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# RUSHES COMPLEXES OF *MAGNOCARICION* (KOCH 1926) IN THE CONDITIONS OF LIMITED UTILIZATION IN GREAT OBRA RIVER WETLAND (PL. WIELKI ŁĘG OBRZAŃSKI) (PLB300004)

*Summary*

*A natural and site valorization of rushes complexes of Magnocaricion was the aim of the research conducted in the Great Obra River Wetland in the years 2007-2012. The inclusion of the terrain into NATURA 2000 region imposes some limitation in agricultural utilization of the area which, along with the site conditioning and the characterization of Obrzanskie Channels (pl. Kanały Obrzańskie) overflow, forms rushes phytocenoses. The analysis and assessment of flora was conducted on the basis of 400 phytosociological releves taken with Braun-Blanquet's method. The complex was characterized on the basis of soil opencast, collected soil samples and with a phytoindication method. Five plant groups from Magnocaricion were identified: Caricetum ripariae, Caricetum acutiformis, Caricetum elatae, Caricetum gracilis and Phalaridetum arundinaceae. These phytocenoses developed on organic and peat soils of a diverse trophism. Floral structure was rich in species and included numerous synatrophic species from the neighbouring grasslands. Fooder value of these communities was low, yet their extensive utilization (in accordance with the outlines of the Environmental Management Scheme) allows for the maintenance of highly natural rushes phytocenoses and relatively high natural qualities. It also contributes to the protection of nest and feeding sites of water-marsh birds.*
***Key words**: Great Obra River Wetland, grass and sedge rushes, utilization, site, soils, diversity of flora*

# ZBIOROWISKA SZUWAROWE ZE ZWIĄZKU *MAGNOCARICION* (KOCH 1926) W WARUNKACH OGRANICZONEGO UŻYTKOWANIA NA WIELKIM ŁĘGU OBRZAŃSKIM (PLB300004)

*Streszczenie*

*Celem badań prowadzonych w latach 2007-2012 na Wielkim Łęgu Obrzańskim (WŁO) była waloryzacja przyrodniczo - siedliskowa zbiorowisk szuwarowych ze związku Magnocaricion. Objęcie tego terenu ochroną w postaci obszaru NATURA 2000 wymusza na rolnikach pewne ograniczenia w użytkowaniu, co wraz z uwarunkowaniami siedliskowymi oraz charakterem wylewów Kanałów Obrzańskich kształtuje fitocenozy szuwarowe. Analizę i ocenę szaty roślinnej przeprowadzono na podstawie 400 zdjęć fitosocjologicznych wykonanych metodą Braun-Blanqueta. Siedlisko scharakteryzowano w oparciu o wykonane odkrywki glebowe oraz pobrane próbki glebowe, a także metodą fitoindykacyjną. Wyróżniono 5 zespołów roślinnych należących do związku Magnocaricion: Caricetum ripariae, Caricetum acutiformis, Caricetum elatae, Caricetum gracilis i Phalaridetum arundinaceae. Fitocenozy te wykształciły się na glebach organicznych i torfowych o zróżnicowanym trofizmie. W strukturze florystycznej zanotowano znaczne bogactwo gatunkowe, w tym wiele gatunków synantropijnych wkraczających z sąsiednich łąk. Wartość paszowa tych zbiorowisk jest niewysoka, jednak bardzo ekstensywne, ale zgodne z wymogami pakietów Programu Rolnośrodowiskowego ich użytkowanie pozwala na zachowanie dużej naturalności fitocenoz szuwarowych oraz stosunkowo wysokich walorów przyrodniczych. Przyczynia się ponadto do ochrony miejsc lęgowych i żerowisk ptactwa wodno-błotnego.*
***Słowa kluczowe:** Wielki Łęg Obrzański, szuwary trawiaste i wielkoturzycowe, użytkowanie, siedlisko, gleby, różnorodność florystyczna*

## 1. Introduction

Communities of great sedge rushes of *Magnocaricion* (Koch 1926) are relatively popularized and occupy significant parts of river detention basins. What is typical to them is their high naturalness [1, 2, 3, 4, 5, 6, 7]. The formation of various phytocenoses is usually determined by the differences in the trophism of water and marshy sites. Located on peat soils, they are particularly exposed to floral transformations caused by site changes [8]. From a management point of view, the value of great sedges rushes is low, yet recently the interest in such communities as cheap biomass for the energetic purposes has been growing [9, 10, 11]. What is also worth considering, is the natural meaning of these complexes as very valuable retention basins, phyto-sanitary filters, refugia of biodiversity or nest sites for numerous birds [12, 13]. Great sedge rushes occupies about 20 percent of the non-forestry area of the Great Obra River Wetland.

