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# Rare ferns of Hungary, I. Botrychium virginianum (L.) SW. var europeum ANGSTR. in the Kiskunság National Park

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ABSTRACT: One of the rare representative of the domestic flora, Botrychium virginianum var. europeum is to be found in the National Park of Kiskunság, in the natural reserve area of Kunfehértó. Coenological samples were taken from Botrychium virginianum oakwood, in the framework of the National Park of Kiskunság (NPK) research programme, in July 1978. The cenological samples show that the species lived in the Convallario-Quercetum association, which - in many places - has transformed into Bromo sterili-Robinietum, as a result of afforestation. Owing to the spread of Robinia pseudo-acacia, the survival of B. virginianum may become doubtful.

B. virginianum, a rare member of our domestic flora, is known only from one habitat. ZÓLYOMI and BAKSAY discovered the plant in 1951, in an oakwood, in the confines of Kunfehértó. Owing to its botanical rarities, this area is of the nature reserves of the National Park of Kiskunság. The Natural History Museum Botanical Department has been in contact with the Directorial Board of NPK since 1976. It has been collecting and studying the flora of the NPK since that time.

Only very little is known about the phenological and coenological conditions of B. virginianum. Since no continuous observation has been carried out, the changes that have taken place in the plant species could not be traced. It is however a fact that, as a result of plantations, in certain parts of the oakwood the B. virginianum habitat has become densely populated with acacias, and other kinds of planted wood species also occur, as for example Celtis and Aesculus.

Table 1. Development stages and phenophases in ferns

| Stage | Phenophase | Decimal number |
|---|---|---|
| Anabiotic resting | Spore, rhizome-bud | 11 |
| Juvenile vegetative | Spore germinates, and the development of the prothallium sets out | 21 |
| Adult generative | Sex organs develop in the prothallium, and fertilization takes place | 31 |
| Vegetative | The first leaf of the sporophyton appears | 22 |
| | Sporophyton has leaves which are developed but sterile | 23 |
| | The first mature sori appear on the leaves | 24 |
| | All the sori have developed on the leaves | 25 |
| Senile disorganized | The sori are open, the lower leaves begin to dry away | 41 |
| | All the leaves have dried off | 42 |

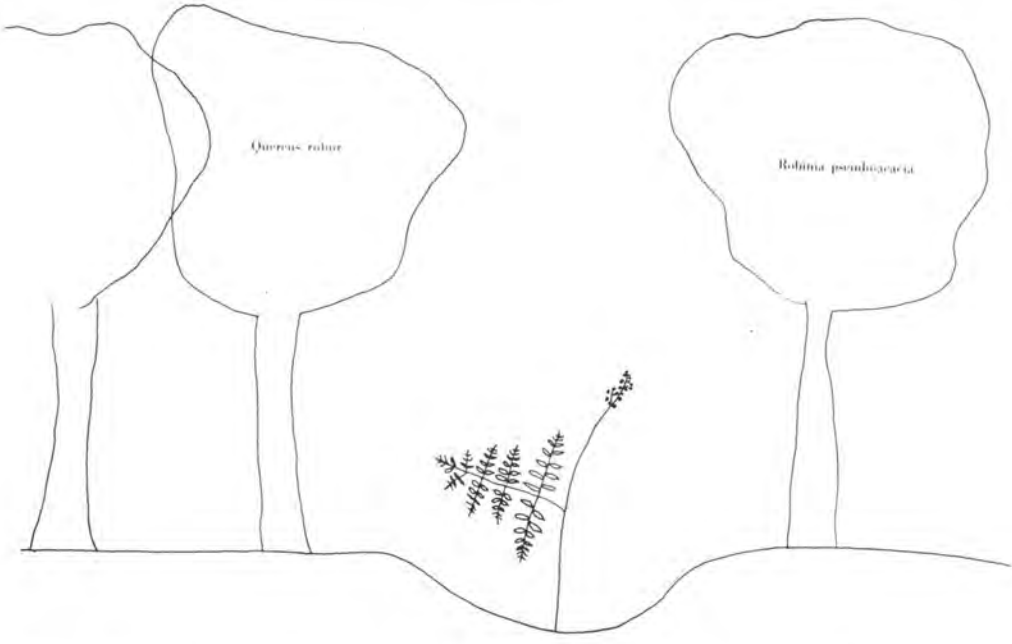


Fig.1. Occurrence of Botrychium virginianum in the shallow dips of the surface

In 1978, we began to examine the coenological conditions of B. virginianum. We are trying to establish to what extent the acacia plantations have changed the ecological conditions of the original plant association and whether the changes have not endangered the survival of B.virginianum.

