

THE ECOLOGICAL AND PHYTOSOCIOLOGICAL CHARACTERISTICS OF COMMUNITIES WITH *ACHILLEA CARTILAGINEA* LEDEB. EX RCHB. IN LITHUANIA

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Gudaityte O. 2010. The ecological and phytosociological characteristics of communities with *Achillea cartilaginea* Ledeb. ex Rchb. in Lithuania. *Acta Biol. Univ. Daugavp, Suppl. 2: 17 - 27.*

The ecological requirements of *Achillea cartilaginea* and regional distribution patterns are discussed. *A. cartilaginea* is most frequent along the banks of the Nemunas River and its' tributaries, while in other sites it is rather rare. Most plants of this species grow in wet, alluvial soil, flooded in the spring. The distribution and abundance of *A. cartilaginea* depends most on the acidity and humidity of the soil, as well as light and temperature conditions. Registered yarrows biotopes coincided with other registered data in Lithuania.

Keywords: *Achillea cartilaginea*, distribution, habitat, community.

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Introduction

In Lithuania, willow-leaved yarrow (*A. cartilaginea* Ledeb. ex Rchb.) occurs quite rarely compared with common yarrow (*A. millefolium* L.), and it grows only in typical habitats. *A. cartilaginea* is a Euro-continental mesohygrophilous species. It is found abundantly from Siberia and Japan till the Pyrenees Peninsula (Davidjuk 1980; Klovov & Kriczka 1984; Lavrenov & Lavrenova 1999). The southern growing sites of *A. cartilaginea* are in Romania, the Caucasus, Turkey and Central Kazakhstan, while in the north it reaches the Arctic Circle (Arabaci & Yildiz 2006; Davidjuk 1980; Klovov & Kriczka 1984; Sytnik et al. 1984). According to S. A. Tokarevskikh (1977) this species is boreal-Eurasian. G. B. Kljavine (1974) reported that willow-leaved yarrow can be ascribed to boreal-temperate-submeridional species, while Z. V. Karamyshova and E. I. Rachkovskaja (1973) attribute it to the Eurosibirc species group (Davidjuk 1980).

According to the literature, *A. cartilaginea* is found on the banks of ditches and flooded riverbanks (Sytnik et al. 1984; Lazdauskaite et al. 2003; Weymar 1974). The willow-leaved yarrow is found also in wet meadows, lakes shores, shrub areas, roadsides, and near settlements (Kepczynski & Rutkowski 1991; Swedler & Sobkowiak 1998; Arabaci & Yildiz 2006). More frequently it occurs beside the River Vistula in northern Poland (Kepczynski & Rutkowski 1991). The majority of communities with *A. cartilaginea* are concentrated on the banks of the Donets, Desna and Prypiat rivers, in northern and northeastern Ukraine (Sytnik et al. 1984), and in Lithuania along the River Nemunas (Galinis 1980; Gudaityte 2005 a, b; 2006 a). It is rather rarely extended in all regions of Germany and Latvia, while in Estonia it is spread only in the eastern regions (Lazdauskaite 1985; Lazdauskaite et al. 2003; Kuk & Kull 2005).

There are only a few publications in which plant communities with *A. cartilaginea* have been

surveyed (Baleviciene, 1991; Kepczynski & Rutkowski 1991), and little is known about the ecological properties of *A. cartilaginea* habitats in the Baltic countries. The aim of this research was to characterize the ecological characteristics of habitats and phytosociological dependence of the communities with willow-leaves yarrow in Lithuania.

Material and methods

Field research was performed in summer from 2001 to 2008. Vegetation records were made at 28 habitats of *A. cartilaginea* (Table 1). The phytosociological relevés were assigned and *Achillea* species prevalence was assessed following the principles of vegetation research of the French-Swiss school (Baleviciene 1991; Baleviciene et al. 1998; Navasaitis et al. 2003). The distribution of species in the country was mapped applying the NATIONAL grid system (Gudzinskas 1993).