The aim of the work was a natural and site valorization of *Magnocaricion* community taking into consideration flora and soil conditions.

## 2. Research area

The Great Obra River Wetland (PLB300004) is a broad grassland area located in the western part of Wielkopolska and is a nest site for various water-marsh birds of the European significance. It covers the broadest part of River Obra valley, which is also cut by numerous channels and ditches.

The area is padded with soils of hydrogenic origin of various moisture level and peat distribution. It is covered with a mosaic of meadows and pastures. Area subsidence – highly moisturized for most of the vegetation season – are covered with grass and sedge rushes, which are home for birds and also for numerous invertebrates, mainly butterflies. The inclusion of this area into NATURA 2000 requires some limits in agricultural utilization, therefore in the years 2007-2013, a lot of regions were subsidized from 3.1 package (extensive management on meadows and pastures) and from specialty packages 3.2 (the protection of birds nest sites) and 4.2 (great sedge rushes). In case of grass and great sedge rushes from *Magnocaricion*, grassland management is limited to mowing the area at most once a year, depending on the package and in the accordance with its outlines. Such utilization in proper site conditions allows natural plants growth which helps to maintain or even regenerate valuable complexes from *Magnocaricion.*

## 3. Materials and methods

The analysis and assessment of flora was conducted on the basis of 400 phytosociological releves taken with Braun-Blanquet's method [14] in vegetation seasons of 2007-2012. On their basis, phytosociological, botanical and floral structures of utilization groups and the fodder value score - FVS [15] were determined. Moreover, natural qualities of the meadow-pastures community were assessed with Oswit's method [16]. Site was characterized on the basis of plants' phytoindicative properties [17], moreover, 12 opencast exposures were done. From each genetic horizon, soil samples of affected and intact structure were collected. Such properties were determined experimentally:

- specific density – with picnometric method in mineral formations [18] and with Okruszko's model in mineral-organic and organic formations [19];
- bulk density – with Nitzshe's vessels;
- total porosity was calculated on the basis of specific and bulk densities;
- moisture – with a drier-weigh method;
- pH – potentialmetrically in 1 M KCl;
- content of organic matter – by weigh on the basis of ignition loss [18].

Also, ground water level was taken. Soils were classified in accordance with Polish Soil Classification [20].

## 4. Results and discussion

Five associations from *Magnocaricion* (class *Phragmitetea* which includes great sedge and grass rushes) were identified in the area of the Great Obra River Wetland. The biggest areas are taken by patches of *Caricetum gracilis* (53,6%), *Phalaridetum arundinaceae* (30,7%) and *Caricetum ripariae* (12,6%) groups, mosaically located among complexes of *Molinietalia.* Areas taken by phytocenoses of *Caricetum elatae* and *Caricetum acutiformis* (Tab. 1) groups were minor. Most of the area covered by *Magnocaricion* community in the Great Obra River Wetland was subsidized from the natural and agricultural program. These grasslands are mowed at most once a year due to the utilization limitations outlined in the program and site conditions.

*Caricetum ripariae* association in the Great Obra River Wetland composes one-layer dense rushes usually of 1,5 m height. Patches of phytocenoses were usually formed in the foreshore sphere of watercourses and few terrain basins. Phytocenoses of *Carex riparia* in Wielkopolska are relatively unpopular [21, 22, 23, 24], yet they were observed in 52 patches in Great Obra River Wetland, which amounts to almost 13% of the area within rushes complexes (Tab. 1). Most often, they were located next to the phytocenoses of *Carex gracilis* sometimes also with the patches of *Phalaridetum arundinaceae.*

The most popular sedge community not only in Great Obra River Wetland (53,6% of area), but also in other Polish and European river valleys is *Caricetum gracilis* [1, 22, 23, 25, 26]. This group has got a partly anthropogenic character and is usually maintained as a once or twice moan grassland, which is similar to other regions [27]. In the Great Obra River Wetland, *Carex gracilis* rushes occupies mainly mosaically distributed small basins.

