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SEASONAL VARIATION OF PHYSICOCHEMICAL PARAMETERS OF REEDBED HABITATS OF SEVERAL WATER BODIES IN EŁK LAKELAND AND THEIR DOMINANT MACROPHYTES IN 2006–2007

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Summary. Several physicochemical parameters of a few water bodies of Ełk Lakeland were assessed every month during the growing seasons of 2006 and 2007. Water, sediment and plant tissues were examined. The content of phosphates decreased in the tissues of green stems during the growing season. It did not follow the phosphate level variation in the habitat. The iron content was the highest in the water and sediment of astatic ponds. The macrophytes from those habitats also had a relatively high level of this element in their tissues. However, the highest level was noted in *Sparganium erectum* from Lake Łaśmiady, being higher than the content of iron in *S. erectum* from a pond as well. In some cases habitats covered by the same species had different physicochemical parameters. Several parameters changed in the successive months of the growing season irregularly, and the pattern of the variation was not repeated in the next year.

Key words: macrophytes, nutrients, physicochemical parameters, Ełk Lakeland

INTRODUCTION

Water quality is one of the most important environmental indicators. Relationships between the physicochemical parameters of water and organisms inhabiting it are the foundations of the law regulations of environmental protection. Macrophytes are one of the indicators listed in the Ordinance of the Minister of Environment concerning the classification which is used to present the status of surface and underground waters [2008]. These relationships are still not known well enough, partially due to differences in methodology causing difficulties in the comparison of results [Tomaszewicz and Ciecierska 2009]. As physicochemical parameters in different periods of a year may differ significantly [Joniak and Kuczyńska-Kippen 2008], it is important to assess them in a systematic way to estimate their seasonal and year-to-year dynamics.

Not only are macrophytes dependent of their habitat, which makes them bioindicators, but they also affect it. Plants intake some chemical substances from their environment and release other substances, which leads to changes in its chemical content and some physical conditions. For example, peat mosses (*Sphagnum* sp.) exchanging cations with a habitat cause its acidification [Andrus 1986]. Since macrophytes are considered to be able to accumulate nutrients and toxic substances, natural or constructed wetlands are used to improve water quality [Obarska-Pempkowiak *et al*. 2002]. Bioindication and bioremediation issues are related, as the chemical content of plant tissues differs in different periods of time as well as the physicochemical conditions of their habitat [Asaeda *et al*. 2006].

The aim of this work was to evaluate seasonal changes of some physicochemical parameters of water ecosystems (both in habitats and plants) and to compare their patterns during two successive years.

AREA, MATERIALS AND METHODS

The monitoring was conducted at 8 sites within the Ełk Lake District. They were located in three average-sized lakes: Łaśmiady (sites tagged as Ł), Zawadzkie (Z) and Woszczelskie (W), and in two astatic ponds (X, Y). As the aim of the study was to determinate the features of phytocoenoses, samples were taken only in the littoral zone, within vegetation patches (Kłosowski 2006). The studies were conducted in representative phytocoenoses, with high values of cover abundance and apparent dominance of characteristic species: *Typha angustifolia* L. (TA), *Typha latifolia* L. (TL), *Sparganium erectum* L. em. Rchb. (SE) and *Schoenoplectus lacustris* (L.) Palla (SL). Every community was represented by two phytocoenoses from different habitats (1, 2). The communities grew on different types of substrate: mineral (M), organic (O) or mineral-organic (i.e. gyttja) (G). This combination constituted 8 sites: TA1 (Ł, M), TA2 (Z, G), TL1 (W, G), TL2 (X, O), SE1 (Ł, M), SE2 (Y, O), SL1 (Ł, M) and SL2 (W, G). The samples were collected every month during the growing season (May–October) in 2006 and 2007. Every sample consisted of a sample of water, substrate and the plants of dominant species (separately: assimilating shoots and rhizomes). The sample collection methods met the standards of phytocoenoses and their habitat assessment protocols [Kłosowski 2006, Tomaszewicz and Ciecierska 2009].

