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THE NEW LOCALITIES OF RARE SPECIES *NEIDIUM HERCYNICUM* MAYER ON THE PEATLAND AREAS OF SOUTHERN AND SOUTH-EASTERN POLAND

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ABSTRACT

The studies were conducted on watercourses flowing out of raised peat bog areas in Orawsko-Nowotarska Basin and raised peat bogs and transitional moor in „Międzyrzeki" Reserve on the territory of the Roztocze National Park. New localities where *Neidium hercynicum* occurred were found on the peatland areas of Southern Poland (Orawsko-Nowotarska Basin) and South-eastern (the Roztocze National Park) during the studies conducted on Jamów, Tokarka and Chyżny streams and on the territory of "Międzyrzeki" Reserve between 2007–2013. Longer and wider specimens were found on both investigated sites in comparison to the dimensions listed in the Krammer and Lange-Bertalot key. *N. hercynicum* were always found as individual specimens.

Keywords: *Neidium hercynicum*, new localities, peat bogs, Orawsko-Nowotarska Basin, „Międzyrzeki" Reserve.

INTRODUCTION

The *Neidium hercynicum* Mayer species was described at first by Mayer [1917] in Bavaria and then by Hustedt [1930] as *Neidium affine* f. *hercynica* (Mayer) Hust. According to Krammer and Lange-Bertalot [1986], this species is probably widespread in the temperate zone, however, further investigation is required due to the errors in the determination.

It was reported in Europe in i.e. England [Whitton et al. 2003], Romania [Caraus 2002, 2012], Czech Republic [Nováková 2002, Štefková 2008, Fránková et al. 2009] and Germany where it was listed on the red list in R category as very rare species [Lange-Bertalot, Steindorf 1996]. On the territory of Poland *N. hercynicum* was reported in a few localities: in the Eemian profile in freshwater deposits at Imbramowice near Wrocław [Kaczmarska 1976, 1997], in the peat bog in Modlniczka near Kraków [Piątek 2007] and the Mleczka River and the Duszatyńskie Lakes in the territory of Podkarpacie Province [Pajączek et al. 2012, Noga et al. 2013, 2014].

The aim of the study was to present new localities where *N. hercynicum* occurred on the peatland areas of Southern Poland (the Roztocze National Park) with regard to the habitat conditions in which the species was found. A few algological studies conducted previously on the territory of the Roztocze National Park [Szczurowska 2003, 2006, 2009] and Orawsko-Nowotarska Basin [Grzelewska 1974, Wasylik 1960, 1993, Wojtal 1999] concerned different algae group, but did not demonstrate the presence of *N. hercynicum* in any studied locations.

STUDY AREA

The studies were conducted on watercourses flowing out of raised peat bog areas in the Orawsko-Nowotarska Basin and on raised peat bogs and transitional moor in „Międzyrzeki" Nature Reserve on the territory of the Roztocze National Park (Figure 1).

The area of research is located in the Orawsko-Nowotarska Basin where Chyżny stream and its spring streams Tokarka and Jamów flows. The Orawsko-Nowotarska Basin is located between the Western Beskid chain in the north and the Spisko-Gubałowskie Foothills in the south. The bottom of the valley is situated up to 1000 m lower from the nearby mountains. The eastern boundary of the Orawsko-Nowotarska Basin goes along the European watershed between the basins of Orawa and Dunajec. The coniferous forest of Orawa comprise extensive complex of raised peatbogs and marshy coniferous forest [Ładygin 1885, Sobczyński, Zawadzka 1988, Kondracki 2001].

The Roztocze National Park was created in 1974, it occupies the area of 8481.76 ha, where of 93% is comprised of forests. Most part of the area has retained their original character, there is some diversity in terms of tree stands and habitats. „Międzyrzeki" Reserve was created in 1990 and was incorporated in the Roztocze National Park as the area of strict protection in 1992. This area includes transitional moor and raised peat bogs where 9 complexes of bog vegetation and forest habitat associated with wetlands can be found [Lorens et al. 1991, Pawłowski 2003].