In highly moisturized places, among vast grassland complexes and most often in the direct neighborhood of channels, one can find numerous yet small *Phalaridetum arundinaceae* patches. Altogether, 127 phytosociological releves of this group were taken (Tab. 1). Also in Wielkopolska, *Phalaridetum arundinaceae* is one of the most popular proper rushes and, just like in the other regions, it forms belts along rivers, ditches and channels [22, 24, 28, 29].

Unlike other complexes of this order, patches of *Caricetum acutiformis* and *Caricetum elatae* were observed sporadically here. In the Great Obra River Wetland, *Carex acutiformis* rushes was formed only in 6 areas, whereas *Caricetum elatae* was observed in 7 phytosociological releves which were dominated by up to 7 m high tussocks of *Carex elata.* They developed in natural basins laid with peat soils, always soaked with water, which nothing but confirms the observations of other authors according to whom this plant most often develops in post-peat basins and other minor inter-grassland and inter-field waterholes [2, 30].

### 4.1. Flora analysis

The most significant floral diversity was fund in *Phalaridetum arundinaceae* and next – in *Caricetum gracilis* and *Caricetum ripariae* (Tab.1).

In the sward of *Caricetum ripariae*, a characteristic species - *Carex riparia* appeared in some locations in patches of a bit over 50%. About 60% of phytocenoses characterized with a poor species composition (6-14 species) but, due to it, high naturalness. Other patches were richer in species (12-31 species) and similar in composition to grasslands of a differentiating moisture from *Molinietalia* order.

Rushes of *Carex gracilis* developed usually as double-layer patches with a dominant in the upper layer - *Carex gracilis*, but also *Phalaris arundinacea*, *Deschampsia caespitosa*, whereas the lower layer was formed of *Agrostis stolonifera, Poa palustris, Ranunculus repens*, or *Potentilla anserina*. Each patch is different when it comes to physiognomy. 36% of the area is characterized with a small number of species (up to 15), where *Carex gracilis* forms dense, dark green fields up to 0,7 m high. In the other patches *Carex gracilis* is observed much more seldom.

A very similar, double-layer structure is observed in the phytocenoses of *Phalaridetum arundinaceae*. Also here, the species differentiation is visible – from poor patches of typical proper rushes with the domination of *Phalaris*

Table 1. Phytosociological and floral diversity of the patches of the listed phytocenoses
*Tab. 1. Różnorodność fitosocjologiczna i florystyczna płatów wyróżnionych fitocenoz*

| Association | Number of releve | The share of releve [%] | Number of species | Average number of species in the releve | Number of botanical family | Average cover [%] |
|---|---|---|---|---|---|---|
| *Caricetum ripariae* | 52 | 12,6 | 120 | 16,1 | 34 | 75,1 |
| *Caricetum acutiformis* | 6 | 1,4 | 72 | 24,0 | 26 | 67,5 |
| *Caricetum elatae* | 7 | 1,7 | 42 | 13,4 | 20 | 78,6 |
| *Caricetum gracilis* | 222 | 53,6 | 176 | 19,3 | 36 | 79,3 |
| *Phalaridetum arundinaceae* | 127 | 30,7 | 179 | 19,8 | 34 | 84,6 |

*Source: Own work / Źródło: opracowanie własne*

Table 2. Natural and utilization values of the patches of the listed phytocenoses
*Tab. 2. Walory przyrodnicze i użytkowe płatów wyróżnionych fitocenoz*

| Association | Valorisation index in the releve | Average valorisation index | Values | Class of valorisation | Proportion of cover of useful groups [%] | | | | FVS (Fodder Value Score) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | grasses | sedges | legumes | and weed | |
| *Caricetum ripariae* | 1,8 - 4,5 | 2,86 | moderate average | V | 20,8 | 58,6 | 0,4 | 20,3 | 2,34 |
| *Caricetum acutiformis* | 2,1 - 3,9 | 2,65 | moderate | IV | 22,4 | 64,7 | 0,2 | 12,7 | 2,45 |
| *Caricetum elatae* | 2,3 - 4,9 | 3,85 | high | VII | 6,3 | 77,1 | 0,2 | 16,4 | 1,42 |
| *Caricetum gracilis* | 2,1 - 4,2 | 2,81 | moderate average | V | 28,8 | 51,6 | 0,8 | 18,8 | 2,81 |
| *Phalaridetum arundinaceae* | 1,8 - 5,4 | 2,72 | moderate average | V | 75,4 | 5,1 | 1,0 | 18,5 | 5,81 |

*Source: Own work / Źródło: opracowanie własne*

*arundinaceae* and species characteristic to wet sites (up to 13 species in a releves – 26%), to ones much richer in species (13-42 taxons), yet strictly connected to the neighboring grasslands from *Molinio-Arrhenatheretea* class.

