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CHANGES OF GROUNDWATER LEVEL AT „KRASNORYKI" MEADOW SITE IN THE POLESKI NATIONAL PARK

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Summary. The studies were conducted in the years 2008–2009 at the „Krasnoryki" meadow site comprised within „Łąki Zienkowskie" in the Poleski National Park. Most of that area had been drained and reclaimed in the years 1967–1970. The aim of the studies was to assess the influence of changes in water supply on groundwater level of the tested meadows. The groundwater level was highly dependent on precipitation in the years of the studies. Organic soil probing carried out in 2009 showed that the surface of the peat bog was on average about 30 cm lower than in 1976.

Key words: groundwater level, meadow, Poleski National Park, precipitation

INTRODUCTION

The topography of Polesie Lubelskie has little variety and has not been conducive to the development of a drainage network. In many areas, it contributed to the accumulation of an organic soil substrate (peat) formed by vegetation. Organic soils formed in permanently and excessively humid conditions, which facilitated the development of rush, sedge or moss-sedge communities. The direction of the development of these communities depended on the type of water supply to boggy habitats. Both the aboveground and underground biomass formed by vegetation was successively deposited during the peat-forming process and underwent humification, to a smaller or larger extent, depending on periodical aeration intensity. The long-lasting peat-forming process resulted in the emergence of peat deposits varying in thickness depending on physiographic conditions (lake basins, river valleys, local depressions). At the end of the 19th and beginning of the 20th c., attempts were made to drain excessively humid areas in order to increase the acreage of grasslands, particularly pastures for

grass-eating animals [Rostworowski 1882]. These efforts intensified particularly in the 1960s and 1970s. The draining of surface layers of organic soils resulted in a quickly progressing muck soil formation process that caused changes in the physicochemical properties of the soil substrate and its loss resulting from the mineralisation of organic matter. That process lead to the subsidence of the surface layer of the soil and even to the entire disappearance of organic soil layers. Therefore, the muck soil formation process has to be controlled by maintaining a stable, high groundwater level and by reducing the outflow of waters, particularly in protected areas. In addition, monitoring should be conducted in order to establish the direction of changes in the habitat, both with respect to the physicochemical properties of the soil and the plant cover.

The aim of the studies was to assess the influence of changes in water supply on groundwater levels at the „Krasnoryki" meadow site in the Poleski National Park.

MATERIAL AND METHODS

The studies were conducted in the years 2008–2009 at the „Krasnoryki" meadow site comprised within „Łąki Zienkowskie" in the Poleski National Park. Located in the catchment basin of Ciek Zienkowski, the site covers approx. 370 ha (Fig. 1). The complex is bounded by a dirt road between the villages of

