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PHYTOSOCIOLOGICAL STUDY CONCERNING HABITATS WITH *LIGULARIA SIBIRICA* (L.) CASS. AND *CLADIUM MARISCUS* (L.) POHL FROM HĂRMAN MARSH

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Abstract: Hărman Marsh is known for its biodiversity and conservation of many relict species on its territory. The *Cladietum marisci* Allorge 1922 ex Zobrist 1935 association was identified at Hărman Marsh while carrying out phytosociological research on a relict species of community importance, *Ligularia sibirica* (L.) Cass, during June and August 2014. The association studied belongs within Natura 2000 Habitat 7210* Calcareous fens with *Cladium mariscus* and species of *Caricion davallianae*, respectively Eunis Habitat D5.24 Fen *Cladium mariscus* beds characteristic for sedges and tall fens. The present paper aims to describe the *Cladietum marisci* Allorge 1922 ex. Zobrist 1935 association and the habitat in which it is included, as well as a short presentation of the glacial relicts *Ligularia sibirica* (L.) Cass. and *Cladium mariscus* (L.) Pohl from Hărman Marsh. Qualitative analysis was performed for the accompanying flora of *Cladium mariscus* (L.) Pohl, represented by the analysis of the bioforms, geo-elements, the main ecological factors (humidity, temperature and soil reaction) and also the genetic structure analysis and the parameter diploids calculation. The results of the qualitative analysis reveal the high percentage of hemicryptophytes, Eurasian species, mesohygrophilic species, micro-mesotherms low-acid neutrophilous and polyploidy species. The significant difference between the 1958–1959 floristic inventory of Morariu and the inventory conducted by us at Hărman in 2014, is an increase in the number of species listed in the association featured by *Cladium mariscus* (L.) Pohl, from 32 to 60 species. Also in 2014, we observed in the studied association the presence of the relict *Ligularia sibirica* (L.) Cass., a species absent from the floristic inventory conducted by Morariu.

Keywords: *Cladietum marisci*, *Ligularia sibirica*, Hărman, phytosociological study, plant association.

Introduction

The relict species *Ligularia sibirica* (L.) Cass. dates from the Tardiglacial – early Postglacial period. In Romania the existence of the taxon from the Tardiglacial period until now has been demonstrated according to the research conducted for Würmian age determination in eutrophic wetlands from Fânețele seculare Ponoare Natural Reserve [15].

Based on botanical research conducted on the flora of Romania, Kitaibel (1796) was the first naturalist in our country to mention *Ligularia sibirica* (L.) Cass. relict in the bog of Tăul lui Dumitru Natural Reserve. *Cladium mariscus* (L.) Pohl was described for the first time in Romania by Salzer at Borsec, and Simkovics at Valea Morii [10]; and the *Cladietum marisci* association was first described in our country by I. Prodan (1939) [9].

Natura 2000 Habitat, 7210* – Calcareous fens with *Cladium mariscus* and species of *Caricion davallianae*, respectively Eunis Habitat – D5.24 Fen *Cladium mariscus* beds, occupies small areas in our country, especially in valleys, in the proximity of certain lakes or as a succession stage in wet meadows [14].

The habitat 7210* / D5.24 is characteristic of marshes with alkaline or acidic substrate, common in Europe [8, 1] but sporadic in our country, being found in Natura 2000 sites such as: Dealul Cetății Lempeș-Mlaștina Hărman, Delta Dunării [13], Făgetul Clujului-Valea Morii and in the Pădurea și Mlaștinile eutrofe de la Prejmer [2, 16, 18]. Eunis Habitat D5.24 – Fen *Cladium mariscus* beds, as well as Natura 2000 Habitat 7210* – Calcareous fens with *Cladium mariscus* and species of *Caricion davallianae* is included within the Red List of the Carpathian Non-forest Biotopes (Habitats) as Endangered in Romania [1].

In our country *Cladium mariscus* (L.) Pohl phytocoenoses are sporadically found on the edge of Căldarușani lake and in the area of eutrophic marshes: Hărman [9], Stupini, Valea Morii and in Mangalia, all being on hydromorphic soils which hold a variable content of lime and have a low nutrient level [11].

The *Cladietum marisci* Allorge 1922 ex Zobrist 1935 association was described at Hărman Marsh by Morariu in 1964, having *Cladium mariscus* (L.) Pohl as the characteristic and dominant species. The compact clumps of large sedge association joins *Schirpo-Phragmitetum* W. Koch 1926 and *Orchido-Schoenetum nigricantis* Oberd. 1957 associations [4].

Material and Methods

The floristic survey was undertaken at Hărman Marsh (Lat. N 45°43'05"; Long. E 25°40'17") which is located in the Eastern Carpathians, in the Țara Bârsei Basin, Brasov County.