The distribution of plants was determined according to personal and herbaria data of the Institute of Botany (BILAS), the Station of Nature Research and Environmental Education in Marijampole (HSUD) and Vilnius University (WI)

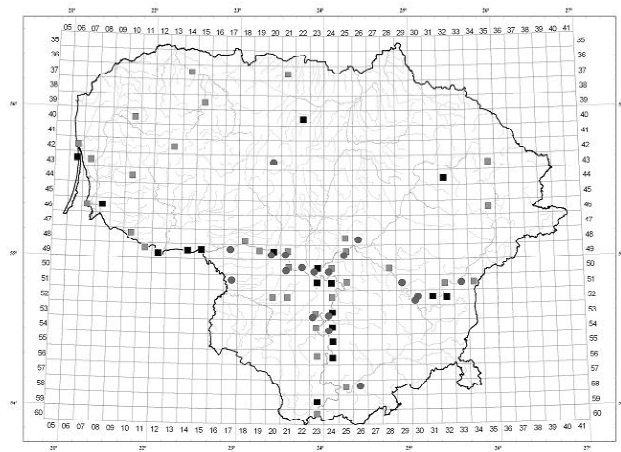


Fig. 1. The map of *Achillea cartilaginea* distribution according to the data of the author (L, %), WI, BILAS, HSUD herbaria, the Lithuanian Fund for Nature (program 'National Grassland Inventory in Lithuania' (% – several localities, % – one locality)

as well as the data of the project "National Grassland Inventory in Lithuania" in 2003–2004 (Fig. 1). Soil samples were determined according to A. J. Motuzas and colleagues (1996). Chemical analysis of soil was done at the Sector of Chemical Analysis of the Institute of Botany (Gudaityte 2006 b). Soil samples were evaluated under the scale of Lithuanian soil evaluation (Adomaitis et al. 1998).

Results and discussion

A. cartilaginea habitats prevail on the banks of the River Nemunas (Fig. 1.) and its tributaries (Gudaityte 2005 b). Analysis of the obtained data revealed that populations of *A. cartilaginea* in localities were quite diverse in regard to the area occupied and density of plants, ranging from spots with single plants to areas covered by large, pure stands. The largest stands of *A. cartilaginea* (about 3000 m²) were registered on the right bank of the Nemunas and Neris rivers (Table 1, No 6, 17, 18). *A. cartilaginea* were situated rarely in northeastern Lithuania.

Furthermore, one of the reasons for this species rarity in our country seems to be a deficiency in proper habitats. According to our research data, in Lithuania this species prefers wet habitats with alluvial soils, which are usually situated in river floodplains and lower reaches, on slopes with eastern, southern or southwestern inclines. The slopes of riverbanks were oriented toward the southwest, south or southeast, and sometimes to the northwest and west. This confirms literature data (Hamet-Ahti 1970; Davidjuk 1980; Kepczynski & Rutkowski 1991). *A. cartilaginea* occurs not only on riverbanks, but also on lakeshores, flood-meadows as well as in shrubberies. However, in such habitats population of this species was not numerous. The frequent occurrence of *A. cartilaginea* on riverbanks is probably related to the hydrochoria along river corridors, high level of disturbance of herb and shrub