In the patches of *Caricetum acutiformis* 72 species of vascular plants. Their number differed in various releves from 14 to 34 (24 on average), which significantly stands out when compared to other phytocenoses of *Magnocaricion* (Tab. 1). Similarly to previously presented rushes, apart from a characteristic species, also here *Carex gracilis* and *Phalaris arundinacea* were observed most often. In the floral compositon of the sward, species which are widely represented are ones of *Molinio-Arrhenathereta* class, especially of the orders *Molinietalia* and *Trifolio fragifere - Agrostietalia stoloniferae* (*Alopecurus pratensis, Potentilla anserina, Ranunculus repens, Festuca arundinacea* and *Plantago major*). Such a composition of phytocenoses of *Caricetum acutiformis* proves that a grassland variant of the group was formed, which has been pointed out by Bocieczko [31], Trąba and Wolański [32], Wyłupek [33].

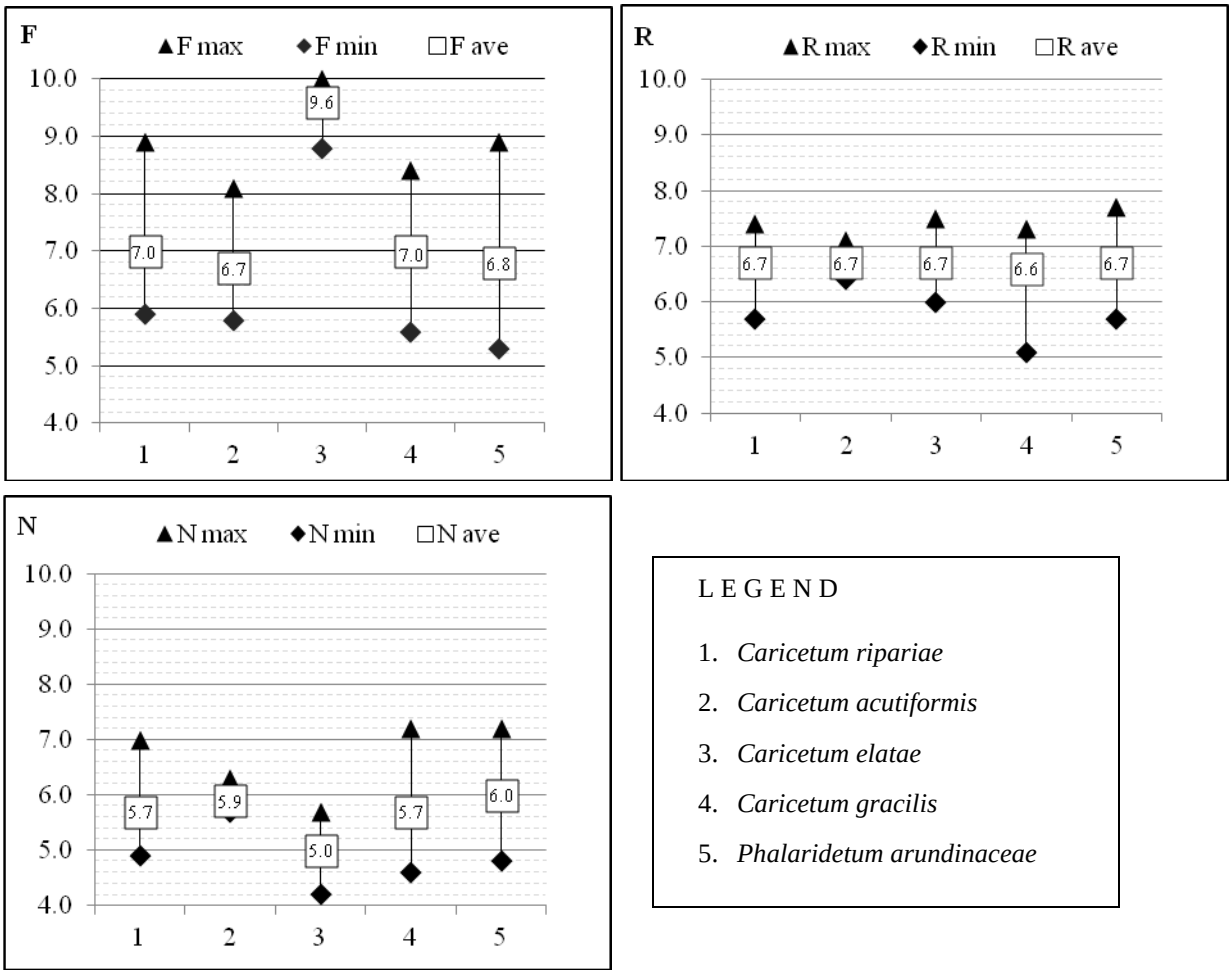
Among the clumps of *Carex elata***,** in the phytocenosis of *Caricetum elatae*, which covered about 80 % of the area in the releves, *Carex riparia* and *Galium palustre* were seen most often. *Carex elata* was often itself a site for other species and was particularly often settled by *Stellaria palustris*. They were the only patches subsidized from the 4.2 package - *Magnocaricon* and, according to its outlines, a yearly mown cover cannot be larger than 20% or it can be mown totally once per 5 years.

