HABITATS, THEIR ANTHROPOGENIC CHANGES AND THEIR INFLUENCE ON WETLAND ECOSYSTEMS CONDITIONS

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Abstract: Wetlands ecosystems are unusually rich ecosystems with a different degree of biodiversity. It is accepted that the classic floristic division of the wetland vegetation is related to different abiotic conditions. The controlling factors are believed to be the direction and rate of water flow, nutrient supply and pH value. But man also induces changes in the environment. To have an adequate analysis of human influences affecting the dynamics of the various nutrients and vegetation composition, as well as to evaluate how management measures affect these dynamics, two transects located in the Biebrza National Park, in Kuligi and Mścichy were selected. Here we report only a description of the vegetation and the anthropogenic changes in the selected areas.

Kuligi transect is characterized by groundwater (topogenic) discharges. Piezometers in Kuligi transect are installed on areas of a various use: mowed areas dominated by low vegetation of *Moilnio-Arrhenatheretea* (*Molinion* meadows) and non-mowed vegetation where we noted a clear succession to the scrubs vegetation (*Salix cinerea* and *Betula pubescens* cover 15% of the area). Groundwater table differs from very low level in late summer and in early autumn (till 103 cm beneath) to levels arranged on surface of the ground or nearly below it, occurring in winter and spring. Mowing changes biodiversity, domination of species, amounts of biomass and litter and ratio between them. Frequently mowing keeps species staying in early stage of vegetation and inhibits blooming also reduces diversity. Early mowing prevents early blooming species from blooming and fructification, while late mowing favours tall species of flora and decreases the feeding quality of plants, especially if the first moving is carried out at the end of June.

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The Mścichy transect is fed by rainwater (fluviogenic). Soils have favourable properties of retention and comparatively large resistance to overdrying. Transect is situated in a *Magnocaricion* (*Caricetum gracilis* and *Caricetum elatae*). Tall sedges (e.g. *Carex acuta*, *Carex elata*) build there the upper layer of community growing up to 100 cm height. Sedges occur in large concentration leaving other plants from bottom layers limited access to light. *Caricetum gracilis* is very expansive. It sometimes occupies considerable surfaces and produces large quantity of hard decomposing biomass. Groundwater table fluctuates from very low levels in late summer and in early autumn (till 98.5 cm beneath) to quite high inundation in winter and spring (max 67.4 cm above). Grazing by cattle limits rank vegetation and domination of expansive species. It provides promotion of structural diversity of species being able to maintain without sowing.

INTRODUCTION

Wetland ecosystems are unusually rich ecosystems with different degree of biodiversity. It is accepted that the classic floristic diversification of the wetlands vegetation is related to different abiotic conditions. There is a big group of factors influencing diversity of habitats responsible for developing different wetland ecosystems and theirs sustaining in good ecological status. It is believed that significant factors are hydrological conditions, nutrient supply, pH value, water quality and management (e.g. grazing, mowing).

But man also induces changes in the environment, and one of the directions of changes in the environment can be degradation. We need to protect ours unique and precious surrounding – natural environment, in particular wetlands which are very susceptible to degradation. We should restore degredated by human impact areas and further protect them. Water Framework Directive (WFD) obligates us to prevent further deterioration as well as to protect and enhance the status of aquatic ecosystems and wetlands.

In order to fulfill the WFD objectives - to keep wetlands in good surface water and groundwater status (determined by good ecological, chemical and quantitative status) we need to specify proper conditions for them. In this case monitoring of wetlands habitats is very important. Therefore there is a need to monitor factors responsible for wetlands conditions in natural areas to implement achieved knowledge about relations in the ecosystems in protection and restoration projects (Wassen *et al*., 2002), (Fig. 1). To obtain a standardized dataset for a board range of vegetation communities, water levels, water composition and the anthropogenic activities we sampled five transects along the relatively undisturbed Biebrza wetlands. These dataset is very useful to restore and to re-establish ecological habitats. The re-establishment of some habitats along the Biebrza river is expected to occur naturally with the restoration of the valley's historic hydrological, geomorphological and management characteristics.

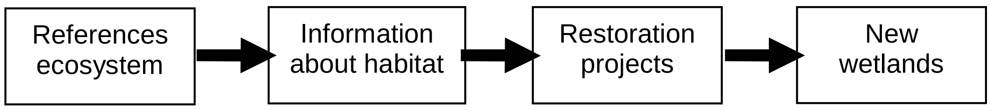

Figure 1. Scheme showing importance of monitoring of wetlands habitats.