Table 1. Characteristic of *Achillea cartilaginea* habitats

Locality No	Collection No	Locality	Habitat	Coordinates	Alliance	Soil type
1	2	3	4	5	6	7
1	OG01068	Santaka, Vilnius d.	River bank	N54°53'35.1"/E25°38'18.8"	<i>Salicion albae</i>	gravel
2	OG01070	Birstonas m.	River bank	N54°35'29.9"/E24°02'04.9"	<i>Salicion albae</i>	clay loam
3	OG01071	Prienai d.	River bank	N54°38'16.0"/E23°57'24.5"	<i>Senecion fluviatilis</i>	sand
4	OG02015	Gelgaudiskis, Sakiai d.	River bank	N55°05'02.0"/E22°58'14.2"	<i>Senecion fluviatilis</i>	sandy loam
5	OG02018	Vilkija, Kaunas d.	Meadow	N55°02'27.9"/E23°30'30.4"	<i>Senecion fluviatilis</i>	sandy loam
6	OG02019	Veliuona, Jurbarkas d.	Meadow	N55°01'33.1"/E22°04'16.2"	<i>Senecion fluviatilis</i>	clay loam
7	OG02028	Siaulėnai, Radviliskis d.	Shore	N55°42'11.6"/E23°27'13.2"	<i>Calthion palustris</i>	sand
8	OG02052	Bikavenai, Silute d.	Meadow	N55°24'06.6"/E21°59'06.4"	N	clay loam
9	OG05001	Draseikiai, Jonava d.	River bank	N55°00'26.5"/E24°05'59.9"	<i>Senecion fluviatilis</i>	clay loam
10	OG05002	Padagai, Jonava d.	Forest edge	N55°02'22.0"/E24°27'34.9"	<i>Calthion palustris</i>	clay loam
11	OG06001	Kulautuva, Kaunas d.	River bank	N54°55'58.7"/E23°40'28.6"	<i>Senecion fluviatilis</i>	sand
12	OG06002	Siline, Jurbarkas d.	Meadow	N55°05'17.8"/E22°56'47.7"	<i>Senecion fluviatilis</i>	clay loam
13	OG06003	Sviliskes, Vilnius d.	River bank	N54°43'28.9"/E25°01'38.0"	<i>Senecion fluviatilis</i>	clay loam
14	OG07001	Dukstas, Vilnius d.	River bank	N54°48'48.0"/E24°56'55.0"	<i>Senecion fluviatilis</i>	clay loam
15	OG07005	Netoniai, Kaunas d.	River bank	N54°56'10.3"/E23°42'28.6"	<i>Senecion fluviatilis</i>	gravel
16	OG07007	Kulautuva, Kaunas d.	River bank	N54°55'35.3"/E23°38'31.0"	<i>Senecion fluviatilis</i>	clay loam
17	OG07008	Radikiai, Kaunas d.	River bank	N54°57'16.2"/E23°55'21.9"	<i>Senecion fluviatilis</i>	clay loam
18	OG07009	Lapes, Kaunas d.	River bank	N54°58'00.0"/E24°02'19.1"	<i>Senecion fluviatilis</i>	clay loam
19	OG07010	Kurmagala, Jonava d.	River bank	N55°03'13.0"/E24°10'16.7"	<i>Senecion fluviatilis</i>	sand
20	OG07012	Stirmiai, Elektrenai m.	River bank	N54°43'20.0"/E25°02'30.7"	<i>Senecion fluviatilis</i>	clay loam
21	OG07017	Gudakalnis, Birstonas m.	River bank	N54°36'22.9"/E24°04'06.5"	<i>Senecion fluviatilis</i>	clay loam
22	OG07018	Skevonys, Birstonas m.	River bank	N54°36'06.9"/E24°59'27.9"	<i>Salicion albae</i>	sand
23	OG07019	Nemajunai, Birstonas m.	River bank	N54°33'11.3"/E24°04'02.3"	<i>Senecion fluviatilis</i>	clay loam
24	OG07021	Merkine, Varena d.	River bank	N54°09'24.7"/E24°10'48.1"	<i>Senecion fluviatilis</i>	sand
25	OG08011	Rugaliai, Silute d.	Channel bank	N55°23'28.2"/E21°20'25.2"	N	peat
26	OG08012	Rugaliai, Silute d.	Meadow	N55°23'27.3"/E21°20'18.5"	N	clay loam
27	OG08015	Smelte, Klaipeda m.	Lagoon shore	N55°39'27.8"/E21°08'52.0"	<i>Senecion fluviatilis</i>	sand
28	OG08017	Smelte, Klaipeda m.	Lagoon shore	N55°38'21.8"/E21°09'05.4"	<i>Senecion fluviatilis</i>	sand

d. – district, m. – municipality, N – not identified syntax.

layers by water and high nutrient supply on alluvial soil (Burkart 2001). We assume that *A. cartilaginea* diaspores were spread by wind, through water or brought with soil from riverbanks to lake shores or on floodplain meadows. There was a registered habitat (Budvytyte et al. 1997) in the western part of the country (Silute district), where *A. cartilaginea* grew in medium humidity and humus-rich meadows. According to D. Smaliukas (1964), a plant species tolerant to new annual silt layer

confined to the river floodplains and lower reaches, where soils have good drainage and deep ground water.

Registered yarrows biotopes coincided with herbaria and project data. More frequently *A. cartilaginea* grew besides different water bodies (rivers, lagoons, lakes) shores (67.1 %) and wet meadows (18.6 %). Few other *A. cartilaginea* localities (roadsides, on the outskirts of forests, shrubs and slopes) were

mentioned in herbaria. Some researchers (Weymar 1974; Uotila 1978; Kepczynski & Rutkowski 1991) noticed that habitats of *A. cartilaginea* were situated in ruderal communities or were plentiful on the banks of ditches. There could be two reasons for these untypical *A. cartilaginea* habitats (in pine forest, forest fields, lakes shore) mentioned in the labels of herbarium samples. *A. cartilaginea* could be brought with soil from the riverbanks of the Sventoji (a tributary of the Nemunas) as well as from Lake Baluosa (a tributary of the River Neris) or through water.

