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VEGETATION OF OLD RIVER-BEDS IN THE AGRICULTURAL LANDSCAPE OF THE CENTRAL BUG RIVER VALLEY (EAST POLAND)

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Celem pracy było ukazanie różnorodności botanicznej starorzeczy środkowego Bugu (Polska Wschodnia). Badaniom poddano 5 starorzeczyy, znajdujące się w różnym stadium zamierania. W badanych starorzeczach stwierdzono 109 gatunków roślin naczyniowych w strefie wodnej i brzegowej. W strefie roślinności wodnej stwierdzono niemal 50 gatunków roślin należących do hydrofitów. Z kolei w strefie roślinności brzegowej notowano prawie 50 gatunków hemikryptofitów, z których niemal połowa posiada jednocześnie status hydrofita, geofita lub terofita. Największa liczba gatunków w badanych starorzeczach przypada na zbiorowiska z rzędów *Potametalia, Phragmitetalia* oraz związku *Magnocaricion*. Natomiast w randze klasy dominują 3 zbiorowiska: zbiorowisko rzęs *(Lemnetea minoris)*, zbiorowisko makrofitów *(Potametea)* i zbiorowisko szuwarowe (*Phragmitetea)*.

Słowa kluczowe: roślinność, starorzecza, dolina środkowego Bugu.

Introduction. Old river beds are all that remains from former river beds. Most often they are characterized by small width, extended, sometimes arched shape and thus their basic morphometric parameter is length. They are relatively young formations, often modified during high water stages. In the Bug river valley they take up small areas; within the Polish part of the Bug river valley there are about 450 old river beds with the area of a little over 0,25 ha (Michalczyk et al., 2002).

Scientists usually present the vegetation of old river beds in the form of a spatial system described as toposequence (Faliński et al. 2000, Tomaszewicz, 1969). Most often the marginal zone is taken up by reed or rushes, while in the littoral zone there are water plant communities with floating leaves. Next, the deepest parts of old river beds are taken up by plant communities with leaves immersed. As the basin becomes more and more shallow, or is eutrophicated, plant systems undergo modifications.

Unfortunately, those interesting enclaves and reservoirs of biological and landscape diversity in the Bug river valley are systematically degraded. Thus, there is a great need of protection, preservation and valorization as well as evaluation of biodiversity of that type of ecosystems. A number of vascular plants alone – mainly hydrophytes, perennial plants and therophytes in the aquatic and littoral zones of the old river beds amounts to about 100 species (Dyguś, 2007).

Most of the old river beds are found in the agricultural areas of the valley, where the preservation of natural wealth does not always go hand in hand with the idea of nature conservation. The greatest threat for the old river beds are dewatering melioration works and also frequently observed contamination of agricultural origin, burning of vegetation or even filling in.

The aim of the work was the presentation of botanical diversity of the old bed of the central Bug river valley (Eastern Poland).

Material and methods. Phytosociological investigations of aquatic and riparian vegetation were carried out in the years 2007–2008. The investigations included 5 old river beds which were at various stages of dying away. Samples of aquatic plants were collected directly with the net dipper, wading in the water to about 1.5 m in depth, on the determined research hydrofoils. They were rectangular transects, perpendicular to the waterbanks, with the size of 40 m^2 (2x20). The investigation of the riparian vegetation was done by determining research surfaces with the size of 100 m^2 (5x20), which included the vegetation of the offshore, inshore and riverside. During the investigations 76 phytosociological records were taken using the Braun-Blanquet method (Pawłowski, 1977).

Species nomenclature was accepted after Mirek et al. (2002). Phytosociological units were determined and presented in the table form according to the syntaxonomic system and nomenclature by Matuszkiewicz (2001).

Stability and the range of their covering were calculated. The enclosed phytosociological tables present the calculated stability classes (I-V) for each species. Class V is granted to species appearing within the range from 81 to 100% of phytosociological records of the analyzed table. Class IV stability includes species which appear in 61-80% of phytosociological records, class III, respectively, 41-60%, class II – 21-40% and class I – 0.1-20%. The range of species covering in particular phytosociological records was described by a seven degree scale (r, + and 1-5 range). The scale of covering shows what part of the phytosociological record is covered by a certain species. The size of covering is marked by the superscript, next to the stability scale, e.g. IV^{1-3}.