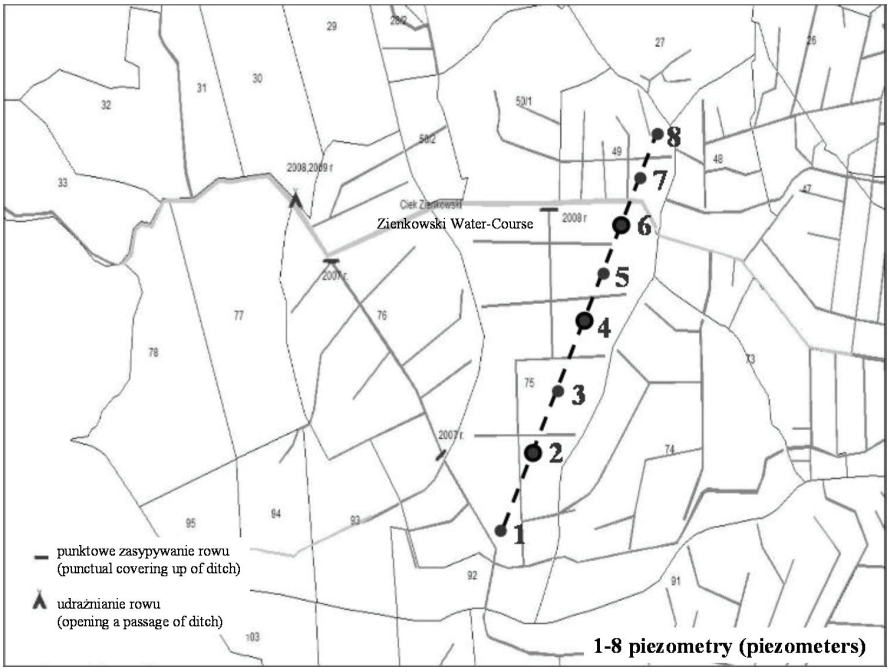


Fig. 1. Distribution of piezometers on studied complex

Zbójno and Lipniak on the east, and by forest ecosystems on the west, south and north. Most of this area was drained and reclaimed in the years 1967–1970. In the years 1974–1975, drainage facilities were modernised, i.e. the existing drainage ditches were deepened to 150 cm, and additional 100 cm ditches were dug [Szajda 1977]. Subsequently, the area was prepared for agricultural use by sowing a seed mixture on organic soils with the following species composition: *Phleum pratense* 17%, *Festuca pratensis* 15%, *Dactylis glomerata* 12%, *Alopecurus pratensis* 3%, *Festuca rubra* 13%, *Poa palustris* 10% and *Lotus corniculatus* 10%. In case the groundwater level fell below 60–80 cm, it was planned to irrigate the meadows with water from the Bogdanka-Wola Wereszczyńska Canal. Currently, the complex is used as meadows cut once a year. The sward is dominated by plant communities of the *Molinio-Arrhenatheretea* class, mainly the *Alopecuretum pratensis* association and *Poo-Festucetum rubra* community. Patches of high sedge rushes or the *Typhetum latifoliae* association grow in local depressions.

In the vegetation season, groundwater level was measured approximately every 10 days (3 times per month) using 8 piezometers (observation wells) located within divisions 49 and 75 of the site (Fig. 1). In autumn 2009, soil profiles were sampled within the piezometers in order to determine the thickness of the organic soil horizon and the intensity of the muck formation process. Meteorological data (amounts of precipitation and mean vegetation temperatures in 2008 and 2009) were obtained at the Automatic Meteorological Station of the Klimaks type in Sosnowica, 6 km away in a straight line from the study site. Based on those data, the correlation between the amount of precipitation over a 10-day period and the groundwater level difference in relation to the previous 10-day period was calculated. The data obtained were compared with the results of studies conducted within the same piezometers in 1976–1977 by staff members of the Lublin branch of the Institute for Land Reclamation and Grasslands Farming [Szajda 1977]. Correlation rates for the years 1976–1977 were calculated based on the results of studies by Szajda [1977] and meteorological data from the Meteorological Station in Sosnowica.

RESULTS AND DISCUSSION

An analysis of the results concerning groundwater levels at the site under study in the years 2008–2009 reveals large variation year to year and in the particular months of the vegetation period. The groundwater level in 2009 was considerably higher than in 2008, which resulted from the greater amount of precipitation in the vegetation period in 2009 (approx. 477 mm) compared to 2008 (approx. 341 mm). The groundwater level was already high in the early spring, mainly as a result of the large amount of precipitation (approx. 225 mm) in the winter of 2008 (Oct–Dec) and 2009 (Jan–Mar). In the corresponding period a year before (2007/2008) the amount of precipitation was only 96 mm. A high