MATERIAL AND METHODS

The material for this study was collected between 2007 and 2011 on the Jamów stream (6 sampling sites), the Tokarka stream (5 sampling sites) and the Chyżny stream (2 sampling sites) and between 2012 and 2013 on the area of strict reserve "Międzyrzeki" (3 sampling sites).

Water samples with algae were collected in the streams from stones, slit and mosses growing on rocks, whereas in the reserve "Międzyrzeki" from small depressions filled with water or squeezed from moss. The samples were preserved in 4% formaldehyde. A portion of each sample was

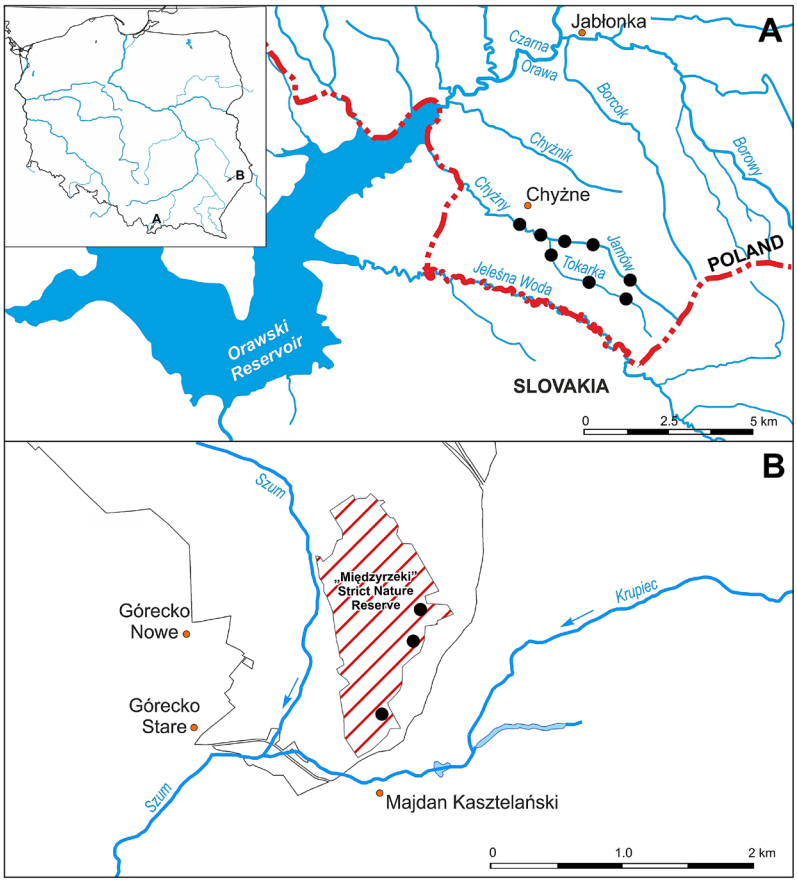

Figure 1. Location of sampling sites on Jamów, Tokarka and Chyżny streams (Orawsko-Nowotarska Basin) (A) and on the area of "Międzyrzeki" Strict Nature Reserve (B)

cleaned with a mixture of sulfuric acid and potassium dichromate, and then washed in a centrifuge at 2500 rpm. Diatoms were mounted in synthetic resin (Pleurax; refractive index 1.75). The material was collected and described according to the method recommended by Kawecka [1980].

Diatoms were identified and counted using DIC (Differential Interference Contrast) under a *Nikon ECLIPSE 80i* microscope according to keys by Krammer and Lange-Bertalot [1986]. The photos were taken under the same light microscope and in scanning electron microscope *HITACHI SU 8010*.