Another reason for *Achillea cartilaginea* rarity in Lithuania could be differences in soils. The most abundant yarrows *A. cartilaginea* grew in clay loam (54.2% of all localities), but rarely in sand (25%), gravel (12.5%) or sandy loam (8.3%). Clay loam provided better conditions to entrench diaspores, because of high constancy and abundant humidity there. Our results confirmed the proposition of K. Kepczynski & L. Rutkowski (1991) that plants of this species frequently grow in heavier soils of constant humidity. Analysis of soil chemical composition (Table 2) in *A. cartilaginea* habitats demonstrated that the amount of potassium (15.6–143.0 mg/kg), phosphorus (6.4–337.1 mg/kg) and nitrogen (0.02–0.28%) compounds and humus content (0.57–4.28%) varied, however, soil reaction was from neutral to alkaline (pH 7.2–7.8). According to data of other researches (Weymar 1974) soil from *A. cartilaginea* habitats was poor in potassium and phosphorus, but rich in humus. In our investigated populations *A. cartilaginea* requires more humid and heavier, more alkaline soils, poorer in nitrogen, potassium, phosphorus and humus than *A. millefolium* (Gudaityte 2006 b).

In Lithuania *A. cartilaginea* is a dominant species of *Achilleo–Cuscutum lupuliformis* Tx. 1950

communities of the *Artemisietea vulgaris* Lohm., Prsg. et Tx. in Tüxen 1950 em. Kopeckz 1979 class (Baleviciene 1991). However, the prescription of this association was confusing. According to R. Schubert and colleagues (1988) *Achilleo–Cuscutum lupuliformis* association was attributed to *Galio–Urticetea dioicae* Passarge ex Kopeckz 1969 class, while J. Baleviciene (1991) it assigned to *Artemisietea vulgaris* classis, whereas but in both literature sources it was ascribed to the same *Convolvulietalia sepium* R. Tx. 1950 order. Meanwhile, in Germany (Oberdorfer 1983) *A. cartilaginea* was ascribed to *Filipendulion* Seg. 1966 alliance *Filipendulo–Petasition* Br.-Bl. et al. 1947 community, then in Poland it was assigned to the characteristic species of *Achilleo–Cuscutum lupuliformis* Tx. et Prsg. 1976 and *Senecion fluviatilis* R. Tx. 1950 or accompanying species of *Isoëto–Nanojuncetea* Br. Bl. et R. Tx. 1943, *Bidentetea tripartiti* R. Tx., Lohm et Prsg. 1950, *Phragmitetea* R. Tx. et Prsg. 1942 and *Plantaginetea majoris* R. Tx. et Prsg. 1950 communities earlier (Kepczynski & Rutkowski 1991). At present time it is approached as only accompanying species of plant communities in Poland (Matuszkiewicz 2001).

From 13 to 49 vascular plants species per community with *A. cartilaginea* were registered. Generally, vascular plants of 176 species from 43 families were inventoried in communities with *A. cartilaginea* (*Asteraceae* Dumort. and *Poaceae* (R. Br.) Bernhart families were most numerous in species). Communities with willow-leaved yarrow are characterised by mixed tree layer where the most important were different willow species and black alder (Appendix 1). In herb layer, the most abundant and constant species were *Artemisia vulgaris*, *Calystegia sepium*, *Eupatorium cannabinum*, *Mentha aquatica*, *Lythrum salicaria*, *Urtica dioica*, *Phalaris arundinacea*, *Schoenoplectus*

Table 2. Characterization of *Achillea cartilaginea* growing habitats

Classis	Soil type	N (total),%	Humus, %	P ₂ O ₅ , mg/kg	K ₂ O, mg/kg	pH _{KCl}
<i>Molinio-Arrhenatheretea elatioris</i>	Clay loam	0.28	7.29	41.8	140.0	7.4
<i>Salicetea purpurea</i>	Clay loam, sand, gravel	0.07±0.03	1.43±1.34	77.4±60.4	51.2±42.4	7.6–7.8
<i>Artemisietea vulgaris</i>	Clay and sandy loam, sand, gravel	0.11±0.03	2.25±0.43	132.4±29.0	40.5±10.6	7.2–7.8

lacustris, *Tanacetum vulgare*, and *Veronica longifolia* (Appendix 1).

