SYNTAXONOMY AND ECOLOGY OF *PETASITES ALBUS*,
P. HYBRIDUS AND *P. KABLIKIANUS* PHYTOCOENOSES
IN BULGARIA AND ROMANIA

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Received on February 4, 2021

Presented by V. Golemansky, Member of BAS, on September 29, 2021

Abstract

In this study the phytocoenoses of *Petasites albus*, *P. hybridus* and *P. kablikianus* were investigated on the territory of Bulgaria and Romania. Numerical classification and ordination were performed by PC-ORD and JUICE software packages. Diagnostic species were determined by calculating the Phi-coefficient. Three associations of the *Petasisition officinalis* alliance were recognized – *Petasisitetum albae* Dihoru ex Nazarov et al. 2022, *Petasisitetum hybrido-kablikiani* Sillinger 1933, and *Telekio-Petasisitetum hybridi* Morariu ex Resmeriță et Rațiu 1974.

Key words: wetlands, *Mulgedio-Aconitetea*, vegetation classification, Balkan Peninsula

Introduction. Plant communities with *Petasites* spp. are widespread mainly along rivers from lowlands to subalpine belt. Typically, they are dominated by hygrophytes. These phytocoenoses consist of tall-herb plants often reaching up to 2 m in height. Such communities usually occupy narrow strips of 2–3 m along

This investigation was carried out with the financial help of the National Scientific Programme “Young scientists and Postdoctoral students”, contract No 22-0078/ 22.04.2019 and the Bulgarian National Science Fund (Contract DKOCT 01/7/19.10.2018 and Project No KP-06-N31/12).

DOI:10.7546/CRABS.2022.01.06

running waters or wet shores [1]. Since *Petasites* dominated phytocoenoses are characterized by great variability, in time, they have been subjected to different classes – *Betulo-Adenostyletea* [2,3], *Galio-Urticetea* [4,5], *Epilobietea angustifolii* [6], or *Mulgedio-Aconitetea* [7].

The aim of this study is an investigation of syntaxonomical and ecological diversity of the phytocoenoses of *Petasites albus* (L.) Gaertn., *P. hybridus* (L.) Gaertn. et al. and *P. kablikianus* Berch on the territory of Bulgaria and Romania.

Materials and methods. The research area is located in two countries in the southeastern part of Europe: Bulgaria and Romania (Fig. 1). The largest proportion of the studied territory is situated just to the north of the Balkan Peninsula, but the peninsula itself is also included. The investigated areas include the Carpathian Mountains, the Balkan Range, Rila, Pirin, the Rhodopes and Vlahina Mountain. It falls mostly within the temperate climate zone, with a strong Mediterranean influence to the south.

During 2018–2020 from the territory of Bulgaria 16 vegetation plots (relevés) were collected in phytocoenoses of the 3 studied *Petasites* species following the Braun-Blanquet approach. On the other hand, the Romanian Grassland database was the source for 287 relevés in which at least one of the 3 *Petasites* species has a cover > 10%. Data from Bulgaria and Romania was exported and merged in

Fig. 1. Map of the study area and distribution of *Petasites* associations

JUICE 7.0 software [8]. The numerical classification was performed by PC-ORD program [9]. Relative Sorensen distance and Ward's algorithm were used to perform the hierarchical clustering. The species values were square-root transformed.

The diagnostic species were determined by calculating the Phi-coefficient [10]. All clusters were standardized to equal size and only the statistically significant Phi-coefficient values evaluated by Fisher's exact test ($P < 0.05$) were considered. The threshold value for a species to be considered diagnostic was set at Phi-coefficient ≥ 0.3 . Species with Phi-coefficient ≥ 0.5 were considered highly diagnostic. The relevant literature sources were also considered in order to explain the diagnostic role of the species. Species with coverage above 50% at least in 20% of the relevés in any cluster were considered dominants, whereas constant species were those having at least 50% presence in a cluster.

Detrended Correspondence Analysis (DCA) incorporated in CANOCO ver. 4.5 [11] was applied as an indirect ordination technique in order to reveal the major environmental gradients affecting the vegetation. Square-root transformation and down-weighting of the rare species were applied. The habitats' ecological conditions were assessed using the "Ellenberg Indicator Values" [12] and projected onto the ordination space.

The nomenclature of vascular plants followed [13] and subsequently standardized according to the Euro+Med PlantBase (2006–2020). The nomenclature of the high rank syntaxa was harmonized with [7]. All taxa determined below species level were aggregated.

