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Staurastrum cyclacanthum var. *pseudobrevissimus* – a new variety of desmids and some other rare taxa found in peat bogs (Western Pomerania, Poland)

Abstract

New variety of *Staurastrum cyclacanthum* var. *pseudobrevissimum* and four other taxa: *Korshikoviella limnetica*, *Polyedriopsis spinulosa*, *Monactinus simplex* var. *echinulatum* and *Cosmarium* sp. rarely reported from the studied region of north-western Poland are noticed. For all of them, detailed descriptions with original documentation and ecological characteristics of the studied sites are presented in this article.

Key words: Chlorophyceae, Chlorococcales, Desmidiales, new locality, Western Pomerania
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Introduction

Peat reservoirs, are water reservoirs artificially created as a result of the exploitation of the organic mass of peat. One of the largest in terms of area in the West Pomeranian Voivodeship (north-western Poland) is the complex of peat cut created in the extensive peat bog Czarnocińska Basin on the eastern side of the Szczecin Lagoon. In this area, which is occupied by one of the largest peat deposits in Pomerania, peat was exploited in the last century for the needs of the synthetic gasoline factory in Police. As a result, a set of shallow pond-like water bodies was created here, with a total area of approximately 200 ha and a maximum depth not exceeding 1.7 m. The largest of these workings, called “Starfish” (N 53^{o} 33’ 55” E 14^{o} 38’ 21”; Goleniów municipality) due to its shape, has an area of 32 ha. It used

to be flow-through and connected to the Oder River by canals. Unfortunately, over the years the canals have been filled in by land improvement contractors.

These types of backwaters are an excellent place for the growth of freshwater plankton, especially single-cell algae. It is worth emphasizing that this area has not yet been sufficiently researched in this respect. Extensive research conducted here concerned primarily the vascular flora of peat bogs and the types of plant communities (e.g. Jasnowski, 1962; Jasnowska, 1968). Analyses of algological materials continue to provide interesting information about new taxa not recorded here.

The aim of this study is to characterise interesting taxa of the phycoflora of peat lakes occurring in the peat bog Czarnocińska Basin. This analysis is part of a larger research project.

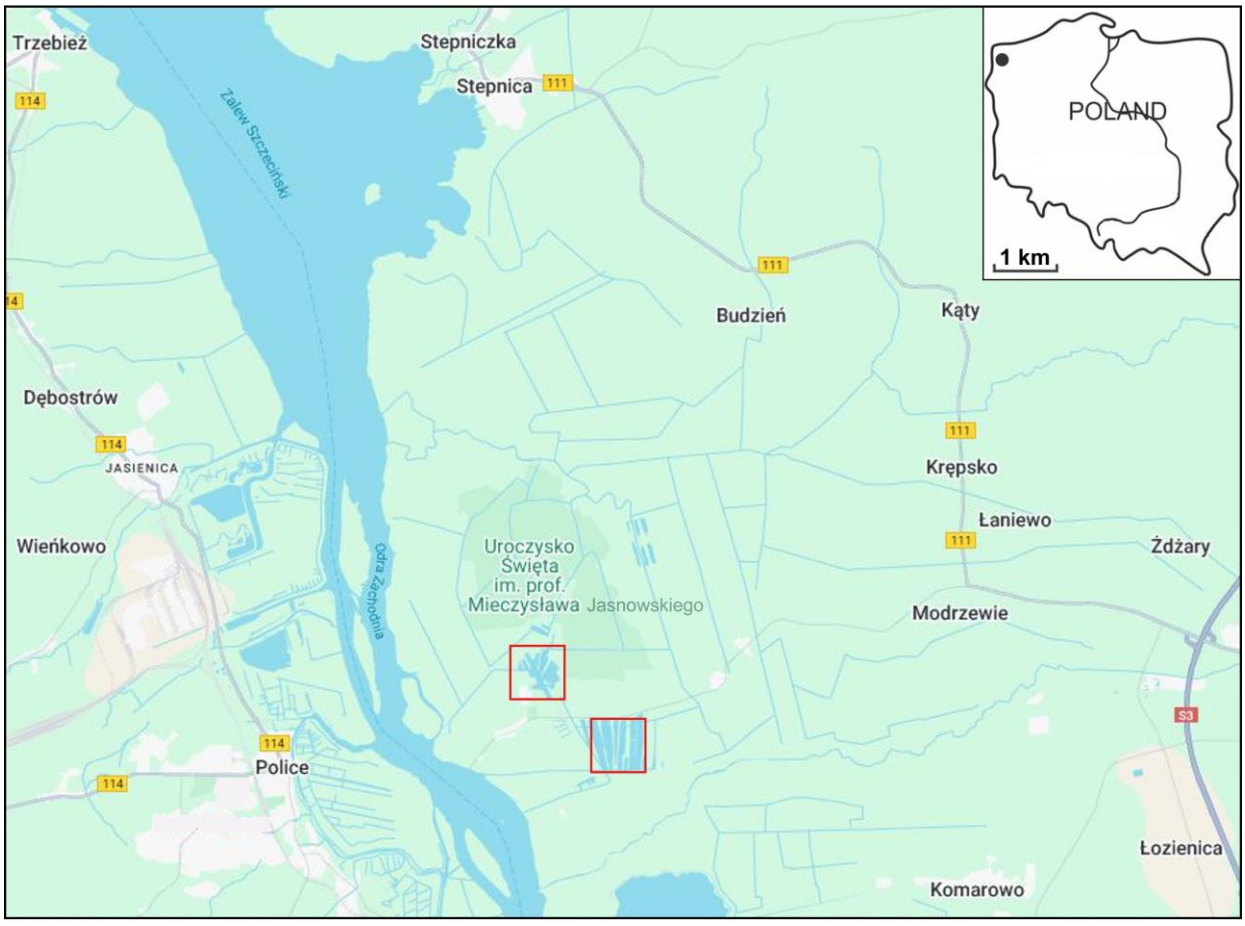


Fig. 1. Location of the studied water reservoirs (red squares) in the peat area complex on the eastern side of the Oder estuary into the Szczecin Lagoon

Study area

The materials were collected during research conducted as part of a study of the qualitative and quantitative diversity of plant plankton in peat pits. The research on the algae flora covered five post-exploitation peat cut in the complex of a vast peat area of peat bogs located between the Ina River and the mouth of the Oder River in the Szczecin Lagoon (Fig. 1).

During the research, plankton material was collected from 11 research sites and periphyton material from 8 sites. The researched peat areas are one of the numerous places in this area where peat was exploited in the past. Peat exploitation in cavities no. 1, 2 and 3 dates back to the turn of the 19th and 20th centuries, the remaining two peat pits, i.e. cavities no. 4 and 5, were created in the early 1990 (Fig. 2).