Water samples were taken from an intermediate depth of phytocoenose habitat, transferred to plastic containers, filtered and stored in a refrigerator at 4°C. Substrate samples were collected with a Kajak probe from the rhizosphere,

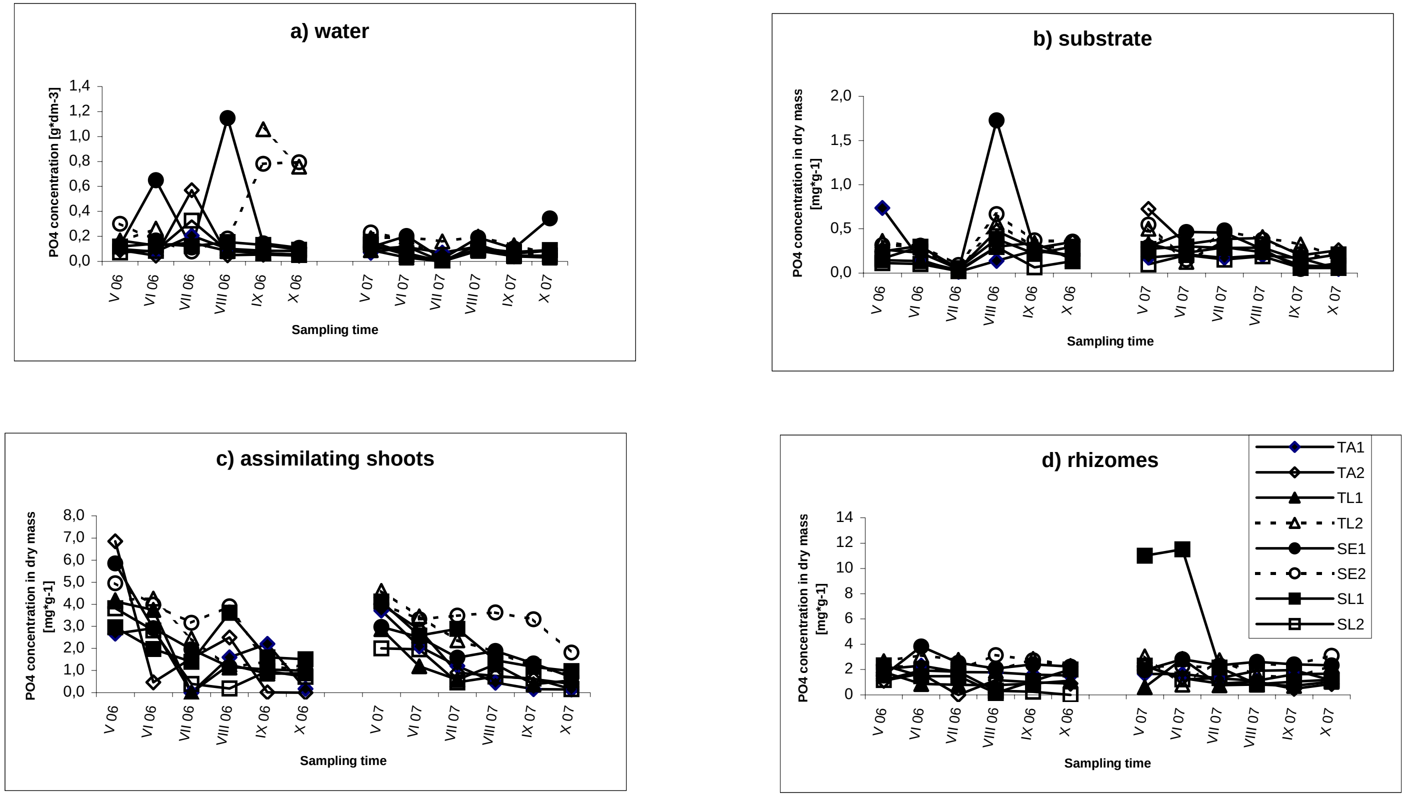

Fig. 1. Phosphate concentration in: a) water, b) sediment, c) assimilating shoots, d) rhizomes

