Zeitschrift: Veröffentlichungen des Geobotanischen Institutes Rübel in Zürich
Herausgeber: Geobotanisches Institut Rübel (Zürich)
Band: 8 (1932)

Artikel: The beech forests of Czechoslovakia
Autor: Domin, Karel
Kapitel: IV: Soils
DOI: https://doi.org/10.5169/seals-307034

of a wider treeless zone at the crest on the side of the gentle slope, than on the steep side.

The upper limit of the tall-trunk beech forest in our Eeastern Carpathians is, when it forms the forest limit, at an average of 1280 meters (max. 1376 meters), and of the shrubby beech forest at 1350 meters (max. 1484 meters). This limit is usually regarded as climatic, but detailed study in the Svidovec range has convinced me that very often it is a secondary forest limit. The formation of this shrubby beech zone is not a conclusive proof of the natural upper forest limit, since it can also arise after the artificial lowering of the forest limit due to deforestation. In some cases, the formation of the upper forest limit by the beeches is due to the fact that the mountain spruce zone, once lying directly above it, has been destroyed by grazing and is now covered, about half-way up, with grass or subalpine shrubby thickets (A l n e t u m v i r i d i s, J u n i p e r e t u m n a n a e).

c) In conformity with the principles of substitution of ecological factors, beech forests may also develop in a climate unfavourable to them provided the soil conditions are favourable, such as a limestone substratum, or a high soil-water content.

IV. Soils.

Beech forests in Czechoslovakia develop on all types of rocks, be they limestone, dolomite, marly limestone, granit, gneiss, amphibolite, schists, sandstones, basalt, andesite, or other eruptive rocks, conglomerates, etc. This, and the different climatic conditions explain the great lack of uniformity in the character of the beech soils, in their reaction (soil acidity) and in their lime, nitrogen, and water contents. The production of humus depends not only on the rock strata, but also on the climatic conditions and often on the exposure of the slope. In a dry continental climate, the decay of the fallen leaves is delayed and the substratum is loamy to the surface, without humus, and covered with a thick layer of dried and slightly-decayed leaves. In a humid climate, leaf decay is much more intensive and often forms a very thick layer of humus. The acidity of the soil also varies greatly, although, even on siliceous soils, the beech itself aids in lowering the acidity. Typical beech forests have generally slightly acid to alkaline soils, while degraded

and spurious beech forests have decidedly acid soils. The higher the acidity, the more atypical the undergrowth becomes, until finally the herbaceous stratum of the beech forest takes on a spruce character. Zlatník [1] studied the soils of beech forests in the Krkonoše Mts. and found some considerable variations in their acidity, that is, from pH 4.2 to pH 6.65. But here, also, soils are in optimally developed beech forests, located even on a siliceous substratum, only slightly acid (pH 5.5—5.7), and on limestone with a pH 6.7. The most acid soils are found near the upper limit of the beech forests (pH 4.2—4.7) where on a distinctly podzolate soil in these beech forests we find undergrowth more properly belonging to spruce. Zlatník states that, on the whole, the soil acidity rises with the altitude, resp. with the humidity of the climate. This does not disagree with the phenomenon that soils of beech forests, in shaded and damp valleys, are comparatively more acid. Podzolation of the soil frequently corresponds to the degradation of the beech forest soil and to the effect of forest culture. The rhizospheres of the beech and the ground vegetation often show different acidities; but even in this respect, various modifications have been ascertained. According to Zlatník [1, 4], the profiles in lower situations show a regular increase in acidity as we go downward, whereas the fern types of the Krkonoše Mts. and of Subcarpathian Russia show the highest acidity in the podzolate layer.

Of extreme importance is the formation of mould which is favoured by a lime substratum. In the Carpathians, however, we know of beech forests with quite a typical ground vegetation though on a soil nearly devoid of humus; the loamy soil here, however, is not podzolate and shows a slightly acid to alkaline reaction. Of great importance, also, is the intensity of the nitrification process which depends upon the microbe vegetation. Humification in beech forests is aided by the mycorrhiza layer beneath the decayed leaves. However, this layer is not always equally developed in our beech forests, and can also be found beneath the leaves of *Acer pseudoplatanus* (Domin, [1], p. 40—41). Jar. Peklo [1, 2, 3] investigated, as did P. E. Müller in the Danish beech forests, forest mycorrhizas and the ecology of the beech forests soils and obtained some new interesting data. Peklo did his studies in some of the Bohemian beech forests, as for instance near Jevany (granit), near the Sázava