According to the physico-geographical division (Kondracki 2002) the investigated objects are situated in the mesoregion of the Podlasie Bug river gap. That region is a middle segment of the Bug river valley and belongs to the South Podlasie Lowland (Fig.1).

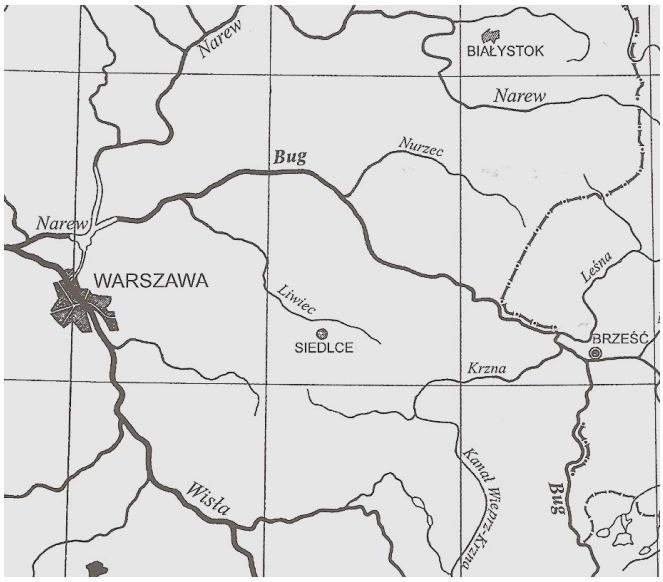

Figure 1. Localization of the investigated area

Flora of the old river beds. Old river beds in the investigated objects are characterized by a relatively big species abundance of the vascular plants. As many

as 109 species of vascular plants were found in the investigated old river beds. Floristic investigations included aquatic and riparian vascular vegetation. Most often the riparian vegetation borders with arable lands (arable fields, meadows, pastures) and woods.

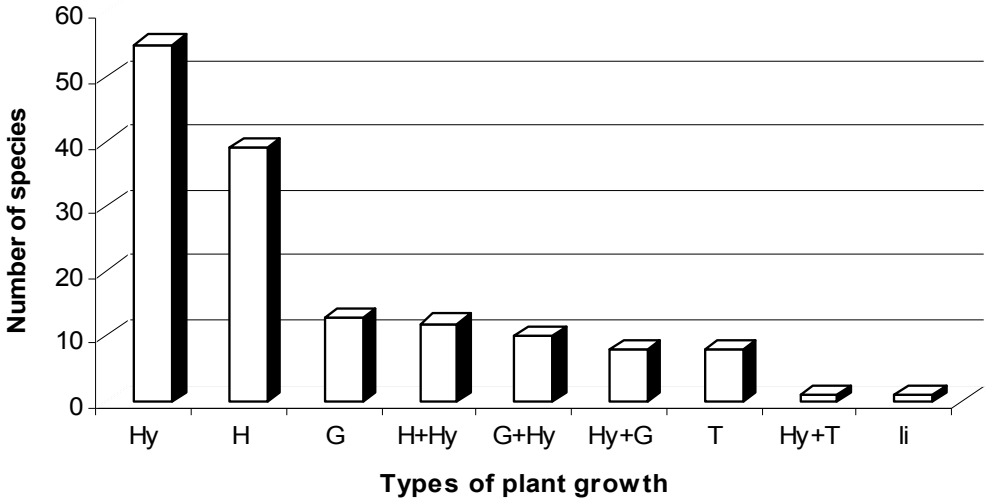

Figure 2. Types of plant growth analysis according Raunkiaer. Hy – hydrophyte, H – hemicryptophyte, G – geophyte, T – therophyte, li – liana

In the zone of aquatic vegetation and transition zone of the investigated old river beds nearly 60 species of typical hydrophytes were found. Among those forms of plant life the following populations were predominant: *Lemna minor, L. trisulca, Nymphaea alba, Nuphar lutea, Potamogeton natans, Ceratophyllum demersum, Potamogeton lucens, Equisetum fluviatile, Phragmites australis, Equisetum fluviatile.* In the zone of riparian vegetation, about 50 species of hemicryptophytes, geophytes and therophytes were found, out of which nearly half has at the same time the status of hydrophyte, geophyte or terophyte. In this group, the most popular were *Poa palustris, Carex riparia, Equisetum fluviatile, Typha latifolia, Myosotis palustris* (Fig. 2).