The managers of nature reserves involved in restoration try to solve water pollution problems, acidification and eutrophication; at the same time they try to understand the anthropogenic changes (positive and negative). The work deals with projects carried out in the Biebrza National Park wetlands with the following vegetation types: tall sedge community (*Caricetum gracilis*), sedge-moss community (*Caricetum diandrae* or *Caricetum lasiocarpae*), wet meadow (*Molinietum caeruleae*) and alder forest (*Ribeso nigri – Alnetum*). The interactions between vegetation, ground- and surface-water, soil and management are considered to be important for this restoration and conservation projects. In this paper there will be presented a general description of two transects with *Caricetum gracilis* and *Molinietum caeruleae* vegetation. The hydrological, ecological and anthropogenic conditions of these two vegetation types will be discussed.

DESCRIPTION OF THE STUDY AREA

BIEBRZA NATIONAL PARK

The Biebrza National Park was established on September 9, 1993. This Park covers a large part of the Biebrza proglacial valley, situated in northeast part of Poland. The Biebrza National Park is the biggest among Polish National Parks. Its total area is 59.223 ha, surrounded by 66.824 ha of the Park protection zone. Most of the Biebrza valley's peatland are protected. The Biebrza National Park was divided into three basins using a relation of the higher order morphologic features. The Upper Basin located on the Augustów outwash spreads from the springs of Biebrza to the Sztabin city. The Middle Basin covers the area from the Sztabin city to the Osowiec village. The Lower basin is located in the southern part of the valley, from Osowiec village to junction with Narew river (http://gate.mos.gov.pl/).
The main task of the Park is to protect the variety of species of fauna and flora within the existing ecosystem, including various kinds of peat and peat bogs. An elaborate ecosystem of the Biebrza river valley can exist if proper water conditions are maintained. This requires that both: conservation within the park and adjacent areas, as well as necessary protective measures be implemented in those areas, where man has already influenced the environment.
The Biebrza river Valley is the largest and the best-preserved area of fens and forest-raised bogs in the temperate biogeographically zone. The most valuable feature of the Biebrza Marshes is its perfectly formed and well-preserved diagonal and longitudinal ecological zonation. It is based on the top sequence of plant communities from the riverbanks to the edges of the Valley.

TRANSECTS DESCRIPTION

To have an adequate analysis of human influences affecting the dynamics of the various nutrients and vegetation composition, as well as to evaluate how management and groundwater level changes affect these dynamics, several transects along the Biebrza National Park were selected. The present study focuses on two of these transects, the Kuligi- and Mścichy-transect situated respectively in the middle- and lower-basin.

Transect Kuligi. This transect, with four installed piezometers, is situated near Kuligi village (Fig. 2). A layer of peat on study area is comparatively small – does not expand 1 m, only close to the Jegrznia river it may increase even to over 2 m.
Characteristic types of soils for this terrain are hydrogenic soils. They are shallow (the layer of peat is ca. 80 cm thick). They are situated on light formations – the light sands. The layer of peat shows the strong degree of decomposition as well as an amorphous and fibrous structure. The bottom layers of peat show considerable silting.
Transect is placed on soils defined as periodically dry. They have particularly unfavourable properties of water retention. Simultaneously, they are very susceptible to over drying because of the thin layer of peat. The fall of groundwater table lower than 70 – 80 cm below ground level causes unfavourable changes and transformation of these soils (Banaszuk, 2000).
The type of hydrological supply of this terrain is classified as topogenic (by underground water).

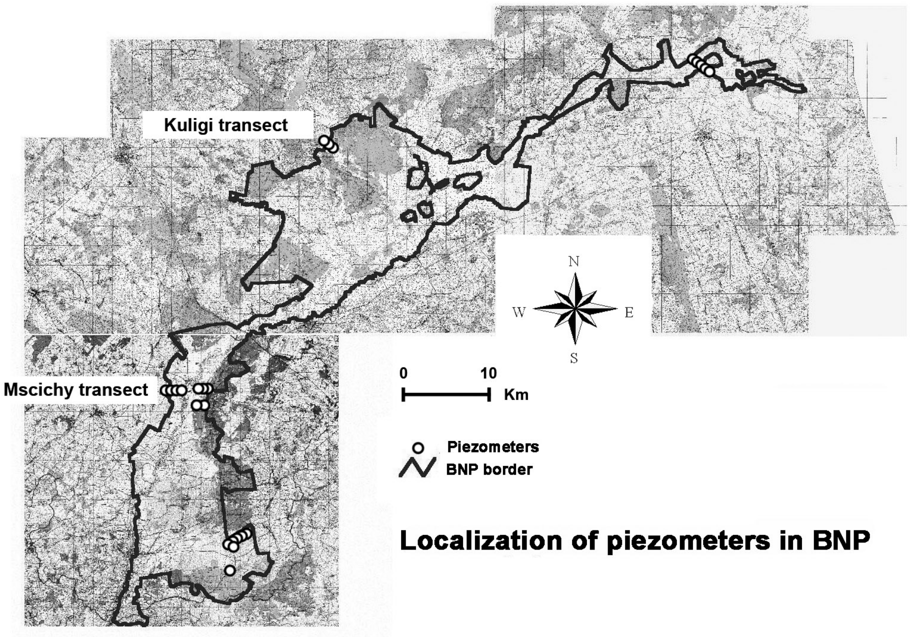

Figure 2. Localization of transects in the Biebrza National Park.