Results. The three types of vegetation communities inhabit ecologically similar conditions (Fig. 2). The first axis (eigenvalue = 0.425, gradient length: 4.166) in the diagram can be related to the humidity level of the communities. Hydrological conditions are changing periodically during the vegetative period, as far as the associations of *Petasitetum albae* and *Petasitetum hybrido-kablikani* are concerned. On the contrary, these conditions are the same or slightly change

Fig. 2. Ordination diagram of the analyzed data set along the first two DCA axes

for the association of *Telekio-Petasitetum hybridi*. The variability expressed by the second axis (eigenvalue = 0.325, gradient length: 3.588) may be associated with the gradient of continentality. The total inertia of analysed data set is 16.180. The communities of the associations of *Petasitetum hybrido-kablikani* and *Telekio-Petasitetum hybridi* are typical for shady habitats. Heterogeneity is weaker in vegetation plots where denuded rocks appear. The communities of *Petasitetum albae* occur in habitats with significant fluctuations in temperature due to their open structure, heterogeneity and remoteness from the river bed.

The clusters obtained were recognized and interpreted as follows:

Cl. *Mulgedio-Aconitetea* Hadač et Klika in Klika et Hadač 1944

Ord. *Petasito-Chaerophylletalia* Morariu 1967

All. *Petasition officinalis* Sillinger 1933

Ass. *Petasitetum albae* Dihoru ex Nazarov et al. 2022

Ass. *Petasitetum hybrido-kablikani* Sillinger 1933

Ass. *Telekio-Petasitetum hybridi* Morariu ex Resmeriță et Rațiu 1974

Ass. *Petasitetum albae* Dihoru ex Nazarov et al. 2022 (Fig. 1, 2;

Table 1 – cluster 1)

Syn.: *Petasitetum albae* Dihoru 1975 nom. prov. (Art. 3b), As. *Telekia speciosa* – *Petasites albus* Beldie 1967 (Art. 10), *Telekio* – *Petasitetum hybridi* Morariu ex Resmeriță 1974 *Petasitetosum albae* (Beldie 1967) Coldea 1991 (Art. 27d).

Nomenclatural type: Sanda, Popescu et Doltu, 1977, Table 13, rel. 1, neotypus hoc loco.

Constant species: *Stellaria nemorum* (66%), *Ranunculus repens* (62%), *Telekia speciosa* (52%), *Chaerophyllum hirsutum* (52%).

Dominant species: *Petasites albus*.

Distribution and ecology: This plant community type occurs mainly in shady habitats, in the sub-montane and montane belts, from 500–600 to 1600–1700 m a.s.l., along river banks, low lying forest combs, as well as in flatland areas with high groundwater. It is found on flat or slightly inclined terrains with varying aspects. Soils are shallow to moderately deep (generally skeletal, colluvial and humus-rich soils). Stands are also characterized by high air and soil humidity. The bedrock type is predominantly silicate.

On the territory of Romania this vegetation is established sporadically in the Southern (Piatra Craiului, Siriu Massif, Vrancea Mountains) and Eastern Carpathians (Maramureș Mountains). In Bulgaria this vegetation type is found in Rila Mountain, Western Balkan Range, West Rhodope Mountains and Vlahina Mountain.

Synmorphology: A moderately species-poor community with closed horizontal structure and strongly dominated by *Petasites albus*, which has a cover between 60–100%. The herb layer is well-developed with a cover of 90–100%. Other frequent herb species with a cover between 10–25% are *Telekia speciosa*, *Ae-*

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Shortened synoptic table of *Petasites albus*, *P. kablikianus* and *P. hybridus* communities in Romania and Bulgaria

