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Asplenio trichomanis-Carpinetum betuli Pînzaru - ass. nova (*Carpinion betuli* Issler 1931) in the Republic of Moldova

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Abstract. This article describes the phytocoenoses dominated by *Carpinus betulus* L. found in the cliff zone of the Republic of Moldova, which have been grouped in a new association *Asplenio trichomanis-Carpinetum betuli* Pînzaru ass. nova, of the alliance *Carpinion betuli* Issler 1931, order *Fagetalia sylvaticae* Pawlowski 1928, class QUERCO-FAGETEA Br.-Bl. et Vlieger in Vlieger 1937. The association has been described on the basis of 30 relevés prepared by the author. Characteristic species of this association: *Carpinus betulus*, *Asplenium trichomanes*, *A. scolopendrium*, *Cystopteris fragilis*, *Hepatica nobilis*, *Scrophularia vernalis*, *Polypodium vulgare*.

Keywords: *Asplenio trichomanis-Carpinetum betuli* ass. nova, characteristics of phytocoenoses, ecology, range, Republic of Moldova.

Asplenio trichomanis-Carpinetum betuli Pînzaru - asociaţie nouă (*Carpinion betuli* Issler 1931) în Republica Moldova

Rezumat. În această lucrare fitocenozele dominate de *Carpinus betulus* L. din zona de stâncării din Republica Moldova sunt grupate într-o asociaţie nouă *Asplenio trichomanis-Carpinetum betuli* Pînzaru ass. nova, din alianţa *Carpinion betuli* Issler 1931, ordinul *Fagetalia sylvaticae* Pawlowski 1928, clasa QUERCO-FAGETEA Br.-Bl. et Vlieger in Vlieger 1937. Asociaţia este descrisă pe baza a 30 relevee efectuate de autor. Specii caracteristice asociaţiei: *Carpinus betulus*, *Asplenium trichomanes*, *A. scolopendrium*, *Cystopteris fragilis*, *Hepatica nobilis*, *Scrophularia vernalis*, *Polypodium vulgare*.

Cuvinte cheie: *Asplenio trichomanis-Carpinetum betuli* ass. nova, caracteristica fitocenozelor, ecologia, răspândirea, Republica Moldova.

1. Introduction

The hornbeam forests on the limestone slopes of the Dniester-Prut interfluve, Republic of Moldova, according to the methods of the Soviet school of geobotanists, were grouped in the associations *Querceto* (*roboris*)-*Carpinetum caricosum* (*pilosae*) and *Querceto* (*roboris*)-*Acero* (*platanoides*) *Carpinetum galicosum* (*odoratis*) [1]. In the early 1990s, the phytosociological research was continued on the basis of the Central European school

(Braun-Blanquet, 1964). As a result of the conducted studies, a new way of grouping hornbeam phytocoenoses that occur in the areas with limestone substrate has been proposed – in the association *Asplenio trichomanis-Carpinetum betuli* ass. nova.

2. Material and Methods

The phytosociological research was conducted according to the methods of the Central-European school [2]. The description of the association was based on 30 relevés. The area of a relevé is 600 m, according to the school of Cluj [3]. The phytosociological research was conducted in 1987-1997, 2009, 2014-2020. The list of the species was presented according to the monograph P. Pînzaru & T. Sîrbu [4]. The rare species, protected by the state – according to the Law LP1538/1998 (Republic of Moldova, Parliament, 1998) and the Red Book of R. Moldova (2015). The soil was described according to A. Ursu [5]. The average annual air temperature and the average amount of precipitation – according to the Atlas of Climatic Resources of the Republic of Moldova [6]. Geomorphological units – according to G. Sârodoev et E. Miţu [7]

3. Results and Discussion

The phytocoenoses dominated by *Carpinus betulus* L. (hornbeam) on the calcareous slopes of the Dniester-Prut interfluve, Republic of Moldova, are developed on shady slopes, with northern, north-western, north-eastern, western or eastern exposure, on carbonate-rich rendzina soils, on the sloping side or on levigated rendzina, formed on the flat side of the terraces. Rendzina soils lack the transition layer (*B*), the profile morphology being of the *AC* type (Figure 1). The carbonate-rich rendzinas reach a thickness of 25-40 cm, and the levigated ones reach a thickness of up to 40-60 cm, therefore, a predominance of mesophilic grass species has been observed on the flat side of the terraces. The habitat of these forests is very different from those formed in the hilly areas, where the soils have been formed on Neogene layers of clay, loam and sand. Thus, on the calcareous cliffs, in these hornbeam forests, species of calcicoles occur, such as *Asplenium trichomanes*, *A. scolopendrium*, *Cystopteris fragilis*, *Scrophularia vernalis*, *Hepatica nobilis*, *Melittis melissophylum* and *Carex alba*. Such species, as a rule, are absent in the hornbeam forests found on other substrates than limestone. The *Carpinus betulus* phytocoenoses in the researched area are bordered by those of *Quercus petraea* or *Quercus robur* with *Cornus mas*. The high degree of canopy cover (85-95 %) does not allow the compact development of the shrub layer, in these forests, shrub species occur rarely, their fruiting is reduced, and such species as *Staphyllea pinnata* and *Euonymus europaeus* occur more often because they are more resistant to shade. As a result of

the analysis of hornbeam associations in Central Europe [8-11], it has been found that hornbeam phytocoenoses in the researched area cannot be included in the associations described above, since they differ both ecologically and floristically, therefore, we propose to include them in a new association, described below.