Naturalness and natural value of the phytocenoses from *Magnocaricion* alliance is visible in their botanical composition and, particularly, in a large number of species typical to hydrogenic sites and small number of antropofits. Patches of phytocenoses from *Magnocaricion* alliance were classified to the IV and the V valorization classes which proves their moderate and semi-moderate natural values (Tab. 2). What is visible, is the differentiation in the value of valorization indicator not only among each phytocenoses but also among the patches of the same phytocenosis. Such a rule is observed in this case: patches with a larger part of grassland plants show lower values when compared to phytocenoses formed in a wetter site where only taxons adjusted to excessive moisturizing, constant for a large part of the vegetation, period were observed. Therefore, about 10% of total number of *Caricetum ripariae, Caricetum acutiformis, Caricetum gracilis* and *Phalaridetum arundinaceae* patches has got a much higher valorization indicator and their values are described as very high and even outstanding. They are usually composed of a small number of species. They are constant taxons, characteristic to marshlands and some of them such as *Teucrium scordium, Hydrocotyle vulgaris, Lathyrus palustris* or *Cirsium rivulare* require some protection, as an effect of processing deformations of sites they become endangered on a country-wide scale [34]. Patches of *Caricetum elatae* group show, on the other hand, have got a high valorization indicator which stems from high naturalness. They were usually composed of non-synatrophic species connected with wet sites whose decrease is currently observed in the whole country. Such floral composition is also visible in the average valorization indicator which is 3,85 and classifies the phytocenosis of *Caricetum elatae* as a complex of high natural values (Tab. 2).

From a feeding point of view, sedge complexes have very low value. The fact that they occupy different settlements is the main factor which influences the differentiation of their floral composition which is then visible in the utilization value of sward. Among all the plants, this value is mostly influenced by the presence of arable grasses and legumes in the utilization sward [35]. It i salso positively influence by herbs [36, 37, 38].

Large parts of rushes complexes in the Great Obra River Wetland are mown once a year according with the out lines of 3.1 package, usually at the turn of June and July, whereas rushes of *Caricetum ripariae* and *Caricetum acutiformis* – at the end of August and the mown sward is turned into silage or biomass for the energetic purposes. In their floral composition, next to the sedge species of low value which

are from 51,6% of *Caricetum gracilis* phytocenosis part to 77,1% , in the patches of *Caricetum elatae* there are numerous poisonous species such as *Caltha palustris, Cardamine pratensis, Sium latifolium* and species from *Ranunculus* genus which is visible in the Fodder Value Score index (FVS) (Tab. 2). The only complex of this class whose sward was characterized with a close to good value, were *Phalaris arundinacea* grasslands where apart from a dominating *Phalaris arundinacea* a large part of grassland species was observed, mainly form *Molinietalia* order.




