

OBSERVATIONS ON THE RESTORATION OF HERBACEOUS VEGETATION IN SOME AREAS IN BACĂU END HARGHITA COUNTY

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Key words: natural ecological reconstruction, *Calthetum laetae*- *Ligularietum sibiricae* N. Ștefan 2007, *Botriochloetum ischaemi* (Krist 1937) I. Pop 1977, *Thymo panonici*-*Chrysopogonetum gryllii* Doniță et al 1992

INTRODUCTION

Since 1990, the social situation in Romania has changed in all fields, nature it self has not escaped some of this influence, often negative aspects have been reported, although the areas of protected nature have increased. After 1-2 decades from the decrease or even disappearance of anthropogenic influences on insignificant areas of low-quality agricultural land, there was an unexpected return of plant formations, which are not identical to those of the primary vegetation, but which have many elements in common. These natural experiments have transformed agricultural lands without economic yield into transitional meadows which, after 2-3 decades, also came to include extensive scrubland regions. It is to be expected to see the emergence of some trees in the scrubs and the decrease of the grassy areas.

MATERIALS AND METHOD

Over the past two decades, places have been sought where vegetation has flourished, where the floristic composition has been enriched and portions of ecosystems have been naturally restored. Where the conditions permitted it, phytosociological investigations were performed and the evolution of the anthropogenic pressure was assessed. We hereby present some analyses stemming from these observations.

RESULTS AND DISCUSSION

1. Swamp with relict species from Lunca de Sus - Izvorul Trotușului

There exists an area of about 1 Ha, with specimens of *Ligularia sibirica* accompanied by *Pedicularis palustris*, *Blysmus compressus*, *Viola palustris*, *Orchis laxiflora* spp. *elegans*, *Listera ovata*, *Leucanthemum waldsteinii*, bryophytes, etc., which was more affected over time by the vegetation series that complemented the growth of the canopy of trees and less by grazing. This vegetation is part of

the association *Calthetum laetae* - *Ligularietum sibiricae* Ștefan 2007.

The Trotuș River has its source upstream Făgetul de Sus village (Harghita County); the first stream, a tributary on the right side, located near the village of Lunca de Sus, has a swampy area completely surrounded by spruce. Here there was identified an area with numerous specimens of *Ligularia sibirica* and other rare plants. It is an easily accessible area, surrounded by forest and pasture, but which has never been destroyed by the locals' cattle. It currently benefits from the existence of a small electric fence.

Regarding research history in these places, we can mention that two more such areas were cited, one nearby, in Făgetel (Ghergheli și Rațiu, 1974; Palfalvi 2011; Kovacs și Palfalvi 2013, Mânzu, C.C., Cîșlariu, A.G., 2019) and another at Valea Întunecoasă - Lunca de Jos.

The flora of cormophytes in the analysed perimeter includes the following species: *Alnus incana*, *Ajuga reptans*, *Blysmus compressus*, *Chrysosplenium alternifolium*, *Carex remota*, *C. flava*, *Crepis paludosa*, *Cirsium oleraceum*, *Daphne mezereum*, *Doronicum austriacum*, *Equisetum sylvaticum*, *E. hiemale*, *Eriophorum latifolium*, *Festuca drymeja*, *Geum rivale*, *Glyceria notata*, *Hieracium murorum*, *Juncus articulatus*, *Leucanthemum waldsteinii*, *Listera ovata*, *Lycopus exaltatus*, *Mentha longifolia*, *M. aquatica*, *Orchis maculata*, *O. laxiflora* spp. *elegans*, *Pedicularis palustris*, *Pyrola secunda*, *Salix incana*, *S. aurita*, *S. pentandra*, *S. silesiaca*, *S. cinerea*, *Scirpus sylvaticus*, *Spiraea ulmifolia*, *Tussilago farfara*, *Valeriana simplicifolia*, *Viola palustris*, *V. montana*, *Vicia sylvatica*.

Relict glacial species are *Ligularia sibirica* and *Viola palustris*. Both can reach complete fruiting. There are 11 circumpolar species (27.5%).