Ass. *Asplenio trichomanis-Carpinetum betuli* Pînzaru, *ass. nova, h. l.*

Name-giving taxa: *Asplenium trichomanes* L., *Carpinus betulus* L.

Nomenclatural type h. l.: Table 1, rel. 7

Synthetic table h. l.: Table 1, 30 relevés

Locations: Altitude 50-250 m. Relief: Northern Moldavian Plateau, the Dniester Plateau, the southern slope of the Podolian Upland, limestone slopes with shaded terraces, it is missing on the southern slopes, the slope inclination varies between 15 and 35 $(50)^0$. Climate – temperate-continental, the average annual temperature is $9.0\text{-}9.5^0$C, the average annual precipitation varies between 550 and 650 mm. Rocks: limestone. Soil: carbonate-rich rendzina (typical), levigated rendzina.

Figure 1. Profile of the carbonate-rich rendzina (typical) soil type, in the hornbeam forest near Calaraşovca commune, Ocniţa district.

Characteristic species: *Carpinus betulus*, *Asplenium trichomanes*, *A. scolopendrium*, *Cystopteris fragilis*, *Hepatica nobilis*, *Scrophularia vernalis*, *Polypodium vulgare*.

Constant species: *Anemonoides ranunculoides*, *Corydalis solida*, *Scilla bifolia*, *Galanthus nivalis*, *Isopyrum thalictroides*, *Ranunculus auricomus*, *Ficaria verna*, *Asarum europaeum*, *Stellaria holostea*, *Carex pilosa*, *C. digitata*, *C. brevicollis*, *Convallaria majalis*, *Mercurialis perennis*, *Polygonatum hirtum*, *Campanula rapunculoides*, *Acer platanoides*, *Tilia cordata*.

Figure 2. Ass. *Asplenio trichomanis-Carpinetum betuli*, Calaraşovca commune, Ocniţa district (type).

Rare species: 31 species (13 – Red Book or R. Moldova, 18 – in the List of Rare Species of R. Moldova)

- Critically Endangered (CR), included in the Red Book of R. Moldova (2015) – *Maianthemum bifolium*, *Melittis melissophyllum*;
- Endangered (EN), included in the Red Book of R. Moldova (2015) – *Aconitum lasiostomum*, *Asplenium scolopendrium*, *Dryopteris carthusiana*, *Polystichum aculeatum*;
- Vulnerable (VU), included in the Red Book of R. Moldova (2015) – *Athyrium filix-femina*, *Cephalanthera damasonium*, *Dryopteris filix-mas*, *Fritillaria montana*, *Galanthus nivalis*, *Hepatica nobilis*, *Polypodium vulgare*;

Figure 3. Ass. *Asplenio trichomanis-Carpinetum betuli*, Rudi commune, Soroca district.

- Near threatened (NT), included in the List of Rare Species (1998) – *Actaea spicata*, *Asplenium trichomanes*, *Asparagus tenuifolius*, *Cystopteris fragilis*, *Epipactis atrorubens*, *E. helleborine*, *Lathyrus venetus*, *Lilium martagon*, *Listera ovata*, *Lonicera xylosteum*, *Neottia nidus-avis*, *Paris quadrifolia*, *Platanthera bifolia*, *Rhamnus tinctoria*, *Scrophularia vernalis*, *Sorbus torminalis*, *Staphylea pinnata*, *Vinca minor*.

Phytosociological composition. In 30 relevés, there are 138 species of vascular plants, most of the species belong to the coenotaxa of cl. QUERCO-FAGETEA Br.-Bl. et Vlieger in Vlieger 1937 (49 species), ord. *Fagetalia sylvaticae* Pawlowski 1928 (34 species), all. *Carpinion betuli* Issler 1931 (21 species), ord. *Quercetalia pubescenti-petraeae* Klika 1933 (16 species), cl. ALNO GLUTINOSAE-POPULETEA ALBAE P. Fukarek et Fabijaniæ 1968 (12 species), cl. ROBINIETEA (6 species). The number of species in a relevé varies between 41 and 72.