The research at Hărman Marsh was based on personal research and bibliographical data. The flora analysis was performed following the methods developed by J. Braun-Blanquet, Zurich-Montpellier phytosociology school, adapted to the vegetation particularities of Romania by Al. Borza [6]. The syntaxonomic unit used is plant association. For qualitative analysis of the flora, association and habitat were used: *Flora Europaea* [17], *Les associations végétales de Roumanie* [4], *Mlaștinile de turbă din Republica Populară Română* [10], *Breviar Fitocenologic* [11], *Manual de Interpretare a Habitatelor Natura 2000* [5], *Habitatele din România* [7], *Flora Ilustrată a României* [3], *Flora cormofitelor spontane și cultivate din România* [12].

Results and Discussion

Natura 2000 Habitat, 7210* Calcareous fens with *Cladium mariscus* and species of *Caricion davallianae*, typical for high sedge and reeds, is represented at Hărman Marsh by the association *Cladietum marisci* Allorge 1922 ex. Zobrist 1935. The association was identified during phytosociological research on the species *Ligularia sibirica* (L.) Cass. between June and August 2014 (Photo. 1).

In coenotic terms, the association belongs to the *Phragmition* Koch 1962 alliance, and to the *Phragmitetalia* Koch 1962 order included in the *Phragmitetea* Tx. and Prsg. 1942 class.

The floristic composition of the *Cladietum marisci* Allorge 1922 ex Zobrist 1935 association at Hărman Marsh has as identifying and characteristic species *Cladium mariscus* (L.) Pohl, along with *Oenanthe aquatica*, *Typha angustifolia* and other species, some of them of Community importance, of which their presence provides a high conservation value to the habitat studied: *Ligularia sibirica*, *Molinia caerulea*, *Carex distans*, *C. riparia*, *Sanguisorba officinalis*, *Galium boreale*, etc. (Tab.1).

Table 1: *Cladietum marisci* Allorge 1922 ex. Zobrist 1935 at Härman Marsh

Survey number	1	2	3	4	5	K ₁	K ₂	ADm
Altitude (m s.m.)	520	519	522	525	518			
Aspect	NE	NE	NE	NE	NE			
Slope (°)	6	3	2	1	5			
Surface (m²)	10	12	15	10	10			
Cover of the herbaceous layer (%)	91.5	86.5	83	86.5	81.5			
Characteristic species of the association								
<i>Cladium mariscus</i>	4	4	4	4	3	V	V	57.5
<i>Oenanthe aquatica</i>	-	-	-	+	+	II	-	0.2
<i>Typha angustifolia</i>	-	+	-	-	-	I	-	0.1
<i>Phragmition et Phragmitetalia</i>								
<i>Phragmites australis</i>	1	1	+	1	1	V	IV	20.6
<i>Lycopus europaeus</i>	+	-	-	+	+	III	-	4.1
<i>Sium latifolium</i>	-	-	+	-	-	I	-	0.1
<i>Phragmiti-Magnocaricetea</i>								
<i>Lythrum salicaria</i>	+	+	+	1	1	V	I	2.3
<i>Lysimachia vulgaris</i>	+	+	+	+	+	V	-	0.5
<i>Eleocharis palustris</i>	1	+	-	+	-	III	-	1.2
<i>Galium palustre</i>	+	+	+	-	-	III	I	0.3
<i>Cicuta virosa</i>	+	+	-	-	+	III	-	0.3
<i>Carex paniculata</i>	+	+	-	-	+	III	I	0.3
<i>Mentha aquatica</i>	-	-	+	+	-	II	-	0.2
<i>Poa palustris</i>	+	-	-	+	-	II	-	0.2
<i>Carex davalliana</i>	+	-	-	-	-	I	I	0.1
<i>Ranunculus acris</i>	-	-	-	-	-	-	I	-
<i>Carex panicea</i>	-	-	-	-	-	-	I	-
<i>Molinietalia s.i.</i>								
<i>Deschampsia caespitosa</i>	1	1	1	1	2	V	I	7.5
<i>Succisa pratensis</i>	+	+	-	+	+	IV	I	0.4
<i>Equisetum palustre</i>	+	+	-	-	+	III	I	0.3
<i>Sanguisorba officinalis</i>	-	+	+	-	+	III	V	0.3
<i>Cirsium canum</i>	-	+	+	-	-	II	-	0.2
<i>Linum catharticum</i>	-	+	+	-	-	II	II	0.2
<i>Filipendula ulmaria</i>	-	-	-	-	+	I	-	0.1
<i>Myosotis palustris</i>	-	-	+	-	-	I	-	0.1
<i>Cirsium rivulare</i>	-	-	-	-	-	-	V	-
<i>Scheuchzerio-Caricetea nigrae</i>								
<i>Ligularia sibirica</i>	+	+	+	+	+	V	-	0.5
<i>Triglochin palustre</i>	-	+	+	+	+	IV	-	0.4
<i>Eriophorum angustifolium</i>	+	+	1	-	-	III	II	1.2
<i>Epilobium palustre</i>	+	+	-	-	+	III	I	0.3
<i>Juncus effusus</i>	+	+	-	-	-	II	-	0.2
<i>Molinio-Arrhenatheretea</i>								
<i>Potentilla erecta</i>	-	+	+	-	+	III	V	0.3