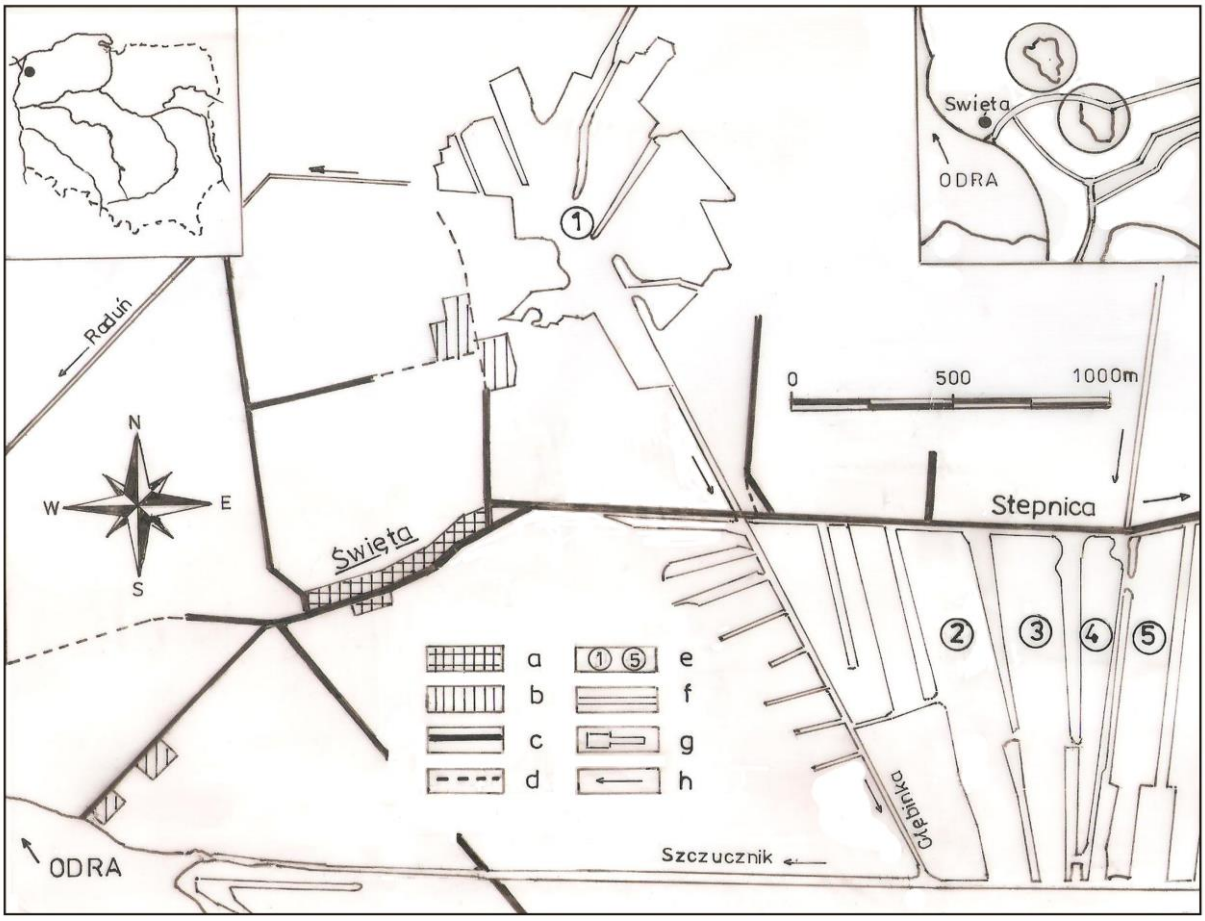


Fig. 2. Topography of the terrain in the area of the examined peat excavations covered by the algological analysis

a – residential buildings, b – farm buildings, c – main roads, d – field roads, e – studied peat reservoirs, f – canals, ditches, g – water reservoirs, h – water flow directions

The existence of these numerous workings is marked on old German maps from 1884–1890 and later ones. The analysis of subfossil remains in the remains of the unexploited organic mass of peat indicate that in the past, mainly peat deposits were formed here on the majority of the surface, formed as a result of the accumulation of plant remains of phytocenoses characteristic of wetland habitats from the *Phragmition communis* W. Koch 1926 and *Magnocaricion elatae* W. Koch 1926 alliances, and locally from the *Alnion glutinosae* (Malc. 1929) Meijer Drees 1936 alliance (Jasnowski, 1962).

Ecological and hydrochemical characteristics of water in the studied peat reservoirs

During each field trip, ecological parameters were measured: temperature, water reaction, electrolytic conductivity and water transparency using a Secchi disc. Samples for hydrochemical analyses were taken from the same sites when obtaining plankton samples. The content of basic nutrients was determined in the tested waters, including: P-PO_4 (mg/l), P-total (mg/l), N-NO_2 (mg/l), N-NO_3 (mg/l), N-NH_4 (mg/l) and Chlorophill *a* concentration (µg/l). Chemical analyses were performed at the Department of Hydrochemistry and Water Protection, West Pomeranian University of Technology in Szczecin.

Water thermals

The water temperature during measurements and on individual research dates in all tested reservoirs reached similar values (Fig. 3 – Appendix 1). The highest water temperatures, above 21 °C, were recorded in the summer months (July, August). In April and September, the water temperature ranged from 14 °C to 20 °C. The lowest water thermal values in the studied peat pits were reached at the end of November – 8-6 °C.

pH of the water habitat

A characteristic feature of the water in all research objects was alkaline reaction. During the research, the pH of water in the studied ponds ranged from 7.4 to 9.3 (Fig. 3 – Appendix 1).
The lowest pH values in the research cycle examined were recorded in July 2005.The highest pH occurs in the summer months. In August 2006 and September 2006 the pH reaches a value of 9.3, peat cut no.3. This is due to the shallow limestone deposits. The differences in pH values between individual research dates and the analysed peat waters are small and insignificant.

Level of electrolytic conductivity

Electrolytic conductivity was measured *in situ* during the collection of plankton samples. The level of electrolytic conductivity of water ranged from 530 µS/cm to 976 µS/cm. Generally, higher values of this indicator were observed in peat cut no. 1. In the remaining tanks,

electrolytic conductivity remained at the level of 530–600 μS/cm. The measured values of the mineralization level of water in the studied reservoirs indicate that their mineralization level reaches values typical of the upper limits of low-mineralised waters (50 to 500 mg/l).

Visibility range of the Secchi disc

Due to the small water depth, the visibility range of the Secchi disc in three peat cut, i.e. 2, 4, and 5 of the five reservoirs covered by the research, was always equal to their depth. Only in peat cut 1, throughout the entire research period, water transparency was low and ranged from 0.25 cm to 0.95 cm. The limited water transparency was caused by a high density of algae cells.

Chlorophyll a content

Chlorophyll *a* is an important indicator of surface water quality. Its content is a determinant of the development of phytoplankton biomass. As the fertilisation of surface waters with nitrogen and phosphorus compounds increases, the biological productivity of aquatic ecosystems increases. The chlorophyll content above 25 μg/dm^3 indicates eutrophication processes (Fig. 4).

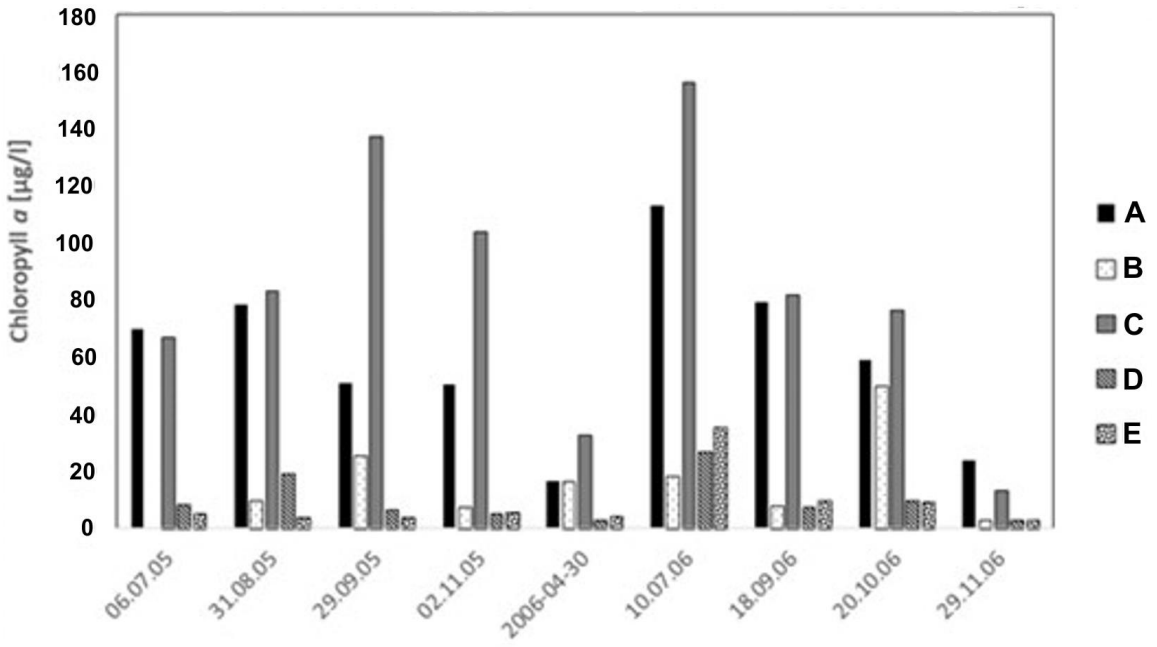


Fig. 4. Content of chlorophyll *a* in the waters of the studied peat cut in the research cycle of 2005–2006; A – peat cut no. 1, B – peat cut no. 2, C – peat cut no. 3, D – peat cut no. 4, E – peat cut no. 5

The highest chlorophyll *a* content was recorded in peat cut no. 1. Its content ranged from 16 μg/dm^3 (April) to 113 μg/dm^3 (July) and in peat cut no. 3 in during the summer months, values ranging from 67 μg/dm^3 to 156 μg/dm^3 were recorded. The lowest chlorophyll

content occurs during low temperatures in spring and autumn. They remain at the level of 2–19 μg/dm^3. The level of chlorophyll *a* content in the summer months indicates an increase in the production of algal biomass related to eutrophication processes and water thermals in most of the analysed peat cut.