Structure: in the vertical structure of the phytocoenoses, two layers are better revealed, the shrub layer is observed very rarely:

(1) The upper layer (A) with the height of the trees about 10-15 (18) m and with the average canopy cover between 85 and 95%, is formed by *Carpinus betulus*

(abundance + dominance 3-5), tree diameter 20-35 (45) cm, accompanied by *Tilia cordata*, *Quercus petraea*, *Q. robur*, *Acer platanoides*, *A. campestre*, *Fraxinus excelsior*, rarely – by *Acer pseudoplatanus*, *Cerasus avium*, *Ulmus glabra*.

(2) The shrub layer (B) is poorly developed, with a cover of about 5-20 (35) %, or is missing, the shrubs *Staphylea pinnata* and *Euonymus europaeus* – shade-resistant species – occur more frequently.

The grass layer (C) is well developed throughout the growing season, the general cover usually varies between 50 and 90 %; on steep slopes, the general cover of grass is lower, up to 30 %. Many species grow in abundant clusters (3-5): *Corydalis solida*, *C. cava*, *Isopyrum thalictroides*, *Stellaria holostea*, *Ficaria verna*, *Carex pilosa*, *Convallaria majalis*, *Polygonatum hirtum*, *Mercurialis perennis*. The species *Asplenium trichomanes*, *Cystopteris fragilis*, *Scrophularia vernalis*, *Sedum maximum*, *Poa nemoralis*, and more rarely – *Asplenium scolopendrium* and *Polypodium vulgare* occur sporadically, in small groups, on limestone cliffs or large rocks. In the Republic of Moldova, *Hepatica nobilis* grows sporadically, only in cliff forests. In these forests, on moist soils near springs, along streams on hills, some rare mesohygrophilous species, characteristic of the vegetation from the floodplain forest alliance *Fraxino-Quercion roboris* Passarge 1968, occur in small groups: *Equisetum hyemale*, *Listera ovata*, *Paris quadrifolia*, *Impatiens parviflora*.

Figure 4. *Asplenium trichomanes* and *Cystopteris fragilis*, in the hornbeam forest, Calaraşovca commune, Ocniţa district.

Figure 5. *Asplenium scolopendrium* in the hornbeam forest, Rudi commune, Soroca district.

The range of life forms contains: hemicryptophytes (H) = 36.3%, geophytes (G) = 31.2%, nanophanerophytes (Phn) = 9.5%, megaphanerophytes (PhM) and therophytes (Th) by = 6.5%, mesophanerophytes (Phm) and biennial plants (TH) by = 4.3%, chamephytes (Ch) and woody lianas (Phl) by= 0.7%.

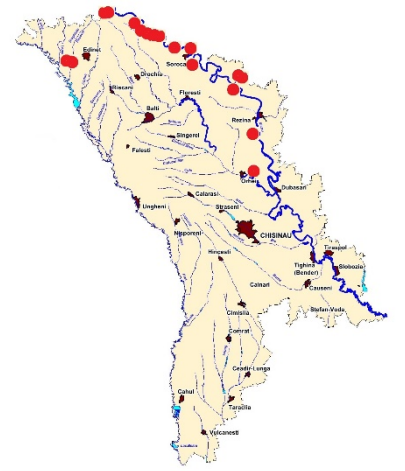

Figure 6. Locations of the ass. *Asplenio trichomanis-Carpinetum betuli* ass. nova in the Republic of Moldova.

Table 1. Ass. *Asplenio trichomanis-Carpinetum betuli* ass. nov.

Life form	Geo elements	Relevé no.	1	2	3	4	5	6	*7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	K
		Aspect	NE	NW	NE	E	E	N	N	E	NW	E	N	E	E	NW	N	E	N	N	NE	NE	N	NW	NW	N	NE	N	NE	NE	N	NW	
		Slope (^{0})	20	25	20	30	25	20	30	45	20	25	35	25	30	20	15	25	25	25	35	20	25	45	20	25	25	50	50	30	25	30	
		Tree layer coverage (%)	95	90	85	90	95	95	85	85	85	85	95	95	90	95	90	85	90	90	95	95	85	90	90	85	90	95	90	90	95	85	
		Shrub layer coverage (%)	10	5	35	5	5	10	35	30	20	35	30	10	20	-	-	30	10	15	10	5	15	10	8	35	10	5	5	15	35	35	
		Spring herbaceous layer coverage (%)	80	85	60	70	45	70	50	60	45	65	70	65	55	75	60	55	50	80	70	60	75	40	35	60	45	50	30	90	60	50	
		Summer herbaceous layer coverage (%)	90	95	80	80	60	80	90	80	80	90	75	85	60	80	70	75	65	75	60	75	80	55	70	90	55	35	30	50	65	60	
		Number of species	56	45	67	42	41	65	41	50	53	54	63	64	48	50	47	58	59	65	55	60	50	68	46	55	46	63	55	69	51	55	
		Plots no.	1	1	4	5	2	10	10	11	20	21	23	25	26	28	29	30	42	2	4	26	17	29	18	17	32	9	34	32	19	11	
		Characteristic species																															
PhM	Eur	*Carpinus betulus*	4	4	4	4	5	4	4	3	3	3	4	4	4	4	4	4	3	2	4	2	4	5	4	3	4	5	5	4	5	3	V
H	Cosm	*Asplenium trichomanes*	+	+	-	-	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+	1	+	+	+	+	+	+	+	+	+	+	IV
H	Eur	*Hepatica nobilis*	+	+	+	+	1	+	+	+	+	+	+	+	+	+	+	+	+	1	-	+	-	-	-	-	-	+	+	+	-	-	IV
G	Circ	*Asplenium scolopendrium*	r	r	-	-	r	-	-	r	r	r	+	r	-	-	-	r	-	r	-	+	r	+	-	-	-	-	-	-	r	r	III
H	Cosm	*Cystopteris fragilis*	-	-	-	-	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+	1	-	+	+	-	+	+	+	r	+	+	III
TH	Euc	*Scrophularia vernalis*	r	r	-	-	-	-	r	+	-	+	r	+	-	-	-	+	r	+	r	-	-	-	r	-	-	-	-	-	r	-	III
G	Circ	*Polypodium vulgare*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	+	+	-	-	I
		Facies																															
Ch	Euc-M	*Vinca minor*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3	-	-	-	-	-	1	-	-	-	-	I