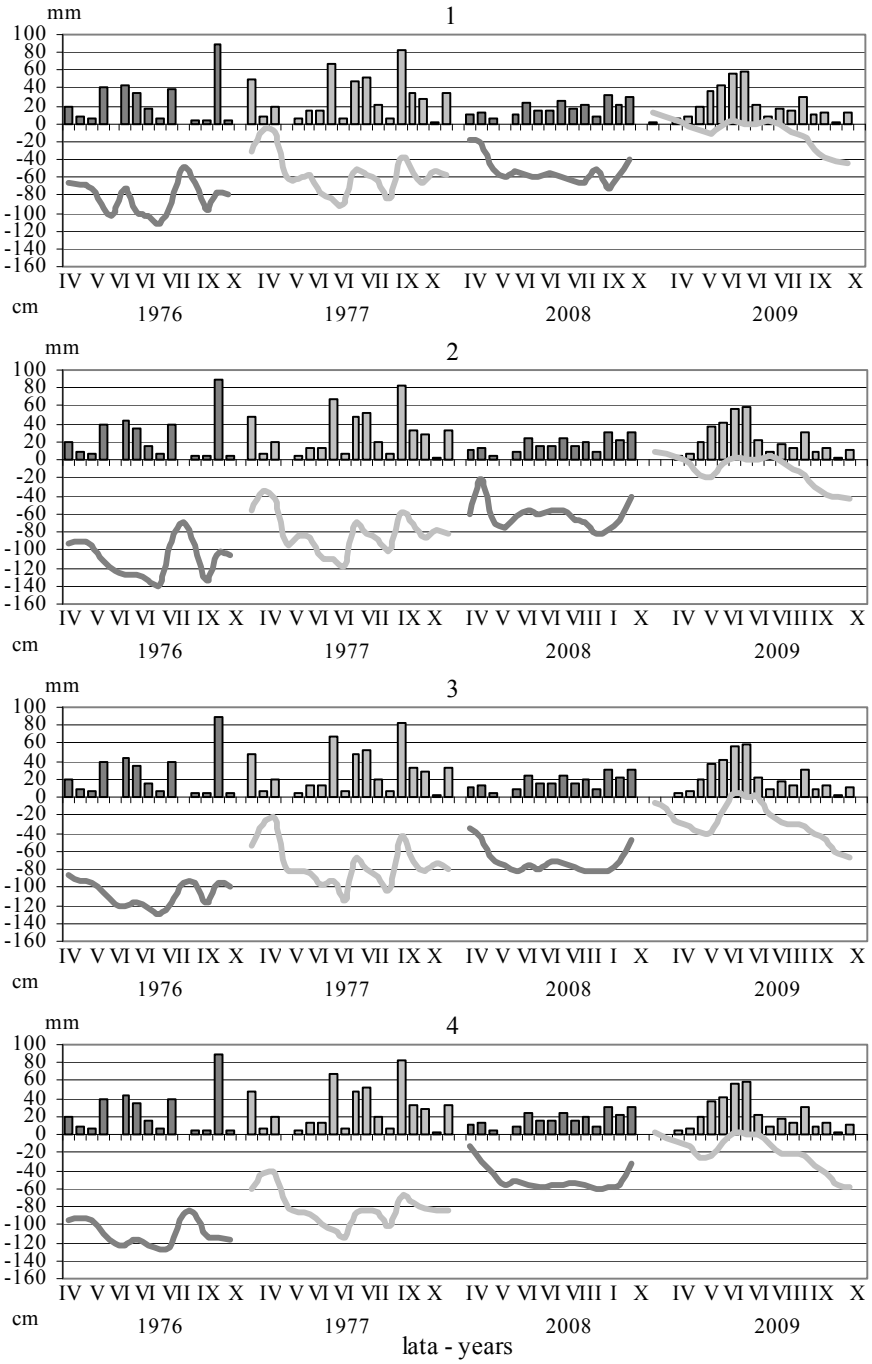
groundwater level was also recorded in the summer of 2009, particularly between the second decade of June and the first decade of August, which resulted from the high amount of precipitation in June (157 mm). Towards the end of summer, the groundwater level fell to 40–50 cm in most piezometers. The influence of precipitation on groundwater levels in post-bog meadows was also confirmed by other authors [Kiryluk 2008, Łyszczarz and Suś 2009].

Correlation rates were calculated for the amount of precipitation in a ten-day period and the groundwater level difference in relation to the previous 10--day period resulting from the delayed infiltration of precipitation through the horizons of the soil profile. These interrelationships were significantly positively correlated in piezometers 3–8 in 1977, 2008 and 2009 (Tab. 1). Therefore, precipitation had a significant impact on groundwater levels in most piezometers. The interrelationships for piezometers 1 and 2 were also positively correlated, but were not proved statistically. Presumably it was related to the damming of outflow in ditch PA in 2007, which led to a high groundwater level within the piezometers mentioned above. The value of the correlation rate was the lowest for piezometer No. 1 in 2008 (0.19). Insignificant correlations were also recorded in 1976, a year after the completion of the drainage and reclamation works.