MATERIAL AND METHOD - Coenological samples were taken in the habitat of B. virginianum, in 2 x 5 continuous squares of 2 x 2 m, with special regard to the fact that the plant occurs in special microrelief. This means B. virginianum is to be found in shallow flat basins and in ditches.

The uptake values of the cenological samples were determined on the basis of estimation and expressed in percentages. For recording the developmental conditions a decimal code-system was applied (cf. SZUJKÓ-LACZA-FEKETE 1973) in which the phenological stages were expressed by appropriate decimal symbols (the stage of rest is 10, vegetative stage is 20, generative 30, disorganized is 40). The phenophases occurring within the developmental conditions are expressed by the first-place numbers. This phenological code-system has already been prepared earlier for phanerogams and cryptogams as well, with the exception of Pteridophyta (SZUJKÓ-LACZA, KOVÁTS, ORBÁN, P. VERSEGHY, P. KOMÁROMY, HAJDU 1976).

The estimated diversity index (H') values according to species and samples of the coverage were calculated by the formula of SHANNON-WEAVER (1948), while the smoothness (J) by that of PIELOU (1975).

RESULTS AND CONCLUSIONS - The decimal codes elaborated for ferns are summarized in Table 1. The species list, compiled on the basis of the coenological samples, given in Table 2. From this table it can be reconstructed that the original association was Convallario-Quercetum danubiale. The canopy level today is mainly composed of Robinia pseudo-acacia which has been planted artificially. Thus, B. virginianum is mainly found in Bromo sterili-Robinietum. The appearance of this species has brought about the changing of the undergrowth everywhere in the original community.

Robinia pseudo-acacias associate most frequently and in mass with Bromus sterilis, and its disturbance is indicated by the presence of a number of weed species, as for example Ballota nigra, Sambucus nigra, Galium aparine, and Cerastium sp.

The members of the original plant community: Quercus robur, Crataegus monogyna, Ligustrum vulgare, Berberis vulgaris, Rhamnus catharticus, Ulmus procera. At the grass level: Viola cyanea, Geum urbanum, Botrychium virginianum, Thalictrum minus, Brachipodium silvaticum (SOÓ 1964).

In Table 2, in addition to the species list, the phenophases and also the frequency rate of species occurrences in the ten coenological samples are to be found.

In Table 5, the species are enumerated in the decreasing order of their occurring together. It can be seen that the four species in every case occur together with B. virginianum. Of the species of Convallario-Quercetum association, B. virginianum was found together with Viola cyanea and Geum urbanum in four cases.

Table 2. Species list, phenophases, and frequency values

| No. | Species | Phenophases | Frequency |
|---|---|---|---|
| 1 | Celtis occidentalis | 24 | 7 |
| 2 | Robinia pseudo-acacia | 24 | 10 |
| 3 | Ulmus procera | 24 | 1 |
| 4 | Quercus robur | 24 | 3 |
| 5 | Berberis vulgaris | 24 | 1 |
| 6 | Crataegus monogyna | 24 | 7 |
| 7 | Euonymus europeus | 24 | 2 |
| 8 | Ligustrum vulgare | 24 | 2 |
| 9 | Prunus domestica | 24 | 3 |
| 10 | Rhamnus catharticus | 24 | 6 |
| 11 | Rubus caesius | 24 | 3 |
| 12 | Sambucus nigra | 24 | 2 |
| 13 | Aegopodium podagraria | 24 | 1 |
| 14 | Anthriscus cerefolium | 43 | 4 |
| 15 | Ballota nigra | 24, 21 | 4 |
| 16 | Botrychium virginianum | 24, 41 | 4 |
| 17 | Brachipodium silvaticum | 24, 31 | 1 |
| 18 | Bromus sterilis | 42 | 8 |
| 19 | Calamintha clinopodium | 24, 21 | 4 |
| 20 | Carex spicata ssp. Lumnitzeri | 24, 33 | 3 |
| 21 | Cerastium sp. | 24 | 1 |
| 22 | Chelidonium majus | 24, 34, 41 | 4 |
| 23 | Draba nemorosa | 43 | 2 |
| 24 | Galium aparine | 42, 43 | 4 |
| 25 | Geranium Robertianum | 24, 32, 33 | 5 |
| 26 | Geum urbanum | 24, 34 | 7 |
| 27 | Muscari racemosum | 43 | 2 |
| 28 | Taraxacum officinale | 22 | 1 |
| 29 | Thalictrum minus | 24 | 4 |
| 30 | Viola cyanea | 24, 21 | 10 |