The tree layer has a coverage of 70-90% and consists of *Salix silesiaca*, *S. pentandra*, *S. aurita*, *S. incana*, *Alnus incana*.

The shrub layer is dominated by *Salix silesiaca*. The herbaceous layer forms a clump only

downstream, also presenting specimens of *Viola palustris*.

This biotope, observed twice at an interval of 10 years, has a great taxonomic diversity, 40 species of cormophytes having been identified. The willow layer restricted the density of these specimens by retaining alluvium. *Ligularia sibirica* grows better on the edge of the stream where it reaches 1m in height and we cannot assess the evolution of this type of vegetation in the long run. The surfaces with *Viola palustris* shrank with the closing of the trees' canopy. Animals generally avoid entering the swamp when they have enough fodder, and this aspect is solved by the electric wire of the fence. The deforestation of some of the *Alnus incana* specimens from upstream and the nearby road did not cause any damage.

2. Vine terraces which have been abandoned or not worked upon have reconstructed their grassy vegetation specific to the region

The *Botriochloetum ischaemi* plant association (Krist 1937) I. Pop 1977

Spread: The hill sandvalley from Balotești-Stănișești (Bacău County)

Floristic composition: over 50% of the inventoried species fall into the class *Festuco-Brometea*, the others are grouped in the classes *Molinio - Arrhenetheretea*, *Artemisietea*, *Stellarietea*, etc.

These phytocoenoses inhabited the vine terraces that existed before 1990. Two decades after the cessation of agricultural work, secondary vegetation with dense phytocoenoses of *Dicanthium ischaemum* set in, which is still presents scattered weeds and which acts as a precursor for the transition

to a vegetation in which woody plants such as *Prunus spinosa*, *Crataegus monogyna* and *Rubus caesius* are present, of which we know that they later form populations that expand over the years. If these lands had been exploited under vine cultivation, they would have been subject to erosion; in a situation where they were abandoned due to their economic inefficiency, an anti-erosion vegetation has been restored which properly stabilizes the soil and which could be better exploited as a pasture.

The analysis of bioforms shows that 50% of the species are Hemicryptophytes, 18, 75% Therophytes, 15.62% Hemitherophytes, 1.56% Geophytes. It can be observed that Therophytes, plants that are common in cultivated areas, still represent a large proportion of the vegetation and some of them were present still in large quantities. The biggest part of geophytes has not been restored. To these may be added Phanerophytes 6,25% and Chamaephytes 7.81%.

The phytogeographical analysis indicates the presence of 15.60% species specific to the southern European region, which generally settle on the sunny slopes of many of the areas around Colinele Tutovei; this category also includes the representative species, *Dicanthium ischaemum*.

The analysis of the indicator species in regard to the nitrogen dissolved in the soil reveals the presence of some species adapted to biotopes which are very poor in nutrients, with moisture deficit, intense light and slightly alkaline pH. The representative species did not spread the way the weeds or plants in wetlands did; it existed in very small proportions in the space between terraces, later filling the land with a slightly higher competitive capacity (Table 1).

Table 1: The *Botriochloetum ischaemi* plant association (Krist 1937) I. Pop 1977

Survey number	1	2	3	4	5
Surface (sqm)	100	100	100	100	100
Slope (°)	30	30	20	20	20
Vegetation coverage (%)	98	95	95	90	95
Exposure	V	V	V	V	V
Car. Ass.					
<i>Dicanthium ischaemum</i>	5	5	5	5	5
Thymo-Festucion rupicolae					
<i>Festuca rupicola</i>	.	1	.	+	.
Festucion valesiacae					
<i>Centaurea stoebe</i> ssp. <i>australis</i>	+	+	.	+	+
<i>Lathyrus nissolia</i>	+	.	.	.	.
<i>Salvia nemorosa</i>	.	.	.	+	.
<i>Verbascum speciosum</i>	+	.	.	.	.
<i>Veronica incana</i>	.	+	.	.	.
<i>Dorycnium pentaphyllum</i> ssp. <i>herbaceum</i>	+	.	1	+	+
Festucetalia valesiacae					
<i>Achillea acolina</i>	.	.	+	+	.
<i>Achillea setacea</i>	+	+	+	.	+
<i>Artemisia austriaca</i>	.	1	.	.	.
<i>Centaurea scabiosa</i> ssp. <i>spinulosa</i>	.	+	+	.	.
<i>Hypericum elegans</i>	.	+	.	.	.
<i>Thymus pannonicus</i>	.	+	.	.	.
Festuco - Brometea					
<i>Agrimonia eupatoria</i>	+	+	.	+	+
<i>Asperula cynanchica</i>	+	+	.	+	.