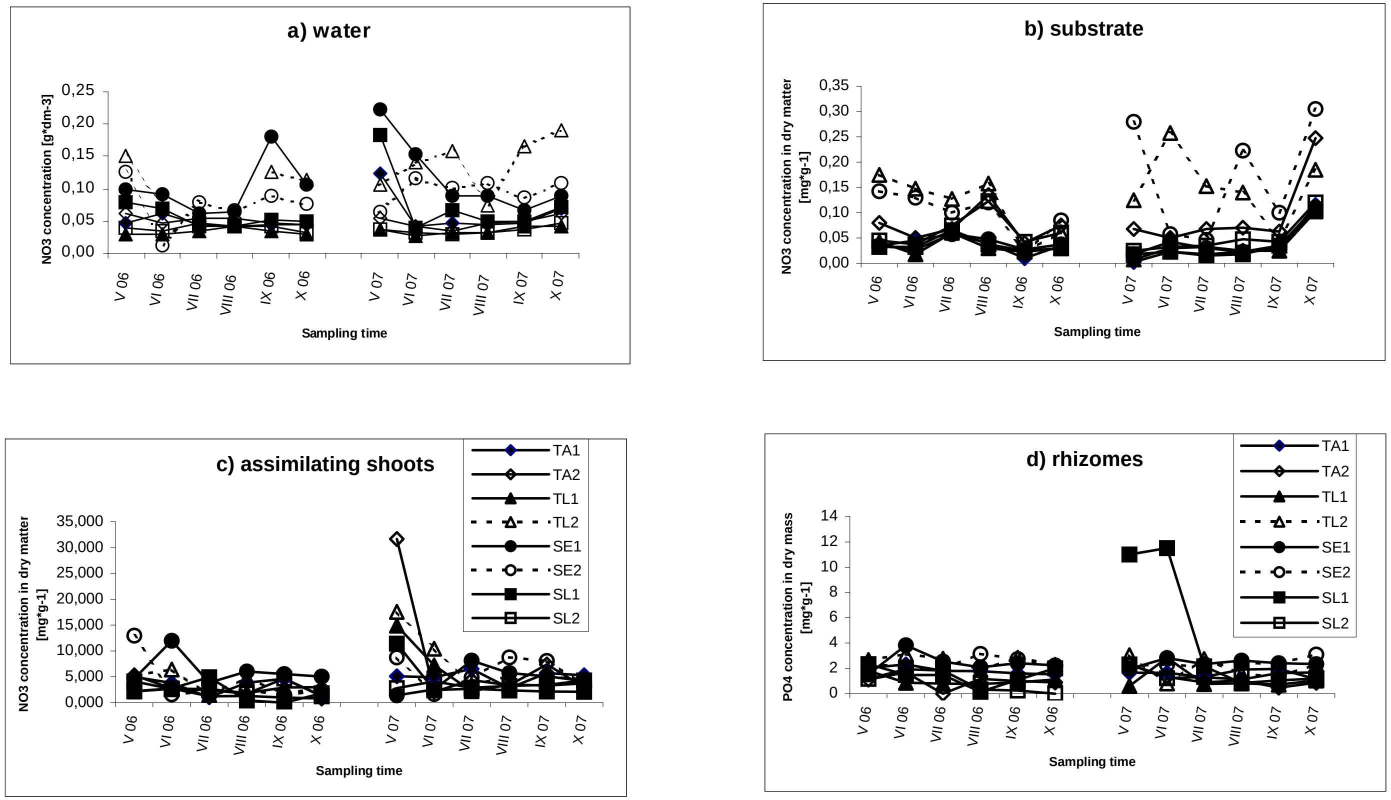

Fig. 2. Nitrate concentration in: a) water, b) sediment, c) assimilating shoots, d) rhizomes