Table 3. Cover values and H', J, N, S

| No. | Cover value %, by sampling | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | | | 0.5 | 0.1 | 2 | 0.1 | | 10.2 |
| 2 | 71.5 | 100 | 100 | 150 | 100 | 100 | 100 | 100 |
| 3 | | | | | 0.2 | | | |
| 4 | | 0.5 | 0.5 | | | | | |
| 5 | | | 0.5 | | | | | |
| 6 | 1.5 | 5 | | | | 41 | 15.2 | 50 |
| 7 | | | 0.5 | 0.1 | | | | |
| 8 | | 0.5 | 0.1 | | | | | |
| 9 | | 0.5 | | 10 | 60 | | | |
| 10 | | | 0.5 | 0.1 | 0.1 | 0.5 | | 0.2 |
| 11 | | | | | | 3 | 5 | |
| 12 | | | | 1 | | | | 0.1 |
| 13 | | | | | | 0.5 | | |
| 14 | | | | | | | 2 | 10 |
| 15 | 10 | 45 | | 10 | 5 | | | |
| 16 | 0.5 | | | | | 0.5 | 5 | 10 |
| 17 | | | | | 1 | | | |
| 18 | 30 | 60 | 70 | 70 | 35 | 50 | 20 | 30 |
| 19 | 0.5 | | | | 0.2 | 2 | 3 | |
| 20 | 2 | 1 | | | 2 | | | |
| 21 | | | | | | | 1 | |
| 22 | | | 0.5 | | | 4 | 4 | 0.2 |
| 23 | 1 | | | | | | 1 | |
| 24 | | | | 2 | 5 | | 5 | |
| 25 | | 0.5 | 0.5 | 2 | | 1 | 1 | |
| 26 | 3 | 1 | 1 | | | 1 | 2 | 0.2 |
| 27 | | | | | | | 0.2 | |
| 28 | 0.2 | | | | | | | |
| 29 | | | 0.1 | 2 | 4 | 1 | | |
| 30 | 70 | 40 | 10 | 10 | 15 | 45 | 25 | 50 |