Syntaxonomic characteristics of the old river beds. It can be assumed on the basis of analysis of floral and phytosociological material that within the investigated old river beds, three communities of the class rank predominated. They are the communities of duck weed, macrophytes and rushes. The highest number of species can be found in the communities of *Potametalia* and *Phragmitetalia* orders and *Magnocaricion* complex (Fig. 3).

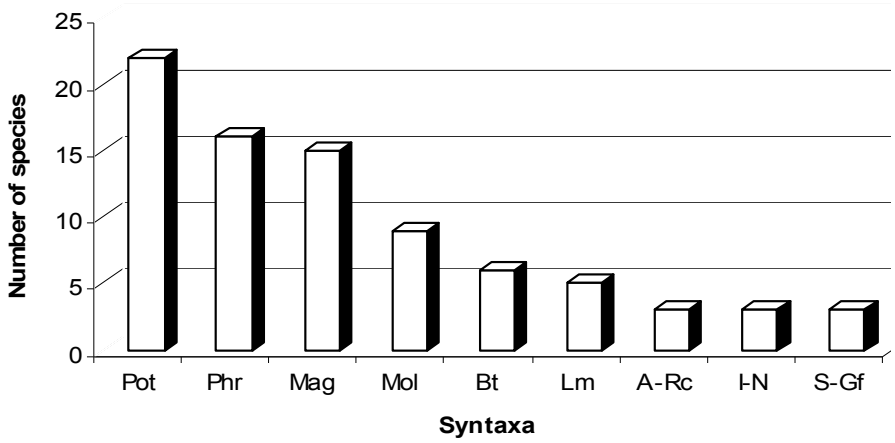

Figure 3. Syntaxonomical analysis of old river-beds vegetation. Pot – *Potametalia*; Phr – *Phragmitetea*, *Phragmitetalia*, *Phragmition*; Mag – *Magnocaricion*; Mol – *Molinietalia caeruleae;* Bt – *Bidention tripartiti;* Lm - *Lemnetalia minoris;* A-Rc – *Agropyro-Rumicion crispi;* I-N – *Isoëto-Nanojuncetea;* S-Gf – *Sparganio-Glycerion fluitantis*

Duck weed community ***(Lemnetea minoris)*** (Tab. 1). In the investigated region that community was observed on the surfaces of old river beds, mainly in the inshore zone within the macrophyte communities (*Potamion, Nymphaeion* and *Hottonion)* and in the vicinity of rush communities (*Phragmition, Magnocaricion).*

Table 1

Duck weed community

Syntaxonomic groups and species	Constancy and cover
Lemnetea minoris, Lemnetalia minoris:	
Lemna minor	V^{2-5}
Lemna. trisulca	V^{1-3}
Lemna gibba	IV^{+-4}
Riccia fluitans	IV^{1-3}
Ricciocarpos natans	III^{1-3}
Spirodela polyrhiza	III^{+-2}
Wolffia arrhiza	II^{+-1}

That community comprised 7 species not including accompanying species belonging to macrophytes and rushes. The biggest share was taken by duck weeds (*Phragmition, Magnocaricion).*

Macrophyte communities ***(Potametea)*** (Tab. 2). This group of communities of the old river beds of the central Bug river is dominated by plants immersed in water. All together 25 species belonging to three complexes were found.

The most abundant in species was the *Potamion* complex. The domineering populations were *Ceratophyllum demersum*, *Potamogeton. lucens*, *Batrachium*

circinatum and others). Among the communities of the *Potamion* complex communities from *Nymphaeion* complex developed. They are dominated by species with floating leaves (*Nymphaea alba, Nuphar lutea* and *Potamogeton natans).* Out of macrophytes, a lesser share is taken up by species of the *Hottonion* complex. Patches of that community with the share of *Hottonia palustris* were found in the shallow inshore waters of the old river beds.