Hydrochemical tests

The chemical parameters of water were tested on 9 dates, from the beginning of July to the end of November, in all 5 post-peat reservoirs. The important biogenic components were: ammonium nitrogen, nitrates (III), nitrates (V), total phosphorus and phosphates (V). The level of nutrients in water in individual peat research periods is illustrated in Fig. 5–6 – Appendix 1. The level of nitrates (V) in the waters of the studied peat cut definitely outweighs the remaining nitrogen compounds. In the summer months, the nitrate content was at a similar level and averaged 0.5–0.6 mg/l. The remaining forms of nitrogen in the waters of the studied peat cut reach low levels, and nitrites are the least important. During the period under study, similar fluctuations in total phosphorus and phosphates (V) were observed (Fig. 6 – Appendix 1).

The lowest P-PO_4 content throughout the research period was observed in all peat cut in July 2006, where it reached the level of 0.07–0.08 mg/l. In the remaining months, similar levels of P-PO_4 and total phosphorus were observed. In the studied ponds, the content of total phosphorus exceeds the limit value specified for eutrophic waters. Basic hydrochemical parameters indicate the species' preferences for eutrophic habitats. This is confirmed by the large quantitative and qualitative diversity of taxa of the Euglenophyceae Schoenichen 1925 class.

Material and methods

The inspiration to undertake the research was primarily the identification of plankton and epiphytic forms of algae inhabiting the organs of selected freshwater macrophytes.

Field qualitative and quantitative sampling of phytoplankton was carried out from spring (late March/early April) to November, five times during two consecutive growing seasons of 2005–2006. Materials for periphyton research were collected only once in September of both years. Periphyton was collected mainly from the stems of the common reed *Phragmites australis* (Cav.) Trin. ex Steud and the petioles of the white water lily *Nymphaea alba* L., and the yellow water lily *Nuphar lutea* (L.) Sibth. & Sm.

Samples were taken from the near-surface water layer at a depth of approximately 0.5 m using a Patalas scoop with a volume of 5 l. The collected sample was concentrated on a plankton net no. 25. A preliminary vital analysis of the material was performed in the laboratory, and then the samples were fixed with lactophenol (Starmach, 1963). Taxa from all systematic units of prokaryotic and eukaryotic forms were identified, analysing the collected material, mainly species rare in the algal flora of Poland. The determinations were made at the Department of Botany and Nature Conservation, Faculty of Environmental Management and Agriculture, West Pomeranian University of Technology in Szczecin, using Zeiss microscope equipment. The drawing documentation was developed on the basis of the designed microscopic image.

Results and discussion

Many rare species of algae from various taxonomic units were found in the planktonic materials of the peat. A total of 680 taxa were identified, representing both priokaryotic and, above all, eukaryotic forms. A detailed analysis of the algae flora in the studied water reservoirs against the background of chemical parameters and ecological conditions will be presented in a separate study. The most interesting species of phycoflora, with not very numerous localities in the country, are taxa from the class Chlorophyceae Wille 1884, order of Chlrococcales Marchand 1895, and Desmidiales Bessey 1907. The most interesting species of phycoflora, apart from Euglenophyceae, represented by the genus *Phacus* sp. div. and *Euglena* sp. div., which do not have many localities in the country, are taxa from the class Chlorophyceae, order Chlrococcales and Desmidiales.

The high species diversity of representatives of the Euglenophyceae class is probably due to the significant organic matter load in the water. There is also a rich biodiversity of other systematic groups of algal flora, among which the presence of cell forms with an undetermined syntaxonomic position has been found.

The peculiarities of the algal flora of the studied water reservoirs include:

✶***Korshikoviella limnetica*** (Lemm.) Silva 1959. Fig. 7A–B – Appendix 1

Basionym: *Characium limneticum* Lemm. 1903

Synonym: *Lambertia limnetica* (Lemm.) Korš. 1953]

Description: Spindle-cylindrical cells, divided into segments, straight, narrowed at both ends and sharply pointed, free-floating. Cells attached to the shells of planktonic crustaceans were not observed in the material. Total cell length 205.9–119.0×6.8–11.6μm, spines 52.0–54.9 μm

long. Each cell segment with a chloroplast bearing one pyrenoid. Single spindle-cylindrical segments, 5.6–8.8 μm long, 6.8–11.6 μm wide.

Found in site: Few cells of *Korshikoviella limnetica* (Lemm.) Silva 1959 were recorded only in phytoplankton of peat cut No. 1 and No. 3. In peat cut No. 1, the taxon was found in samples from September 29, 2005. In peat cut waters no. 3, the occurrence of the species was recorded in material from April 30, 2006.

Distribution in Poland: From in Poland, the species is recorded from plankton, mainly ponds (Krzeczkowska-Wołoszyn, 1977, 1979; Krzeczkowska-Wołoszyn, Kyselowa, 1979; Kyselowa, 1966; Sosnowska, 1957, 1968; Stefko, 1976, and others).

General distribution and ecology:

Korshikoviella limnetica occurs in temperate and tropical waters. Localities of the species are known from Algeria, Japan, Austria, Sweden, Sierra Leone, South Africa, the Czech Republic, Ukraine, Hungary, and the USA (Komarek, Fott, 1983).

The occurrence of this taxon is possible due to the presence of planktonic crustaceans, on whose shell the species develops. Occasionally, the species appears in plankton as free-swimming. Its biology limits the occurrence of typical phytoplankton species in samples. This feature does not allow determining its distribution and therefore it should be assumed that it occurs in scattered locations.

✶ ***Polyedriopsis spinulosa*** (Schmidle) Schmidle 1899, Fig. 7C–G – Appendix 1

Basionym: *Tetraedron spinulosum* Schmidle 1896

Synonym: *Lagerheimia urmaniensis* Wołosz. 1911.

Description: Single, tetradry, 5-sided cells, extended into conical, broadly rounded arms, separated by a wide and shallow bay. The horns are equipped with a bundle of 2–3 delicate hyaline hairs. The cell wall is smooth. Wall chromatophore with one pyrenoid. Cell diameter 15.3–25.5 μm, hairs up to 20.4 μm long.

Found in site: The taxon in the collected research material generally occurred in waters in all peat cut. Its presence was most often recorded in peat cut 1, 2, 3 in samples collected in July 2005. In other water reservoirs it was not very abundant in samples from various research dates.

Distribution in Poland: From Poland, reported so far from four localities (Bucka, 1965; Sosnowska-Półtoracka, 1968; Uherkovich, 1970; Szyjkowski, 1982). In the Catalog of prokaryotic and eukaryotic algae in Poland (Siemińska, Wołowski, 2003), the occurrence of

the taxon is given in the works of Buck (1965), Siemińska et Siemińska (1967), [Sosnowska-] Półtoracka (1968), Szklarczyk-Gazdowa (1965), Uherkovich (1971), Szyjkowski (1982).

General distribution and ecology: *Polyedriopsis spinulosa* occurs in the plankton of lakes and ponds in Europe, Central America and the Middle East.

✶ ***Monactinus simplex*** var. ***echinulatum*** (Wittr.) Pérez, Maidana & Comas, 2009, Fig. 7H–K – Appendix 1

Basionym: *Pediastrum simplex* Meyen 1829 var. *echinulatum* Wittr. in Wittr. et Nordst. in 1883.

Synonym: *Pediastrum clathratum* (Schröder) Lemm. var. *asperum* Lemm. 1897, p. 182, Fig. 6.