Transect Mścichy consists of five piezometers, one with D-diver's, disposed from Biebrza to the direction of Mścichy locality (Figure 2). Archival documentation executes that soils in this region belong to peat soils of about average degree of decomposition. They possess, in majority, an amorphous and fibrous structure and are laid on very light formations – sands. The thickness of peat is not large, average over 1 m.

This terrain has a fluviogenic type of hydrological supply. Soils have favourable properties of water retention and comparatively large resistance to over drying. In western part of the transect soils possess worse hydraulic properties.

Saturated peat soils noted in transect Mścichy, as well as the one in transect Olszowa Droga on the opposite side of Biebrza, have very low bearing capacity. Low bulk density and a large porosity, characterize those peat soils. These physical and hydraulic properties of hydrogenic soils, in large degree, are responsible for difficulties with mechanical mowing of sedge meadows and removing bushes (Banaszuk, 2000).

VEGETATION DESCRIPTION

Transect Kuligi. Piezometers in transect Kuligi are installed on area covered by *Molinietum coeruleae*. *Molinion* meadows can appear on soils poor in basic alimentary components. Strong and distracted root system of *Molinia coerulea* permits it using the alimentary supplies of soil inaccessible for different, more exacting plants (El-Kahloun *et al*., 2000). *Molinietum coeruleae* appeared oneself in the Biebrza valley in result of the changes of original hydrological conditions. The *Molinion* meadows are resistant to significant changes in the state of moisture of soil during a year. In the neighbourhood of locality Kuligi, they are overgrowing considerable areas with lowered level of ground water and significantly transformed peat soils. These meadows are shaped by autumn mowing on mulch carried out once a year or every second year.

Transect Mścichy. In transect Mścichy piezometers are installed in the area overgrown mainly by: *Glucerietum maximae*, *Caricetum gracilis* and *Caricetum elatae*. On this area vegetation shows characteristic zone distribution in river valley (Okruszko, 1991). The nearest to the Biebrza river are found *Phragmition* communities, further *Magnocaricion* communities (Oświt, 1991).

Caricetum gracilis belongs according to phytosociological classification to *Magnocaricion*. *Carex acuta* is the predominant species of team. Other characteristic species are: *Carex riparia*, *Iris pseudacorus* and some meadow grasses: *Alopecurus pratensis*, *Phalaris arundinacea* (Szafer, Zarzycki, 1972). Mentioned species build the upper layer of community growing up to 100 cm height. Sedges occur in large concentration leaving other plants from bottom layers limited access to light. Bottom layer mainly consists of *Agrostis stolonifera*, and mosses. *Caricetum gracilis* characterizes large diversification, bounded with developmental stage, occurring accompanying species. Many varieties were distinguished. They can be grouped in two variants: typical and mossy (Szafer, Zarzycki, 1972). In transect Mścichy predominates typical variant of *Caricetum gracilis*.

METHODS

GROUND WATER MONITORING

In transects located on terrain of the Biebrza National Park were installed piezometers in which the groundwater level was measured. In part of piezometers were placed D-diver's, automatic instruments for measurement of groundwater level. Interval of measurements was 6 hours. Piezometers (if it was possible) were installed in transects cutting across river valley. Location of transects were chosen in view of occurrence of the interesting for us types of vegetation in cross-section. The choice of measuring places had to take into account the habitats representation (the piezometers were installed in organic soils).
Data of water levels in piezometers was collected manually every three weeks during vegetation period. Data from D-divers was downloaded one time, at the end of measurements. In this paper we present water levels measured by D-divers, located in the two selected transects.

VEGETATION

To have a full overview about vegetation covering transects species richness and composition should be recognized. For that purpose full recordings of vegetation relevés according to Braun Blanquet scale (species, cover, abundance, height etc.) were done. This recognition was done in the middle of June 2004. Nearby each piezometer or even often typical square of 4 or 5 m was chosen and vegetation was recognized. In Kuligi transect six vegetation relevés (Fig. 5) were done and seven in Mścichy transect (Fig. 6).
To have information about productivity of different plant communities aboveground biomass was sampled. In chosen plots, along the transect vegetation samples were taken in squares 50x50 cm. Five replicates of vegetation samples were taken in each plot. In each square aboveground vegetation was cut 2 cm above a soil surface and divided into living, dead and mosses parts. Aboveground vegetation samples were dried at 70℃ for 48h, weighted and di gested with sulphiric acid peroxide mixture (Houba *et al*., 1989). P- and N-concentrations were determined colorometrically (SKALAR auto-analyzer).

