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CHARACTERISTICS OF THE *Bidentetea tipartitae* R.TX., LOYMEYER ET PREISING IN R.TX. 1950 CLASS COMMUNITIES IN RIVER VALLEYS OF THE WAŁCZ PLAIN (POLAND)

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Key words:
riverside terophytes, Natura 2000 habitats, Western Pomerania.

SYNOPSIS

The aim of the study was to investigate the divergence, structure, physiognomy and floristic abundance of communities of the *Bidenteta tripartitae* class in the valleys of rivers flowing across the area of the Wałcz Plain in Poland (Dobrzyca, Rurzyca and Piława). 41 phytosociological records were taken using the classic Braun-Blanquet method. The hierarchy classification with the MVSP package was used in order to arrange and group the collected phytosociological data and to single out the types of plant communities. Four plant communities belonging to one alliance, i.e. *Bidention tripartitae* were identified: *Bidenti-Polygonetum hydropiperis* (Miljan 1933) Lohmeyer in R.Tx. 1950 nom invers., *Bidenti-Polygonetum mitis* R.Tx. 1979, *Bidentetum cernui* Kobendza 1948, and a community with *Polygonum minus*.

INTRODUCTION

River valleys are among areas which are exceptionally valuable with respect to their environment. The richness of their flora habitats and vegetation is particularly striking in comparison with the surrounding areas, which are often put to agricultural use. One of the components of vegetation encountered in river valleys includes summer terophytes belonging to the class *Bidentetea tripartitae*. These are communities of pioneer character, encountered in silty habitats where they develop as a result of natural processes of erosion and accumulation taking place in river valleys during prolonged periods of low water (Borysiak, 2004; Borysiak & Stachnowicz, 2000). Such communities frequently develop in the zone adjoining the channel of natural rivers and rivers only slightly altered by human activity, being the

first stage of succession on the freshly uncovered surface. Their maximum territorial range is connected with low and central course of large and medium rivers (Borysiak, 2004). River regulation combined with straightening and deepening of the river channel leads to the elimination of riverside terophyte habitats. In addition, pollution, salification and hyperfertilisation of the habitats results in the recession of particularly sensitive communities, as well as the reshaping of the structure and physiognomy of the remaining phytocenoses (Brzeg & Ratyńska, 1983, Matuszkiewicz, 2002). The habitats of riverside terophytes are protected as part of the European ecological Natura 2000 network, being marked with the code Physis 24. 52 (Borysiak, 2004).

The aim of the conducted research was to investigate the diversification, structure, physiognomy and floristic richness of communities belonging to the class *Bidentetea tripartitae*, encountered in the valleys of rivers flowing through the Wałcz Plain.

STUDIED AREA

The river valleys are right-bank tributaries of the river Gwda. As for their size, they are counted among small rivers. They flow mainly across the Wałcz Plain (Równina Wałecka) (Fig. 1) situated within the boundaries of the South Pomeranian Lakeland (Pojezierze Południowopomorskie) macroregion, which belongs to the South Baltic Lakeland (Pojezierza Południowobałtyckie) subprovince and the Central European Plain (Niż Środkowoeuropejski) province (Kondracki, 2000). As far as administrational divisions are concerned, the area in question is situated on the border between the West Pomeranian Voivodeship and the Greater Poland Voivodeship, within the boundaries of a region called Ziemia Wałecka.

The South Pomeranian Lakeland encompasses territories situated along the route of glacier recession which created vast sandy plains, i.e. sandar, in river valleys. The sandar are stretching from the neighbourhood of Czaplinek in the north towards the Gwda Valley in the south. Between the river valleys there are moraine uplands originating from the period of Poznań phase and Krajeń subphase recessions of the Vistulian Glaciation. Podsolic soils which have developed on sands and gravels accumulated by the flow of a glacial river are prevalent in the region. The Wałcz Plain is nearly entirely covered with a forest and no large human settlements can be found in the region. Szwecja is one of the few villages in there (Kondracki, 2000).

According to the geobotanical regionalisation of Poland, the region in question belongs to the Pomeranian Divide, Sandur Plain Landscape of the Glazier Foreland in the Central Pomeranian Lakeland (Kraina Sandrowych Przedpoli Pojezierzy Środkowopomorskich) Wałcz Subregion (Podkraina Wałecka) – Gwda Valley District

(Okręg Doliny Gwdy), Piła Subdistrict (Podokręg Pilski), Central European Province, South Baltic Subprovince (Matuszkiewicz, 1993). In the vast sandur plains there are developing coniferous and mixed forests. Apart from these, there can also be encountered beech-oak forests and acid beech forests, as well as alder-ash riparian forests and Central European broad-leaved forests.