Chemical analysis of water taken from "Międzyrzeki" Reserve were carried out in the Departmental Laboratory of Analysis of Environmental Health and Materials of Plant Origin, by means of a liquid chromatography apparatus PeakNet Dionex 2001–2006, version 6.80.

Species composition of the samples collected from the studied area was determined by counting specimens on randomly selected transects under microscope light. The number of valves counted was minimum 400 per slide. Species with a content above 5% in a given diatom assemblage were defined as abundant.

RESULTS AND DISCUSSION

New records of *Neidium hercynicum* in the southern and south-eastern Poland are related in both cases to the areas of raised bogs with low pH and electrolyte content (Figure 1). Currently, there are 6 known sites of the occurrence of this species in Poland and all are concentrated in the southern part of the country (Figure 2).

Chemical parameters measured in „Międzyrzeki" Reserve showed that they are poor and oligotrophic habitats with a low content of chlorides, sulphates and nitrates (Table 1). All valves were 47.6–95.3 µm length, 7.3–14.2 µm width and 26–28 striae in 10 µm (Table 1, Figures 3–4). In both areas of research specimens were longer and wider compared to dimensions in Krammer and Lange-Bertalot [1986] key.

According to Krammer and Lange-Bertalot [1986], *N. hercynicum* is a widespread species, frequent in some sites of southern Germany, especially at low mountain ranges. It seems to prefer small water tanks with moderate electrolyte content. According to Van Dam et al. [1994], it is acidophlious species mainly occurring at pH<7.

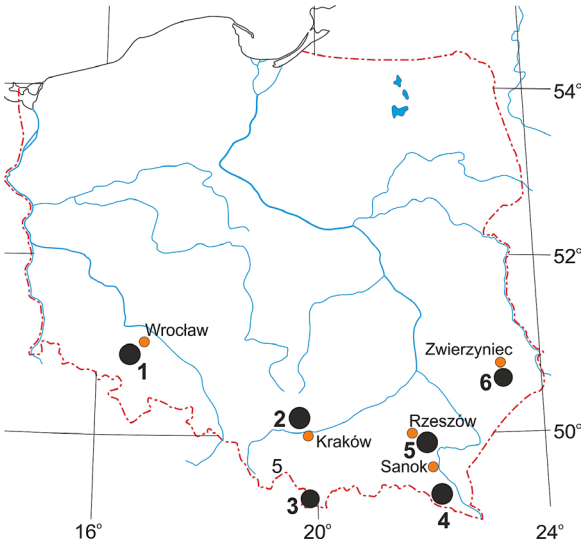

Figure 2. Records of *Neidium hercynicum* Mayer in Poland: 1 – freshwater deposits in Imbramowice near Wrocław, 2 – peat bog in Modlniczka near Kraków, 3 – Jamów, Tokarka and Chyżny stream in Orawsko-Nowotarka Basin, 4 – Duszatyńskie Lakes in Duszatyn, 5 – Mleczka River in Jawornik Polski, 6 – "Międzyrzeki" Strict Nature Reserve in the Roztocze National Park

Table 1. *Neidium hercynicum* valve dimensions and the physico-chemical parameters values measured on studies sites in „Międzyrzeki" Strict Nature Reserve and the streams flowing out of peat bogs in Orawsko-Nowotarska Valley

Physico-chemical parameter	„Międzyrzeki" Strict Nature Reserve	Orawsko-Nowotarska Valley
Lenght [µm]	59–95.3	47.6–90
Width [µm]	11.8–14.2	7.3–14
Striae [in 10 µm]	26–27	26–28
Puncta [in 10 µm]	20–28	–
Temperature [°C]	14.0–28.6	8.0–17.1
pH	3.1–3.6	3.0–4.4
Conductivity [µS/cm]	56–101	28–124
Cl^- [mg/l]	3.33–6.91	–
NO_3^- [mg/l]	<0.1–3.09	–
SO_4^- [mg/l]	10.24–27.59	–

In similar conditions – low pH (average <5) and low electrolyte content (below 100 µS/cm) – this species have been found in peat bogs in the Karkonosze Mts. [Nováková 2002], in mineral-poor *Sphagnum*-fens in the Western Carpathian [Fránková et al. 2009]. Whereas in the peat bog in Modlniczka near Kraków *N. hercynicum* occurred as individual specimens at slightly acidic to circumneutral pH (5.0–7.0) and low electrolyte content (28–530 µS/cm) in small holes in mossy turf [Piątek 2007].