Life forms	Floristic elements	Number of relèves	29		21		251	
		Species	Phi	% Fre- quency	Phi	% Fre- quency	Phi	% Fre- quency
Diagnostic species for ass. <i>Petasitetum albi</i>								
H	Eur-Pont	<i>Petasites albus</i>	84.1	100	—	14	—	10
Diagnostic species for ass. <i>Petasitetum hybridus-kablikianus</i>								
H	Carp-Bal	<i>Petasites kablikianus</i>	—	0	99.7	100	—	1
Diagnostic species for ass. <i>Telekio-Petasitetum hybridus</i>								
H	Eur	<i>Petasites hybridus</i>	—	7	—	43	70.5	100
T	Eur-As	<i>Galium aparine</i>	—	10	—	0	30	26
H	subMed	<i>Telekia speciosa</i>	—	52	—	14	38.5	74
H	Pont-Sib	<i>Cirsium oleraceum</i>	—	17	—	38	15	43
H	Eur-Med	<i>Chaerophyllum aromaticum</i>	—	3	—	0	27.3	16
Diagnostic species for all. <i>Patasition officinale</i>								
H	subBoreal	<i>Calamagrostis arundinacea</i>	—	3	30.5	24	—	4
T	Eur-As	<i>Impatiens noli-tangere</i>	—	48	27	71	—	37
H	Boreal	<i>Urtica dioica</i> agg.	—	45	—	62	—	62
H	subBoreal	<i>Chrysosplenium alternifolium</i>	20.1	34	—	24	—	10
H	subBoreal	<i>Filipendula ulmaria</i> agg.	—	28	—	48	—	30
H	Eur-Med	<i>Doronicum austriacum</i>	5.4	24	21.4	33	—	6
B-H	Eur-Sib	<i>Angelica sylvestris</i> agg.	—	24	—	0	—	13
H	Boreal	<i>Dryopteris filix-mas</i>	14.5	24	—	19	—	6
H	Boreal	<i>Poa trivialis</i> agg.	—	21	—	24	—	9
H	Boreal	<i>Circaea lutetiana</i>	—	14	—	14	—	16
H	Eur-Sib	<i>Aegopodium podagraria</i>	—	7	—	33	—	29
H	Boreal	<i>Elymus caninus</i> agg.	—	3	24.5	19	—	5
H	Eur-Sib	<i>Hypericum hirsutum</i>	—	3	—	0	—	1
H	Eur-As	<i>Stellaria aquatica</i>	—	3	—	0	—	10
H	Eur-As	<i>Brachypodium sylvaticum</i>	—	3	—	5	19.4	15
H	Eur-Med	<i>Rumex sanguineus</i>	—	3	—	0	—	2
H	Eur	<i>Primula elatior</i>	—	0	24.6	10	—	1
B-H	Eur	<i>Anthriscus nitidus</i>	—	0	25.6	10	—	0
Diagnostic species for all. <i>Adenostylion alliariae</i>								
H	Eur	<i>Carduus personata</i> agg.	—	28	41.7	71	—	28
H	Eur	<i>Geranium phaeum</i>	—	7	—	19	—	16
H	Eur-Med	<i>Valeriana sambucifolia</i>	—	0	34	19	—	2
H	Eur-As	<i>Thalictrum aquilegifolium</i>	—	3	20.3	14	—	3
H	Boreal	<i>Viola biflora</i>	—	3	18.1	10	—	0
H	Boreal	<i>Athyrium distentifolium</i>	—	7	—	0	—	1
H	Eur	<i>Ranunculus platanifolius</i>	21.7	7	—	0	—	0
H	Eur	<i>Aconitum plicatum</i>	—	0	—	0	—	1
H	Eur-Med	<i>Delphinium elatum</i> subsp. <i>elatum</i>	—	0	—	0	—	1
H	Alp-Carp-Bal	<i>Adenostyles alliariae</i>	—	0	—	0	—	1