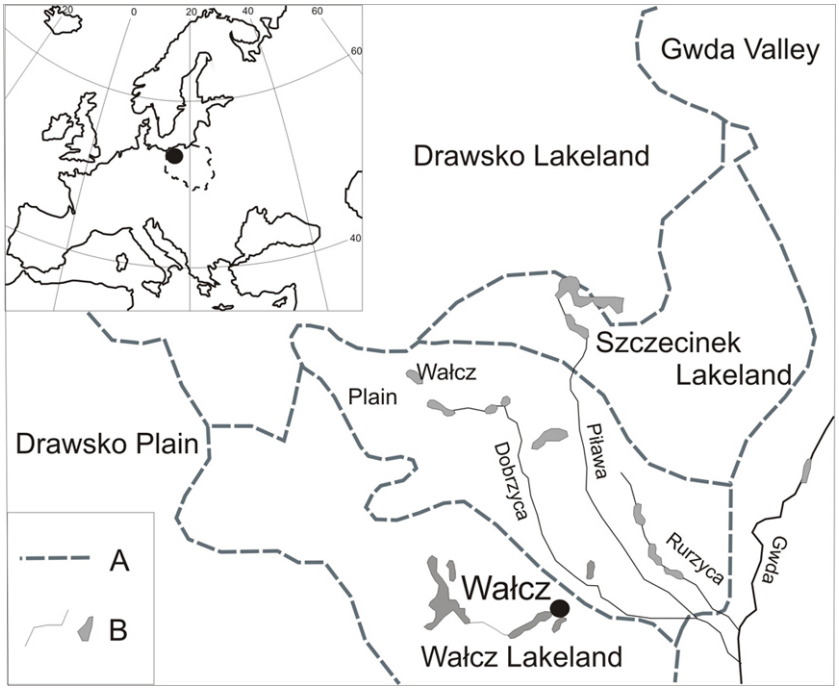

Figure 1: A map of the study area (A – boundaries of geographical mesoregions; B – waters) (Kondracki, 2000).

The Rurzyca River (ca. 25 km long) flows in a deep-cut valley connecting six postglacial lakes situated in a glacial channel through which discharge glacial water used to flow. Steep slopes of the valley are covered with coniferous and mixed forests, as well as the forests characteristic of the seepage spring area. Meadows and open areas constitute only small fragments of the whole. Limestone seepage spring areas and alkaline peat bogs are scattered around the area in question (Charkiewicz et al., 2008). Along the whole length of the Rurzyca glacial channel, at the foot of its slopes, there function ca. 40 seepage spring areas, and the spring water is rich in calcium carbonate (Borówka et al., 2004). As part of the European ecological Natura 2000 network, the Rurzyca River Valley constitutes a special habitat conservation area marked with the site code PLH300017.

The Piława is the longest tributary of the Gwda. It is 79.9 km long, with catchment area of 1388.1 km². The Piława valley is characterised by a mosaic of communities including: forest, shrub, water, bog, seepage spring area, peat bog, silt banks, periodically flooded depressions, loose sandy grassland, moorland and tall-herb saum vegetation. Furthermore, the valley in question is characterised by the presence of a number of water and peat bog ecosystems encountered nowhere else

in the Pomeranian Lakeland belt, which are associated with the postglacial channel deeply cutting through the sandar (Borówka et al., 2004). A fragment of the valley situated in the neighbourhood of water reservoirs near Nadarzyce (Zalewy Nadarzyckie) constitutes a special habitat conservation area included in the European ecological Natura 2000 network and marked with the site code PLH320025.

The Dobrzyca River is 64.3 km long and has the catchment area of 925 km². The sandur river valley is surrounded by bog forests, mainly alder-ash riparian forests, while open areas are encountered only in the neighbourhood of towns.

The area drained by the rivers is rich in lakes, including flow-through lakes, this fact having a considerable influence on the amount of water flowing through the rivers. The valleys are responsible for about 20 to 30% of rainwater flushing, while the value of the total run-off is twice lower, amounting to ca. 4 to 6 l/s/km². This is due to water loss resulting from water evaporating off lake surfaces. Furthermore, the sandur accumulations which dominate in these valleys are water-pervious, increasing underground run-off and simultaneously decreasing surface run-off. The peak river flow is observed in spring (April). At this time of year the water flow in the river channel is 20-60% higher than the annual average. The low water flow is usually observed in August, but it is never lower than a half of the average annual flow. The highest observed water flow amounted to 20 m^3/s for the Piława and 16.9 m^3/s for the Dobrzyca, while the long-term average water flow amounted to 7.49 m^3/s for the Piława and 5.25 m^3/s for the Dobrzyca (Borówka et al., 2004).

According to climatic regionalisation of Poland (Woś, 1999) the investigated area is situated in the Central Pomerania Region. Western and northwestern winds are prevalent in the region. The average annual temperature amounts to 7.5ºC (17 ºC in July, -2 ºC in January). The average annual precipitation amounts to 630 mm. In comparison to many other regions, in the region in question the days characterised by a moderately warm weather and a considerable cloud amount are more frequent (the annual average amounting to 50 days), while the number of cool and rainy days is lower (the annual average amounting to 26 days). Furthermore, the annual average of 36 days is characterised by a moderately warm and rainy weather with a considerable cloud amount. Very warm and sunny days are less frequent in the region in question (the annual average amounting to mere 11 days). The vegetation season is from 210 to 220 days long.

