the more or less identical composition of plant communities requiring accordingly similar measurement methods". The definition reflects the close relationship between site and vegetation.

MAJER arranged his system units, the forest types, in function of soil-pH and the water regime of the site; thus indication to the correlation between essential ecological factors and vegetation.

With this workable system in hand, experts were now able to classify the forest types found in forest regions under their control, and to introduce suitable management methods. Above all, methods including the choice of tree species, regeneration and afforestation were worked out. Thus, special instructions could be defined for each forest type, the observance of which was strictly required by forest authorities.

#### 4. Site requirement of tree species and construction of yield tables

Nearly simultaneously with the above work two other research projects were also carried on. The one had the aim to determine the exact site requirements of our native, stand-forming tree species; the other to determine the amount of timber yield and the growth rate of the most important tree species.

Site requirements were studied by investigating site conditions in stands of various growth and estimating growth and timber yield under the given circumstances. According to this the conditions promoting optimal growth but also those allowing only medium or poor growth could be determined. As the vegetation found on the studied area was also taken into consideration, correlations between site factors, tree growth, timber yield and forest types could be established. In this way numerous observations were obtained concerning certain site factors, their total effect on forest types and their correlation with them. Between forest types and yield no close relation was found. Thus, forest types reflecting natural vegetation helped in most cases in choosing tree species and best regeneration methods.

Simultaneously with above work the occurrence of certain tree species was also studied. Exact data could be obtained from forest management plans. Local informations were completed with data taken from botanical literature which put on maps and completed by climatic, edaphic and other ecological factors allowed to clear up relations between these factors and certain tree species. These relations specified the detailed site investigations mentioned above. One problem had to be solved yet: a scale was necessary to determine the good or poor growth of the tree species numerically.

In order to determine timber yield and evaluate its magnitude numerically yield tables were constructed for the stands of each important tree species.

The determination of site requirements promoted the understanding of relations between tree species and ecological factors; yield tables proved useful in assessing the growth and yield of forests.

#### 5. Site types

As already mentioned, no close connection was found between the natural vegetation and several features of forest management. Thus, instead of forest types, site types were established and dealt with. The natural vegetation could not be used as indicator plants either in some cases, because on several places especially on ploughland under cultivation, the natural vegetation had disappeared. Therefore, Z. JÁRÓ, a prominent leader of the Hungarian forest site survey, introduced and classified the idea of site types. The site type is the average of sites within nearly identical climatic, hydrologic and soil conditions meeting the requirements of a certain plant community. The definition clearly shows that the site type in the management practice is the average of sites where stands of identical purpose,

that is, forests of identical species composition and of nearly similar growth and yield may be established.

In the course of field surveys on site requirements of tree species, important figures were obtained with valuable information on the occurrence of natural vegetation (if there are any) and on tree species of various sites, the growth of which could be numerically evaluated by means of yield table categories. Thus, necessary data have been obtained to define objectively which tree species to choose, what planting methods to use on various site types. The expected timber yield could also be assessed with reasonably accuracy. Site types also indicated what kind of introduced, not indigenous tree species could be planted successfully instead of stands of natural composition and how much the gain would be as compared with the original stand. The site type can be characterized by the site factors, that is by the climatic, hydrologic and soil factors as well as by the factors of living world. Of the four factor groups the impact of flora and fauna outside the soil cannot be neglected but owing to the great variation these may only be considered in local evaluations. From this reason of the site factors we only concentrated on climatic, hydrologic and soil investigations which were the bases of classification, too. The fundamental unit of site classification is the site type, which may be characterized by similar site factors and the average of nearly similar site productivity. The site type is practically such a category that unanimously determines the plantable tree species and goal stands belonging to the type. Now, let us see how the single site factors are characterized in our system.

### Climate

Climate is the least expressable and classifiable factor under Hungarian conditions. The more precise differentiation is aimed, the more problematic situation emerges because of the small number but great variability of climatic characteristics. For the characterization of climatic factors climate indicator tree species and their associations respectively, are used. Mathematical formulas, neither simple nor combined ones have not been proved good bases to delimit the various climates. The following stand forming tree species can be used as climate indicators in Hungarian conditions: beech, hornbeam+oak, Turkey+sessile oak, forest steppe. Others are pioneer tree species not good to indicate climate. There are again some others, sensitive mostly to soil and hydrologic conditions.

After having studied the forested environment of meteorologic stations a rather good correlation has been found between the climate indicator tree species and the air humidity measured in July at 2,00 p.m. This correlation is as follows:

Air humidity in July at 2 p.m.	Indicator tree species
over 60%	beech
55-60%	hornbeam+sessile oak
50-55%	Turkey+sessile oak
less than 50%	forest steppe

## Hydrologic conditions

Hydrologic factors are connected with such water sources which are not in close and immediate connection with the precipitation or with the water holding capacity of the soil. The following sources of water are discussed in connection with hydrologic factors:

1. ground-water, frequent in our lowland regions,
2. water of inundations in the flood-plains and
3. seepage waters gathering in smaller depressions of mountainous and hilly regions as well as in the lowland regions.