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Life forms	Floristic elements	Number of reléves	29		21		251	
		Species	Phi	% Fre- quency	Phi	% Fre- quency	Phi	% Fre- quency
Diagnostic species for cl. <i>Mulgedio-Aconitetea</i>								
H	Eur-Pont	<i>Leucanthemum rotundifolium</i>	—	10	60.5	67	—	8
H	Eur-As	<i>Silene dioica</i>	—	0	44.8	33	—	4
H	Boreal	<i>Geranium sylvaticum</i>	—	0	41.5	24	—	0
B-H	Eur-Pont	<i>Aconitum moldavicum</i> agg.	—	0	40.8	29	—	4
H	Boreal	<i>Senecio nemorensis</i> agg.	—	0	39.3	33	—	9
H	Alp-Carp-Bal	<i>Achillea distans</i> agg.	—	7	38.6	38	—	7
H	subBoreal	<i>Milium effusum</i>	—	0	38	33	—	10
H	subBoreal	<i>Geum rivale</i>	—	10	37.8	43	—	10
H	Alp-Carp-Bal	<i>Poa chaixii</i>	—	0	34.7	19	—	1
H	Alp-Carp-Bal	<i>Rumex alpinus</i>	—	21	22.7	33	—	7
H	Boreal	<i>Hypericum maculatum</i> agg.	—	14	—	14	—	12
H	Eur	<i>Cirsium waldsteinii</i>	—	0	—	14	—	7
H	Alp-Med	<i>Tozzia alpina</i>	—	0	29.2	14	—	1
Ch	subBoreal	<i>Rubus idaeus</i>	—	10	—	10	—	17
H	subBoreal	<i>Rumex arifolius</i>	—	0	—	10	—	5
H	Eur-Med	<i>Cicerbita alpina</i>	24.3	24	—	10	—	4
H	Eur-As	<i>Heracleum sphondylium</i> agg.	—	24	—	5	—	19
Ch	Eur-As	<i>Rubus caesius</i>	—	0	—	0	24.5	9
H	Eur-Med	<i>Cirsium erisithales</i>	—	10	—	0	—	7
H	Eur-Bal	<i>Senecio hercynicus</i>	—	0	—	0	—	4
H	Eur-As	<i>Veratrum album</i>	23	10	—	0	—	2
H	subMed	<i>Aconitum lycoctonum</i> subsp. <i>vulparia</i>	—	0	—	0	—	2
H	subMed	<i>Astrantia major</i>	—	0	—	0	—	2
H	Alp-Bal	<i>Ranunculus serbicus</i>	19.4	7	—	0	—	1
H	Bal-Carp	<i>Aconitum toxicum</i>	—	3	—	0	—	1
H	Eur-Med	<i>Lactuca alpina</i>	—	3	—	0	—	1
Ch	subMed	<i>Ribes petraeum</i>	—	0	—	0	—	1
H	Eur	<i>Aconitum degenii</i>	—	0	—	0	—	1
H	Eur-Sib	<i>Campanula latifolia</i>	—	0	—	0	—	1
Diagnostic species for cl. <i>Molinio-Arrhenatheretea</i>								
H	Boreal	<i>Veronica serpyllifolia</i>	—	0	36.1	19	—	1
H	Bal	<i>Cirsium appendiculatum</i>	33.4	17	—	0	—	1
H	Eur	<i>Cerastium fontanum</i> subsp. <i>vulgare</i>	—	0	31.4	19	—	3
H	Eur-As	<i>Dactylis glomerata</i> agg.	—	17	24.6	43	—	22
H	Boreal	<i>Deschmopsis cespitosa</i> agg.	—	28	16.8	38	—	17
B-H	Boreal	<i>Plantago major</i> agg.	—	10	24.7	24	—	3
H	Eur-Sib	<i>Mentha longifolia</i>	—	14	—	24	29.6	47
B-H	Eur	<i>Campanula patula</i> agg.	—	3	—	14	—	7