values according to species and to samplings

| Cover value %, by sampling | | By species | | | | No. |
|---|---|---|---|---|---|---|
| 9 | 10 | N | S | H' | J | |
| 5.5 | 45 | 63.40 | 7 | 1.3228 | 0.4712 | 1 |
| 100 | 100 | 1021.50 | 10 | 3.3006 | 0.9936 | 2 |
| | | - | - | - | - | 3 |
| 0.2 | | 1.2 | 3 | 1.4834 | 0.9359 | 4 |
| | | - | - | - | - | 5 |
| 100 | 100 | 312.70 | 7 | 2.2036 | 0.7849 | 6 |
| | | 0.6 | 2 | 0.650 | 0.650 | 7 |
| | | 0.6 | 2 | 0.650 | 0.650 | 8 |
| | | 70.50 | 3 | 0.6483 | 0.4090 | 9 |
| | 0.2 | 1.6 | 6 | 2.2988 | 0.8893 | 10 |
| 0.1 | | 8.1 | 3 | 1.0386 | 0.6553 | 11 |
| | | 1.1 | 2 | 0.4395 | 0.4395 | 12 |
| | | - | - | - | - | 13 |
| 15 | 20 | 47 | 4 | 1.7192 | 0.8596 | 14 |
| | | 70 | 4 | 1.4838 | 0.7419 | 15 |
| | | 16 | 4 | 1.2607 | 0.6303 | 16 |
| | | - | - | - | - | 17 |
| | | 355 | 8 | 2.8539 | 0.9513 | 18 |
| | | 5.70 | 4 | 1.4951 | 0.7475 | 19 |
| | | 5 | 3 | 1.5219 | 0.9602 | 20 |
| | | - | - | - | - | 21 |
| | | 8.7 | 4 | 1.3928 | 0.6964 | 22 |
| | | 2 | 2 | 1.0000 | 1.0000 | 23 |
| 10 | | 22 | 4 | 1.8031 | 0.9016 | 24 |
| | | 5 | 5 | 2.1219 | 0.9139 | 25 |
| 0.2 | | 8.4 | 7 | 2.3768 | 0.8466 | 26 |
| 0.2 | | 0.4 | 2 | 1.0000 | 1.0000 | 27 |
| | | - | - | - | - | 28 |
| | | 7.1 | 4 | 1.4662 | 0.7331 | 29 |
| 60 | 50 | 375 | 10 | 3.0868 | 0.9292 | 30 |

B. virginianum grows together with Rhamnus catharticus and Geranium Robertianum in two cases, and with Carex spicata ssp. Lumnitzeri, Thalictrum minus, Muscari racemosum and Aegopodium podagraria in one case.

In Table 3 and 4, the estimated values of the species coverage, and also the diversity values (H') of the various samples and of the individual species are to be found. The minimum is shown by sample No. 3. Two species, viz. Robinia pseudo-acacia and Bromus sterilis, are dominant here. The coverage values of the other species are small, and this even refers to that of Viola cyanea, although this occurs with high coverage values elsewhere. The maximum values can be found in sample No. 7. The proportion of Bromus sterilis is considerably smaller here. Although the coverage value of Robinia pseudo-acaica is high, the other species have quite considerable values as well. B. virginianum is also present in this sample. Of the diversity values by species, the greatest belong to the three dominant species, viz. Robinia pseudo-acacia, Bromus sterilis and Viola cyanea.

Table 4. Cover values and H', J, N, S values according to samplings

| | Cover value % | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| N | 190.2 | 254.0 | 185.7 | 256.3 | 229.5 | 249.6 | 189.4 | 250.9 | 291.2 | 315.2 |
| S | 11 | 11 | 14 | 11 | 13 | 14 | 15 | 11 | 10 | 6 |
| H' | 2.0189 | 2.1288 | 1.4922 | 1.6964 | 2.2481 | 2.2492 | 2.4031 | 2.3349 | 2.0498 | 2.1324 |
| J | 0.5836 | 0.6154 | 0.3919 | 0.4904 | 0.6075 | 0.5907 | 0.6151 | 0.6749 | 0.6171 | 0.8249 |

In the case of Crataegus monogyna, Rhamnus catharticus, Geranium Robertianum and Geum urbanum the diversity values are also relatively high. The lowest diversity value is reached by Sambucus nigra.

By studying further habitats, and with more data, a more accurate picture of B. virginianum will be available.

Here I should like to express my thanks to Julia Szujkó-Lacza, Director of the Botanical Department, for her kind help in the necessary methods to be used.

Table 5. Species occurring together with B. virginianum and the frequency of their occurrences

| Species | Frequency |
|---|---|
| Botrychium virginianum<br>Robinia pseudo-acacia<br>Viola cyanea<br>Geum urbanum<br>Bromus sterilis | 4 |
| Calamintha clinopodium<br>Chelidonium majus | 3 |
| Celtis occidentalis<br>Draba nemorosa<br>Geranium Robertianum<br>Rhamnus catharticus<br>Rubus caesius | 2 |
| Taraxacum officinale<br>Carex spicata ssp. Lumnitzeri<br>Ballota nigra<br>Thalictrum minus<br>Sambucus nigra<br>Galium aparine<br>Aegopodium podagraria<br>Anthriscus cerefolium<br>Cerastium sp.<br>Muscari racemosum | 1 |

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