Hydrologic categories are expressed by the following seven categories: water losing sites, sites with perched water table, seepage waters, periodic water influence, permanent water influence, periodically saturated sites, temporary flooded sites.

Water losing sites. The sites which receive water supply only from rainfall belong to this category. No surplus water is present, for the water, storable in the soil and kept against gravitational forces is only available for vegetation.

Sites with perched water table. The category includes sites having excess water in the upper soil layers for a longer or shorter period, which is not able to infiltrate into the soil because of an impermeable layer or of the chemical composition of the soil. The water gathering on the surface of heavy soils and the water surplus occurring in consequence of the impermeability of pseudogley layers etc. are ranged into this category.

Sites of seepage waters. The water, rich in oxygen and moving either in the litter cover or in the soil, parallel and close to the surface may be found here. Its quantity is variable, but always favourable for the stand and is frequent on the lower part of slopes, in valleys, basins and on terraces. It appears in great quantities in differently layered soil, its areal extent is always small.

Sites of periodic water influence. Water surplus originating from ground-water or periodic overflows on flood-plains, can be utilized by roots only in a definite period. Sites with water table between 150-220 cm from the surface (in April) and the medium high elevations of flood-plains belong to this category.

Sites of permanent water influence. In the most part of the growing season the roots may utilize ground-water or periodic overflows of longer duration on flood-plains. The water table is, in general, 50-150 cm from the surface (in April). Medium low elevations of flood-plains belong to this category.

Periodically saturated sites. The close capillary zone above water table reaches the soil surface. The water table is 50-60 cm from the surface (in April), but gradually sinks down causing better air-conditions to occur in the surface layers of 20-30 cm. The lower elevations of flood plains and shallow bogs belong to this group.

Temporary floodes sites. The level of ground-water reaches or surpasses the soil surface during almost the whole growing season. The top soil is at least under the effect of closed capillary zone during the whole growing season. The very deep locations of flood-plains and the deeply lying bogs belong to this category. Woody vegetation is only represented by alder and willow, but may be regenerated and harvested only in drier period.

### Soil conditions

The third but the most widely applied and known site factor is the soil. In Hungarian forestry practice the determination and evaluation of genetic soil types is commonly used. It gives the complex expression of soil genesis and partly the climatic and hydrologic effects, too, determining the choice of tree species, the possibilities of afforestation and the influence of growth of stands. It is no doubt that a soil type represents the average but the deviation inside the type can be compensated by the adaptability of some tree species. In our site type classification system there are 9 main genetic soil type groups and 43 types inside them. The 9 main genetic groups are as follows: skeletal soils (rhegosol), sedimentary and alluvial soils (fluvisol), dark coloured forest soils, brown forest soils, chernozem soils, alkaline soils (solonchak, solonetz etc.), meadow soils, bog soils and forest soils on alluvial deposits.

The site types provide a firm basis for the choice of tree species though its close correlation with stand growth turns out only when they are further divided into subtypes by the depth of their solum (active rootable zone). The depth of solum is actually the thickness of soil horizons entangled and utilized by roots. According to depth of solum 5 categories may be distinguished: very shallow, shallow, medium deep, deep and very deep. Each category can be characterized by various cm data.

The most precise category of site types is the site type variant expressing not only climate, hydrologic conditions and genetic soil type, and the depth of solum, but also the physical properties of soils. The most important role of soil texture is in characterizing the water regime of soils. By texture properties six groups are formed: detrital, coarse sandy, sandy, loamy, clayey and heavy clayey.

With the use of above mentioned categories site types can be characterized by composing them with the aforesaid categories as building stones. Great advantage of this method is its practical usability as no intensive laboratory investigations are necessary to find the right site type on a given spot and the basic knowledge of site type determination is also thought in the forestry university and forestry secondary schools alike.

The use and practical application of site types is obligatorily ordered in Hungary both for forest surveyors and for specialists working in the frame of managing enterprises. First of all in cases when new forest stands are being established or old forests regenerated. If the suggested tree species are not used when carrying out these works, the forest enterprises get financial punishment, so they are bound to these prescriptions by financial means, too.

#### SUMMARY

The system for the forest site diagnosis has been compiled. This system is widely used both in the Hungarian forest survey and the forest management. Forest sites can be characterized by the site factors (climate, hydrologic conditions, soil conditions). The categorization of these factors is also reviewed. Also various steps until Hungarian forestry got to the creation of the site type system are described.

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