As an accompanying species, *A. cartilaginea* was also revealed in the *Salicetea purpurea* Moor 1958 class *Salicion albae* Tx 1955 as well as the *Molinio-Arrhenatheretea elatioris* R. Tx. 1937 class *Calthion palustris* R. Tx. 1937 em. Lebrun et al. 1949 communities (Appendix 1).

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Received: 01.12.2008.

Accepted: 20.09.2009.

APPENDIX I

Syntaxonomical interpretation of *Achillea cartilaginea* dominated communities

Class		<i>Salicetea purpurea</i>	<i>Artemisietea vulgaris</i>
Coverage (%):			
woody species layer (a – tree, b – bush, c – in height as herb)		0-30	5-80
herb layer		80-100	70-100
bryophyte layer		-	0-30
Vascular plant species number per relevé		19-25	13-49
Number of relevés		3	19
Presence of relevé			
Woody species			
<i>Alnus glutinosa</i>	a	IV	I
<i>Salix caprea</i>	b	II	I
<i>Acer negundo</i>	b	.	I
<i>Malus domestica</i>	a	.	I
<i>Rhamnus cathartica</i>	b	.	I
Ch.+ D. Cl. Salicetea purpureae			
<i>Lysimachia vulgaris</i>	c	II	III
<i>Equisetum arvense</i>	c	II	I
<i>Salix purpurea</i>	c	II	I
<i>Salix</i> sp.	a	II	I
<i>Salix fragilis</i>	c	II	.
<i>Salix cinerea</i>	b	.	I
<i>Salix viminalis</i>	b	.	I
<i>Filipendula ulmaria</i>	c	.	I
<i>Glechoma hederacea</i>	c	.	I
<i>Humulus lupulus</i>	c	.	I
<i>Lysimachia nummularia</i>	c	.	I
<i>Stachys palustris</i> *	c	.	I
<i>Symphytum officinale</i> *	c	.	I
Ch. Cl. Artemisietea vulgaris			
<i>Artemisia vulgaris</i>	c	IV	II
<i>Tanacetum vulgare</i>	c	IV	II
<i>Urtica dioica</i>	c	II	III
<i>Cirsium arvense</i> *	c	.	I
Ch. O. Convolvuletalia sepii			
<i>Calystegia sepium</i> *	c	IV	III
Ch.+D. All. Senecion fluviatilis			
<i>Achillea cartilaginea</i>	c	V	V
<i>Phalaroides arundinacea</i>	c	II	III
<i>Rubus caesius</i> *	b	II	II
<i>Senecio fluviatilis</i> *	c	.	II
<i>Cucubalus baccifer</i>	c	.	I
<i>Cuscuta europaea</i>	c	.	I
<i>Saponaria officinalis</i>	c	.	I
Ch. All. Onopordion acanthii			
<i>Angelica archangelica</i>	c	.	II
Ch. All. Dauco-Melilotion			
<i>Melilotus albus</i>	c	II	I
<i>Achillea millefolium</i>	c	.	I
<i>Agrostis stolonifera</i>	c	.	I
<i>Daucus carota</i>	c	.	I
<i>Oenothera biennis</i>	c	.	I
Ch. Cl. Molinio-Arrhenatherethea elatioris			
<i>Vicia cracca</i>	c	II	II
<i>Rhinanthus angustifolius</i>	c	II	I
<i>Phleum pratense</i>	c	.	III