<i>Crepis foetida</i>	.	.	+	.	.
<i>Eryngium campestre</i>	+	.	.	+	+
<i>Euphorbia cyparissias</i>	+	+	+	.	.
<i>Kohlruschia prolifera</i>	.	.	.	+	+
<i>Hieracium pilosella</i>	.	.	.	+	.
<i>Hypericum perforatum</i>	.	+	+	.	+
<i>Medicago falcata</i>	.	+	+	+	.
<i>Salvia verticillata</i>	+	.	.	.	.
<i>Senecio jacobaea</i>	.	+	.	.	.
<i>Dianthus carthusianorum</i>	.	+	.	.	.
<i>Teucrium chamaedrys</i>	+	.	.	.	.
<i>Trifolium campestre</i>	.	.	+	+	+
<i>Plantago media</i>	+	.	+	.	.
<i>Pimpinella saxifraga</i>	.	.	+	.	.
Cynosurion					
<i>Odontites vernus</i>	+	.	+	+	+
Arrhenetheretalia					
<i>Cichorium inthybus</i>	+	.	+	+	.
<i>Plantago lanceolata</i>	.	.	.	+	.
<i>Tragopogon pratensis</i>	.	+	+	.	.
Molinio - Arrhenetheretea					
<i>Lotus corniculatus</i>	+	.	+	+	+
Sedo - Scleranthetea					
<i>Dianthus armeria</i>	+	.	.	.	.
Agropyro- Rumicion					
<i>Inula britannica</i>	+	.	.	.	.
Artemisietea s.l.					
<i>Cardus acanthoides</i>	.	+	+	.	.
<i>Verbascum phlomoides</i>	+	.	.	+	.
<i>Berteroa incana</i>	+	.	.	.	.
<i>Xeranthemum annuum</i>	.	.	+	.	.
Quercetea pubescentis					
<i>Rosa canina</i> (juv.)	.	.	.	.	+
<i>Vincetoxicum hirsutarium</i>	.	.	.	+	.
<i>Trifolium alpestre</i>	.	.	+	+	.
Rhamno - Prunetea					
<i>Origanum vulgare</i>	+	.	+	+	+
<i>Prunus spinosa</i>	.	.	.	+	+
<i>Rubus discolor</i>	.	.	+	.	.
<i>Vicia tenuifolia</i>	+	.	.	+	.
<i>Crataegus monogyna</i> (juv.)	+	.	.	.	.
Stellarieteamediae s.l.					
<i>Lathyrus tuberosus</i>	+	+	+	+	+
<i>Medicago lupulina</i>	.	.	+	.	.
<i>Melilotus officinalis</i>	.	.	.	.	+
<i>Xanthium strumarium</i>	.	.	.	+	.
<i>Trifolium arvense</i>	1	2	2	+	+
<i>Convolvulus arvensis</i>	.	+	.	.	+
<i>Daucus carota</i>	.	.	+	+	.

Place and date of the surveys: 1, 2- Balotești - Stănișești (Bacău County) (10. 8. 2010); 3, 4, 5- Valea Rucii - Stănișești (Bacău County).

3. Grassland returned to the owners, used as pasture, rebuilds its structure As *Thymo panonici*-*Chrysopogon**gryllii* Doniță et al 1992.

Spread: Valea Seacă- Nicolae Bălcescu. In the perimeter of Bacău county, these phytocoenoses are still present as vestiges of the forest-steppe vegetation near the city of Onești.