		Carpinion betuli																														
G	Eur	*Anemonoides ranunculoides*	1	1	+	1	1	1	+	1	+	+	+	+	+	+	+	+	+	+	1	1	1	+	1	+	+	+	+	+	1	2	V
H	Eua	*Asarum europaeum*	+	1	+	+	1	1	1	-	1	+	1	+	+	+	+	+	+	1	1	+	1	+	+	+	+	+	-	+	1	1	V
G	Euc-M	*Carex brevicollis*	-	1	+	1	-	-	+	+	1	+	+	+	1	+	+	+	+	1	1	-	1	+	+	1	+	+	-	-	1	1	V
G	Eur	*Corydalis solida*	3	2	2	3	2	3	2	2	1	2	1	2	2	2	1	2	2	2	3	2	3	2	2	2	2	2	1	2	2	2	V
H	Eua	*Ranunculus auricomus*	+	+	+	+	+	+	+	-	+	r	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	+	V
H	Eua	*Stellaria holostea*	2	3	2	2	2	2	2	1	2	-	3	2	2	2	1	2	2	-	2	1	1	1	2	2	1	1	1	2	1	2	V
G	Eur	*Galanthus nivalis*	+	1	+	-	-	1	+	-	+	+	+	+	-	-	1	-	-	+	+	1	-	+	+	+	-	+	-	+	1	1	IV
G	Euc	*Isopyrum thalictroides*	2	1	1	+	1	1	-	-	-	1	1	2	-	2	1	-	-	-	1	1	-	1	1	-	-	1	+	2	1	-	IV
PhM	Eur	*Tilia cordata*	+	+	+	+	-	+	1	+	+	-	+	+	+	+	+	+	r	+	-	+	-	+	-	+	r	r	-	r	r	2	IV
G	Eur	*Corydalis cava*	-	2	-	-	-	2	-	-	-	+	1	2	2	1	2	-	-	-	1	1	1	-	-	-	1	1	+	1	-	-	III
H	Euc	*Galium intermedium*	+	-	3	2	-	+	-	-	-	+	-	+	+	+	+	1	+	-	-	+	-	+	-	+	-	+	+	+	-	-	III
G	P-M	*Lathyrus venetus*	-	-	1	-	-	-	-	-	-	+	+	+	+	+	+	-	-	-	-	-	-	+	-	-	-	-	-	+	-	-	II
Th	Euc-P	*Omphalodes scorpioides*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	I
		Fagetalia sylvaticae																															
H	Eua	*Carex digitata*	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+	+	-	+	V
G	Eur	*Mercurialis perennis*	1	1	+	1	1	1	1	+	1	-	1	+	-	2	+	1	+	-	2	1	2	+	+	1	+	1	+	1	-	2	V
H	Eur	*Pulmonaria officinalis*	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	r	+	+	+	-	+	r	+	r	r	+	+	V
H	Eua	*Viola mirabilis*	+	+	+	-	+	+	-	+	+	+	+	+	+	+	+	+	r	+	+	+	+	+	+	+	+	+	+	-	-	+	+	V
G	Euc	*Carex pilosa*	2	-	2	2	-	2	3	4	2	2	+	+	3	2	3	1	2	1	2	1	1	+	1	2	1	-	-	-	-	2	IV
G	Eur	*Ficaria verna*	2	2	2	-	-	2	-	2	-	1	2	1	1	1	1	-	1	-	2	1	1	+	-	-	1	-	-	1	1	2	IV
G	Eua	*Gagea lutea*	+	+	-	+	-	+	-	+	+	+	+	-	+	-	+	+	+	+	+	+	+	-	-	+	+	+	-	+	-	+	IV
Phl	Med	*Hedera helix*	2	2	-	1	+	-	-	-	1	2	1	-	-	+	+	1	2	-	1	+	+	+	+	1	+	+	+	+	1	1	IV
G	Eua	*Lathyrus vernus*	+	-	+	+	+	+	+	-	+	+	-	-	-	+	-	+	+	+	+	+	-	+	-	+	-	+	+	+	+	-	IV