Description: The variety occurs in the studied peat cut together with the typical form. Most often, very characteristic 4-cell cenobia were observed in the analysed material, less often 8-cell cenobia. Cenobia 4-celled with a small, regularly square central perforation, 8-celled, usually imperforated or with irregular perforation. The wall of the entire cell surface is covered with approximately 1 μm long spines. The processes of the marginal cells of the 4-cell cenobia are slightly arched. Cenobia 4 cells, 59.5–63.7 μm in diameter. Cells with processes 28.9–32.1 μm long, without processes 17.0–18.1 μm long and 13.6–14.5 μm wide. Marginal cell processes 11.9–12.3 μm long.

Cenobia 8 cells with a diameter of up to 81.6 μm. Marginal cells with processes 25.5–32.3 μm long, 8.5–13.6 μm wide, without processes 13.6–20.4 μm long. Inner cells of cenobium with dimensions of 8.5×9.1–10.2×11.2 μm. The most common species in the research material are 4-cell cenobia. Multi-locular cenobia *Monactinus simplex* var. *echinulatum* (Wittr.) Pérez, Maidana & Comas, appear rarely. The research material also includes cenobia of the nominal species *Monactinus simplex* var. *simplex*. They are usually 8–16 multi-celled.

Found in site: In the plankton of the studied water reservoirs, *Monactinus simplex* var. *echinulatum* (Wittr.) Pérez, Maidana & Comas occurs with varying amounts throughout the entire research period from July to November. However, the optimal development of the taxon in individual peat cut is different. The variety has the most favorable conditions for development in peat cut waters No. 1 in July-September at a temperature of 21.8–26.8 °C and a high pH of 7.8–9.2.

Distribution in Poland: In Poland, *Monactinus simplex* var. *echinulatum* (Wittr.) Pérez, Maidana & Comas, 2009 (= *Pediastrum simplex* Meyen 1829 var. *echinulatum* Wittr. in Wittr. et Nordstedt 1883) is recorded relatively very rarely. So far, the taxon was reported

from the plankton of a lake near Gdańsk (Schröder 1898), from a pond near Kraków (Raciborski, 1889), from the area of Greater Poland, from warm-water lakes. Gosławicki, lake Licheńskiego, lake Pątnowskiego, lake Ślesińskiego (Socha, 1993), as well as lake Sumino in the Łęczycko-Włodawa Lake District (Pasztelaniec, Poniewozk, 2004). In a monographic study devoted to species of the genus *Pediastrum* Meyen, based on literature data and research (Lenarczyk, 2014), she confirmed the occurrence of the taxon only in 10 sites out of 71 examined, located in various physiographic regions of Poland. In the research material, new sites were recorded in the area of the Southern Baltic Coast (2 sites), the southern Baltic Lake District (2 sites), the Polesie Lake District - 6 sites and the Northen Sub-Carpathia – 1 site.

General distribution and ecology: *Monactinus simplex* var. *echinulatum* (Wittr.) Pérez, Maidana & Comas (= *Pediastrum simplex* var. *echinulatum* is known from France, Israel, and Hungary. According to Lenarczyk (2014), the species prefers plankton of eurotrophic-mesotrophic waters. Research carried out (Lenarczyk, 2014) on the basic hydrochemical and habitats indicate that the taxon prefers water with elevated temperature and alkaline reaction (pH 7.9–9.2), as well as conductivity 280–1588 μS/cm, total handiness 8.6–20.0o, carbonate hardness 8.0–11.6, nitrates <5.0–10.0 mg/ dm^3 and *Monactinus simplex* var. *echinulatum* (Wittr.) Pérez, Maidana & Comas mixed catchments and on oxbow lake. It seems to be an important parameter determining the occurrence of *Pediastrum simplex* var. *echinulatum* is the increased temperature of water and its strong alkaline reaction.

✶ ***Staurastrum cyclacanthum*** var. ***pseudobrevissimum*** W.W.A. Kowalski et K. Komarzewsk. var. *nova*, Fig. 8L–O – Appendix 1

Basionim: lack

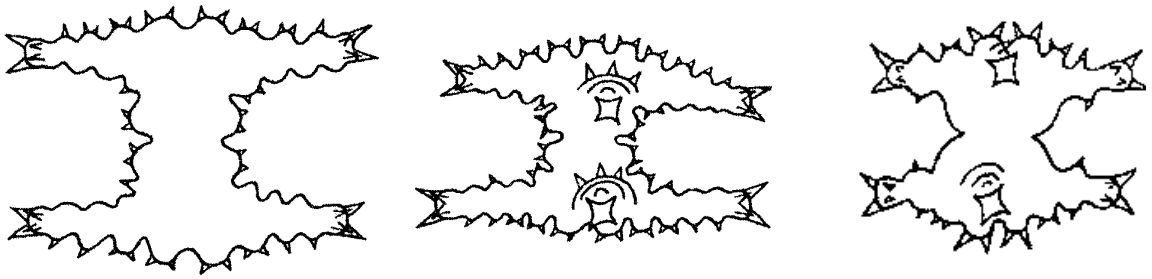
Synonym: lack

Description: Hexagonal cells, almost as long as they are wide, deeply narrowed. Length of cells without spines 34.7–35.0 μm, length with spines 38.9–39.1 μm, width without spines 36.8 μm, width with spines 40.05–41.05 μm, isthmus 7.8–8.4 μm wide. The sinus in the outer part is wide open and linear, at the end it is short and narrow and sharply cut. The semi-cells are trapezoidal, cup-shaped, with a slightly convex top and equipped with 6 papillae. From above, the half-cells are triangular in shape, with three slightly wavy sides. The central protrusion takes up about 1/3 of the side length. On both sides there are smaller bulges of the wall separated by gentle and shallow bays. Along each of the walls of the triangular surface of the half-cell there are two papillary protuberances, arranged parallel to its side, each of which

is equipped with two strong spines, 3.15–3.68 μm long. The corner parts of the triangular half-cells are broadly rounded, equipped with two spines, 3.15–3.68 μm long, below which there is an additional pair of short papilla-like processes. The remaining surface of the cell walls is without ornamentation.

Tab. 1. Characteristics of taxa *Staurastrum cyclacanthum* W.et G.S.West and its described varieties

var. *cyclacanthum* W. et G. S. West (1902)	var. *dissimile* orig. Pal.-Mordv. (1982)	var. *brevissimum* orig. Pal.-Mordv. (1982)
Features of the taxon		
length of cells with spines / length of cells without spines		
according to W. et G. S. West **** 1902		
25.4–49.0 [μm]/22.0–30.0[μm]****	the variety does not occur ****	the variety does not occur****
according to Croasdale, Flint *** 1988		
the entire width of the cells 30.0–31.0 [μm] ***	the variety does not occur ***	the variety does not occur ***
according to Pal.-Mordv. * 1982, ** 2005		
diameter of cells with spines / diameter of cells without spines		
23.0–27.0 [μm] /37.0–49.0 [μm]	22.0–30.7[μm] /30.0–43 [μm]	20.0–21.0 [μm] / 25.4 [μm]
Width of spine cells/width of spineless width of spine cells		
according to W. et G. S. West **** 1902		
no data available ****	the variety does not occur ****	the variety does not occur ****
according to. Croasdale, Flint *** 1988		
the entire width of the cells 41.0–53.0 [μm] ***	the variety does not occur ***	the variety does not occur***
Isthmus		
9.0 [μm] **	5.0–9.1 [μm] **	7.2 [μm] **
8.0 [μm] ***	the variety does not occur ***	the variety does not occur ***
no data available ****	the variety does not occur ****	the variety does not occur ****
Sinus		
wide open, with a narrow indentation at the top, creating an obtuse angle to the outside	broadly circular, with a rounded top. sides of the indentation are almost parallel	short, narrowly indented, with a sharp top
Other features		
semi-cells with a strongly convex top, with 6 two-spiny papillae on the sides and swollen smooth sides. The indentation of the narrowing between the half-cells is semicircular, quite wide, obtuse, and U-shaped in the inner part.	semi-cell with a strongly convex top equipped with 6 two-spiny interconnected papillae on the sides and 1 papilla on each side lying at the base of the outstretched arm, with 2 short spines. The indentation of the narrowing between the half-cells is semicircular, with almost parallel sides in the inner part, U-shaped. The lateral edges of each arm with additional paired spines and one pair lying at the base of the arm. The ends of the arms have two spikes.	half-cells with a moderately convex top, triangular in outline, with a slight concave in the middle of the side, indentations between the top, the lateral and top surfaces of the half-cells, with 6 two spiny papillae not connected in a circular wreath. Opposite each side of the half-cell are two two-spined papillae. The arms are weakly extended with 3 pairs of short spines, two of which are located laterally, 1 pair under the top of the semi-cell arm. The ends of the arms are rounded with two spikes.
Occurrence		
Western Europe, and New Zealand. Sir Lanca,	Only in Ukraine	Only in Ukraine