MATERIALS AND METHODS

The field research in the Wałcz Plain was conducted in August 2009. The investigated area encompassed the valleys of the Dobrzyca, the Rurzyca and the Piława. The relevés placed in the patches of plant communities belonging to the

Bidentetea tripartitae class were analysed according to the standard Braun-Blanquet method (Pawłowski, 1977) with several additional categories (2m, 2a, 2b) (Barkman et al., 1964). While choosing representative phytocenoses their homogeneity was a criterion taken into account (Matuszkiewicz, 1972). The GPS system was utilised to help locate the investigated patches of plant communities. A database was created with the help of the software Turboveg for Windows. The MSVP software package was utilised for the purposes of hierarchical classification, in order to systematize and arrange into groups the collected phytosociological data, as well as to differentiate particular types of plant communities. In order to evaluate similarity of samples with respect to species composition the percent similarity was calculated (Gauch, 1982) and the Unweighted Pair Group Method with Arithmetic Mean (UPGMA) was applied (Sneath & Sokal, 1973). The classification of plant communities was taken from Brzeg & Wojterska (2001). Vascular plant nomenclature was taken from MIREK et al. (2002) and bryophyte nomenclature was taken from OCHYRA et al. (2003).

RESULTS AND DISCUSSION

Forty-one relevés were established in the patches of plant communities belonging to the class *Bidentetea tripartitae* and encountered on the banks of rivers flowing through the Wałcz Plain.

Four plant communities belonging to one alliance, namely *Bidention tripartitae*, were identified on the basis of numerical classification (Fig. 2):
Bidentetea tripartitae R.Tx., Lohmeyer et Preising in R.Tx. 1950
Bidentetalia tripartitae Br.-Bl. et R.Tx. 1943
Bidention tripartitae Nordhagen 1940 em. R.Tx. i Poli et J.Tx. 1960
Bidenti-Polygonetum hydropiperis (Miljan 1933) Lohmeyer in R.Tx. 1950 nom invers.
Bidenti-Polygonetum mitis R.Tx. 1979
Bidentetum cernui Kobendza 1948
Community with *Polygonum minus.*

A majority of the investigated patches of plant communities belonged to the association *Bidenti-Polygonetum hydropiperis* (Miljan, 1933) Lohmeyer in R.Tx. 1950 nom invers. In the dendrogram it is represented by the following groups: 1, 2, 3, 5 (Fig. 2). The phytocenoses of water pepper developed on flat river banks and within the boundaries of small avulsion where a layer of fertile silt covered the sand material accumulated by the river. Similarly to the patches encountered in the Wartan alluvia, described by BORYSIAK (1994), in the habitats in question the silt formation process was frequently observed taking place in the soil. If this was the case, the colour of soil surface was very dark, sometimes even black. Patches of plant community which developed on the avulsion covered areas considerably varied

in sizes, ranging from 3m^2 to even 100 m^2. However, such large patches were rarely encountered and were usually partially interwoven with neighbouring plant communities. The habitats in question developed at the back of small shoals accumulated both on the inside and the outside of the meander bend, often immediately behind a cluster of trees which obstructed the river current.

Patches of the *Bidenti-Polygonetum hydropiperis* association were also encountered in watering places visited by animals and at the edge of a footpath trodden by people. These patches were situated clearly lower than the surrounding vegetation in the immediate proximity of the river. The phytocenoses in question also accompanied the outflow of subsoil water and were developing on a very soggy, watery surface, where the layer of dark, aggradate mud might be even as thick as 15 cm.