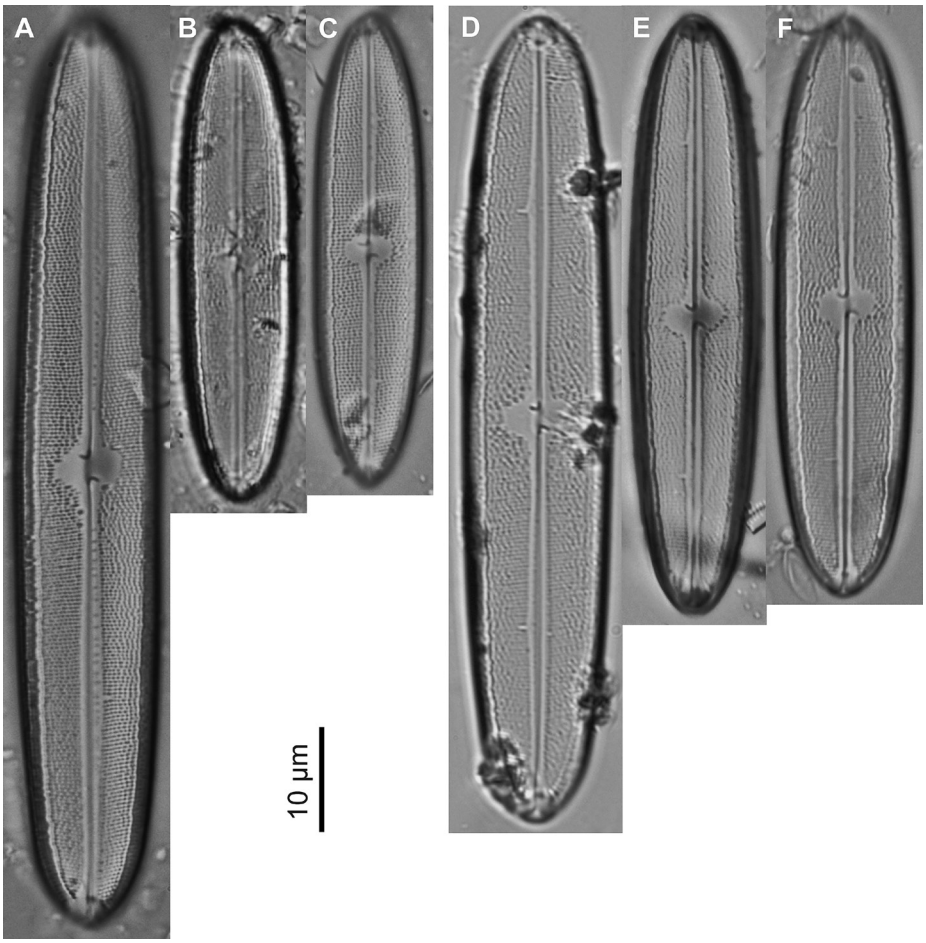

Figure 3. Light Microscope (LM) images of *Neidium hercynicum*; A-C – population from streams of Orawsko-Nowotarska Basin, D-F – population from peat-bogs of "Międzyrzeki" Strict Nature Reserve