river between Vlkančice and Česká Skalice (gneiss) and between Drlatín and Radlice near Kourím (phyllit). He summarises the general results of his studies as follows: In all typical cases we find usually beneath the loose-leaf layer and beneath the thin layer of closely packed leaves, a thick mycorrhiza layer composed of smooth mycorrhizas, and of already — more or less — decayed and crumbled leaves. In this layer, the leaves have already disintegrated into humous matter. Beneath the mycorrhiza layer there is always present a more or less thick layer of mould in which mycorrhizas are already dying off, or are only very scarce. Peklo, therefore, considers mycorrhizas as a leading pedological factor of the beech forests on certain geological substrata. In contrast to the mycorrhiza which covers macroscopically wide surfaces, the mould and bacteria seem to play an insignificant role. Mycorrhiza, however, have a decided effect on the nitrogen content in the soil.

In general, it is possible to say that the soils of our natural beech forests are in every respect favourable, that is they are either non podzolate or only slightly podzolate, slightly acid to alkaline, and have a good air capacity. However, spurious beech forests, particularly those with a spruce ground vegetation (viz. with *Vaccinium myrtillus* or with *Calamagrostis villosa*), show an acid reaction and usually are podzolated. Mixed forests with *Fagus*, *Acer*, *Abies*, *Tilia* and *Picea* show also advantageous soil conditions. I showed in my paper on the virgin forest of Boubin ([3]) that even on the archean siliceous soils of the Šumava Mts., the podzolation of forest profiles is comparatively slight and the acidity comparatively small, decidedly lower than in some other Hercynian districts in which forest culture resulted in far-reaching deterioration of soil conditions. Likewise, the investigations of Włodek and Strzemienski (1925) show that the soil acidity in the Piceo-Abietetum albae association in the Polish Tatras is considerably lower (pH 5.3—6.6) than in the Picetum myrtillosum (pH 3.4—3.9).

For the study of soil conditions, the Carpathian beech forests are of course most appropriate, partly because they occupy vast areas which have a large altitudinal zone, a great range of climatic conditions, and a variety of rocks on which they occur; and partly because many of them are virgin forests, as well as forests only slightly changed by forest culture. These virgin beech forests, also,

show the validity of the above mentioned facts. The vast virgin beech forests of Subcarpathian Russia have, in general, very advantageous soil conditions, though the geological substrata are formed here by sandstone and schists of the so-called Flysch formation. The soil reaction, according to Zlatník ([4], pp. 411), shows here a wide range from pH 3.9 to 7.4, but the markedly acid soils are characteristic only for the «spruce» associations of the beech forests, especially those with *Vaccinium myrtillus*. Podzolation, even at high altitudes is only slight.

V. **Regeneration of the beech within the forest.**

The regeneration of the beech is good in natural beech growths, but not very uniform. Of special interest is the type without herbaceous undergrowth having instead, real thickets of a very rich natural growth of young beech. This type is to be found in the virgin forests of Subcarpathian Russia where imposing beeches, a hundred to three hundred years old, attain a height of 30 to 40 meters; these forests are not very dense. Pure virgin beech forests with only Acer pseudoplatanus interspersed, as well as mixed forests, are usually never densely developed. The thick layer of half-decayed beech leaves on the forest floor does not favour the growth or germinating beeches. In the Little Carpathians, I have seen mighty bare-floor beech forests with a dense undergrowth of beech-seedlings, but the thick layer of dry leaves cheked their development so that only a few out of thousands could maintain themselves. In a loose Caricetum pilosae growth, the conditions for beech-seedlings already are somewhat more favourable. The shrubby beech colonies in old bare-floor beech forests arise in such manner that, under the protection of a young beech that has somewhat disturbed the dry-leaf carpet, new beech-seedlings take root and finally form these characteristic colonies.

VI. **Dominance of the beech and mixture of other trees.**

We know all possible intermediate stages of forests beginning with a 100 % dominance of the beech, to various types of coniferous and deciduous forests in which the beech is only scattered. Typical trees accompanying the beech in our beech forests are: deciduous *Acer pseudoplatanus*, *A. platanoides*, *Fraxinus excelsior*, *Ulmus*