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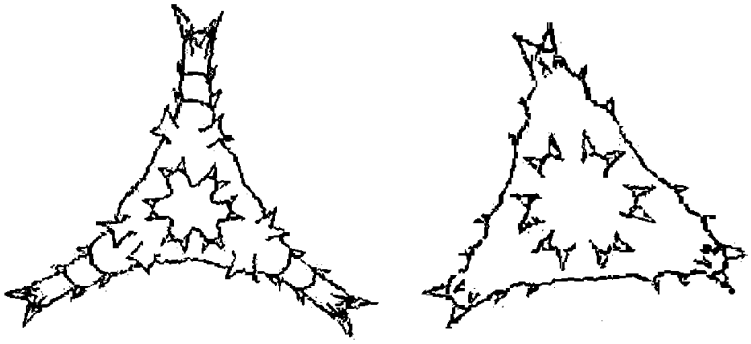

* – according to Palmar-Mordvienceva (1982); ** – according to Palmar-Mordviencevwa (2005); *** – according to. Croasdale, Flint (1988); **** – according to W..et G. S. West (1902)

Comments: The found cells in terms of form, size and ornamentation correspond to the characteristics of *Staurastrum cyclacanthum* W. et G.S. West, however, they differ from both the form of the nominal species and the previously described variety of *S. c.* var. *brevissimum* Pal.-Mordv. The table below provides the basic parameters and characteristic features of the species *S. c.* var. b*revissimum* Pal.-Mordv. and the variety found.

Tab. 2. Comparison of the characteristics of *Staurastrum cyclacanthum* var. *brevissimum* Pal.-Mordv. and a new variety of *Staurastrum cyclacanthum.* var. *pseudobrevissimum* W.W.A. Kowalski. et K. Komarzewska. var. *nova*

var. *brevissimum*	var. *pseudobrevissimum* W.W.A. Kowalski. et K. Komarzewska. var. *nova*
Features of the taxon	
length of cells with spines / length of cells without spines długość komórek z kolcami / długość komórek bez kolców	
25.4 [μm]/ 20.0–21.0 [μm]**	38.9–39.1/34.7–35.0 [μm]
Width of spine cells/width of spineless cells	
no data in the study from 2005	40.05–41.05 [μm]/36.8[μm]
Isthmus	
7.2 [μm]**	7.8–8.4 [μm]
Sinus	
short, narrowly indented, with a sharp top	widely exposed, pyramidal in outline
Other features	
Half-cells with a moderately convex top, triangular in outline, with a slight concave in the middle of the side, indentations between the top, the lateral and top surfaces of the half-cells, with 6 two spiny papillae not	The semi-cells are triangular in shape, inversely trapezoidal, the apical parts are gently rounded, slightly convex, with regularly rounded ends, little distinct arms, and slightly concave between the two pairs of

connected in a circular wreath. Opposite each side of the half-cell are two two-spined papillae. The arms are weakly extended with 3 pairs of short spines, two of which are located laterally, 1 pair under the top of the semi-cell arm. The ends of the arms are rounded with two spikes.	external spines. Isthmus with a small bulge in the middle part. The top of each half-cell has 4 pairs of well-developed spines and one pair at the ends of the arms. In the apical view, the cells are regularly triangular, rounded at the tops, with a pair of spines, at the base of which there is a pair of poorly developed blunt spines. The sides of the semi-cells are tripartite, separated by shallow sinuses. Opposite each side of the half-cell there are two papillae with two spines, each two-spine papilla not connected to the adjacent one. The remaining surface is devoid of other ornamentation elements.
Occurrence	
Only in Ukraine	In the plankton of peat cut waters no. 1
Habitat parameters	
No data available	Plankton of surface waters, material collected in September 2005, pH – 8.1, temperature 15.6, electrolytic conductivity of water 808 μS/cm

** – according to Palmar-Mordvienceva (2005)

Distribution in Poland: Unknown. The occurrence of the variety in the algae flora in Poland has not yet been recorded in the Catalog of Polish prokaryotic and eukaryotic algae. Catalog of prokaryotic and eukaryotic algae in Poland (Siemińska, Wołowski, 2003) as well as in the icon library of the Institute of Botany. W. Szafer in Kraków. This form of cells has not been found in the basic algological literature (W. et G.S. West 1912, 1923; Hirano, 1959, 1960; Coesel, 1997; Coesel, Meesters, 2007; Lenzenweger, 1997; Palmar-Mordvienceva, 1982, 2005; Kanetsuna, Yamagishi, 2018.

General distribution and ecology: *Staurastrum cyclacanthum* var. *brevissimum* and *S. c.* var. *dissimile* were described by Palmar-Mordviencev (1982) from lake waters in Ukraine. Nominal taxon *S. c.* var. *cyclacantum* W. et G.S. West was described from lakes in the lake area of Western Europe. The occurrence of the *S. c.* var. *cyclacantum* W. et G.S. West in New Zealand was confirmed by Casdale, Flint (1988). The authors also report its occurrence in Sri Lanka and South America.

The source literature on the ecology of the nominal taxon and its varieties does not contain detailed information on the habitat parameters of the species.

Found in site: Measurements of basic ecological parameters and hydrochemical features of water in the post-peat reservoir No. 1 at the research date are given in Tab. 3. Table 2 compares the features characteristic of *Staurastrum cyclacanthum* W. et G.S. West var. *brevissimum* Pal.-Mordv. and varieties *S. c.* var. *pseudobrevissimum* W.W.A. Kowalski et K. Komarzewska var. *nova*.

Tab. 3. Ecological and hydrochemical parameters of the taxon's habitat *Staurastrum cyclacanthum* var. *pseudobrevissimum* W.W.A. Kowalski. et K. Komarzewska. var. *nova*

Ecological and hydrochemical parameters (29 September 2005)								
T [°C]	pH	conductivity [µS/cm]	$P\text{-}PO_4$ [mg/l]	P_{total} [mg/l]	$N\text{-}NO_2$ [mg/l]	$N\text{-}NO_3$ [mg/l]	$N\text{-}NH_4$ [mg/l]	Chl *a* [µg/l]
15,6	8.1	808	0.175	0.323	0.074	0.957	0.026	51.054

✶***Cosmarium* sp.** Fig. 8P–S – Appendix 1

In the plankton materials of peat cut water No. 2, an unidentified taxon from the order Desmidiales belonging to the genus *Cosmarium* was found. The taxon occurred in near-surface waters on various research dates, both in 2005 and 2006.

Description: The cells are small in size, oval in outline from the front view. Cell wall structure with two types of ornamentation. In the central part, semi-cells are made of 4 oval granules, not connected to each other, forming a bulge. The remaining surface is covered with regularly arranged round granules. Cell length 17.0 µm, width 15.3 µm. Length to width ratio 1.11×. Thickness in the top and side view 1.45 µm. Ellipsoidal semi-cells with rounded sides. The apical part is flat to slightly convex, forming a bulge separated from the main surface of the half-cells by shallow sinus indentations. Isthmus narrow, 3.4 µm wide, open, regularly U-shaped in the inner part. Sinus in the side view of the half-cell, obtuse, open and rounded in the inner part. There is an angular bulge on the sides of each half-cell. In the gable view, the semi-cells are oval, regularly rounded at the ends, widening in the central part and equipped with an angular protruding central ornamentation.

Found in site: The recorded ecological and hydrochemical parameters of the *Cosmarium* sp. habitat for individual research dates are given in table 4.

Tab. 4. Ecological and hydrochemical parameters of the habitat of the taxon *Cosmarium* sp.