PhM	Eur	*Quercus petraea*	1	+	+	1	r	+	-	-	3	-	+	1	-	1	1	1	2	-	-	+	-	r	+	1	1	+	-	1	-	-	IV
G	Circ	*Adoxa moschatellina*	-	1	-	-	2	1	-	1	-	-	1	1	1	1	-	-	1	-	1	-	-	1	-	1	1	1	1	1	-	1	III
TH	Eur	*Chaerophyllum temulum*	r	-	+	-	-	r	-	-	-	-	+	-	-	r	+	+	-	r	-	-	r	-	-	r	-	r	-	r	-	r	III
G	Sm	*Euphorbia amygdaloides*	-	-	r	-	-	r	-	-	+	r	r	r	r	r	-	r	r	+	r	r	-	-	-	r	r	r	r	-	-	-	III
Th	Cosm	*Geranium robertianum*	r	-	r	-	r	+	-	+	+	-	-	r	-	-	-	-	+	+	r	+	r	-	r	-	-	+	+	r	r	r	III
H	Eua	*Lamium maculatum*	-	-	-	-	-	+	-	+	1	+	1	+	-	-	+	-	+	+	+	-	-	-	+	-	-	+	+	+	+	-	III
H	Eur	*Viola reichenbachiana*	+	r	+	-	r	-	-	-	+	+	r	-	-	+	-	+	r	r	-	-	r	+	-	+	r	-	-	+	-	r	III
PhM	Euc	*Acer pseudoplatanus*	-	-	r	-	-	-	r	+	-	-	+	r	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	r	-	-	II
G	Eua	*Galium odoratum*	-	-	-	-	-	2	1	-	1	-	+	1	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	2	-	II
G	Eur	*Cardamine bulbifera*	1	1	2	-	-	-	-	-	1	-	-	1	-	1	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	-	II
H	EurE	*Aconitum lasiostomum*	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	r	-	I
G	Eua	*Actaea spicata*	-	-	-	-	-	-	r	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Eur	*Ajuga reptans*	-	-	-	-	-	-	-	-	-	-	-	r	r	-	r	-	r	-	r	-	-	-	-	r	-	r	-	-	-	-	II
G	Eur	*Allium ursinum*	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Cosm	*Athyrium filix-femina*	-	-	-	-	-	r	-	-	-	-	-	-	-	r	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Eua	*Campanula trachelium*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	r	r	-	r	-	I
TH	Eua	*Cardamine impatiens*	-	-	r	-	-	-	-	-	r	-	-	-	-	-	-	r	-	-	-		-	r	-	-	-	-	r	-	-	-	I
Th	Eua	*Galeopsis speciosa*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
G	Eua	*Lathraea squamaria*	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	r	-	-	-	-	-	-	-	-	-	-	+	-	-	I
G	Eua	*Maianthemum bifolium*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
G	Eua	*Neottia nidus-avis*	-	-	r	-	-	r	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	I
G	Eua	*Platanthera bifolia*	-	-	-	-	-	r	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Eua	*Polystichum aculeatum*	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Eua	*Salvia glutinosa*	-	-	-	-	-	+	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Eua	*Stachys sylvatica*	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I

		Quercetalia pubes.-petraeae																															
Phn	Sm	*Euonymus verrucosus*	+	r	+	+	r	+	r	+	+	+	+	-	+	-	-	r	r	+	+	-	r	r	+	r	r	-	+	+	+	1	IV
H	Circ	*Poa nemoralis*	-	-	2	1	2	1	1	+	-	-	-	-	+	-	-	+	+	-	+	-	-	+	+	+	-	+	+	+	+	+	IV
Phn	Sm	*Viburnum lantana*	r	-	+	+	r	-	r	+	+	+	+	+	+	-	r	r	r	+	+	+	+	r	+	+	+	-	-	+	1	+	IV
Phn	P-M	*Cornus mas*	-	+	+	-	r	-	+	-	+	+	-	-	+	-	-	r	-	r	-	r	-	r	+	+	-	r	r	r	-	+	III
TH	Med	*Arabis turrita*	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	r	-	-	+	+	-	r	+	+	+	-	r	II
G	P-M	*Asparagus tenuifolius*	-	-	r	-	-	r	-	r	-	-	-	-	r	-	-	r	-	r	-	r	-	-	-	r	r	-	r	r	-	r	II
H	Eur	*Campanula persicifolia*	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	r	-	-	-	-	r	+	r	-	r	r	-	r	r	II
H	Eua	*Vincetoxicum hirundinaria*	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	r	-	r	-	+	r	-	-	r	r	+	r	-	-	II
Phn	P-M	*Cotinus coggygria*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	I
G	Euc	*Lathyrus niger*	-	-	r	-	-	-	-	-	-	-	-	-	-	r	-	-	r	-	-	r	-	r	r	-	-	-	-	-	-	-	I
H	P-Euc	*Piptatherum virescens*	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
Phn	Euc-M	*Rhamnus tinctoria*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	r	r	r	-	-	I
H	Eua	*Silene nutans*	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
Phm	Euc	*Sorbus torminalis*	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	I
H	Eua	*Tanacetum corymbosum*	-	-		r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	I
G	EurE	*Tulipa biebesteiniana var. biebersteiniana*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	I
H	P-B	*Viola sieheana*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	I
		Querco-Fagetea																															
PhM	Eur	*Acer platanoides*	+	r	r	+	r	1	+	1	+	+	1	+	+	+	+	+	r	1	+	+	-	r	+	r	r	r	-	+	+	+	V
H	Eua	*Campanula rapunculoides*	+	-	+	+	-	-	-	+	+	+	+	+	-	+	+	+	+	+	1	+	+	+	+	+	+	+	+	+	+	+	V