STATISTICS

Differences in above ground biomass, N/P ratio and nitrogen and phosphorus concentrations between locations within the two transect were tested using two-way analysis of variance (STATISTICA 5).

MANAGEMENT

Information about management of transects area was collected during the field works. Main sources of information were individual observations of land use during the whole year period and the interviews with the local farmers. This information allows to have a clear overview of management of transects area within last few years (1993 – 2004).

RESULTS

WATER LEVELS

In Mścichy transect D-diver was installed in piezometer located in *Caricetum gracilis* community (vegetation relevé MZ4). Groundwater table changes were measured by D-diver collecting data from the beginning of August 2003 till the end of June 2004 (Fig. 3). In this year there were very big fluctuations of groundwater levels from very low levels in late summer and in early autumn to quite high inundation in winter and spring. High inundation with more than 30 cm above ground surface was present continuously nearly by 150 days in the measurement period. Maximum inundation occurs on 16th and 17th February 2004, in these days water level was 67.4 cm above the ground surface. Maximum lowering of water table was observed on 30th of September 2003 and was situated 98.5 cm below ground surface.
High and long lasting inundations are specific for tall sedges communities such as *Caricetum gracilis* and *Caricetum elatae* (De Mars *et al*., 1997). Soils in Mścichy transect are characterized by average degree of decomposition (Banaszuk, 2000). Comparing this information with presence of deep lowering of groundwater table, allow us to assume that soils have comparatively large resistance to overdrying.

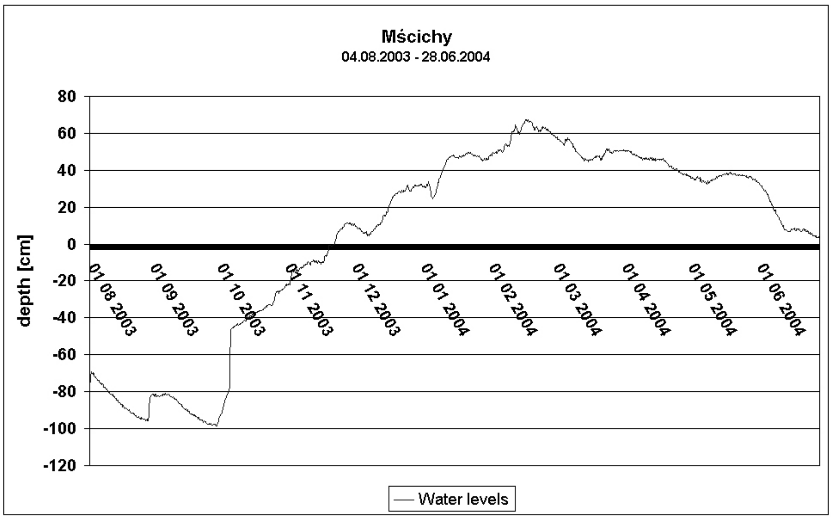

Figure 3. Groundwater table level changes in Mścichy transect measured by D-diver.

In Kuligi transect D-diver was installed in piezometer located in *Molinietum caeruleae* community (vegetation relevé KZ3). Information about water level table was recorded by D-diver from the beginning of May 2003 till the end of June 2004 (Fig. 4).

In Kuligi transect we can observe fluctuations from very low levels in late summer and in early autumn to levels arranged on surface of the ground or nearly below it, occurring in winter and spring. During a measurement period was observed big lowering of groundwater table. Deep lowering with more than 60 cm beneath ground surface was present continuously by 73 days in the measurement period. The deeper level of groundwater table occured on 28th of August 2003, this day water level reached 103.9 cm beneath the ground surface. For most of the time water levels were observed on surface of the ground or nearly below it. There were no high inundations. Maximum level of water table was observed on 27th of February 2004 and was situated 9.8 cm above the surface of the ground.

Soils in Kuligi transect are characterized by thin layer of peat and strong degree of decomposition. They have unfavourable properties of retention and they are very susceptible to over drying. Long-lasting lowering of groundwater table can cause huge damages in soil structure by mineralization processes. Changes and transformation in the soil can be irreversible.