Test dates	Ecological and hydrochemical parameters of the peat cut water habitat								
	T [°C]	pH	conductivity [µS/cm]	$P\text{-}PO_4$ [mg/l]	P total [mg/l]	$N\text{-}NO_2$ [mg/l]	$N\text{-}NO_3$ [mg/l]	$N\text{-}NH_4$ [mg/l]	Chl *a* [µg/l]
06.07.2005	21.0	7.5	683	0.173	0.238	0.008	0.562	0.030	✶
30.04.2006	14.2	8.3	630	✶	✶	✶	✶	✶	13.632
10.07.2006	28.4	8.8	627	0.073	0.187	0.010	0.568	0.088	18.140
18.09.2006	19.9	8.1	605	0.132	0.253	0.030	0.378	0.074	8.029
20.10.2006	10.0	7.6	729	0.139	0.290	0.068	0.923	0.111	50.026
29.11.2006	7.0	7.8	730	0.160	0.319	0.027	1.006	0.281	2.940

✶ – not tested

In available literature (West et G.S. West, 1908, 1912; Hirano, 1957/III, 1957/IV; Lennzenwger, 1999; Coesel, 1991; Coesel, Meesters, 2007; Palmar-Mordvintseva, 1982, 2005; Croasdale 1988 and Floristic Desmidia studies), such a form was not recommended taxon, which would correspond to the morphology of its cell. For a comparative analysis of the found cell, illustrations included in the materials of the icon library of the Institute of Botany of the Polish Academy of Sciences in Krakow were also used.

Conclusions

The paper presents the characteristics of taxa from the class Chlorophyceae, orders Chlorococcales and Desmidiales, rarely reported from Western Pomerania. Their occurrence was found during the analysis of the algae flora in the peat habitats of a vast peat complex covering an inaccessible area on the south-eastern side of the Szczecin Lagoon. In the rich flora of algae, a variety new to science was recorded – *Staurastrum cyclocantym* var. *pseudobrevissimum* and taxa not reported from the area, i.e.: *Korshikoviella limnetica*, *Polyedriopsis spinulosa*, *Monactinus simplex* var. *echinulatum* and *Cosmarium* sp. There are also other taxa of Desmidia that require determination of species affiliation. Detailed studies of hydrochemical and ecological parameters allowed to determine the spectrum determining their occurrence. The content of basic nutrients was tested, i.e.: $P\text{-}PO_4$, P_{total}, $N\text{-}NO_2$, $N\text{-}NO_3$, $N\text{-}NH_4$, Chl *a*. The waters of all peatlands were characterized by an alkaline reaction, dynamic changes in temperature due to their small depth, and the level of chlorophyll a content. The content of basic nutrients indicates the eutrophic nature of the waters of the former peatlands.

Conflict of interest

The authors declare no conflict of interest related to this article.

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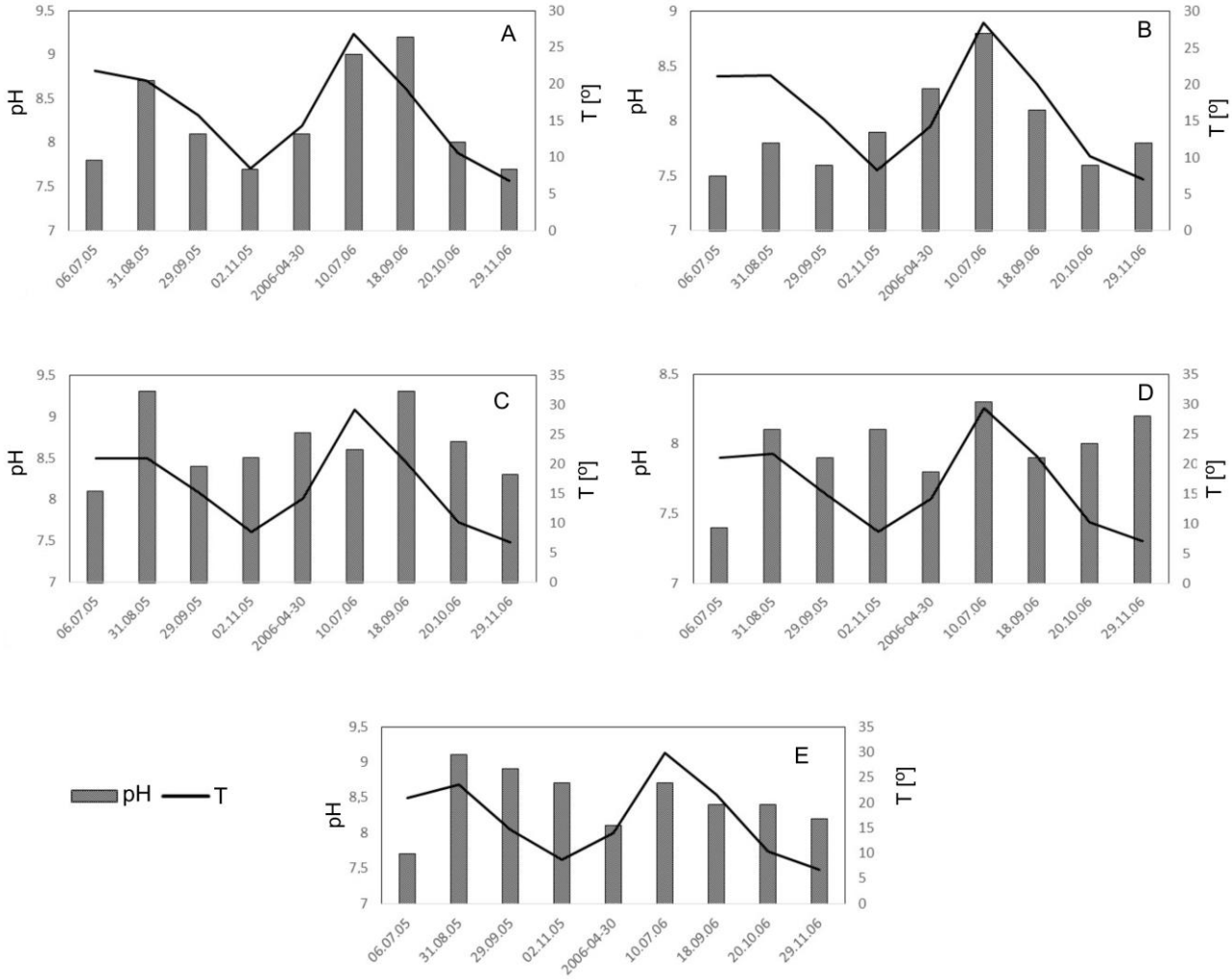

Fig. 3. Changes in the reaction [pH] value and temperature [T] of water in the studied peat cut in the research cycle of 2005–2006; peat cut: A – no. 1, B – no. 2, C – no. 3, D – no. 4, E – no. 5