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Life forms	Floristic elements	Number of réléves	29		21		251	
		Species	Phi	% Fre- quency	Phi	% Fre- quency	Phi	% Fre- quency
H	Eur	<i>Caltha palustris</i>	22.7	31	—	14	—	10
H	Eur-Med	<i>Inula britannica</i>	—	0	24.6	10	—	1
H	Eur-As	<i>Cardamine pratensis</i> agg.	12.8	14	—	10	—	3
H	Boreal	<i>Agrostis stolonifera</i> agg.	—	10	—	10	—	12
H	subBoreal	<i>Juncus effusus</i>	—	7	—	10	—	14
H	Eur-Sib	<i>Leucanthemum vulgare</i> agg.	—	10	—	5	—	8
T-B	Eur	<i>Lysimachia nummularia</i>	—	14	—	0	21.4	22
H	Kos	<i>Carex leporina</i>	—	7	—	0	—	5
H	Eur-Sib	<i>Silene flos-cuculi</i>	—	7	—	0	—	3
H	Eur	<i>Centaurea phrygia</i> agg.	—	0	—	0	—	1
H	Eur-As	<i>Mentha arvensis</i>	23.9	10	—	0	—	1
H	Boreal	<i>Carex hirta</i>	—	0	—	0	—	6
T-B	Eur-As	<i>Conium maculatum</i>	—	0	—	0	—	2
H	Eur-As	<i>Veronica chamaedrys</i> agg.	—	0	—	0	—	6
H	subBoreal	<i>Scirpus sylvaticus</i>	—	3	—	0	—	8
H	subBoreal	<i>Lathyrus pratensis</i>	—	0	—	0	22.8	8
H	Kos	<i>Ranunculus acris</i> agg.	—	0	—	0	24.5	9
H	Eur-Med	<i>Lotus corniculatus</i>	—	0	—	0	21.5	7
H	Eur-Med	<i>Cirsium palustre</i>	—	0	—	0	25.1	9
H	Eur-Med	<i>Trifolium hybridum</i> agg.	—	3	—	0	—	8
Diagnostic species for cl. <i>Carpino-Fagetea</i>								
B-H	Eur-As	<i>Myosotis sylvatica</i> agg.	—	14	53.6	62	—	8
H	Eur	<i>Luzula sylvatica</i>	—	3	38.9	29	—	2
H	Eur	<i>Euphorbia amygdaloides</i>	—	0	32.7	19	—	2
H	Eur-As	<i>Bistorta officinalis</i>	—	0	31.6	14	—	0
H	Eur	<i>Ranunculus lanuginosus</i>	—	0	31.6	14	—	0
H	Kos	<i>Athyrium filix-femina</i>	—	38	—	33	—	21
H	Eur-As	<i>Stachys sylvatica</i>	—	17	—	14	—	18
H	Carp-Pont	<i>Symphytum cordatum</i>	5.3	17	18.4	24	—	3
H	subMed	<i>Carex sylvatica</i>	—	14	—	5	—	6
H	Med	<i>Lactuca muralis</i>	24.2	14	—	0	—	4
H	Eur	<i>Luzula luzuloides</i> agg.	—	10	—	10	—	9
H	subBoreal	<i>Oxalis acetosella</i>	22.2	10	—	0	—	2
T-B	Eur-As	<i>Cardamine impatiens</i>	—	10	13	14	—	2
H	Bal-Dac	<i>Silene heuffelii</i>	—	10	—	0	—	4
H	Eur	<i>Primula acaulis</i>	—	7	—	0	23.2	17
H	Eur-As	<i>Salvia glutinosa</i>	—	7	—	19	21.3	31
H	Boreal	<i>Poa nemoralis</i>	—	7	24.1	29	—	13
H	subBoreal	<i>Scrophularia nodosa</i>	—	3	26.9	24	—	8
P	Eur	<i>Fagus sylvatica</i>	—	3	16.7	10	—	1
H	subBoreal	<i>Cardamine bulbifera</i>	—	3	24.5	14	—	1
P	subBoreal	<i>Sorbus aucuparia</i>	—	3	—	0	—	2
P	Eur-Med	<i>Acer pseudoplatanus</i>	—	0	22.7	10	—	1
H	Bal-Eur-Pont	<i>Cardamine glanduligera</i>	—	0	25.5	14	—	3