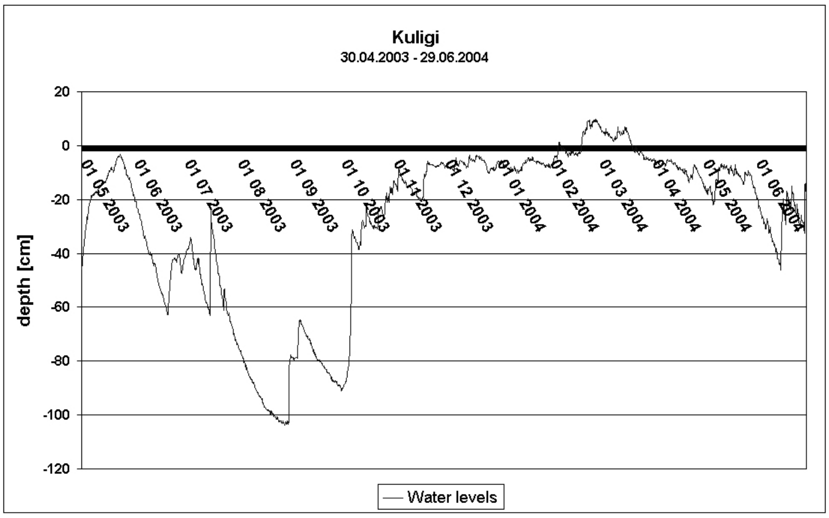

Figure 4. Groundwater table level changes in Kuligi transect measured by D-diver.

CLASSIFICATION OF VEGETATION

Transect Kuligi. Piezometers in transect Kuligi are installed on area of a various use divided by the management. There are present mowed and not mowed areas. Along the transect six vegetation relevés were done (Fig. 5, Tab. 1). On mowed areas dominate low vegetation of *Moilnio-Arrhenatheretea*, on not mowed areas we observed clear succession.

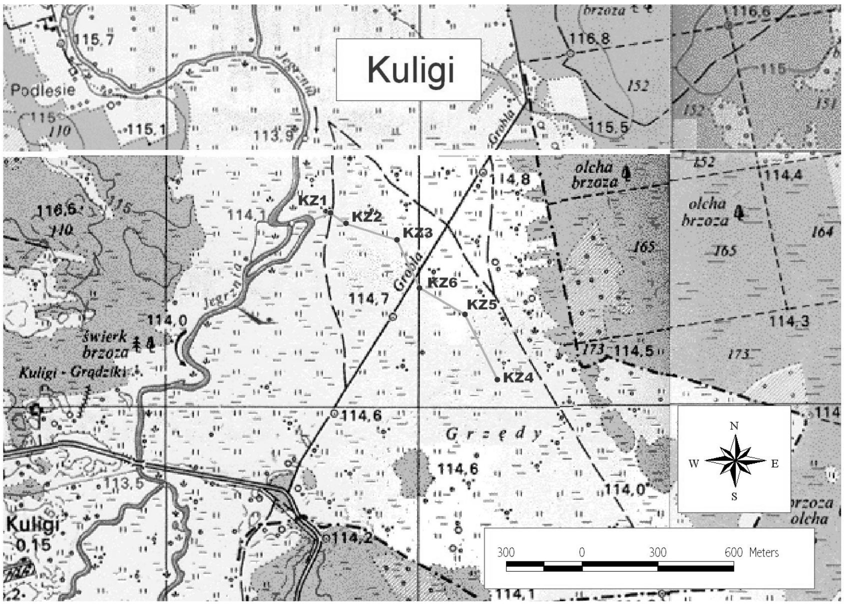

Figure 5. Localization of vegetation relevés along the Kuligi transect.

Table 1. Recognition of plant communities in Kuligi transect.

vegetation relevé	plant community
KZ1	*Deschampsietum caespitosae*
KZ2	*Phalaridetum arundinaceae*
KZ3	*Molinietum caeruleae* subass. *caricetosum paniceae*
KZ6	*Calamagrostis canescens*
KZ5	*Molinietum caeruleae* subass. *caricetosum paniceae*
KZ4	*Molinietum caeruleae* subass. *caricetosum paniceae*

First plot (KZ1) is situated on mowed area, 20 m away from the Jegrznia river. There were found 25 plant species. 20 of them are classified to *Moilnio-Arrhenatheretea* (Tab. 2). Plant community might be classified to *Deschampsietum caespitosae (Calthion).* Dominate *Deschampsia caespitosa*, *Poa pratensis*, *Festuca rubra* and *Ranunculus repens*. This community stretches on the width of 60 m along the Jegrznia river.