Table 2

Macrophyte communities

Syntaxonomic groups and species	Constancy and cover
Potametea, Potametalia, Potamion:	
Ceratophyllum demersum	V^{1-3}
Potamogeton. lucens	IV^{1-3}
Utricularia vulgaris	IV^{+-3}
Batrachium circinatum	IV^{+-2}
Elodea canadensis	III^{+-2}
Batrachium trichophyllum	II^{+-2}
Myriophyllum spicatum	II^{+-1}
Potamogeton crispus	II^{+-1}
Potamogeton acutifolius	II^{+-1}
Potamogeton pectinatus	II^{+-1}
Hippuris vulgaris f. submersa	I^{+}
Potamogeton friesii	I^{+}
Potamogeton pusillus	I^{r}
Potamogeton gramineus	I^{r}
Nymphaeion:	
Nymphaea alba	V^{1-5}
Nuphar lutea	V^{1-3}
Potamogeton natans	IV^{1-3}
Stratiotes aloides	III^{+-1}
Myriophyllum verticillatum	II^{+-2}
Hydrocharis morsus-ranae	II^{+-1}
Polygonum amphibium	II^{+-1}
Nymphoides peltata	I^{r}
Hottonion:	
Hottonia palustris	III^{+-2}
Callitriche cophocarpa	I^{+}
Batrachium aquatile	I^{r}

Rush communities **(*Phragmitetea)*** (Tab. 3) are the phytocenoses of the inshore and waterside of the investigated old river beds, the most abundant in species – 77 species were recognized.

Out of common rushes *(Phragmition)* the biggest surfaces were taken up by the narrow-mace rush with a large share of reed-mace *Typha latifolia.* Significant areas were taken up by the horsetail rush community. Species making up those communities, mainly with swamp horsetail *Equisetum fluviatile* most often

occupied the inshore zones between the macrophyte communities and rushes. Smaller share of the investigated objects were taken up by communities with *Glyceria maxima, Sparganium emersum, Phragmites australis and Acorus calamus* aggregations.

Table 3

Rush communities

Syntaxonomic groups and species	Constancy and cover	Syntaxonomic groups and species	Constancy and cover
Ch. *Phragmitetea, Phragmitetalia, Phragmition:*		**Others species:**	
Typha latifolia	V^{+-3}	*Myosotis palustris*	V^{+-3}
Equisetum fluviatile	IV^{+-2}	*Cardamine pratensis*	IV^{+-2}
Phragmites australis	III^{1-5}	*Cyperus fuscus*	III^{+-2}
Sparganium emersum	III^{+-4}	*Alopecurus aequalis*	III^{+-2}
Glyceria maxima	III^{+-3}	*Agrostis stolonifera*	III^{+-2}
Acorus calamus	III^{+-2}	*Epilobium hirsutum*	III^{+-1}
Oenanthe aquatica	III^{+-2}	*Filipendula ulmaria*	III^{+-1}
Sium latifolium	III^{+-1}	*Alnus glutinosa*	III^{+-1}
Alisma plantago-aquatica	III^{+-1}	*Lathyrus palustris*	III^{+-1}
Rorippa amphibia	II^{+-2}	*Comarum palustre*	III^{+-1}
Sagittaria sagittifolia	II^{+-1}	*Juncus bufonius*	II^{1-2}
Typha angustifolia	II^{+-1}	*Calla palustris*	II^{+-2}
Butomus umbellatus	II^{+-1}	*Lysimachia. vulgaris*	II^{+-1}
Rumex hydrolapathum	II^{+}	*Lythrum salicaria*	II^{+-1}
Eleocharis palustris	II^{+}	*Mentha aquatica*	II^{+-1}
Sparganium erectum	I^{+}	*Solanum dulcamara*	II^{+-1}
Schoenoplectus lacustris	I^{+}	*Scirpus sylvaticus*	II^{+-1}
Hippuris vulgaris	I^{+}	*Limosella aquatica*	II^{+}
Ch. *Magnocaricion:*		*Salix cirenea*	II^{+}
Carex riparia	V^{2-4}	*Polygonum hydropiper*	II^{+}
Poa palustris	V^{1-3}	*Equisetum palustre*	II^{+}
Carex acutiformis	IV^{1-3}	*Myosoton aquaticum*	II^{+}
Carex gracilis	III^{1-3}	*Polygonum lapathifolium*	I^{+}
Carex pseudocyperus	III^{+-2}	*Menyanthes trifoliata*	I^{+}
Iris pseudacorus	III^{+-2}	*Potentilla anserina*	I^{+}
Phalaris arundinacea	III^{+-2}	*Stachys palustris*	I^{+}
Carex paniculata	II^{+-1}	*Ranunculus sclerantus*	I^{+}
Lysimachia thyrsiflora	II^{+}	*Menyanthes trifoliata*	I^{+}
Ranunculus lingua	II^{+}	*Rumex conglomeratus*	I^{+}
Carex versicaria	II^{+}	*Rumex palustris*	I^{+}
Carex vulpina	II^{+}	*Ranunculus flamulla*	I^{+}
Cicuta virosa	II^{+}	*Urtica dioica*	I^{+}
Peucedanum palustre	II^{+}	*Scutellaria hastifolia*	I^{+}
Galium palustre	II^{+}	*Senecio paludosus*	I^{+}
Scutellaria galericulata	II^{+}	*Symphytum officinale*	I^{+}
Carex elata	II^{+}	*Succisella inflexa*	I^{+}
Ch. *Sparganio-Glycerion fluitantis:*		*Calamagrostis stricta*	I^{+}
Glyceria fluitans		*Teucrium scordium*	I^{+}
Glyceria plicata			
Scrophularia umbrosa			
Veronica anagallis-aquatica			