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Life forms	Floristic elements	Number of rélevés	29		21		251	
		Species	Phi	% Fre- quency	Phi	% Fre- quency	Phi	% Fre- quency
Diagnostic species for cl. <i>Epolobietea angustifoliae</i>								
H	Eur-As	<i>Eupatorium cannabinum</i>	—	0	—	10	35.1	30
T-B	subBoreal	<i>Geranium robertianum</i>	—	28	—	38	—	27
H	Eur-Med	<i>Senecio ovatus</i>	28.8	21	—	0	—	6
H	subBoreal	<i>Epilobium angustifolium</i>	—	17	—	19	—	10
H	subBoreal	<i>Geum urbanum</i>	—	17	—	14	—	7
H	Eur-As	<i>Glechoma hederacea</i>	—	14	—	24	—	16
H	subBoreal	<i>Lamium maculatum</i>	—	10	—	24	—	14
H	Eur-Sib	<i>Valeriana officinalis</i>	—	10	—	0	18.5	16
H	Eur-Med	<i>Chaerophyllum aureum</i>	22.2	10	—	0	—	2
H	Kos	<i>Calystegia sepium</i>	—	7	—	0	—	10
T	Eur-As	<i>Galeopsis speciosa</i>	—	7	—	0	—	12
T	Eur-As	<i>Galeopsis tetrahit</i>	—	7	—	0	—	6
B-H	Eur-As	<i>Angelica archangelica</i>	—	3	—	5	—	5
H	Eur-As	<i>Symphytum officinale</i>	—	3	—	0	—	7
H	Eur-Med	<i>Inula helenium</i>	—	0	—	0	—	4
H	Kos	<i>Carex echinata</i>	—	0	—	0	—	1
Diagnostic species for cl. <i>Scheuchzerio-Caricetea fuscae</i>								
H	Eur-Sib	<i>Agrostis canina</i>	—	0	25.6	10	—	0
H	subBoreal	<i>Epilobium palustre</i>	—	3	—	0	22.4	12
H	Eur-Sib	<i>Ligularia sibirica</i>	—	0	—	0	—	2
T-B	subBoreal	<i>Myosotis laxa</i> subsp. <i>caespitosa</i>	—	0	—	0	—	1
Diagnostic species for cl. <i>Phragmito-Magnocaricetea</i>								
H	Eur-Nam	<i>Myosotis scorpioides</i>	22.7	38	—	19	—	16
H	Eur-As	<i>Lysimachia vulgaris</i>	—	7	—	0	—	11
H	Eur-As	<i>Lycopus europaeus</i>	—	3	—	0	—	8
Diagnostic species for cl. <i>Montio-Cardaminetea</i>								
H	Eur-As	<i>Cardamine amara</i> agg.	18.9	24	—	14	—	6
H	Eur-As	<i>Carex remota</i>	—	17	—	0	—	11
H	CEur	<i>Cirsium rivulare</i>	18.9	14	—	5	—	2
B-H	Boreal	<i>Cardamine flexuosa</i>	—	0	—	0	—	2
Diagnostic species for cl. <i>Alno glutinosae-Populetea albae</i>								
P	subMed	<i>Alnus incana</i>	—	10	23.2	24	—	4
Ch	Eur-Med-Cas	<i>Salix purpurea</i>	—	3	—	10	—	2
P	Eur-As	<i>Salix fragilis</i>	—	0	—	0	—	2
Diagnostic species for cl. <i>Rhamno-Prunetea</i>								
Ch	subMed	<i>Rubus hirtus</i> agg.	—	10	—	0	—	14
other species with phi > 10								
H	subMed	<i>Rumex scutatus</i>	—	0	40.9	24	—	1
Ch	Eur-Sib	<i>Cytisus hirsutus</i>	—	0	39	24	—	2
H	Eur	<i>Valeriana tripteris</i>	—	3	32.5	24	—	3
H	Eur-As	<i>Onoclea struthiopteris</i>	—	0	30.8	19	—	4
H	Boreal	<i>Equisetum telmateia</i>	—	0	—	5	26.2	17

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Continued

Life forms	Floristic elements	Number of rélevés	29		21		251	
		Species	Phi	% Fre- quency	Phi	% Fre- quency	Phi	% Fre- quency
P	Boreal	<i>Picea abies</i>	19.4	7	—	0	—	1
H	Kos	<i>Hypericum perforatum</i>	—	0	26.9	14	—	2
H	Boreal	<i>Schedonorus giganteus</i>	—	3	—	5	18.3	14
H	Kos	<i>Pteridium aquilinum</i>	23	10	—	0	—	2
H	Bal-Anat	<i>Achillea grandifolia</i>	11	7	—	5	—	0
H	Med	<i>Lamium galeobdolon</i> agg.	21.4	10	—	0	—	2
T	Kos	<i>Ochlopoa annua</i>	—	3	16.7	10	—	1
H	Boreal	<i>Rumex crispus</i>	—	7	—	0	—	5
H	Eur-As	<i>Tussilago farfara</i>	—	14	—	5	—	15
H	Eur	<i>Alchemilla vulgaris</i> agg.	—	0	—	0	23.4	8
H	subMed	<i>Laserpitium latifolium</i>	—	0	—	0	—	1
Ch-P	subBoreal	<i>Salix caprea</i>	12.4	14	—	10	—	3
H	Kos	<i>Eleocharis palustris</i>	20.5	7	—	0	—	1
B-H	Eur-As	<i>Carum carvi</i>	23.9	10	—	0	—	1
H	subMed	<i>Anacamptis laxiflora</i>	21.7	7	—	0	—	0

gopodium podagraria, *Angelica sylvestris* agg., *Heracleum sphondylium* agg. Young individuals of shrubs coming from neighbouring vegetation types such as *Rubus idaeus*, *R. hirtus* agg., *Salix caprea*, which have a cover up to 5–8% are also rarely found in the species composition. In the vertical structure despite the strong canopy effect and high cover of litter (about 50–70%), bryophytes form a separate layer and their cover is up to 10–15%.