In vegetation relevés KZ3, KZ4, KZ5 were found 14 to 24 plant species. The most numerous are *Moilnio-Arrhenatheretea* species, the fewest *Scheuchzerio-Caricetea* species. Dominating plants are *Carex panicea* and *Carex buxbaumii*. Also in vegetation relevés occur *Carex flava, Comarum palustre,* and from mosses *Drepanocladus vernicosus* and *Calliergonella cuspidate.*

An area of a different use is characterized by a not mowed vegetation relevés. In two places transect crosses abandoned areas, not mowed for a long time (KZ2, KZ6). On this area is noticeable a succession. In this place were found such species as *Salix cinerea* and *Betula pubescens*. In vegetation relevés KZ6 scrubs cover 15% of the area. Dominate *Calamagrostis canescens* and *Filipendula ulmaria*. Comparison with neighbouring mowed areas revealed the lack of *Carex panicea* and more significant share of *Filipendula ulmaria* and *Lythrum salicaria*, species characteristic for *Filipendulion*. On not mowed area described by vegetation relevés KZ2 dominate *Phalaris arundinacea, Carex elata* and *Symphytum officinale*. Also we can find here *Lathyrus palustris*, *Ranunculus lingua* and *Peucedanum palustre*. Plant community can be associated as tall sedges community (*Magnocaricion*) - *Phalaridetum arundinaceae*.

Table 2. Division of species present in vegetation relevés in Kuligi transect.

Vegetation relevé	Number of species	*Molinio-Arrhena-theretea* species	*Phragmi-tetea* species	*Scheuch-zerio-Caricetea* species	Other species
KZ1	27	20	3	4	-
KZ2	16	4	5	2	5
KZ3	24	11	5	4	4
KZ6	14	6	2	1	5
KZ5	17	9	4	-	4
KZ4	21	8	5	3	5

Transect Mścichy. Along the Mścichy transect seven vegetation relevés were done (Fig. 6). First plot (the nearest to the Biebrza river) is situated in association of *Agrostis stolonifera*. Next transect come through *Glycerietum maximae*, then in transect are present tall sedge communities: *Caricetum gracilis* and *Caricetum elatae* (Tab. 3). In hole transect we recognized from 11 to 20 species in vegetation relevés (Tab. 4). Most often occur *Phragmitetea* species, the less numerous are *Scheuchzerio-Caricetea* species.

Wet meadow (from *Agropyro-Rumicion*) recognized as an association of *Agrostis stolonifera* is present nearby the river (MZ1), in a place which is the most frequent inundated. In this vegetation relevé accompanying species to *Agrostis stolonifera* are: *Alisma plantago-lanceolata, Sium latifolium, Oenanthe aquatica, Glyceria maxima, Ranunculus aquatilis, Polygonum amphibium.* Next, a little bit further from the river (MZ2) *Glycerietum maximae* plant community is present. Here in this plant community *Oenanthe aquatica*, *Sium latifolium, Alisma plantago-lanceolata, Rorippa palustris* cover big part of area.

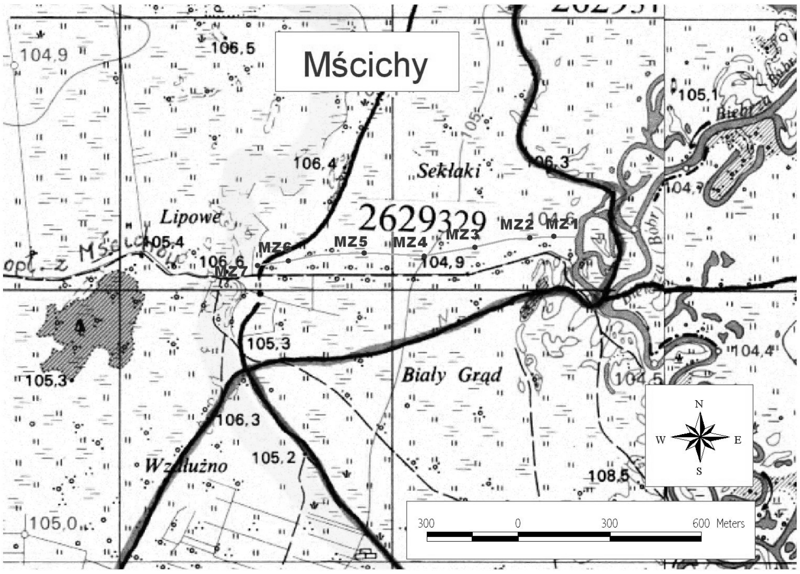

Figure 6. Localization of vegetation relevés along the Mścichy transect.