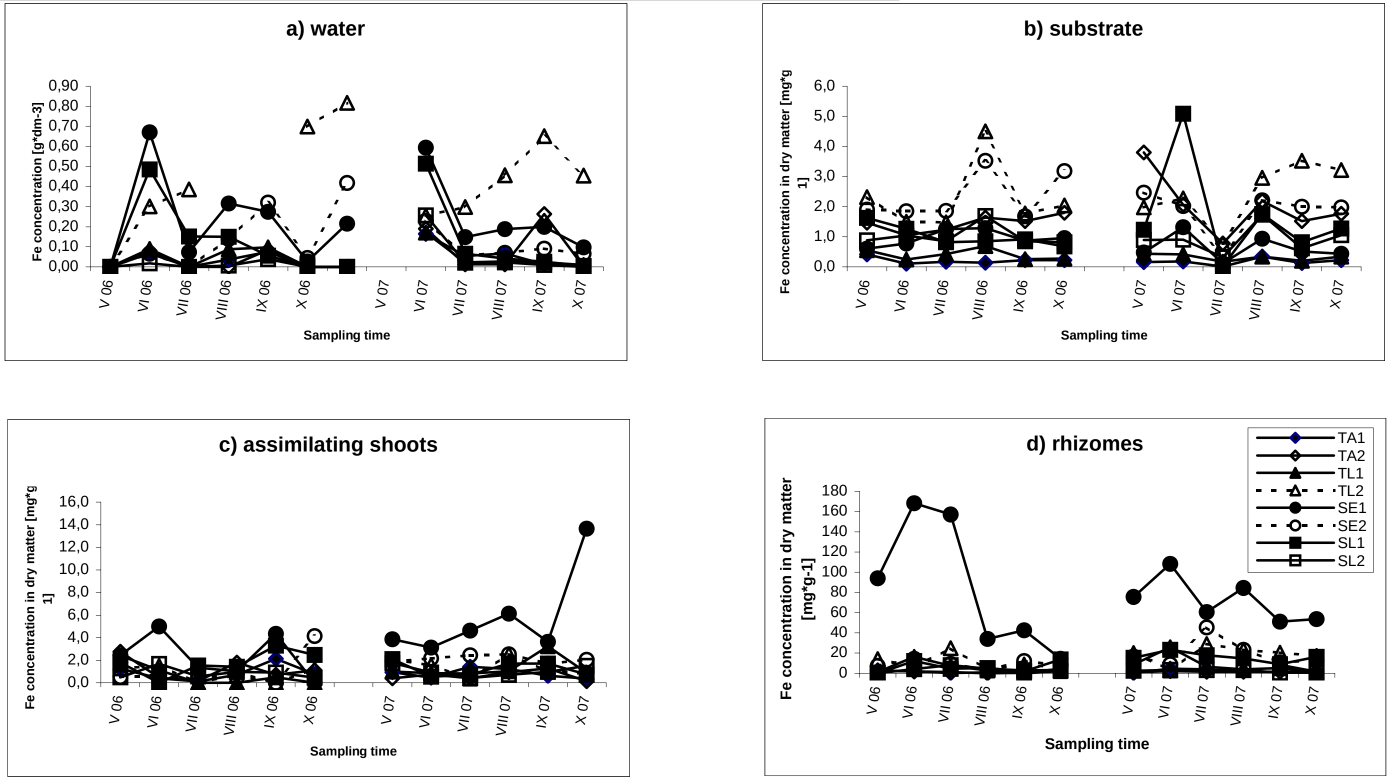

Fig. 3. Iron concentration in: a) water, b) sediment, c) assimilating shoots, d) rhizomes

transferred to air-tight plastic bags and stored in a refrigerator at 4°C. Living (non-rotten) plant samples were washed with distilled water, dried at 65°C, milled into a powder and stored in air-tight plastic bags in a cool place. Half of each water sample was preserved by the addition of H_2SO_4. Solid material was not analysed directly, but water and acid extracts were prepared.

Every sample used for the analyses was a mixture of a few sub-samples collected in various places of a study site. As the astatic pond with the site of TL2 X was desiccated temporarily in the summer of 2006, there is a lack of results from this site.

The following parameters were assessed: nitrate concentration, phosphate concentration and total iron concentration. The analyses were conducted with methods described in Hermanowicz *et al*. [1976] and Siepak [1992].

RESULTS AND CONCLUSIONS

The studied objects often had similar values of parameters. There were apparent exceptions, however. The details of results are presented in Figures 1–3.

Some sites covered by the same community, despite typological differences (e.g. on gyttja or mineral substrate), showed similarity in several physicochemical parameters. For example, one of the *Schoenoplectus lacustris* phytocoenoses inhabits a flat bottom consisting of calcareous gyttja relatively distant from the shore (SL2 W), while the other one covers a gravel slope near the shore (SL1 Ł). However, phosphate concentration was similar at both sites. On the other hand, *Typha latifolia* communities inhabited sites expressing large differences in iron content.