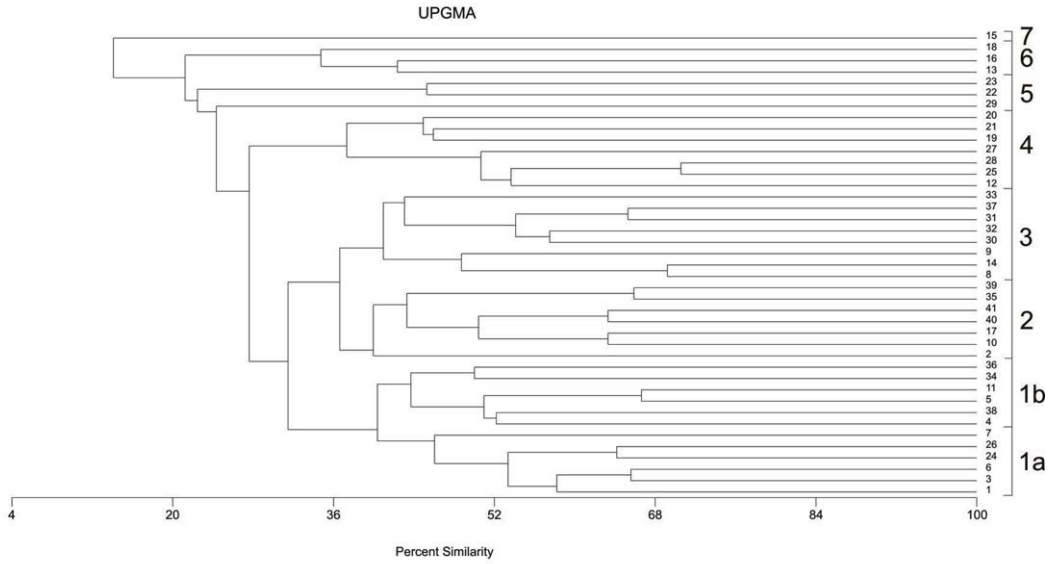

Figure 2: The numerical classification of relevés from rivers of the Wałcz Plain – dendrogram (1-41 – numbers of relevés; groups 1, 2, 3, 5 – *Bidenti-Polygonetum hydropiperis* (Miljan 1933) Lohmeyer in R.Tx. 1950 nom invers., group 4 – *Bidentetum cernui* Kobendza 1948, group 6 – *Bidenti-Polygonetum mitis* R.Tx. 1979, 7 – comm. with *Polygonum minus*).

Many of the investigated vegetation patches were reflooded by the river swollen after torrential summer rains. In the established relevés this fact was associated with a significant presence of *Lemna minor* and *Spirodela polyrhiza*.

The community in question also developed at a certain distance from the river, in shallow depressions filled with the stagnant water lingering there after springtime flooding. When the water receded, the phytocenoses of water pepper developed there.

Phytocenoses were adjoining to rush communities, especially *Caricetum acutiformis*, and less frequently to *Phragmitetum communis*, *Glycerietum maximae*, *Caricetum gracilis*. They also developed at the edges of riparian forests (*Alnion incanae*), sometimes being separated from the forest by a narrow patch of an incompletely developed *Urtico-Calystegietum sepium* community.

The phytocenoses of *Bidenti-Polygonetum hydropiperis* were not floristically rich. In total, 81 plant species were identified in the investigated patches. The number of species in particular relevés varied from 5 to 19. Only 5 species belonged to the constancy classes III-V.

The most significant influence on the physiognomy of the community was exercised by *Polygonum hydropiper*, which was dominating in all patches. Among characteristic species belonging to the class and alliance, very low constancy characterised the following: *Polygonum minus*, *Bidens tripartita*, *Alopecurus aequalis*, *Rorippa palustris* (I) and *Bidens cernua* (II). The numerical classification showed some diversity within the patches belonging to the saaotiation in question. In the dendrogram (Fig. 2) they constitute several groups.

Due to the size of the investigated patches, which was frequently rather small, and their shape, which frequently resembled a narrow belt, it was not uncommon for the species from neighbouring phytocenoses to diffuse into the patches in question. In group 1 of the dendrogram there can very clearly be observed the prevalence of rush species, especially *Carex acutiformis*, which is the species most frequently diffusing from the adjoining phytocenosis, i.e. *Caricetum acutiformis*. In this group there are conspicuous the patches with *Lemna minor*, which are situated in the proximity of the river bank and repeatedly flooded by the river water. Group 2 comprises mainly the patches connected with small outflows of underground water, with stagnant water and a thick layer of soggy aggradate mud. They are characterised by a herbaceous plant cover visibly lower in comparison to other patches. In this type of habitat there grow *Cardamine amara* and *Berula erecta*. *Ranunculus repens* is always present, although only in the locations with low herbaceous plant cover. Group 3 comprises patches which developed on the edges of riparian forests, also in places which had been trodden by people, excluding relevé 33, situated at the edge of a peaty meadow. The physiognomy of the patches in question was influenced by *Poa trivialis*, which rarely occurred in a fully developed form, similarly to *Urtica dioica*.

Moss layer was not usually observed in the investigated patches. However, it was noticeable in group 5. The patches of *Bidenti-Polygonetum* developed within the alder-ash riparian forest phytocenoses, in places where water was present for prolonged periods of time. The presence of *Chrysosplenium alternifolium* and *Thelypteris palustris* was another striking feature of the patches in question. In one of the patches *Bidens tripartita* was clearly dominating and thus determining its character.

Table 1. Association *Bidenti-Polygonetum hydropiperis* (Miljan 1933) Lohmeyer in R.Tx. 1950 nom invers. in river valleys of the Wałcz Plain (rivers: D – Dobrzyca, P – Piława, R – Rurzyca; localities: Cz – Czechyń, G – Golce, K – Krębsko, N – Nadarzyce, O – Ostrowiec, Sz – Szwecja, Z – Zdbice)