*Source: Own work / Źródło: opracowanie własne*

Fig. 1. Average and ranges of phytoindicative factors: F – moisturization, R – soil reaction, N – the content of nitrogen for the listed phytocenoses

*Rys. 1. Średnie oraz zakresy wskaźników fitoindykacyjnych: F- uwilgotnienie, R – odczyn gleby, N – zasobność w azotu w glebie dla wyróżnionych fitocenoz*

### 4.2. Analysis of site conditions

Apart form utilization, site is one of the most important structure forming factors of grassland complexes. Changes in it usually result form direct or indirect anthropopression and lead to the deformations of flora. Changes in floral structure of rushes phytocenoses are usually caused by fluctuations in hydrological conditions and sitetrophism e.g. by dehydration. Soils drying resulting from dehydrating amelioration and, what follows, the decrease of ground waters, is particularly visible in the complexes of marshy and wet settlements [5].

Changes in the moisturization of sites cause the formations of phytocenoses of temporary character by the appearance of species typical to other phytosociological units. Rushes phytocenoses of the Great Obra River Wetland show wide ranges of calculated values of the moisturization factor (F) (Fig. 1). It is a proof of moisture differentiation not only among complexes but is also a base for the determination of various moisturization and floral composition of patches in the inner structure of complexes. It is applicable mostly to the phytocenoses of *Caricetum ripariae*, *Caricetum gracilis*, or *Phalaridetum arundinaceae*, whose patches, formed in the drying sites are very similar to the complexes of *Molinietalia* order. In the more moisturized complexes, patches of *Caricetum elatae* group were formed. A bit lower moisturization was visible in *Caricetum ripariae, C. gracilis, C. acutiformis* and *Phalaris arundinaceae* groups. Trophism of grassland soils is strictly connected with moisturization.

Water-air relations affect the pace and extent of the mineralization process of organic matter which results in the content of nitrogen in soil in forms available for plants [39]. Moreover, soils located in the lowest basins in river valleys are often fertilized with flowing waters rich in biogenes. Different content of nitrogen is visible in the calculated values of N (Fig. 1) whose average content oscillates from 5.0 to 6.0 for the complexes of *Magnocaricion* group. Therefore, it is defined as a moderate richness in nitrogen. Values of soil's reaction factor (R) show a little variability

when compared to pH. Phytocenoses were formed in the settlements from semi-acid to neutral (Fig. 1). Neutral factor, as it is emphasized by Tomaszewski [40], is typical to peat soils, peat-muck soils and alluvial soils whereas soils which undergo the actions of soil-ground water, have got acid mineral and organic connections and an acid factor. These are represented by peat-mineral soils, muck soils and delluvial soils.

Morphological structure and properties marked in various genetic soil horizons allowed such classification of soil: Hemic Sapric Histosol (Drainic) (profile: 1 – *Caricetum ripariae* patch, 2 – *Caricetum acutiformis* patch), Sapric Histosol (Drainic) (profile: 3 – *Caricetum acutiformis* patch, 4, 12 – *Caricetum gracilis* patches, 10, 11 – *Phalaridetum arundinaceae* patches), Hemic Histosol (profile: 6 – *Caricetum gracilis*, 7 – *Caricetum elatae* patch), Sapric Hemic Histosol (profile 9 – *Phalaridetum arundinaceae* patch), Fibric Sapric Histosol (profile 8 – *Caricetum ripariae* patch) and Histic Gleysol (profile 5 – *Caricetum gracilis* patch).

The level of ground water is a significant parameter which determines physical and chemical soil properties [41, 42]. In the patches of rushes complexes it oscillated from 32 in the profile of *Caricetum elatae* phytocenosis (7) to 90 cm in *Caricetum gracilis* patch (profile 12). The determined level of ground water proves a dehydration process in progress in this area. It results in mucked epipedones in most of the analyzed soils.

The content of organic substance and the level of its dissolution is one of the traits of hydrogenic soils [43, 44]. In the presented region, its content in muck soils was between 242,3 in the profile in *Phalaridetum arundinaceae* patch (profile 10) to 691,3 [$g \cdot kg^{-1}$] – in *Caricetum acutiformis* (profile 2). Similar values of this property in the soils of comparable genesis, are given also by other authors [45]. High content of organic substance was also observed in top horizons of peat not mucked soils, in the patches of *Caricetum gracilis, C. elatae, C. ripariae* and *Phalaridetum arundinaceae* rushess (profile 6, 7, 8 and 9).