G	Eua	*Convallaria majalis*	2	2	1	2	2	2	1	+	2	2	2	1	1	2	1	2	2	1	2	1	2	+	2	2	2	1	+	2	1	1	V
G	P-P-B	*Polygonatum hirtum*	1	-	1	1	-	1	1	1	2	+	2	1	1	+	1	-	1	1	1	1	1	+	+	1	+	1	+	1	1	1	V
G	EurS	*Scilla bifolia*	+	+	+	+	+	1	+	1	+	+	+	+	+	+	+	+	+	+	+	+	1	+	+	+	+	1	+	+	1	+	V
H	Circ	*Geum urbanum*	+	+	+	-	+	-	-	-	+	+	+	-	+	-	+	+	+	+	+	-	+	+	+	+	+	+	-	+	+	+	IV
H	P-M	*Glechoma hirsuta*	-	-	1	1	-	-	-	+	1	1	+	+	+	+	-	1	-	+	+	+	+	1	+	1	+	+	+	1	+	+	IV
H	Euc	*Lamium galeobdolon*	1	1	-	+	1	1	1	-	+	-	+	+	1	+	+	-	-	+	1	1	1	+	-	+	1	+	-	1	-	+	IV
G	Eua	*Lilium martagon*	r	r	r	-	r	r	-	-	-	-	r	-	r	-	-	-	r	r	-	r	r	r	r	r	r	r	r	r	r	r	IV
G	Eua	*Polygonatum multiflorum*	+	-	+	+	-	-	-	+	1	-	-	+	+	+	+	+	+	+	-	+	1	+	-	-	-	+	+	+	+	1	IV
PhM	Eur	*Quercus robur*	r	1	+	+	-	-	+	+	-	2	+	+	1	-	-	+	-	3	1	3	1	+	1	1	+	r	+	+	r	+	IV
H	P-M	*Scutellaria altissima*	+	+	1	+	+	-	-	+	1	+	-	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	IV
Phn	Euc	*Staphylea pinnata*	+	+	+	+	-	1	1	2	-	-	+	+	+	-	-	1	+	+	1	+	+	+	-	2	+	-	-	-	2	2	IV
Phm	Eur	*Acer campestre*	+	+	+	r	-	-	-	+	+	+	1	-	-	-	-	+	r	-	+	+	+	+	+	+	+	-	-	-	-	-	III
Phn	Euc	*Cornus sanguinea*	+	-	-	r	+	-	+	1	+	-	+	-	-	-	-	r	+	-	r	+	-	-	-	+	r	-	-	-	+	1	III
Phn	Eur	*Corylus avellana*	+	r	+	-	+	-	+	+	+	-	r	-	-	-	-	r	-	-	+	r	+	r	1	-	-	r	r	r	-	1	III
PhM	Eur	*Fraxinus excelsior*	+	-	-	-	-	-	r	1	-	+	1	+	+	-	+	-	-	1	-	+	-	-	-	r	r	-	-	-	-	+	III
H	Eua	*Viola suavis*	+	+	-	-	-	+	-	-	-	+	+	-	-	-	-	1	-	+	-	-	+	-	-	-	+	-	+	+	1	1	III
H	Eur	*Sedum maximum*	-	-	r	-	r	-	r	r	r	-	r	-	r	-	-	-	-	-	r	-	-	-	r	-	-	r	r	-	r	r	III
PhM	Eur	*Cerasus avium*	-	-	-	-	-	r	-	-	r	-	r	-	-	r	-	r	r	r	r	+	-	r	r	-	-	-	-	r	-	-	II
Phn	Eua	*Crataegus monogyna*	+	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	r	-	+	+	-	+	+	+	-	-	-	1	-	II
H	Eua	*Dactylis glomerata*	+	-	+	+	-	+	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	+	-	-	-	+	+	+	-	-	II
G	Eua	*Epipactis helleborine*	-	-	-	-	-	r	-	-	-	-	-	-	-	-	r	-	-	r	-		-	r	-	-	-	-	r	-	r	r	II
Phn	Eur	*Euonymus europaeus*		+	-	-	-	-	+	+	-	+	r	-	-	-	-	-	r	+	-	r	-	-	-	-	-	-	-	-	r	-	II
Phn	Eua	*Lonicera xylosteum*	r	r	r	r	r	-	-	-	r	+	-	+	-	-	-	r	r	r	-	-	-	-	-	-	-	-	r	r	-	-	II
H	Sm	*Melica uniflora*	-	-	+	+	-	+	-	+	-	-	-	-	+	+	+	-	-	-	+	1	+	-	-	+	-	-	-	+	+	+	II
Phn	Eua	*Acer tataricum*	-	-	-	-	-	-	-	-	-		+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	I
G	P-P-B	*Arum orientale*	-	-	-	-	-	-	r	-	-	r	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	I