Table 3. Recognition of plant communities in Mścichy transect.

vegetation relevé	plant community
MZ1	ass. *Agrostis stolonifera*
MZ2	*Glycerietum maximae*
MZ3	*Caricetum gracilis*
MZ4	*Caricetum gracilis*
MZ5	*Caricetum gracilis*
MZ6	*Caricetum elatae*
MZ7	*Caricetum elatae*

Further transect is crossing tall sedge communities: first *Caricetum gracilis* (MZ3, MZ4, MZ5) and then *Caricetum elateae* (MZ6, MZ7). In *Caricetum gracilis* community besides *Carex acuta* considerable participation have *Phalaris arundinacea* and *Glyceria maxima*, creating in some places compact cover. Also there occur *Alisma plantago-lanceolata* and *Galium palustre*. Favourable conditions for them are high ground water levels and long lasting inundations. Also in vegetation relevés recognized as *Caricetum gracilis* community are present *Filipendulion* species such as: *Lysimacha vulgaris, Lythrum salicaria* and *Lathyrus palustris*. In *Caricetum elateae* community dominating species is *Carex elata*, within accompanying species we can find: *Menyanhtes trifoliate* and *Comarum palustre*.

List of present species in Mścichy transect is full of species which favours very wet conditions with high and long lasting inundations.

Table 4. Division of species present in vegetation relevés in Mścichy transect.

Vegetation relevé	Number of species	*Phragmitetea* species	*Molinio-Arrhenatheretea* species	*Scheuchzerio-Caricetea* species	Other species
MZ1	12	7	2	-	3
MZ2	14	6	3	1	4
MZ3	14	9	3	1	1
MZ4	17	9	4	1	3
MZ5	20	9	4	2	5
MZ6	11	5	3	2	1
MZ7	17	6	4	4	3

NUTRIENTS IN VEGETATION

Sampling of vegetation was carried out in the peak of vegetation grow so we can work only on a living part of biomass and have reliable results of analysis. Presented results describe five locations in each transect, labeled from 1 to 5. The lower label of location, the nearer place to the river. Presented results are mean values from 5 replicates in each location. In Kuligi transect the first location is situated in *Deschampsietum caespitosae*, the fifth in *Calamagrostis canescens* and the rest in *Molinietum caeruleae* community. In Mścichy transect all of the locations are situated in *Caricetum gracilis* community.

Results of two-way ANOVA method analysis of dry weight of aboveground living part biomass, N/P ratio and nitrogen and phosphorus concentration, in five locations along the transect, are shown in 4 charts on figure 7.

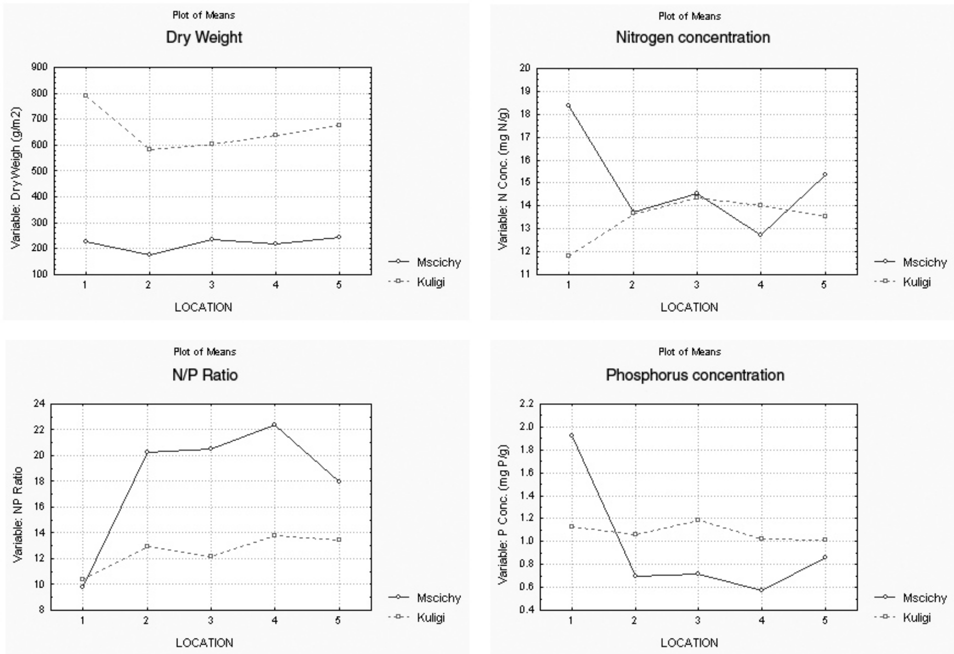

Figure 7. Dry weight, N/P ratio and nitrogen and phosphorus concentration in living part of biomass in two transects within five locations. Values are means from 5 replicates.

There are observed high differences in biomass production within two transects. Vegetation covering Kuligi transect is low productive. Three different vegetation communities present in Kuligi are rather the same productive – produce about 200 g/m^2. Vegetation present in Mścichy transect is more productive. Dry weight of living part of biomass differs from 582.2 g/m^2 to 788.7 g/m^2. The most productive area is located near to the Biebrza river, then productivity decreases to 582.2 g/m^2 and then increases to nearly 700 g/m^2 along the transect.