	1a	1a	1a	1a	1a	1a	1b	1b	1b	1b	1b	1b	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	5	5	5	Constance
Succesively no. of relevé	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	
No. of relevé on dendrogram	1	3	6	24	26	7	4	38	5	11	34	36	2	10	17	40	41	35	39	8	14	9	30	32	31	37	33	29	22	23	
No. of relevé in field	50	53	56	79	81	57	54	93	55	61	89	91	52	60	67	95	96	90	94	58	64	59	85	87	86	92	88	84	77	78	
Date (day, month, year)	21	21	21	28	28	21	21	31	21	21	31	31	21	21	22	31	31	31	31	21	22	21	31	31	31	31	31	28	28	28	
	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	08	
	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	
River	P	P	P	R	R	P	P	D	P	P	D	D	P	P	P	D	D	D	D	P	P	P	D	D	D	D	D	R	R	R	
The nearest locality	N	N	Z	O	K	Z	N	O	N	Sz	G	O	N	Sz	Cz	O	O	G	O	Z	Sz	Z	G	G	G	O	G	K	O	O	
Area of relevé [m2]	3	8	8	2	4	3	2	8	4	6	2	4	3,5	8	2	5	8	8	8	8	5	6	5	3	4	8	2	3	10	8	
Density of herb layer c [%]	95	60	95	70	50	85	95	96	93	95	92	85	40	65	60	75	75	65	70	85	90	90	90	60	97	40	55	65	85	90	
Density of moss layer d [%]	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	zn	-	-	3	-	-	-	-	1	-	-	-	3	4	25	
No. of species	13	10	8	11	12	13	5	6	6	10	9	9	8	12	14	12	13	11	19	13	12	18	12	12	6	6	14	11	19	15	
Ch. Ass.																															
Polygonum hydropiper	4.3	3.3	4.4	4.3	3.2	4.3	5.4	3.3	4.4	5.5	4.3	4.3	3.3	3.3	3.3	3.2	4.3	3.3	3.3	4.4	4.4	3.2	4.3	3.3	4.3	3.2	3.3	3.2	2m.2	3.2	V
Polygonum minus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2m.1	.	.	.	2a.2	.	.	I
Ch. Bidention tripartitae																															
Bidens cernua	.	.	.	.	1.1	2a.1	.	.	.	.	.	.	.	.	.	.	+	2b.1	2b.1	r	2a.1	3.1	.	.	r	.	.	.	.	.	II
Bidens tripartita	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4.3	.	I
Alopecurus aequalis	.	.	+	.	.	2b.2	.	.	.	.	.	.	2b.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Ch. Bidentetalia tripartitae et Bidentetea tripartitae																															I
Rorippa palustris	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	I
Ch. Phragmitetea																															
Galium palustre	.	.	.	2a.1	.	1.2	.	.	.	+	.	.	.	.	+	.	.	.	+	+	1.1	+	.	.	.	.	+	+	.	1.1	II
Mentha aquatica	.	.	.	2m.1	.	.	.	.	1.2	+	.	.	.	+	+	.	+	.	.	.	.	.	.	.	+	.	.	.	1.1	.	II
Carex acutiformis	2m.1	2a.2	2b.2	2a.1	2a.1	2m.2	2a.2	2a.1	2b.2	2a.2	2a.1	1.1	.	.	.	.	.	.	.	.	.	2a.2	+	.	.	.	.	.	1.1	.	III
Glyceria maxima	.	+	.	.	+	+	+	.	.	.	.	.	.	+	2m.2	.	.	.	.	+	+	.	.	.	.	.	.	2a.2	.	.	II
Acorus calamus	.	.	.	.	.	1.2	.	.	2a.2	.	.	.	.	.	.	.	.	.	.	.	.	2a.2	.	.	.	.	.	.	.	.	I
Phalaris arundinacea	.	+	.	.	.	.	.	.	.	.	1.1	1.1	.	.	.	.	1.1	.	.	.	+	+	.	.	.	.	.	.	.	.	I
Berula erecta	2b.2	2a.1	2m.1	+	1.1	.	.	.	.	.	.	+	1.2	.	1.1	1.1	1.1	1.1	.	1.1	1.1	2b.2	.	.	.	.	+	.	+	.	III
Epilobium roseum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2m.1	.	+	2a.1	.	.	.	r	.	.	.	2m.1	.	.	.	I
Scrophularia umbrosa	.	.	.	.	.	.	.	.	1.1	2a.1	.	.	.	.	+	.	.	.	.	.	.	.	r	.	.	.	.	1.1	.	.	I
Sporadic species: Alisma plantago-aquatica 15 (+); *Carex gracilis* 1 (+.2); *Equisetum limosum* 1 (r); *Iris pseudacorus* 6 (+), 14 (1.1); *Peucedanum palustre* 28 (+); *Phragmites australis* 7 (2a.1); *Rumex hydrolapatum* 1 (+); *Scutellaria galericulata* 22 (+); *Sium latifolium* 1 (1.1); *Sparganium erectum* 6 (1.1), 10 (+); *Veronica beccabunga* 5 (+), 17 (+), 19 (2m.2)																															
Ch. Molinio-Arrhenatheretea																															