H	Eua	*Brachypodium sylvaticum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	r	-	-	I
G	Circ	*Carex alba*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	I
H	Circ	*Carex contigua*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	r	-	-	I
G	Eur	*Cephalanthera damasonium*	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	r	-	-	-	I
H	Eur	*Clematis recta*	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	r		-	-	-	-	-	r	-	-	r	-	-	-	I
H	Eua	*Cruciata glabra*	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Circ	*Dryopteris carthusiana*	-	-	-	-	-	r	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Eua	*Dryopteris filix-mas*	-	-	-	-	-	r	-	-	-	-	r	r	-	r	-	-	-	r	-	-	r	-	-	-	-	-	-	-	r	I
G	Eua	*Epipactis atrorubens*	-	-	r	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
G	P-M	*Fritillaria montana*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	l	-	-	-	-	-	-	+	+	l	-	-	I
H	Eua	*Hypericum hirsutum*	-	-	r	-	r	-	-	-	-	-	-	r	-	-	+	-	-	r	-	+	-	-	-	-	-	-	-	-	r	I
H	Eur	*Lactuca muralis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	r	-	r	-	-	-	I
Th	Eua	*Lapsana communis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	r	-	-	-	+	-	-	-	-	-	-	r	-	I
Phm	Eur	*Malus sylvestris*	-	-	-	-	-	-	-	r	r	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	I
H	Sm	*Melittis melissophyllum*	-	-	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
TH	Eua	*Moerhingia trinervia*	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	r	-	-	r	r	-	-	-	-	-	-	-	I
Phm	Eur	*Pyrus pyraster*	-	-	r	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Eua	*Scrophularia nodosa*	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	r	r	-	-	-	-	r	-	-	-	-	r	-	-	I
Phm	Eua	*Ulmus glabra*	+	-	-	-	-	r	-	+	-	r	-	r	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	I
Phm	Eua	*Ulmus minor*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Med	*Viola odorata*	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	+	-	-	-	+	-	+	-	-	I
		Fraxino-Quercion roboris																														
H	Eua	*Aegopodium podagraria*	1	+	+	+	-	1	+	1	-	1	1	-	-	1	-	1	+	1	+	1	1	+	-	1	1	-	-	1	1	2	IV
G	Eua	*Gagea minima*	-	-	-	-	-	+	-	-	l	+	1	-	-	-	+	-	-	l	+	+	+	-	-	+	-	+	-	+	-	-	II

Phn	Eur	*Sambucus nigra*	+	-	+	-	-	-	-	+	-	-	+	+	-	-	-	-	-	1	-	+	-	-	-	-	-	-	-	-	-	II
G	Cosm	*Equisetum arvense*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
G	Cric	*Equisetum hyemale*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
Th	Adv	*Impatiens parviflora*	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
G	Eua	*Listera ovata*	-	-	-	-	-	r	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
H	Circ	*Milium effusum*	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	I
Th	Med	*Parietaria officinalis*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	I
G	Eua	*Paris quadrifolia*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	r	-	-	-	-		-	-	-	-	-	-	-	-	-	-	I
Th	Cosm	*Stellaria media*	-	-	-	-	-	-	-	-	-	-	r	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I
		Robinietea																														
TH	Eua	*Alliaria petiolata*	r	+	-	+	+	r	-	-	-	+	+	+	+	+	+	+	+	r	+	+	+	+	-	-	+	+	+	+	-	-	IV
H	Eua	*Chelidonium majus*	-	-	+	-	+	+	+	r	+	+	+	+	+	+	-	+	+	+	-	-	+	+	-	-	+	+	+	+	+	+	IV
Th	Circ	*Galium aparine*	-	-	+	-	-	+	-	-	1	+	-	+	+	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	II
Th	Eua	*Veronica hederifolia*	-	-	-	+	+	-	-	-	-	+	+	+	-	-	-	+	-	+	+	-	-	-	+	-		+	+	+	-	-	II
Th	Circ	*Fallopia convolvulus*	-	-	-	-	-	-	-	-	-	-	-	-	+	-	r	-	-	-	-	-	-	-	-	-	-	r	r	r	r	-	I
PhM	Adv	*Robinia pseudacacia*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I