Syntaxonomical notes: Based on the results of the multivariate analysis, in this article we adopted the opinion of [3] who considered that communities dominated by *Petasites albus* have the same syntaxonomical rank as those dominated by other *Petasites* species. However, by assigning the *nomen provisorium* to this syntaxon, the name *Petasitetum albae* Dihoru 1975 was not validly published (cf. article 3b in International Code of Phytosociological Nomenclature). Moreover, because the original diagnosis of the association was based on a synoptic table consisting of 4 relevés, we had to proceed to the typification of this syntaxon and to choose a *neotype* following the Recommendation 21A in ICPN.

Ass. *Petasitetum hybrido-kablikani* Sillinger 1933 (Fig. 1, 2; Table 1 – cluster 2)

Nomenclatural type: Sillinger 1933, tab. 134, rel. 1, lectotypus [15].

Constant species: *Impatiens noli-tangere* (71%), *Urtica dioica* agg. (62%), *Stellaria nemorum* (57%), *Chaerophyllum hirsutum* (57%).

Dominant species: *Petasites kablikianus*.

Distribution and ecology: The association occurs from 650 m to 1450 m

a.s.l., in river valleys in mountainous areas, in *Fagus sylvatica* belt, as well as in the lower parts of the coniferous belt. This vegetation type is also found on the first river terrace, in humid areas near forest roads, combs, and ditches and in the ecotone zone with forest phytocoenoses. The slope varies between 5° and 8°. These territories often represent narrow strips (15–20 m), located near river beds. Denudation and erosion take their toll and stones with sizes up to 0.5 m appear. Soils are shallow to moderately-deep, alluvial, sandy, with gravels. Silicate rocks dominate the terrains, however, limestones are also a part of the landscape. This association is more typical for Romania, occurring preponderantly in the northern part of Eastern Carpathians (Rodna Mountains), and sporadically in Vrancea, Siriu and Țarcu-Godeanu Mountains. It occurs in Bulgaria, as well but it is known only from one locality in Pirin Mountain where it occupies more extensive areas.

Synmorphology: The communities of the association have a closed horizontal structure where *Petasites kablikianus* is the dominant species. Total coverage is between 95–100%. They are species-rich communities (26 in average, in vegetation plots of 25–100 m²). The vertical structure is built up by herb and moss layers. In some vegetation plots, the forest and the shrub species cover reaches 10–20% with species such as *Rubus idaeus*, *Alnus incana*, *Fagus sylvatica*, *Salix caprea*, *Sorbus aucuparia*. Other species typical for the forest habitats are *Myosotis sylvatica* agg., *Luzula sylvatica*, *Euphorbia amygdaloides*, *Ranunculus lanuginosus*, etc. Nitrophylous species like *Urtica dioica* agg., *Rubus idaeus*, *Impatiens noli-tangere*, *Aegopodium podagraria* are also common as well, due to the presence of organic biomass.

Syntaxonomical notes: The association of *Petasitetum hybrido-kablikiani* unites phytocoenoses with the dominance of *Petasites kablikianus*, which is typical for the Czech Republic [14]. KLIMENT and JAROLÍMEK [15] classify the communities of *Petasites kablikianus* from Slovakia to the association of *Agropyro caninae-Petasitetum kablikiani* Pawlowski et Walas 1949 em. Kliment et Jarolímek 2002.

In Romania, communities dominated by *Petasites kablikianus* were (until recently) always classified under ass. *Petasitetum kablikiani* Szafer, Kulczynski et Pawlowski 1926 [3, 16] or *Petasitetum kablikiani* Pawlowski et Walas 1949 [5, 17–19]. COLDEA [4] highlighted the increased similarity of these phytocoenoses to those in Slovakia and classified them in ass. *Petasitetum officinalis – glabrati* Sillinger 1933, opinion we were in agreement with in this study.

Ass. *Telekio-Petasitetum hybridi* Morariu ex Resmeriță et Rațiu 1974 (Fig. 1, 2; Table 1 – cluster 3)

Syn: *Petasiteto – Telekietum speciosae* Morariu 1967 (Art. 2b), *Petasito – Cicerbitetum* Tx. 1937 subass. *dacicum* Boșcaiu 1971 (Art. 34).

Nomenclatural type: Resmeriță et Rațiu 1974, Table 3, rel. 3, lectotypus hoc loco.

Constant species: *Urtica dioica* agg. (62%).

Dominant species: *Petasites hybridus*.