The large areas of *Chrysopogon gryllus* identified near the city of Bacău were exploited prior to the 1990 as pastures; later on, they became the property of the villagers where they are used as hayfields. This plant association fits very well in the class *Festuco – Brometea*, also comprising by chance small proportions of species from *Molinio – Arrhenatheretea*.

Over the past 3 decades, non-forage species have been greatly reduced, only rare specimens of the *Artemisietea* class remain, which are quantitatively insignificant. The layer of tall grasses is dominated by the representative species that exceeds 150 cm and by rare specimens of *Centaurea spinulosa*, *Picris hieracioides*, *Daucus carota*, and *Ferulago campestris*. The emergence of some specimens of *Sambucus ebulus* does not represent a danger for these hayfields, we believe that they evolved on the more fertile soil subjected in the past to grazing. No other disruptive factors have been identified, so this type of vegetation will have a long lifespan.

The analysis of the geographical elements highlights the thermophilic character of the vegetation, the edifying and dominant species is sub-Mediterranean; however, in the list of species, there

are a few species specific to the southern geographical area, among which we mention the following: *Centaurea spinulosa*, *Stachys annua*, *Salvia verticillata*, *Carthamus lanatus*.

The analysis of the indicator species with regard to the ecological factors shows that the dominant species is very well adapted on very dry soils, warm climate and with high mineral nitrogen deficiency. In the analysed ecosystem, these two do not act as vegetation-limiting factors; on the contrary, they are better represented, they are close to the average values and an increased biomass is obtained which here has raised considerable economic interest. The area occupied by this vegetation looks like a valley with a predominantly southern and eastern exposure, hence, with a large amount of light. With

the exception of small plants, most prefer full exposure to light (54%) and partial exposure, with little shade (36%). The temperature factor is conclusive, it indicates the presence of some species that have preferences towards temperate and warm climates (45%) and some species that are adapted to large temperature variations (50%). When it comes to moisture, most species thrive on dry and mildly dry soil (80%). The pH factor indicates the presence of only two categories of species, some adapted to neutral pH of the soil solution (46%) and others that support large variations in the hydrogen ions concentration in the soil solution, so euriionic (54%). The hay obtained has economic value only for large animals, if it is cut before fruiting (Table 2).

Table 2. As Thymopanonici-Chrysopogonetumgryllii Doniță et al. 1992

Survey number	1	2	3
Surface (sqm)	100	100	100
Vegetation coverage (%)	95	90	100
Slope (°)	15	10	10
Altitude (m.a.s.l.)	290	381	396
Exposure	SE	SV	NE
Car. Ass.			
<i>Thymus panonnicus</i>	.	+	.
<i>Chrysopogon gryllus</i>	4	4	5
Festucetalia valesiacae			
<i>Centaurea spinulosa</i>	+	+	+
<i>Achillea setacea</i>	+	.	.
<i>Falcaria vulgaris</i>	+	.	.
<i>Knautia arvensis</i>	+	+	+
<i>Onobrychis viciifolia</i>	.	.	+
<i>Elymus hispidus</i> ssp. <i>hispidus</i>	.	.	+
<i>Centaurea stoebe</i> ssp. <i>australis</i>	.	.	+
Cirsio - Bracypodion			
<i>Doricionium pentaphyllum</i> ssp. <i>herbaceum</i>	+	+	+
Festuco - Brometea			
<i>Thalictrum minus</i>	+	+	+
<i>Senecio jacobaea</i>	+	.	.
<i>Galium verum</i>	+	.	+
<i>Cuscuta epithymum</i>	+	.	.
<i>Scabiosa ochroleuca</i>	+	.	+
<i>Eryngium campestre</i>	+	.	.
<i>Filipendula vulgaris</i>	+	+	.
<i>Agrimonia eupatoria</i>	+	.	+
<i>Echium vulgare</i>	+	.	.
<i>Asaperula cynanchica</i>	+	.	+
<i>Chamaezytis heuffelii</i>	+	.	.
<i>Campanula glomerata</i>	.	+	.
<i>Salvia verticillata</i>	.	+	+
<i>Medicago falcata</i>	.	+	+
<i>Anthericum ramosum</i>	.	.	+
<i>Crepis foetida</i> ssp. <i>rhoadifolia</i>	.	.	+
Molinio – Arrhenatheretea s.l.			
<i>Stachys officinalis</i>	+	+	.
<i>Tragopogon pratense</i>	+	.	.
<i>Ononis arvensis</i>	+	+	.
<i>Vicia cracca</i>	+	.	.
<i>Rhinanthus minor</i>	+	+	+
<i>Silene vulgaris</i>	+	.	.
<i>Dactylis glomerata</i>	.	.	+
<i>Achillea millefolium</i>	.	+	+
<i>Lathyrus pratensis</i>	.	+	.
Sedo - Scleranthetea			
<i>Dianthus armeria</i>	+	.	.