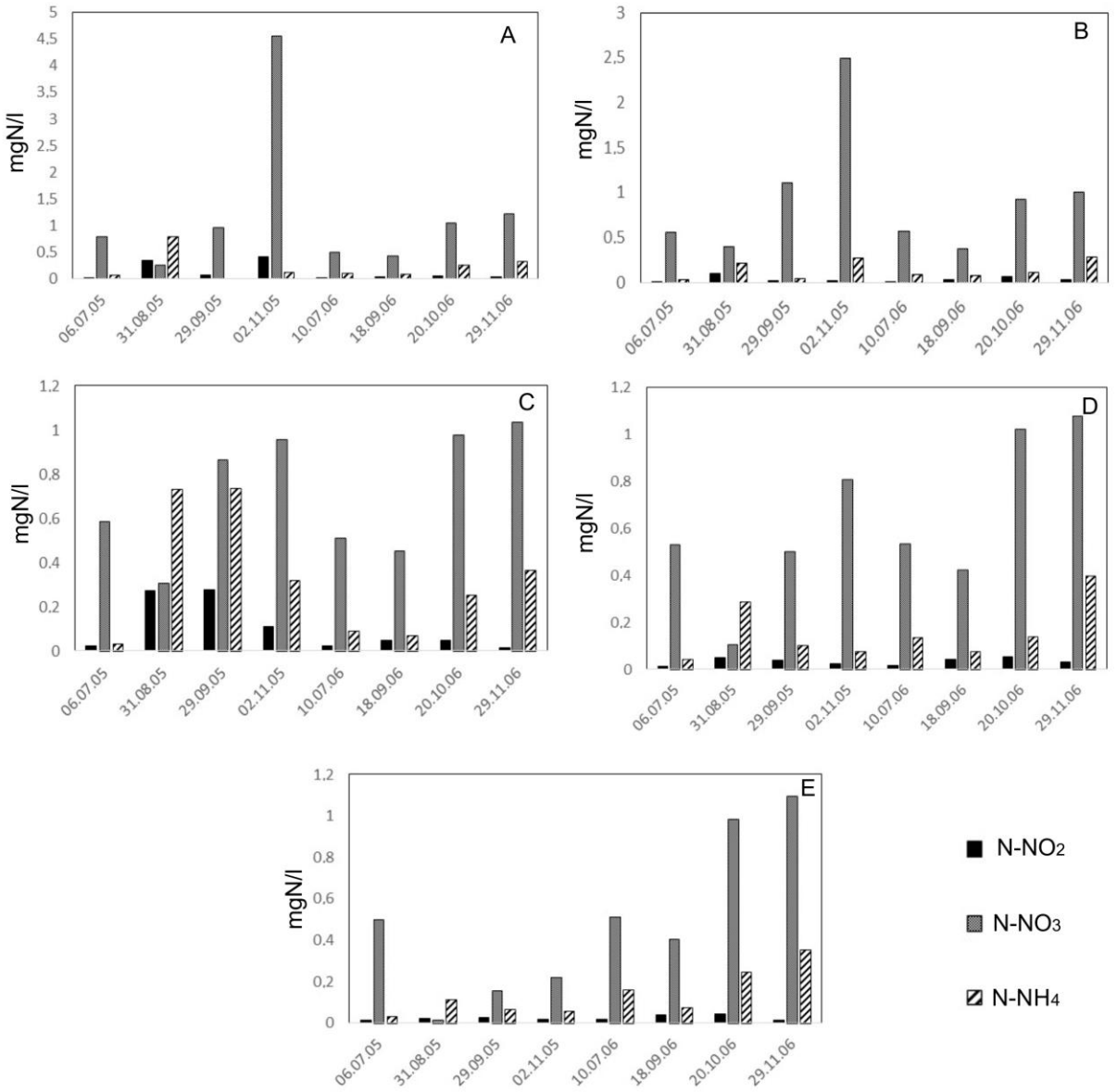

Fig. 5. Changes in the content of nitrogen [$N\text{-}NO_2$, $N\text{-}NO_3$, $N\text{-}NH_4$] compounds in the waters of the studied peat cut in the research cycle of 2005–2006; peat cut: A – no. 1, B – no. 2, C – no. 3, D – no. 4, E – no. 5

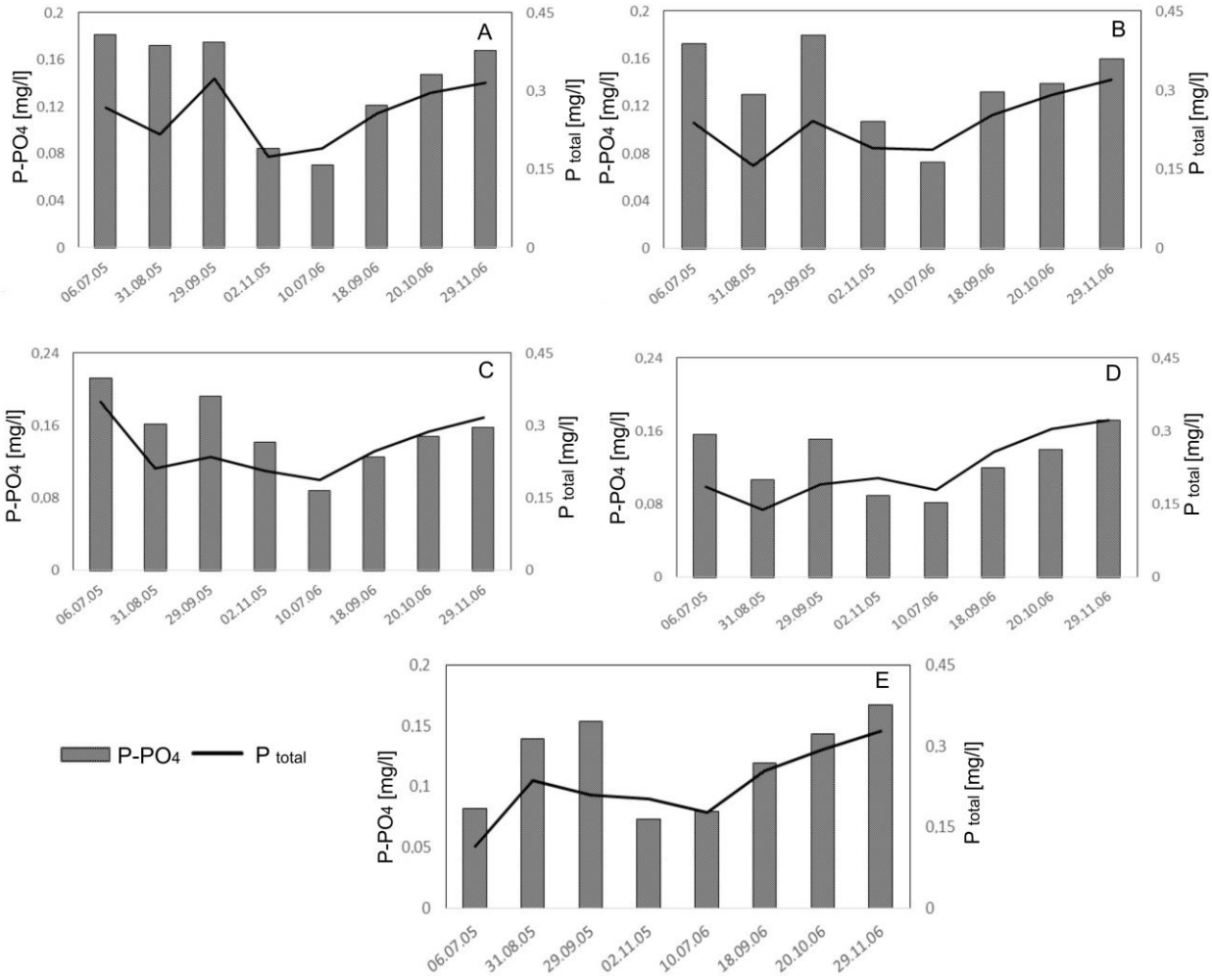

Fig. 6. Changes in the content of phosphates [P-PO_4] and total phosphorus [P_{total}] during the research cycle in the water of the tested peat; peat cut: A – no. 1, B – no. 2, C – no. 3, D – no. 4, E – no. 5