Poa trivialis	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2m.2	2b.2	2b.2	2b.2	2b.2	3.2	2b.2	2a.2	.	.	.	II
Ranunculus repens	.	.	.	.	1.1	.	.	.	.	.	.	.	+	1.1	+	1.1	+	+	+	+	.	.	2m.2	2m.1	.	.	.	.	+	3.2	III
Cirsium oleraceum	.	.	.	.	.	.	.	.	.	.	2a.1	.	.	.	.	.	.	.	r	.	.	.	2m.1	.	.	.	.	.	.	.	I
Myosotis palustris subsp. *palustris*	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	1.1	1.1	.	.	.	.	.	+	+	+	.	1.1	.	.	.	II
Myosotis palustris subsp. *radicans*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	2m.1	+	.	.	.	.	.	.	.	.	I
Poa palustris	+	.	.	.	.	2a.2	.	.	.	.	.	.	.	2a.2	2a.2	+	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Scirpus sylvaticus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	+	.	.	.	.	1.1	.	.	.	I

Sporadic species: Caltha palustris 2 (+), 14 (r); *Cirsium palustre* 29 (+); *Deschampsia caespitosa* 24 (+), 29 (+); *Equisetum palustre* 13 (+); *Filipendula ulmaria* 27 (+);*Geum rivale* 8 (+); *Holcus lanatus* 29 (r), 30 (+); *Hypericum tetrapterum* 28 (1.1); *Juncus effusus* 15 (+); *Lychnis flos-cuculi* 29 (r); *Lysimachia vulgaris* 11 (+); *Lythrum salicaria* 3 (r), 22 (+)

	1a	1a	1a	1a	1a	1a	1b	1b	1b	1b	1b	1b	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	5	5	5	
Ch. Artemisietea																															
Urtica dioica	.	.	.	.	.	.	.	.	.	+	2a.1	1.1	+	1.1	+	.	1.1	.	.	.	2m.1	1.1	2b.2	+	2m.1	1.1	.	.	.	.	III
Myosoton aquaticum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	I
Symphytum officinalis	.	.	.	.	.	.	.	.	.	.	2m.1	.	r	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	I
Rumex obtusifolius	.	.	.	.	.	.	.	+	.	.	.	+	.	r	.	2a.1	1.1	+	+	.	.	.	.	.	.	+	.	.	.	.	II
Sporadic species: Cirsium arvense 27 (+); *Cuscuta europaea* 11 (+); *Epilobium parviflorum* 20 (+), 28 (+); *Eupatorium cannabinum* 28 (+), 29 (+);*Galeopsis tetrachit* 22 (+); *Geranium robertianum* 29 (+), 30 (2m.1); *Glechoma hederacea* 12 (2b.2); *Impatiens parviflora* 18 (1.1), 19 (r); *Rubus caesius* 21 (r), 30 (+)																															
Ch. Montio-Cardaminetea																															
Cardamine amara	.	r	.	.	1.1	.	.	.	.	.	.	.	.	1.1	2m.1	2a.2	2a.1	+	+	1.1	+	.	.	.	1.2	.	.	.	+	.	II
Stellaria uliginosa	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Ch. Alnetea glutinosae																															
Lycopus europaeus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	1.1	+	.	.	.	+	.	.	+	+	.	.	+	II
Solanum dulcamara	.	.	.	1.1	+	+	2m.1	.	.	.	.	1.1	+	+	+	.	.	.	+	+	+	.	.	.	.	.	.	.	1.1	+	II
Thelypteris palustris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2a.1	+	I
Ch. Alnion incanae																															
Chrysosplenium alternifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	1.1	2a.1	I
Festuca gigantea	.	.	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	+	I
Impatiens noli-tangere	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	I
Stellaria nemorum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2m.2	+	.	.	.	.	.	.	I
Others																															
Brachythecium rutabulum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	2m.2	2b.2	I
Epilobium palustre	2b.1	.	.	+	.	2m.1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	I
Lemna minor	2m.2	2m.2	2m.2	2a.2	2a.2	2m.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I
Plagiomnium undulatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	.	.	.	.	+	.	.	.	.	+	2a.2	I
Stellaria media	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	+	.	.	.	.	I

Sporadic species: *Carex remota* 28 (+); *Eurhynchium striatum* 28 (1.2); *Hydrocharis morsus-ranae* 3 (+), 4 (1.2), 5 (+); *Juncus articulatus* 20 (+); *Leptodictyum riparium* 12 (+), 24 (1.2); *Myosotis caespitosa* 3 (+); *Oxyrrhynchium hians* 16 (r), 19 (1.2); *Spirodela polyrhiza* 4 (2m.2), 5 (1.2); *Trifolium repens* 27 (+); *Viola palustris* 30 (+)