Artemisietea s.l.			
<i>Daucus carota</i>	+	+	+
<i>Carduus acanthoides</i>	+	.	.
<i>Artemisia absinthium</i>	+	.	.
<i>Cerinth minor</i>	.	+	.
<i>Melilotus alba</i>	.	+	.
<i>Picris hieracioides</i>	+	+	.
<i>Cichorium inthybus</i>	+	.	.
<i>Cirsium vulgare</i>	+	+	.
<i>Xanthium strumarium</i>	+	.	.
<i>Erigeron annuus</i>	+	.	.
Trifolio – Geranietea s.l.			
<i>Lavatera thuringiaca</i>	.	+	.
<i>Clinopodium vulgare</i>	+	+	.
Orno - Cotinetalia			
<i>Ferulagocampestris</i>	+	.	.
Querco –Fagetea s.l.			
<i>Rosa canina</i>	.	+	.
<i>Campanula trachelium</i>	+	.	.
<i>Galium schultesii</i>	+	.	.
Aliae			
<i>Equisetum telmateja</i>	.	.	+
<i>Sambucussebulus</i>	+	.	.
<i>Stachysanua</i>	+	.	+

Place and date of the surveys: 1, 2, 3- Valea Seacă- Nicolae Bălcescu; 28.7.2019

46°2837N/ 26°5228; 46°2717N/ 26°5457; 46°3315N/ 26°5523

CONCLUSIONS

Nowadays, the primary vegetation can be found in very small areas and it seems that no corner of the land has remained untouched by human activities. In the phytosociological literature, you can often come across the term “secondary vegetation”, which defines a semi-natural vegetation that sometimes appears on lands of agricultural interest, after the long-term cessation of any anthropo-zoogenic pressure. From our observations, we can say that by the cessation of agricultural activities, after 1-2 decades, the grassy vegetation is reinstated, quantitatively similar to the primary, ancient vegetation. Subsequently, specimens of shrubs that form areas of scrub landemerge. We can say that, sometimes, after half a century, the secondary grassy vegetation coverage is reduced, the areas of scrubland increase and specimens of trees may appear in them. In this respect, we can compare it to the reduction of areas with woody vegetation over the centuries, caused by the diversification of human activities, major social events, population growth and the need for resources. Only a judicious exploitation of resources can ensure the integrity and functioning of fragile ecosystems. It is necessary to gain experience in the natural restoration of parts of vegetation and to make the right decisions regarding the management of these places.

ABSTRACT

Three plant associations are presented, from different areas whose structure restored significantly, after the cessation of the anthropo-zoogenic pressure, without the need for specific actions. The association *Calthetum laetae- Ligularietum sibiricae* N. Ștefan

2007, from Lunca de Sus, is mainly spared from the anthropogenic pressure, but the vegetation series in the area can cause it to have an uncertain future; we believe that there are also natural possibilities for maintenance available. The *Dicanthietum ischaemi* association from an area of hills has quickly regained its right to populate the biotopes which it is best adapted to cover. The association of *Thymo panonici-Chrysopogonetum gryllii* from an upper terrace of the Siret surprises by its very presence.

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