<i>Deschampsia cespitosa</i>	c	.	II
<i>Briza media</i>	c	.	I
<i>Centaurea jacea</i>	c	.	I
<i>Festuca pratensis</i>	c	.	I
<i>Leontodon hispidus</i>	c	.	I
<i>Poa pratensis</i>	c	.	I
<i>Plantago lanceolata</i>	c	.	I
<i>Prunella vulgaris</i>	c	.	I
<i>Ranunculus acris</i>	c	.	I
<i>Rumex acetosa</i>	c	.	I
Ch. All. Arrhenatherion elatioris			
<i>Rumex thyrsoflorus</i>	c	.	II
<i>Geranium pratense</i>	c	.	I
Ch. All. Cynosurion cristati			
<i>Anthoxanthum odoratum</i>	c	.	I
<i>Agrostis capillaris</i>	c	.	I
<i>Geum rivale</i>	c	.	I
Ch. O. Arrhenatheretalia elatioris			
<i>Dactylis glomerata</i>	c	II	I
<i>Galium mollugo</i>	c	II	.
<i>Campanula patula</i>	c	.	I
<i>Helictotrichon pubescens</i>	c	.	I
<i>Lotus corniculatus</i>	c	.	I
Ch. O. Molinietalia caeruleae			
<i>Galium uliginosum</i>	c	.	I
<i>Lychnis flos-cuculi</i>	c	.	I
Ch. + D. All. Cathion palustris			
<i>Cirsium oleraceum</i>	c	II	I
<i>Crepis paludosa</i>	c	II	.
<i>Geranium palustre</i>	c	.	I
<i>Scirpus sylvaticus</i>	c	.	I
Ch. All. Alopecurion pratensis			
<i>Veronica longifolia</i>	c	II	II
<i>Bromopsis inermis</i>	c	.	I
Ch. All. Molinion caeruleae			
<i>Galium boreale</i>	c	II	I
<i>Molinia caerulea</i>	c	II	I
<i>Equisetum palustre</i>	c	.	I
<i>Thalictrum lucidum</i>	c	.	I
Ch. Cl. Nardetea strictae			
<i>Carex echinata</i>	c	.	I
<i>Danthonia decumbens</i>	c	.	I
<i>Potentilla erecta</i>	c	.	I
<i>Thymus pulegioides</i>	c	.	I
Ch. Cl. Koelerio-Corynephoretea canescentis			
<i>Rumex acetosella</i>	c	II	I
<i>Dianthus deltoides</i>	c	.	I
Ch. Cl. Trifolio-Geranietea sanguinei			
Ch. All. Geranium sanguinei			
<i>Veronica teucrium</i>	c	.	I
Ch. All. Trifolion medii			
<i>Agrimonia eupatoria</i>	c	.	I
<i>Vicia cassubica</i>	c	.	I
Ch. Cl. Festuco-Brometea erecti			
<i>Veronica spicata</i>	c	.	I
Ch. All. Mesobromion erecti			
<i>Phleum phleoides</i>	c	.	I

<i>Thalictrum minus</i>	c	.	I
Ch. + D. Cl. Galio-Urticetea dioicae			
<i>Aegopodium podagraria</i>	c	.	I
<i>Anthriscus sylvestris</i>	c	.	I
<i>Heracleum sibiricum</i>	c	.	I
Ch. All. Arction lappae			
<i>Silene pratensis</i>	c	.	I
Ch. Cl. Agropyretea			
<i>Elytrigia repens</i>	c	.	II
<i>Convolvulus arvensis</i>	c	.	I
Ch. + D. Cl. Epilobietea angustifolii			
<i>Calamagrostis epigejos</i>	c	.	I
Ch. Cl. Chenopodietea			
<i>Erysimum cheiranthoides</i>	c	II	I
Ch. Cl. Plantaginetea majoris			
<i>Plantago major</i>	c	II	I
<i>Carex hirta</i>	c	.	I
Ch. All. Lolio-Potentillion anserinae			
<i>Potentilla anserina</i>	c	II	IV
<i>Mentha arvensis</i>	c	II	I
<i>Taraxacum officinale</i>	c	.	I
<i>Potentilla reptans</i>	c	.	I
Ch. All. Polygonion avicularis			
<i>Tussilago farfara</i>	c	II	.
Ch. Cl. Phragmitetea australis			
<i>Alisma plantago-aquatica</i>	c	II	.
<i>Cicuta virosa</i>	c	II	.
<i>Typha latifolia</i>	c	II	.
<i>Calamagrostis canescens</i>	c	.	I
<i>Persicaria amphibia</i>	c	.	I
<i>Phragmites australis</i>	c	.	I
Ch. All. Magnocaricion elatae			
<i>Carex acuta</i>	c	.	I
<i>Poa palustris</i>	c	.	II
<i>Carex acutiformis</i>	c	.	I
<i>Carex rostrata</i>	c	.	I
<i>Carex vulpina</i>	c	.	I
<i>Scutellaria galericulata</i>	c	.	I
Ch. All. Phragmition australis			
<i>Schoenoplectus lacustris</i>	c	IV	I
<i>Acorus calamus</i>	c	.	I
<i>Glyceria maxima</i>	c	.	I
Ch. Cl. Scheuchzerio-Caricetea nigrae			
<i>Menyanthes trifoliata</i>	c	II	.
<i>Carex panicea</i>	c	.	I
<i>Ranunculus flammula</i>	c	.	I
Ch. All. Caricion lasiocarpae			
<i>Carex lepidocarpa</i>	c	.	I
Ch. All. Alnetea glutinosae			
<i>Myosotis scorpioides</i>	c	II	I
<i>Solanum dulcamara</i>	c	.	I
Accompanying species			
<i>Lythrum salicaria</i>	c	V	II
<i>Eupatorium cannabinum</i>	c	IV	I
<i>Mentha aquatica</i>	c	IV	I
<i>Xanthium strumarium</i>	c	II	II
<i>Acinos arvensis</i>	c	II	I