Table 3. Physical properties of soils
*Tab. 3. Właściwości fizyczne gleb*

| Profile number/ Green complex | Genetic horizon | Depth [cm] | Content of organic matter [$g \cdot kg^{-1}$] | Specific density [$kg \cdot m^{-3}$] | Bulk density [$kg \cdot m^{-3}$] | Porosity [%] | Capacity moisture [%] | pH in 1M KCl | Level of ground water [cm] |
|---|---|---|---|---|---|---|---|---|---|
| 1. *Caricetum ripariae* | M1 | 0-32 | 615,1 | 1874,4 | 521,3 | 72,19 | 51,21 | 5,9 | 85 |
| | Oe1 | 36-80 | 827,2 | 1641,1 | 270,3 | 83,54 | 76,87 | 5,9 | |
| | Oe2 | 80-100 | 888,9 | 1573,2 | 201,3 | 87,26 | 84,22 | 6,2 | |
| 2. *Caricetum acutiformis* | M1 | 0-31 | 691,3 | 1790,6 | 340,1 | 81,00 | 75,88 | 6,1 | 70 |
| | M2 | 31-45 | 668,4 | 1815,8 | 370,6 | 79,67 | 73,32 | 6,3 | |
| | Oe | 45-100 | 800,3 | 1670,7 | 256,4 | 84,43 | 80,12 | 6,5 | |
| 3. *Caricetum acutiformis* | M1 | 0-37 | 435,4 | 2072,1 | 750,6 | 63,77 | 49,98 | 5,6 | 80 |
| | M2 | 37-50 | 402,1 | 2108,7 | 810,2 | 62,67 | 48,56 | 5,6 | |
| | Oa | 50-100 | 623,5 | 1865,2 | 356,2 | 80,75 | 75,31 | 5,9 | |
| 4. *Caricetum gracilis* | M1 | 0-23 | 511,1 | 1988,8 | 700,1 | 64,82 | 55,41 | 6,3 | 77 |
| | M2 | 23-37 | 501,3 | 1999,6 | 720,0 | 64,00 | 54,98 | 6,1 | |
| | Oa | 37-100 | 710,2 | 1769,8 | 410,2 | 76,84 | 70,12 | 6,4 | |
| 5. *Caricetum gracilis* | M1 | 0-25 | 267,1 | 2257,2 | 840,4 | 62,83 | 50,14 | 5,9 | 65 |
| | M2 | 25-55 | 171,2 | 2362.7 | 870,3 | 63,14 | 49,87 | 5,9 | |
| | Cg | 55-100 | 12,30 | 2650,0 | 1754,0 | 33,96 | 29,54 | 5,8 | |
| 6. *Caricetum gracilis* | Oe1 | 0--32 | 770,2 | 1703,8 | 320,3 | 81,18 | 74,23 | 6,1 | 74 |
| | Oe2 | 32-60 | 797,3 | 1674,0 | 300,2 | 81,82 | 74,99 | 6,2 | |
| | Oe3 | 60-100 | 856,2 | 1609,2 | 0,270 | 83,23 | 80,21 | 6,3 | |
| 7. *Caricetum elatae* | Oe1 | 0-21 | 792,3 | 1679,5 | 370,2 | 77,84 | 69,12 | 5,7 | 32 |
| | Oe2 | 21-43 | 670,4 | 1813,6 | 400,1 | 77,90 | 70,03 | 6,1 | |
| | Oea | 43-100 | 500,1 | 2000,9 | 712,3 | 64,50 | 58,44 | 6,3 | |
| 8. *Caricetum ripariae* | Oe1 | 0-18 | 682,3 | 1800,5 | 381,2 | 78,89 | 69,21 | 5,9 | 67 |
| | Oe2 | 18-54 | 706,4 | 1774,0 | 385,6 | 77,97 | 65,44 | 5,9 | |
| | Oei | 54-100 | 889,2 | 1572,9 | 198,4 | 87,26 | 82,19 | 6,1 | |
| 9. *Phalaridetum arundinaceae* | Oe | 0-31 | 636,1 | 1851,4 | 351,2 | 81,08 | 71,21 | 6,5 | 60 |
| | Oea1 | 31-48 | 289,2 | 2232,9 | 854,1 | 61,88 | 50,20 | 7,0 | |
| | Oea2 | 48-100 | 220,3 | 2308,7 | 922,3 | 60,17 | 48,61 | 6,3 | |
| 10. *Phalaridetum arundinaceae* | M1 | 0-39 | 242,3 | 2284,5 | 920,1 | 59,65 | 44,11 | 6,1 | 83 |
| | M2 | 39-54 | 256,4 | 2269,3 | 900,4 | 60,35 | 46,28 | 6,2 | |
| | Oa | 54-100 | 442,3 | 2064,5 | 811,3 | 60,68 | 52,33 | 6,5 | |
| 11. *Phalaridetum arundinaceae* | M1 | 0-23 | 258,1 | 2267,1 | 911,2 | 59,91 | 42,22 | 6,4 | 70 |
| | M2 | 23-47 | 264,8 | 2259,7 | 908,3 | 59,73 | 43,85 | 6,1 | |
| | Oa | 47-100 | 456,7 | 2048,6 | 832,6 | 59,51 | 52,31 | 6,3 | |
| 12. *Caricetum gracilis* | M1 | 0-33 | 475,2 | 2028,3 | 720,6 | 64,53 | 52,37 | 6,1 | 90 |
| | M2 | 33-52 | 480,6 | 2022,3 | 710,9 | 64,85 | 53,84 | 5,7 | |
| | Oa | 52-100 | 600,9 | 1890,0 | 392,3 | 79,36 | 73,25 | 6,0 | |