Distribution and ecology: This association is distributed between 400 m and 1600 m a.s.l., from the xero-mesophile oak forests, to the beech and coniferous belts of the foothills and the mountains. The communities of *Petasites hybridus* occur along the river beds, as well as in meadows with high humidity. Terrains are flat or with a slope inclination of 10–15°. However, in some areas the slope reaches up to 40–50°. Soils are shallow. There are some types with medium thickness as well and all are characterized by high humidity. Droughts are not frequent and if they occur, it is only for a short period of time. Eutrophication is also typical for these territories. The association is widely spread throughout Romanian Carpathians (Fig. 1). As far as Bulgaria is concerned, it is typical for the Western and Central Balkan Range, the Central Rhodopes and Rila Mountain.

Synmorphology: The phytocoenoses have a poor species composition (21 species in average) and *Petasites hybridus* is the dominant taxon. The presence of *Telekia speciosa* depends on hydrologic conditions. In vegetation plots that are characterized by constant humidity *Telekia speciosa* is subdominant. The species composition includes Carpathian and Carpathian-Balkan elements, such as *Leucanthemum waldsteinii*, *Cirsium waldsteinii*, *Symphytum cordatum*, *Pulmonaria rubra*. *Petasites hybridus* and *Telekia speciosa* have a shadowing effect, resulting in a decline of the overall species diversity and abundance.

Syntaxonomical notes: The tall herb, nitrophilous vegetation dominated by *Petasites hybridus* was classified for the first time in Romania by MORARIU [6] in association *Petasiteto – Telekietum speciosae*, at the same time when the order *Petasito-Chaerophylletalia* Morariu 1967 was defined (accepted today). Before this date, the same communities were considered a part of *Petasitetum hybridi* Dost. 1933 [6] or they were included in ass. *Petasites hybridus – Aegopodium podagria* Borza et Boşcaiu 1965 (*nomen nudum*). A vision more close to that of the central European phytosociologists was expressed by BOŞCAIU [16], who grouped the communities of *Petasites hybridus* in ass. *Petasito – Cicerbitetum* Tx. 1937 subass. *dacicum* (based on the presence of some regional differential species). COLDEA [18] unites communities of *Petasites hybridus* and those of *Petasites albus* in one syntaxon (but in different subassociations), namely *Telekio – Petasitetum hybridi* Morariu ex Resmeriță et Rațiu 1974, opinion widely accepted in Romanian phytosociological literature [5,19].

Discussion. In the Romanian syntaxonomical literature, the communities of tall-herb, hygrophilous vegetation dominated by *Petasites* spp., with particular physiognomy, were mainly subordinated to the class *Betulo – Adenostyletea* Br.-Bl. et Tx. 1943, either in alliance *Adenostylion alliariae* Br.-Bl. 1925 (Beldie, 1967 [2,3,16,20] or within alliance *Petasition officinalis* Sillinger 1933 [17]. Sometimes they were considered a part of the class *Galio – Urticetea* Passarge et Kopecký 1969 [4,5,17] or *Epilobietea angustifolii* Tx. et Preising ex von Rochow 1951 [6]. Currently, they are grouped, together with other tall-herb communities, from eu-

trophic habitats of higher altitudes, in class *Mulgedio-Aconitetea* Hadač et Klika in Klika et Hadač 1944, order *Petasito-Chaerophylletalia* Morariu 1967 and alliance *Petasition officinalis* Sillinger 1933 [7]. In Bulgaria, the communities dominated by *Petasites* spp. have not been studied so far.

While the communities of *Petasites* spp. in Europe are ecologically similar, there are some differences in their species composition. The phytocoenoses of *Petasites albus*, *P. hybridus* and *P. kablikianus* in Bulgaria and Romania have local specifics. Some species, such as *Leucanthemum waldsteinii*, *Cirsium waldsteinii*, *Symphytum cordatum*, *Pulmonaria rubra* that are distributed in the Carpathians and in the Balkan Peninsula, are typical for them. In order to clarify the ecological and syntaxonomical diversity of the three species, an analysis of data from Central and Northern Europe should be initiated.

Conclusions. The research aimed at the investigation of the phytocoenoses of *Petasites albus*, *P. hybridus* and *P. kablikianus* in Bulgaria and Romania. The results show that three associations were recognized – *Petasitetum albae* Dihoru ex Nazarov et al. 2022, *Petasitetum hybrido-kablikani* Sillinger 1933, and *Telekio-Petasitetum hybridi* Morariu ex Resmeriță et Rațiu 1974, which inhabit similar ecological conditions. Further studies are needed to add more scientific data for in-depth analyses.

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