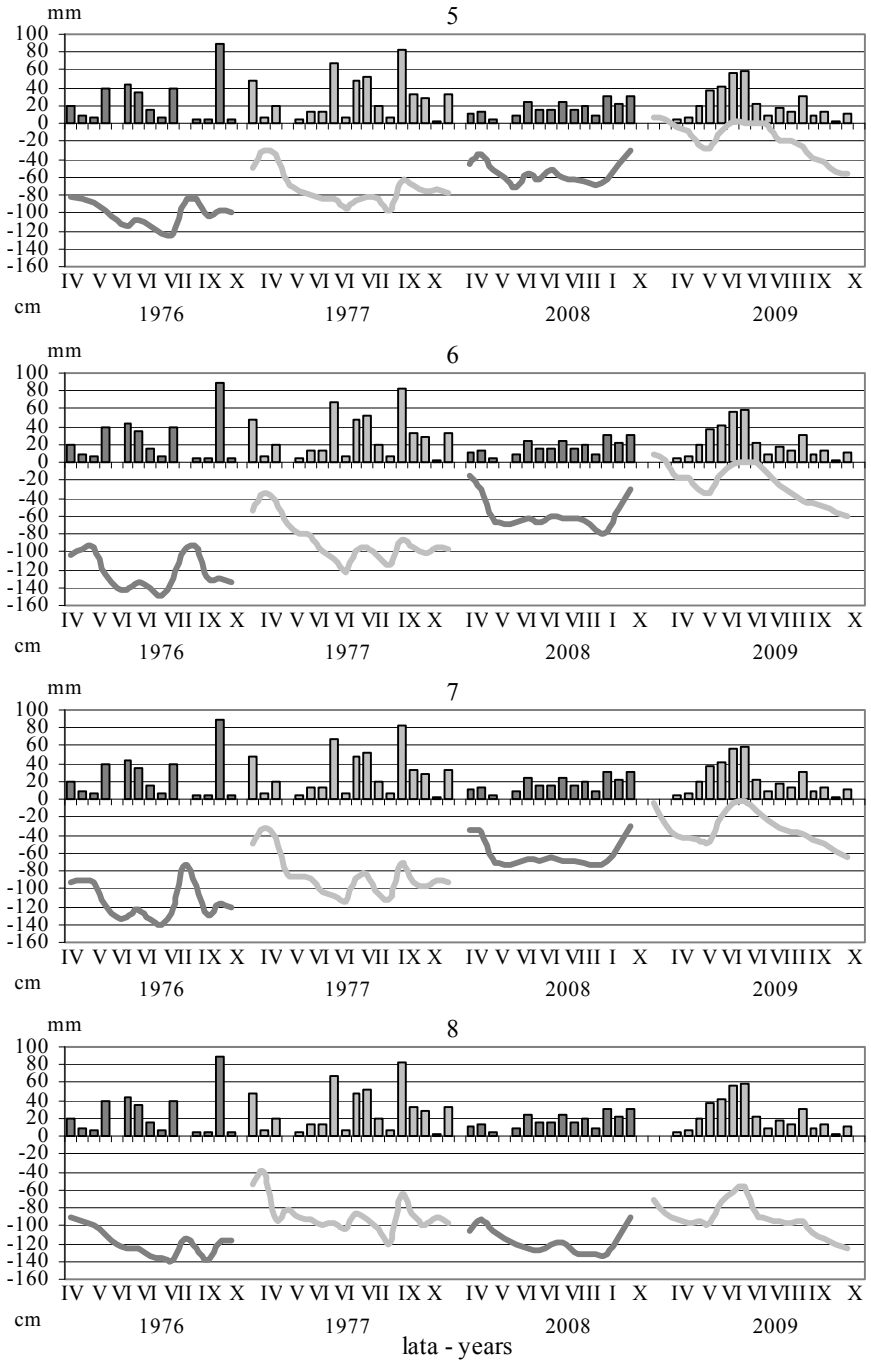
Table 1. Correlation between the amount of precipitation in a ten-day period and groundwater level difference in relation to the previous 10-day period

Years	Piezometers							
	1	2	3	4	5	6	7	8
1976	0.29	0.49	0.49	-0.05	0.08	0.06	0.19	0.37
1977	0.47	0.45	0.55*	0.60*	0.64*	0.52*	0.52*	0.41
2008	0.19	0.46	0.68*	0.64*	0.61*	0.58*	0.64*	0.54*
2009	0.46	0.46	0.70*	0.68*	0.54*	0.61*	0.74*	0.62*
The critical value of the correlation rate $\alpha = 0.05$* 1976, 2008 – n = 0.5324; 1977, 2009 – n = 0.4821)								