Seven relevés represented the association *Bidentetum cernui* Kobendza 1948 (group 4 – Fig. 2, Table 2). Its patches were developing within the avulsions situated at the edge of riparian forests or peaty meadows, on the surfaces covered with a thick layer of soggy silt. Similarly to the phytocenoses of *Bidenti-Polygonetum hydropiperis*, the characteristic species of the class and alliance in question were represented rather scarcely. The same situation was observed over the peatbog near the village of Ludomy (Kępczyński & Peplińska, 1998). On the other hand, there was observed a significant share of species belonging to the class *Phragmitetea*. In total, 34 species representing this class were observed in the investigated patches, ranging from 8 to 13 per patch. Only 4 species were characterised by III-V constancy classes. The phytocenoses were based mainly on *Bidens cernua*, which in all patches was accompanied by *Polygonum hydropiper*, however its share in the vegetation cover varied from one patch to another. Apart from the two, in a majority of patches there was also recorded the presence of *Berula erecta* and *Cardamine amara*. In relevés 19-21, which encompassed communities that had developed at the edges of peaty meadows, the presence of *Calla palustris* was significant. The surface of some patches was underwater and then there was observed the presence of *Lemna minor*. Moss layer was absent from all patches, similarly to the patches observed on stagnant waters in the region of South Baltic Lakeland (Kępczyński & Rutkowski, 1993). That phytocenoses were adjoining to mainly rush communities – *Caricetum acutiformis*, *Phragmitetum acutiformis*, *Caricetum paniculatae*.

On the riverside of the investigated rivers there were recorded three patches belonging to the alliance *Bidenti-Polygonetum mitis* R.Tx. 1979 (group 6 – Fig. 2, Table 2). They had developed on the surface of avulsions situated in the proximity of the river banks. From the land side they were in contact with *Caricetum gracilis* and *Urtico-Calystegietum sepium.* One patch was separated from water by a belt of *Glycerietum fluitantis*. A striking feature of the phytocenoses in question was the considerable share of *Poa trivialis* and *Urtica dioica* as well as the presence of moss layer in two patches.

One of the investigated patches, namely the community with *Polygonum minus* (7 – Fig. 2, Table 2) was distinguishable by the significant cover of *Polygonum minus* in the absence of other species belonging to the genus *Polygonum*. There was also a large share of rush species, such as *Veronica anagalis-quatica*, *Veronica beccabunga*, and *Carex acutiformis*. The cover of *Myosotis caespitosa* was also considerable. Furthermore, *Bidens cernua* was also observed in the patch in question. It had developed in a different habitat from that of *Bidentetum cernui*, namely on a flat, sandy shoal covered with aggradate mud.

The investigated phytocenoses belonging to the class *Bidentetea tripartitae* developed on the banks of small rivers. Contrary to communities also belonging to this class but situated in the valleys of large rivers, such as the Warta and the Oder (Brzeg & Ratyńska, 1983; Borysiak, 1994; Ratyńska, 2001; Borysiak, 2002), no

communities belonging to the alliance *Chenopodion glauci* (R.Tx. in Poli et J.Tx. 1960) Hejný 1974 were observed. Furthermore, no characteristic species of this alliance were recorded in the investigated patches. Such species had been recorded in the valley of a small river, i.e. the Główna, however the river in question, flowing through an agricultural landscape, flew directly to the Warta (Ratyńska, 2003). The association *Bidenti-Polygonetum hydropiperis* was the one most frequently encountered in the Wałcz Plain. In comparison to the phytocenoses of this association that had been described from the Warta valley (Brzeg & Ratyńska, 1983; Borysiak, 1994) and from the proximity of water reservoirs on the Dunajec (Loster, 1976), the absence of species representing the class *Isoëto durieui-Juncetea bufonii* (Br.-Bl. et R.Tx. 1943 ex Westhoff et al. 1946) was significant. An important part was played by the rush species of the class *Phragmitetea*, exactly as in the patches of other alliances observed in the proximity of the rivers in the Wałcz Plain. This was directly connected with contact phytocenoses, mainly *Caricetum acutiformis*.

The phytocenoses of the water pepper, which had been described by a number of authors, had both natural and anthropogenic character (Faliński, 1966; Brzeg & Ratyńska, 1983; Ratyńska, 2001). Such a phytocenosis was described from the Dobrzyń Plateau (Wysoczyzna Dobrzyńska), where it was encountered on the flat, silty, and periodically flooded stream banks (Kępczyński, 1965). In the investigated area they developed as a natural succession stage. Contrary to the phytocenoses described from the Warta in the surroundings of Poznań (Brzeg & Ratyńska, 1983), synanthropic species played a marginal role in there, which was a proof of the natural origin of these phytocenoses. Only one patch developed in a place rarely visited by people. The presence and character of such patches confirmed the natural character of rivers flowing across the Wałcz Plain.

Table 2. Communities of *Bidentetea tripartitae* class in river valleys of the Wałcz Plain (rivers: P – Piława, R – Rurzyca; localities: Cz – Czechyń, K – Krębsko, O – Ostrowiec, Sz – Szwecja; 4 – *Bidentetum cernui* Kobendza 1948, 6 – *Bidenti-Polygonetum mitis* R.Tx. 1979, 7 – comm. with *Polygonum minus*).