Place and date of the relés: 1-2, ”Stânca”, Naslavcea commune, Ocnița district, 04.IV.1989, 04.VII.1996, 24.VI.2014; 3-4, ”La 33 de vaduri”, Naslavcea commune, Ocnița district, 04.IV.1989, 23.VI.2015; 5, Verejeni village, Ocnița district, 05.IV.1989, 25.VI.2015; 6, *7,8, Calarașovca commune, Ocnița district, 03.V.1987, 11.VIII.1987, 26.VI.2015; 9-10, Arionești commune, Dondușeni district, 12.VIII.1987, 09.IV.1992, 26.V.2015; 11-13, Rudi commune, Soroca district, 10.IV.1992, 20.V.1993; 14.VI.2015; 14-15, Tătărăuca Veche commune, Soroca district, 04.VI.1991, 15.V.1993; 16-17, Balinții Noi village, Soroca district, 12.IV.1992, 14.VIII.2015; 18, Holoșnița commune, Soroca district, 06.V.1987, 08.VIII.1987, 30.VII.2014; 19, Cosăuți commune, Soroca district, 04.V.1987, 05.VIII.1987, 15.VI.2015; 20, Trifăuți commune, Soroca district, 07.V.1987, 26.VII,1987, 15.VIII.2015; 21, Poiana commune, Șoldănești district, 08.IV.1988, 16.VIII.1988, 19.VI.2009; 22-24, Saharna village, Rezina district, 11.IV.1997, 19.IV.1996, 19.V.2009; 25, Trebujeni commune, Orhei district, 08.V.1988, 11.VI.2015; 26, Fetești commune, Edineț district, 27.VII.1993, 18.IV.1994; 27-28, Gordinești commune, Edineț district, 25.VII.1993, 15.IV.1994; 29, ”Glubocaia dolina”, Rașcov commune,Camenca district, 10.IV.1987, 11.VII.1997, 10.VI.1997; 30, ”Bugornea”, Rașcov commune, Camenca district, 11.IV.1987, 13.VII.1987, 07.V.2017.

The following geoelements predominate: Eurasian (Eua) = 36.9%, European (Eur) = 20.2%, circumpolar (Circ) = 8.6%, South-Eastern European (Euc) = 7.0%, cosmopolitan (Cosm) and Pontic-Mediterranean (P-Med) by = 4.3%, the other geoelements are few in number, about 1-5 species.

Range (Fig. 6). The plant communities of the *Asplenio trichomanis-Carpinetum betuli* association occur on limestone slopes in the districts: Edineţ (near Feteşti and Gordineşti communes), Ocniţa (Naslavcea, Verejeni, Calaraşovca), Donduşeni (Arioneşti), Soroca (Rudi, Tătărăuca Veche, Balinţii Noi, Holoşniţa, Cosăuţi, Trifăuţi), Şoldăneşti (Poiana), Rezina (Saharna), Orhei (Trebujeni), Camenca (Raşcov).

Territorial protection. The phytocoenoses of this association are protected in the Orhei National Park, in the landscape reserves "La 33 de Vaduri", "Calaraşovca", "Rudi-Arioneşti", "Holoşniţa", "Cosăuţi", "Poiana-Curătura", "Saharna", "Feteşti", "La Castel", "Bugornea", "Glubocaia Dolina", in the natural monuments "Tectonic Fault near Naslavcea" and "The Steep Bank of the Dniester River between Naslavcea and Lencăuţi"

4. Conclusions

The association *Asplenio trichomanis-Carpinetum betuli* Pînzaru *ass. nova* presents Southeastern European phytocoenoses of calcicoles, xeromesophytes, formed on carbonate-rich or levigated rendzina soils on shady slopes.

In the floristic composition of phytocoenoses, 138 species of vascular plants have been identified, including 31 rare species, protected by the state, 13 of them are included in the Red Book of the Republic of Moldova (2015). The phytocoenoses of this association are included in the network of protected areas of the Republic of Moldova.

In the spectrum of life forms, species of hemicryptophytes (36.3 %) and geophytes (31.2 %) predominate, and among the geoelements, there are more Eurasian (36.9 %) and European ones (20.2 %), followed by circumpolar (8.6 %) and Central European (7.0 %) geoelements.

The association *Asplenio trichomanis-Carpinetum betuli* Pînzaru has been included in the alliance *Carpinion betuli* Issler 1931, ord. *Fagetalia sylvaticae* Pawlowski 1928, cl. QUERCO-FAGETEA Br.-Bl. et Vlieger in Vlieger 1937.

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