When one compares groundwater levels in the years 2008–2009 with analogous measurements in the years 1976–1977, it is worth noting the considerably lower level in 1976 when it fell down to -150 cm, while the mean level in the vegetation period was considerably lower (approx. -108 cm) in comparison with 1977 (approx. -79 cm) (Fig. 2). The low groundwater level in 1976 was probably linked to the considerably lower (by 100 mm) amount of precipitation in comparison with 1977. The relatively low groundwater level after the regulation of water conditions at the site under study in the years 1974–1975 indicates that the design objective to maintain groundwater at the level of 60–80 cm was not actually achieved. It had a negative impact on soil processes and physicochemical properties of organic soils, which caused the intensification of the muck formation process as well as a systematic loss of organic soil matter [Okruszko 1974, Gotkiewicz and Szuniewicz 1987, Kiryluk 2008, Łyszczarz and Suś 2009]. Maintaining



1, 2, 3, 4 – piezometers



5, 6, 7, 8 – piezometers

Fig. 2. Decade amounts of precipitation and groundwater level in the years 1976–1977 and 2008–2009

the optimum humidity level of muck-soil meadows and their appropriate use may considerably slow down the degradation processes of these habitats [Chrzanowski and Szuniewicz 2002]. In many Western European countries, the degradation of muck-soil meadows caused by strong drainage and intensive use necessitated the renaturalisation of these ecosystems [Ramseier 2000, Zedler 2000]. Organic soil probing within three piezometers (2, 4 and 6) carried out in 2009 showed that the surface of the peat bog was on average about 30 cm lower than in 1976 (Tab. 2). The strong mineralisation of organic matter and the settling

Table 2. Sections of soil profiles

Years	
1976 [Szajda, 1977]	2009
Profile 2	
0–14 cm turf layer 14–65 cm sedge peat at varying stages of decay < 65 cm loamy sand	0–15 cm turf layer 15–35 cm layer of muck < 35 cm loamy sand
Profile 4	
0–7 cm turf layer 7–58 cm sedge partially-decayed peat 58–77 cm reed-sedge peat 77–124 cm rush peat < 124 cm gythia on loose sand	0–12 cm turf layer 12–50 cm layer of muck 50–100 cm reed-sedge peat overlying rush peat < 100 cm gythia on loose sand
Profile 6	
0–10 cm turf layer 10–25 cm moorshing peat 25–50 cm sedge peat with an admixture of reed 50–100 cm rush peat < 100 cm sand	0–12 cm turf layer 12–65 cm muck overlying a layer of rush peat < 65 cm sand

of peat deposits in the drained peat bogs by about 1 cm per year were also confirmed by the results of other studies [Roguski and Bieńkiewicz 1967, Gotkiewicz 1983, Gotkiewicz and Szuniewicz 1987].

CONCLUSIONS

The groundwater levels were highly dependent on precipitation in the years of the studies. The studies revealed a significant correlation between the amount of precipitation in a 10-day period and the groundwater level difference in relation to the previous 10-day period in most piezometers in 1977, 2008 and 2009. The year 1976, the first year after the completion of drainage and reclamation works, was an exception to the above as there were two piezometers where a high groundwater level was recorded, probably in relation to the damming of

outflow in one of the ditches. Organic soil probing carried out in 2009 showed that the surface of the peat bog was on average about 30 cm lower than in 1976. It probably resulted from the strong mineralisation of organic matter and the settling of peat deposits, which indicates that the design objective to maintain groundwater at the level of 60-80 cm was not actually achieved.

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ZMIANY POZIOMU WODY GRUNTOWEJ NA OBIEKCIE ŁĄKOWYM „KRASNORYKI" W POLESKIM PARKU NARODOWYM

Streszczenie. Badania przeprowadzono w latach 2008–2009 na obiekcie łąkowym „Krasnoryki", stanowiącym fragment „Łąk Zienkowskich" w Poleskim Parku Narodowym. Większość tego terenu została zmeliorowana i zagospodarowana w latach 1967–1970. Celem badań była ocena wpływu zmian zasilania wodnego na poziom wody gruntowej na badanych łąkach. W latach badań poziom wody gruntowej uzależniony był w dużym stopniu od opadów atmosferycznych. Wykonane w 2009 r. sondowania gleb organicznych wykazały obniżenie się powierzchni torfowiska średnio około 30 cm w porównaniu z 1976 r.

Słowa kluczowe: poziom wody gruntowej, łąka, Poleski Park Narodowy, opady