The concentration of a given macroelement in plant tissues often showed a similar trend,l from high values at the start of the growing season to low ones in its end (e.g. phosphates in all studied plants). This pattern was independent from the actual content of the element in a habitat.

Conspecifics often had a similar chemical content, but sometimes large differences were observed in plants of the same community from different sites. For example, iron content in *Sparganium erectum* tissues from SE1 was apparently higher than the respective content in *Sparganium erectum* tissues from SE2, being even more elevated than in other plants.

Results obtained in one year sometimes differed from the results from the other year, e.g. phosphate content in TA sites, which shows that any conclusions based only on one-year study should be treated with caution.

REFERENCES

Andrus R.E., 1986. Some aspects of Sphagnum ecology. Can. J. Bot. 64(2), 416–426.

Asaeda T., Manatunge J., Roberts J., Hai D.N., 2006. Seasonal dynamics of resource translocation between the aboveground organs and age-specific rhizome segments of Phragmites australis. Env. Exp. Bot. 57, 9–18.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy – O.J. EU L 327.

Hermanowicz W., Dożańska W., Dojlido J., Kozierowski B., 1976. Physicochemical assessment of water and waste water (in Polish). Arkady, Warszawa.

Joniak T., Kuczyńska-Kippen N., 2008. Effect of aquatic macrophytes on water trophy of lowland water bodies in aspect of their surface differentiation. Teka Kom. Ochr. Kszt. Środ. Przyr. – OL PAN, 5 A, 47–52.

Kłosowski S., 2006. Methods of identification of communities and their ecological amplitudes (in Polish) [in:] Szmeja J., Przewodnik do badań roślinności wodnej, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk.

Obarska-Pempkowiak H., Ozimek T., Haustein E., 2002. The removal of biogenic compounds and suspended solids in a constructed wetland system. Pol. J. Environ. Stud. 11(3), 261–266.

Ordinance of the Minister of Environment concerning the classification which is used to present surface and underground waters state (in Polish). Dz.U. 2008 nr 162 poz. 1008.

Siepak J. (ed.), 1992. Physicochemical analysis of water and soil (in Polish). Wydawnictwo UAM, Poznań.

Tomaszewicz H., Ciecierska H., 2009. Changes in macroelement content in *Nuphar lutea* (L.) Sibith. & SM. during the growing season. Acta Soc. Bot. Pol. 78(2), 151–165.

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SEZONOWA ZMIENNOŚĆ CZYNNIKÓW FIZYCZNO-CHEMICZNYCH SIEDLISK SZUWAROWYCH KILKU ZBIORNIKÓW POJEZIERZA EŁCKIEGO ORAZ DOMINUJĄCYCH W NICH MAKROFITÓW W LATACH 2006–2007

Streszczenie. W sezonach wegetacyjnych 2006 i 2007 comiesięcznie badano parametry fizyczno-chemiczne ośmiu siedlisk szuwarowych znajdujących się na Pojezierzu Ełckim oraz dominujących w nich roślin. Niezależnie od zmian zawartości fosforanów w siedlisku, zawartość tego czynnika w pędach asymilacyjnych roślin spadała przez cały sezon wegetacyjny. Zawartość żelaza najczęściej była największa w wodzie i osadzie zbiorników astatycznych. W tkankach makrofitów zasiedlających te siedliska była ona stosunkowo wysoka, jednak najwyższa u *Sparganium erectum* z jeziora Łaśmiady, często kilka- lub kilkudziesięciokrotnie wyższa niż w tkankach innych roślin, również *S. erectum* ze zbiornika astatycznego. W niektórych przypadkach zaobserwowano, że siedliska zdominowane przez ten sam gatunek różnią się znacznie pod względem niektórych czynników fizyczno-chemicznych. Wiele parametrów zmieniało się w trakcie sezonu wegetacyjnego w sposób nieregularny, nie powtarzając wzorca w następnym roku.

Słowa kluczowe: makrofity, biogeny, czynniki fizyczno-chemiczne, Pojezierze Ełckie