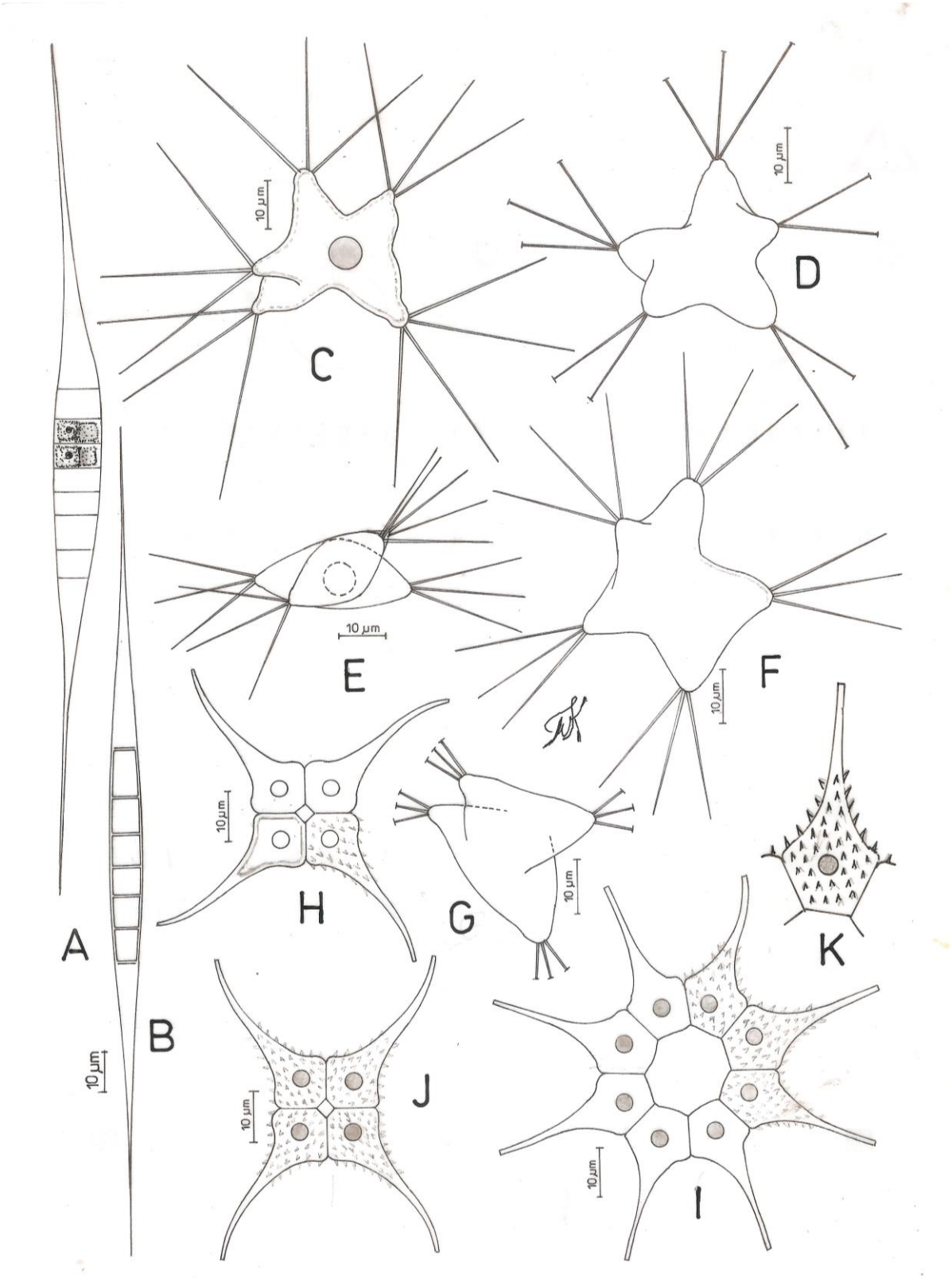

Fig. 7. A-K. A-B. *Korshikoviella limnetica*; C–G. *Polyedriopsis spinulosa*: various forms of cells; H–K. *Monactinus simplex* var. *echinulatum* (= *Pediastrum simplex* var. *echinulatum*): H–J. four- and eight-cell cenobia, K. marginal cell of cenobium with pyrenoid (orig. engravings W. W. A. Kowalski)

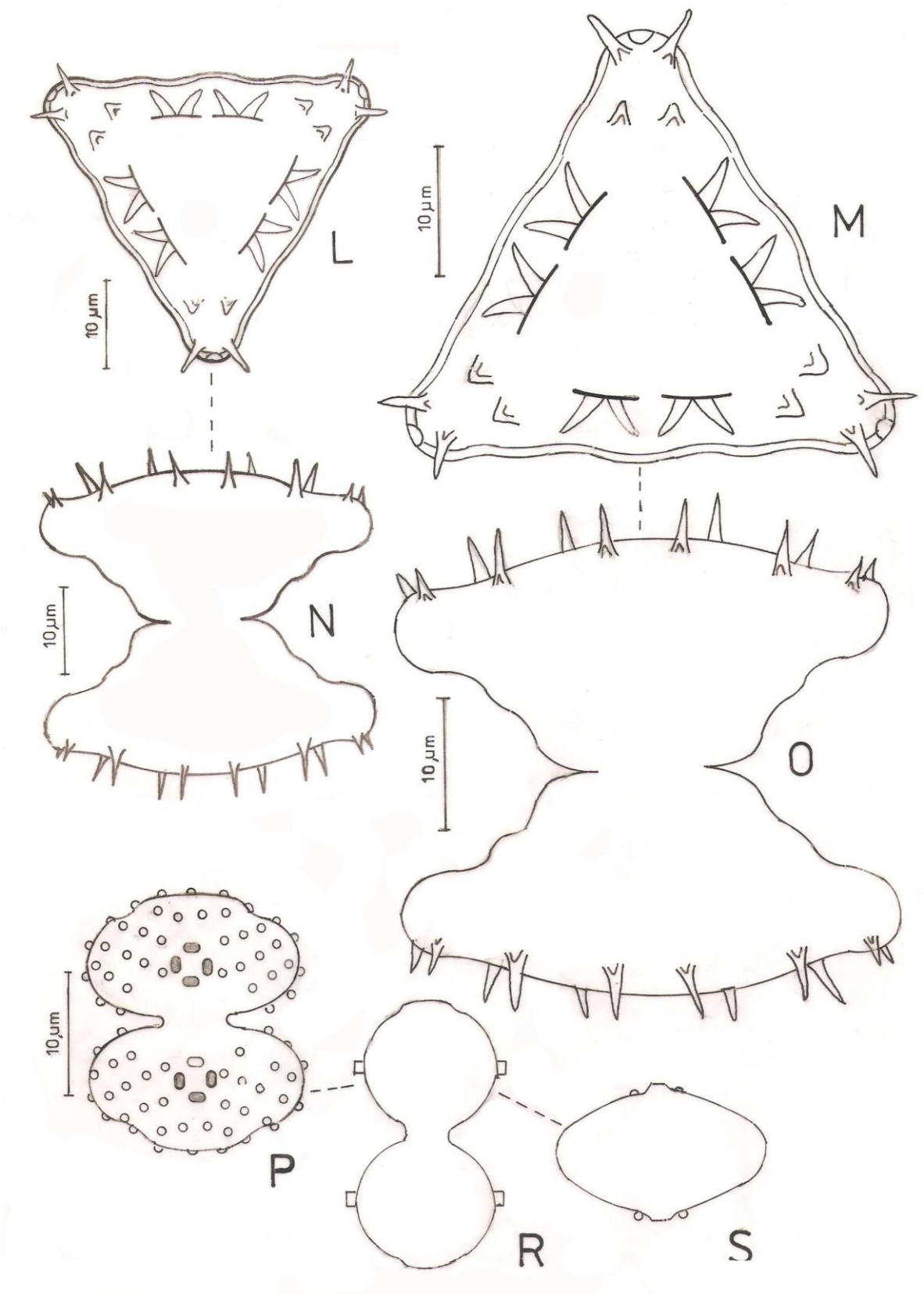

Fig. 8. L-T. L-O. *Staurastrum cyclacanthum* var. *pseudobrevissimum*: L–M. cell ornamentation – view of the apical side, N–O. ornamentation of the front side of the cell; P-S. *Cosmarium* sp.: P – z ornamentation on the front side of the cell, R. side view (without ornamentation), S. view of the gable side (without ornamentation) (orig. engravings W. W. A. Kowalski)

Staurastrum cyclacanthum var. *pseudobrevissimus* – nowa odmiana desmidów oraz kilka innych rzadkich taksonów znalezionych na torfowiskach (Pomorze Zachodnie, Polska)

Streszczenie

W artykule opisano nową odmianę *Staurastrum cyclocanthum* var. *pseudobrevissimum* wraz z oryginalną dokumentacją rysunkową oraz charakterystyką ekologiczną siedliska. Charakterystyka ta obejmuje podstawowe parametry hydrochemiczne i najważniejsze cechy ekologiczne siedliska, w tym termikę wód, odczyn pH, przewodnictwo elektrolityczne. W pracy uwzględniono również informacje dotyczące czterech innych taksonów, tj.: *Korshikoviella limnetica*, *Polyedriopsis spinulosa*, *Monactinus simplex* var. *echinulatum* i *Cosmarium* sp. Taksony te występowały w płytkich potorfiach rozległego kompleksu torfowiskowego północno-zachodniej Polski i rzadko są podawane z tego regionu. Na podstawie dostępnej bibliografii algologicznej dla rodzaju *Cosmarium* sp. nie udało się ustalić przynależności gatunkowej.

Słowa kluczowe: Chlorophyceae, Chlorococcales, Desmidiales, nowe stanowiska, Pomorze Zachodnie

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