<i>Bidens cernua</i>	c	II	I
<i>Bidens tripartita</i>	c	II	I
<i>Carex</i> sp.	c	II	I
<i>Chamerion angustifolium</i>	c	II	I
<i>Chenopodium</i> sp.	c	II	I
<i>Echinochloa crus-galli</i>	c	II	I
<i>Fallopia convolvulus</i>	c	II	I
<i>Lycopus europaeus</i>	c	II	.
<i>Persicaria maculosa</i>	c	II	.
<i>Phalacrolooma annuum</i>	c	II	.
<i>Senecio paludosus</i>	c	II	.
<i>Petasites spurius</i>	c	.	III
<i>Festuca gigantea</i>	c	.	II
<i>Rumex aquaticus</i>	c	.	II
<i>Agrostis</i> sp.	c	.	I
<i>Alchemilla</i> sp.	c	.	I
<i>Angelica sylvestris</i>	c	.	I
<i>Anthriscus sylvestris</i>	c	.	I
<i>Bistorta major</i>	c	.	I
<i>Blasmus compressus</i>	c	.	I
<i>Capsella bursa-pastoris</i>	c	.	I
<i>Carex arenaria</i>	c	.	I
<i>Carex spicata</i>	c	.	I
<i>Carex vesicaria</i>	c	.	I
<i>Carlina vulgaris</i>	c	.	I
<i>Cichorium intybus</i>	c	.	I
<i>Cirsium palustre</i>	c	.	I
<i>Cirsium rivulare</i>	c	.	I
<i>Echinocystis lobata</i>	c	.	I
<i>Epilobium palustre</i>	c	.	I
<i>Euphorbia esula</i>	c	.	I
<i>Euphorbia helioscopia</i>	c	.	I
<i>Festuca</i> sp.	c	.	I
<i>Galinsoga parviflora</i>	c	.	I
<i>Galium aparine</i>	c	.	I
<i>Galium rivale</i>	c	.	I
<i>Glyceria fluitans</i>	c	.	I
<i>Heracleum sosnowskyi</i>	c	.	I
<i>Hippophae rhamnoides</i>	c	.	I
<i>Holcus lanatus</i>	c	.	I
<i>Impatiens noli-tangere</i>	c	.	I
<i>Inula salicina</i>	c	.	I
<i>Iris pseudacorus</i>	c	.	I
<i>Lamium</i> sp.	c	.	I
<i>Linum catharticum</i>	c	.	I
<i>Luzula campestris</i>	c	.	I
<i>Luzula multiflora</i>	c	.	I
<i>Medicago falcata</i>	c	.	I
<i>Odontites verna</i>	c	.	I
<i>Onobrychis viciifolia</i>	c	.	I
<i>Ononis arvensis</i>	c	.	I
<i>Ranunculus auricomus</i>	c	.	I
<i>Ranunculus repens</i>	c	.	I
<i>Ranunculus</i> sp.	c	.	I
<i>Rumex crispus</i>	c	.	I
<i>Silene vulgaris</i>	c	.	I
<i>Sinapis arvensis</i>	c	.	I

<i>Sonchus arvensis</i>	c	.	I
<i>Sonchus</i> sp.	c	.	I
<i>Stellaria palustris</i>	c	.	I
<i>Stellaria</i> sp.	c	.	I
<i>Thalictrum aquilegifolium</i>	c	.	I
<i>Trifolium repens</i>	c	.	I
<i>Veronica chamaedrys</i>	c	.	I
<i>Viola</i> sp.	c	.	I

Diversity of bryophytes was not investigated in all communities, so the presence of relevé is not analysed.

* – according to K. Kepczynski & L. Rutkowski (1991) it was the dominant species of syntaxon.



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