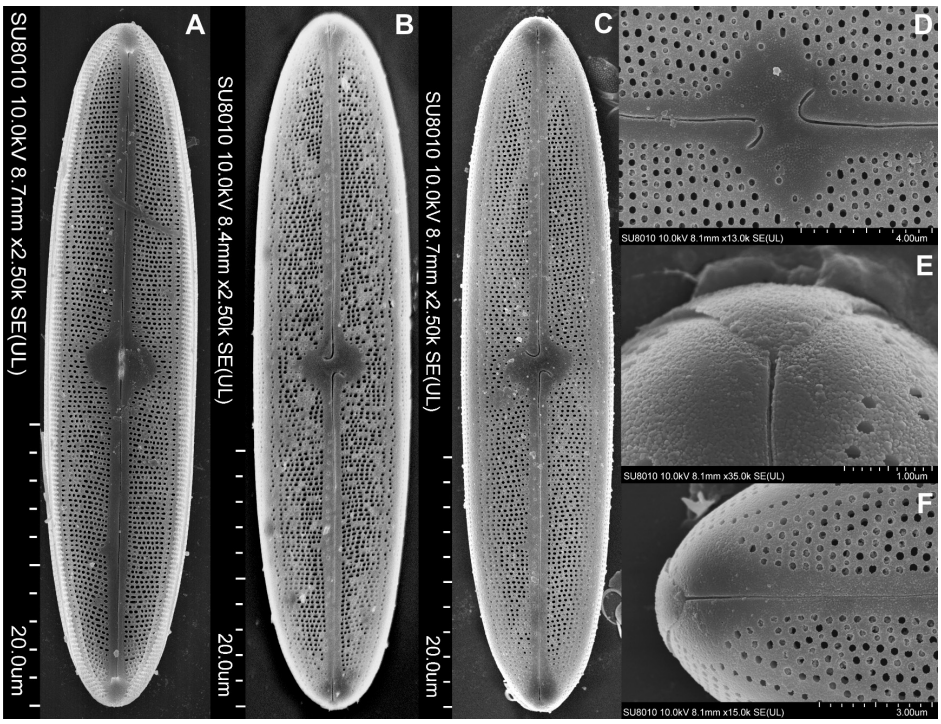

Figure 4. Scanning Electron Microscope (SEM) images of *Neidium hercynicum* from "Międzyrzeki" Strict Nature Reserve; A – internal view of an entire valve, B-C – external view of an entire valve, D – external detail of the central area of valve, E-F – external view of valve apex

On sampling sites *N. hercynicum* were always found as single specimens, both in the streams of Orawsko-Nowotarska Basin, and the reserve „Międzyrzeki". The most numerous specimens were observed in a bog in the reserve „Międzyrzeki" in shallow hollows filled with water high content of organic matter. On the area of the Orawsko-Nowotarska Basin most cells were observed in the Tokarka stream, in the place where large amount of organic matter from decaying moss was deposited on stream bottom and shores were abundantly covered with mosses of the genus *Sphagnum* and *Polytrichum*. Both sites were characterized by very low pH (3.1–3.6) and conductivity (75–101 μS/cm). Water on all sites was reddish-brown color characteristic for peat areas. The most abundant, i.e. reaching a minimum 5% share in assemblages included: *Brachysira serians* (Bréb.) Round & D.G. Mann, *Eunotia paludosa* Grunow, *E. exigua* (Bréb.) Rabenh. and *Frustulia saxonica* Rabenh. on peat bog in "Międzyrzeki" Reserve, and *Eunotia meisterii* Hust. and *Frustulia saxonica* Rabenh. in the Tokarka stream.

The conducted studies show that the *Neidium hercynicum* seems to prefer oligotrophic waters, lentic (mainly small water bodies) and the flowing water in the areas of raised bogs. It has the best growth conditions in waters with low pH (below 5), low to moderate electrolyte content with high content of organic matter on the bottom. This is also confirmed by specimens found in both sampling sites which went beyond the dimensions given in the key (single cells were longer even up to 15 μm), which could indicate a favorable habitat conditions. It probably develops as individual specimens and does not usually create massive populations.

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