<i>Calystegia sepium</i>	-	-	+	+	-	II	-	0.2
<i>Festuca rubra</i>	-	+	-	-	+	II	-	0.2
<i>Briza media</i>	-	-	-	+	-	I	II	0.1
Varia								
<i>Molinia caerulea</i> ssp. <i>arundinacea</i>	-	+	+	+	1	IV	-	1.3
<i>Schoenus nigricans</i>	+	+	+	-	+	IV	III	0.4
<i>Molinia caerulea</i>	1	+	-	+	-	III	II	1.2
<i>Agrostis stolonifera</i>	+	+	-	+	-	III	-	0.3
<i>Serratula tinctoria</i>	-	+	+	-	+	III	IV	0.3
<i>Sesleria caerulea</i>	-	+	+	-	+	III	II	0.3
<i>Eupatorium cannabinum</i>	-	+	+	+	-	III	-	0.3
<i>Carex distans</i>	+	+	-	-	+	III	I	0.3
<i>Sonchus arvensis</i>	-	-	+	-	+	II	I	0.2
<i>Thelypteris palustris</i>	-	+	-	-	+	II	-	0.2
<i>Parnassia palustris</i>	-	-	+	-	-	I	I	0.1
<i>Carex flava</i>	-	-	-	-	+	I	II	0.1
<i>Mentha arvensis</i>	-	-	-	+	-	I	-	0.1
<i>Polygonum lapathifolium</i>	-	-	-	-	+	I	-	0.1
<i>Epilobium hirsutum</i>	+	-	-	-	-	I	-	0.1
<i>Amaranthus retroflexus</i>	-	-	-	+	-	I	-	0.1
<i>Allium ochroleucum</i>	-	-	-	+	-	I	I	0.1
<i>Primula farinosa</i>	-	-	-	-	-	-	III	-
<i>Pinguicula vulgaris</i>	-	-	-	-	-	-	II	-
<i>Pedicularis sceptrum-carolinum</i>	-	-	-	-	-	-	II	-
<i>Carex gracilis</i>	-	-	-	-	-	-	I	-
<i>Achillea asplenifolia</i>	-	-	-	-	-	-	I	-
<i>Orchis elegans</i>	-	-	-	-	-	-	I	-
<i>Vicia angustifolia</i>	-	-	-	-	-	-	III	-
<i>Genista tinctoria</i>	-	-	-	-	-	-	II	-

Survey of *Cladietum marisci* Allorge 1922 ex Zobrist 1935 association at Härman Marsh: 1-5, K₁, ADm - Matei A. N. 2014; K₂ – 5 reference surveys after Morariu I. 1958-1959.

Although the compact structure of the association does not allow the existence of a large number of species associated with the relict *Cladium mariscus* (L.) Pohl, there has been a distinct increase in the number of plant species, from 32 species in 1964 to 60 species in 2014; new species found are: *Oenanthe aquatica*, *Typha angustifolia*, *Lycopus europaeus*, *Sium latifolium*, *Eleocharis palustris*, *Lysimachia vulgaris*, *Mentha aquatica*, *Carex paniculata*, *Cicuta virosa*, *Poa palustris*, *Cirsium canum*, *Filipendula ulmaria*, *Myosotis palustris*, *Ligularia sibirica*, *Triglochin palustre*, *Epilobium palustre*, *Juncus effusus*, *Calystegia sepium*, *Festuca rubra*, *Molinia caerulea* subsp. *arundinacea*, *Amaranthus retroflexus*, *Agrostis stolonifera*, *Eupatorium cannabinum*, *Sonchus arvensis*, *Mentha arvensis*, *Thelypteris palustris*, *Polygonum lapathifolium* and *Epilobium hirsutum*. The current large number of species is considered to be due to the conservation measures adopted over the years at Härman Marsh.

The 60 taxa in the floristic inventory are distributed in 23 families, the largest percentage being in Poaceae (18%), Cyperaceae (12%), Lamiaceae (8%) and Asteraceae (8%).

The species in the *Cladietum marisci* Allorge 1922 ex. Zobrist 1935 association were qualitatively analysed. With regard to the bioforms, one can observe the high percentage of hemicryptophytes (60%), followed by geophytes (26%) and helohidatophytes (14%).

The highest percentage of geo-elements is held by Eurasian species (39%), followed by the Circum-polar species (31%) and European species (13%).