N/P ratio value can presents us factor which limits growth of vegetation (El-Kahloun *et al*., 2000; Olde Venterink *et al*.). In Mścichy transect there is comparatively high concentration of phosphorus and low nitrogen concentration in biomass. Concentration of phosphorus differs in five locations along the transect from 1.06 to 1.19 mg P/g of dry material. The lowest nitrogen concentration in dried living part of vegetation is present in first location and equal: 11.80 mg N/g of dry material, the highest concentration was noticed in third location – 14.37 mg N/g of dry material. N/P ratio differs from 10.42 to 13.80, lowest in first location, highest in fourth location. N/P ratio indicates nitrogen limitation in Mścichy transect. In Kuligi transect in locations covered by *Molinion* meadow N/P ratio indicates phosphorus limitation, N/P ratio differs from 20.24 in second location to 22.36 in fourth location. Also in fifth location (covered by *Calamagrostis canescens*) N/P ratio indicates P-limitation (N/P ratio = 17.96) but first location is different, we observed there

N-limitation (N/P ratio = 9.82). First location in Kuligi transect covered by *Deschampsietum caespitosae* is located close to the Jegrznia river, which has big influence on present vegetation and nutrient availability. We observed here the highest concentration of nitrogen and phosphorus. The rest of the transect is characterized by comparatively low concentration of nitrogen and phosphorus.

DISCUSSION

N/P ratio of aboveground biomass in Kuligi transect indicates a P-limitation. Except first location, in transect we can find very low phosphorus concentration in biomass which indicates a low availability of phosphorus. The high concentration in first location is caused by influence of water from the Jegrznia river. Neighbourhood of the Jegrznia river also induces high concentration of nitrogen in first location. Concentrations of nitrogen in two transects aren't much diversified (except first location), but transects are characterized by differences in phosphorus concentration. P-limitation in Kuligi transect causes small productivity. Mowing the areas in Kuligi transect increases amount of available nutrients by removing the biomass from the field.

In Mścichy transect phosphorus concentration maintains on higher level than in Kuligi transect. We observe bigger biomass production than in Kuligi transect. Higher phosphorus concentration and comparatively the same concentration of nitrogen induces that phosphorus availability is responsible for productivity in this area. N/P ratio values confirm this assumption, in Mścichy transect we observe N-limitation. In the nearest location to the river we observe bigger productivity. This place is subjected to longer inundations and higher water levels.

Caricetum gracilis is subjected to long-lasting river inundations (in spring, autumn and sometimes in the summer). After receding of inundation, groundwater arrange on level of surface of the ground or nearly below it, however there might be also observed considerable overdrying of the soil. Deep lowering of groundwater table level can cause irreversible changes in habitats by increasing peat decomposition process. *Caricetum gracilis* is very expansive. It sometimes occupies considerable surfaces and produces large quantity of hard decomposing biomass. As a consequence it is of importance in overgrowing and shallowing of river valleys. In plant succession these community bear down *Phragmition*, gradually transforming oneself into communities from class *Molinio-Arrhenatheretea* or in Alder communities.

Caricetum gracilis present in Mścichy transect is subjected to grazing by cattle. Grazing by cattle limits rank vegetation and domination of expansive species. Grazing in selected locations isn't frequent because cows choose food which is easier to get. Ditch lying along the transect, on the north side of a road is a barrier for cows. Small diversity between locations and quite high productivity indicate that there is no big influence of grazing.

Water table levels in Kuligi are mainly arranged on level of surface of the ground or nearly below it (winter and spring). There are also observed very low water levels in late summer and in early autumn. Deep and long-lasting lowering of groundwater table can lead to irreversible changes in soil structure by increasing the decomposition of peat. Especially dangerous is lowering of water table 60 – 70 cm beneath the ground because of the thin peat layer.

In Kuligi transect there are observed two different situations from management point of view. There are present mowed and not mowed areas. On not mowed areas we can see clear succession to scrubs vegetation. Abandonment of management leads to domination of less valuable species and possible loss of habitats due to development of shrubs. It leads to changes in biodiversity, domination of species and amounts of biomass. To have present in this area valuable *Molinion* meadows we are obligated to practice mowing. *Molinion* meadows are shaped by autumn mowing on mulch carried out once a year or rarer. Also too frequent and too early mowing can cause changes in *Molinion* vegetation. Abandonment of mowing can lead to changes in vegetation to tall sedges communities from *Magnocaricion* class and further to scrubs communities and Alder forest.

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