*Source: Own work / Źródło: opracowanie własne*

Peat levels in the analyzed soils were decomposed to the level that allowed, in most cases, for the classification as *sapric* forms. *Hemic* forms were much more rare. Also, *fibric* peat was observed [20]. The domination of highly decomposed peats is a proof of a developed mucking process in the area.

Specyfic density was inversely proportional to the content of organic matter (Tab. 3). In top levels it oscillated between 1679,5 kg · $m^{-3}$ do 2284,5 kg · $m^{-3}$ so it was the lowest in the profile made in *Caricetum elatae* patch (profile 7), whereas the highest – in *Phalaridetum arundinaceae* (profile 10). In endopedones formed from peat it was lower and oscillated between 1573,2 and 2308,7 kg · $m^{-3}$ (respectively - profiles 1- *Caricetum ripariae* and 9 - *Phalaridetum arundinaceae*). High content of organic matter determined low bulk density and, what follows – lower porosity. Usually, in top horizons, one could observe higher density and lower porosity than in the maternity rocks beneath. In epipedones bulk density oscillated between 320,3 in *Caricetum gracilis* patch (profile 6) to 920,1 kg ·$m^{-3}$ in *Phalaridetum arundinaceae* (profile 10). In the same profiles one could observe relatively the highest and the lowest porosity (59,65 i 81,18%) (Tab. 3). Capacity moisture of all the examined soils and endopedones in particular, was very high, often close to total porosity. The lowest moisture was observed in highly mucked epipedone in profile 11 – of a drying *Phalaridetum arundinaceae* patch, and the highest – in *hemic* peat of profile 1 (Tab. 3). The reaction of the analyzed soils was usually moderately acid [46]. Lower pH values (from 5,6 to 6,4) were observed in top horizons than in those formed of peat, endopedones where pH values oscillated between 5,9-7,0. The decrease of pH along with the processing mucking, was also observed by other authors [47, 48, 49]. Łachacz [49] explained it as the process of constant access of hydrogen cations which occurs during mineralization.

## 5. Conclusions

1. Sites covered by phytocenoses of *Magnocaricion* alliance show great variety especially when soil's moisture is concerned. In the most moisturized sites typical patches of plant aggregate character with s small number of species i.e. *Caricetum elatae* developed, whereas in the driest ones – multi-species and similar to differently moisturized grasslands patches of *Caricetum ripariae*, *Caricetum gracilis* and *Phalaridetum arundinaceae*.

2. The analyzed phytocenoses appear on organic and peat soils, yet highly decomposed peat are dominant, therefore mucking process is highly advanced.

3. Extensive utilization, dictated by the packages of the environmental management scheme, allows for the maintenance of a significant naturalness of these phytocenoses which is visible in the calculated value of the valorization indicator (IV-VII valorization class) and a large number of genuine species characteristic to hydrogenic sites. These rushes are also a perfect nest and feeding site for numerous groups of animals including mainly water-marsh birds.

4. The analyzed rushes complexes in the Great Obra River Wetland show low fooder value which is additionally decreased by the poisonous species mainly from *Ranunculaceae* family.

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