The range of large-sedge rushes was marked by the inshore occurrence of a few sedge species: stream-bank sedge *Carex riparia*, marsh sedge *Carex acutiformis,* acute sedge *Carex gracilis* and others.

Conclusions:

1. Old river beds in the Bug river valley are characterized by rich flora and vegetation, the composition and structure of which may be a good indicator of the state of the environment.
2. Preservation of the waterside vegetation of the old river beds may prevent its dying out and lowering of the water-levels, inhibiting eutrophication of the agricultural origin.
3. Most of the old river beds in the Bug river valley should be taken under area protection (e.g. ecological lands, nature and landscape complex, reserves).
4. Performing botanical monitoring of the old river beds may contribute to the improvement of the state of the environment in the agricultural landscape of the Bug river valley and help in accomplishing the aims of the balanced development of the region.

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РОСЛИННІСТЬ СТАРИЦЬ В АГРОКУЛЬТУРНИХ ЛАНДШАФТАХ ЦЕНТРАЛЬНОЇ ЧАСТИНИ ЗАХІДНОГО БУГУ (СХІДНА ПОЛЬЩА)

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Описано ботанічну різноманітність стариць Західного Бугу (Східна Польща). Дослідженнями охоплено 5 стариць, що перебувають у різних стадіях розвитку. Підтверджено 109 видів рослин, які зростають на прибережних територіях та у воді. У межах водних фітоценозів зафіксовано близько 50 видів рослин, що належать до гідрофітів. З досліджуваної берегової рослинності – близько 50 видів гемікриптофітів, з яких майже половина є водночас гідрофітами, геофітами або терофітами.

Найбільша кількість видів у досліджуваних старицях припадає на рослинні угруповання порядків *Potametalia, Phragmitetalia* та союзу *Magnocaricion.* Однак на рівні класу домінують 3 угруповання: ряскові (*Lemnetea minoris)*, макрофітові *(Potametea)* та очеретяні (*Phragmitetea)*.

Ключові слова: рослинність, стариці, долина Західного Бугу.

РАСТИТЕЛЬНОСТЬ СТАРИЦ В АГРОКУЛЬТУРНЫХ ЛАНДШАФТАХ ЦЕНТРАЛЬНОЙ ЧАСТИ ЗАПАДНОГО БУГА (ВОСТОЧНАЯ ПОЛЬША)

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Описано ботаническое разнообразие стариц Западного Буга (Восточная Польша). Исследованиями охвачено 5 стариц, которые находятся в разных стадиях развития. Подтверждено 109 видов растений, которые растут на прибрежных территориях и в воде. В пределах водных фитоценозов зафиксировано около 50 видов растений, которые принадлежат к гидрофитам. Из исследуемой береговой растительности – около 50 видов гемикриптофитов, из которых почти половина является в то же время гидрофитами, геофитами или терофитами.

Наибольшее количество видов в исследуемых старицях приходится на растительные группировки порядков *Potametalia*, *Phragmitetalia* и союзу *Magnocaricion*. Однако на уровне класса доминируют 3 группировки: рясковые (*Lemnetea minoris*), макрофитовые (*Potametea*) и камышовые (*Phragmitetea*).

Ключевые слова: растительность, старицы, долина Западного Буга.