The analysis of the main ecological factors such as humidity, temperature and soil reaction shows the high percentage of meso-hygrophilic species from the humidity point of view. With regard to the temperature factor, micro-mesotherms are predominant, and the soil reaction analysis results indicate the high percentage of low-acid neutrophilous species.

Taking into consideration the karyological aspects of the plant species from the *Cladietum marisci* Allorge 1922 ex. Zobrist 1935 association, it can be observed that the percentage of polyploid species (63%) is higher than the diploid (32%), due to the high competition capacity of polyploids. The diploids parameter has 1.95 values, as result of the typical climate of the area.



Photo 1: *Ligularia sibirica* (L.) Cass. and *Cladium mariscus* (L.) Pohl
Mlaştina Hărman (photo: A.N. Matei 2014 – original)

Conclusions

The relict species *Ligularia sibirica* (L.) Cass. is located in Hărman Marsh in the *Cladium mariscus* coenoses, developed on hydromorphic soils which contains a variable level of lime and a low nutrient level.

Natura 2000 Habitat 7210* Calcareous fens with *Cladium mariscus* and species of *Caricion davallianae* / Eunis Habitat D5.24 Fen *Cladium mariscus* beds, typical for high sedge

and reeds is represented at Hărman Marsh by *Cladietum marisci* Allorge 1922 ex. Zobrist 1935 association.

The *Cladietum marisci* Allorge 1922 ex. Zobrist 1935 association, holds a high percentage of poliploid species, and the diploid index has 1.95 value, due to the typical climate of the area.

Nowadays the favourable conservation capacity of Hărman Marsh allows the existence of relict species such as *Cladium mariscus* (L.) Pohl and *Ligularia sibirica* (L.) Cass. The current association studied in 2014 includes a species of Community importance, *Ligularia sibirica*.

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**STUDII FITOSOCIOLOGICE PRIVIND HABITATELE CU *LIGULARIA SIBIRICA* (L.) CASS.
ȘI *CLADIUM MARISCUS* (L.) POHL DE LA MLAȘTINA HĂRMAN**

(Rezumat)

Mlaștina de la Hărman este cunoscută datorită biodiversității acesteia și conservării pe teritoriul ei a numeroase specii relict. Asociația *Cladietum marisci* Allorge 1922 ex Zobrist 1935 a fost identificată la Mlaștina Hărman, în timpul desfășurării cercetărilor fitosociologice asupra speciei relict de importanță comunitară *Ligularia sibirica* (L.) Cass., în perioada iunie-august 2014.

Prezenta lucrare își propune descrierea asociației *Cladietum marisci* Allorge 1922 ex Zobrist 1935, și a habitatului în care este cuprinsă; precum și prezentarea succintă a relictelor glaciare *Ligularia sibirica* (L.) Cass. și *Cladium mariscus* (L.) Pohl de la Mlaștina Hărman.

Asociația *Cladietum marisci* Allorge 1922 ex Zobrist 1935 este încadrată în habitatul Natura 2000: 7210* Mlaștini calcaroase cu *Cladium mariscus* și *Caricion davalianae*, respectiv Eunis Habitat D5.24 Fen *Cladium mariscus* beds caracteristic stufărișurilor și rogozișurilor înalte. Asociația este încadrată cenotic în alianța *Phragmition* Koch 1962, ordinul *Phragmitetalia* Koch 1962 în clasa *Phragmitetea* Tx. et Prsg. 1942.

Compoziția floristică a asociației *Cladietum marisci* Allorge 1922 ex Zobrist 1935 la Mlaștina Hărman, are ca specie edificatoare și caracteristică *Cladium mariscus* (L.) Pohl alături de speciile caracteristice: *Oenanthe aquatica*, *Typha angustifolia* și numeroase specii relict unele de importanță comunitară, a căror prezență oferă o valoare conservativă mare habitatului, precum: *Ligularia sibirica*, *Molinia caerulea*, *Carex distans*, *Carex riparia*, *Sanguisorba officinalis*, *Galium boreale*, etc.

Inventarul floristic cuprinde 60 taxoni, fiind incluși în 23 familii, ponderea cea mai mare fiind deținută de familiile Poaceae și Cyperaceae.

Rezultatele analizei calitative relevă o pondere mare a hemicriptofitelor, speciilor eurasiatice, mezo-higrofile, micro-mezoterme, acid-neutrofile, poliploide. Comparția inventarului floristic din 1958 efectuat de Morariu I. cu cel din 2014 efectuat de noi la Hărman, relevă o creștere importantă a numărului de specii cuprinse în asociația edificată de *Cladium mariscus* (L.) Pohl de la 32 la 60 de specii. Concomitent s-a observat prezența relictului *Ligularia sibirica* (L.) Cass. în asociația luată în studiu în 2014, specie ce lipsește din inventarul floristic realizat de Morariu I.

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