No. of cluster on dendrogram	4	4	4	4	4	4	4	4	6	6	6	7
Succesively no. of relevé	1	2	3	4	5	6	7	Constance	8	9	10	11
No. of relevé on dendrogram	12	25	28	27	19	21	20		13	16	18	15
No. of relevé in field	62	80	83	82	74	76	75		63	66	73	65
Date (day, month, year)	22	28	28	28	28	28	28		22	22	28	22
	08	08	08	08	08	08	08		08	08	08	08
	09	09	09	09	09	09	09		09	09	09	09
River	P	R	R	R	R	R	R		P	P	R	P
The nearest locality	Sz	K	K	K	O	O	O		Sz	Cz	O	Cz
Area of relevé [m2]	4	10	8	6	6	10	2		6	6	5	3
Density of herb layer c [%]	95	55	85	50	90	95	85		85	80	60	85
Density of moss layer d [%]	-	-	-	-	-	-	-		-	8	6	-

No. of species	10	8	9	8	13	10	11		24	12	15	12
Ch. Ass.												
Bidens cernua	5.4	3.2	2b.2	3.2	4.3	5.4	4.3	V	2b.1	+	.	2a.1
Polygonum mite	.	.	.	.	+	.	.	I	2m.1	3.3	2b.2	.
Polygonum minus	.	+	.	.	+	.	.	I	.	.	2a.1	3.2
Ch. *Bidention tripartitae*												
Polygonum hydropiper	2m.1	2a.2	4.3	2a.2	+	+	2a.2	V	3.2	.	2a.2	.
Alopecurus aequalis	+	.	.	.	.	.	.	I	.	.	.	.
Ch. *Phragmitetea*												
Alisma plantago-aquatica	+	.	.	.	.	.	.	I	r	.	.	+
Equisetum limosum	.	.	.	+	1.1	.	+	II	.	.	.	.
Galium palustre	.	.	.	.	2m.1	.	2m.1	I	+	.	.	.
Mentha aquatica	.	1.1	1.1	.	.	+	.	II	.	.	.	.
Carex acutiformis	.	.	1.1	.	2a.1	2m.1	.	II	.	.	.	1.2
Glyceria maxima	2a.2	1.1	2m.2	.	.	.	.	II	r	.	.	.
Berula erecta	+	2b.2	2a.1	.	.	+	2a.2	IV	.	.	.	.
Veronica beccabunga	.	.	.	.	.	.	.		+	.	1.2	1.1
Sporadic species: *Phragmites australis* 5 (2a.2), 10 (2a.2); *Sium latifolium 6* (+); *Carex paniculata* 1 (+); *Carex gracilis* 7 (2m.1); *Epilobium roseum* 8 (+), 10 (2m.1); *Glyceria fluitans* 10 (+); *Scrophularia umbrosa* 8 (2a.1), 11 (+); *Sparganium emersum subsp. emersum* 11 (1.1); *Veronica anagalis-aquatica* 11 (2b.1).												
Ch. *Molinio-Arrhenatheretea*												
Poa trivialis	.	.	.	.	.	.	.		1.2	2a.2	2b.2	.
Myosotis palustris subsp. *radicans*	+	.	+	+	.	.	.	II	1.1	.	.	.
Sporadic species: *Agrostis gigantea* 5 (2b.2); *Caltha palustris* 7 (1.1); *Filipendula ulmaria* 10 (+); *Holcus lanatus* 6 (+); *Hypericum tetrapterum* 8 (+); *Juncus effusus* 8 (1.2); *Lythrum salicaria* 1 (+), 11 (+); *Poa palustris* 8 (2a.2); *Ranunculus repens* 7 (+), 9 (1.1); *Scirpus sylvaticus* 8 (2m.2), 9 (1.2)												
Ch. *Artemisietea*												
Urtica dioica	.	.	.	.	.	.	.	.	1.1	2m.1	1.1	.
Epilobium parviflorum	.	.	.	.	+	+	+	II	.	.	.	.
Sporadic species: *Geranium robertianum* 10 (1.1); *Impatiens parviflora* 8 (+); *Symphytum officinalis* 8 (1.1), 9 (+)												
Ch. *Montio-Cardaminetea*												
Cardamine amara	.	+	1.1	+	1.1	.	.	III	+	+	+	.
Others												
Calla palustris	.	.	.	.	r	+	1.2	II	.	.	.	.
Lemna minor	2m.2	2m.2	.	2a.2	.	.	.	II	.	.	.	.
Lycopus europaeus	+	.	.	.	.	.	.	I	r	.	.	+
Stellaria media	.	.	+	.	.	.	.	I	2b.2	2b.2	.	.
Sporadic species: *Alnus glutinosa* 8 (r); *Solanum dulcamara 6* (+), 11 (+); *Thelypteris palustris* 4 (1.1); *Brachythecium rutabulum* 10 (2a.2); *Ceratophyllum demersum* 4 (+); *Epilobium palustre* 5 (+); *Juncus articulatus* 8 (1.1); *Mentha xverticillata* 7 (1.1); *Moehringia trinervia* 10 (+); *Myosotis caespitosa* 11 (2b.2); *Oxyrrhynchium hians* 9 (2a.2); *Plagiomnium affine* 9 (+); *Plagiomnium undulatum* 9 (+), 10 (+); *Spirodela polyrhiza* 4 (1.2); *Stellaria nemorum* 9 (+); *Trifolium repens* 8 (+).												

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