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CRATICULA BUDERI (*BACILLARIOPHYCEAE*) IN POLAND

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Craticula buderi (Hustedt) Lange-Bertalot was established by Hustedt in 1954 as *Navicula buderi*, after which this diatom was transferred to the genus *Craticula* by Lange-Bertalot (Rumrich *et al.* 2000). I found several specimens of *C. buderi* in the Chechło River in southern Poland during diatomological studies of this area. *Craticula buderi* is known from North America (USA; e.g., Bahls 2009), South America (Colombia; e.g., Montoya-Moreno *et al*. 2013), Australia (Queensland) and New Zealand (Bostock & Holland 2010), and the Middle East (Israel; Tsarenko *et al.* 2000). In the Arctic it is known from Ellesmere Island (Michelutti *et al*. 2013), and in Europe from Great Britain (Hartley *et al*. 1986), Germany (Hofmann *et al*. 2013) and Romania (Cărăuş 2012). This diatom is widespread in Central Europe, where it is known from water of high calcium content and moderate to higher electric conductivity, including saline water (Lange-Bertalot 2001; Bąk *et al*. 2012; Pliński & Witkowski 2013). Previously the species was reported only from two localities in northern and central Poland (Dziengo 2003; Żelazna-Wieczorek 2011; Fig. 1). There is little published data on the distribution of *C. buderi* in Poland. For the diatom names regarded as synonyms of *Craticula buderi* (*Navicula pseudohalophila* Cholnoky 1960, *Navicula adsidua* R. E. M. Archibald 1971) I found no information on their distribution in Poland. Other *Navicula* species similar to *Craticula buderi* [*Navicula simplex* Krasske, *N. halophila* (Grunow) Cleve] are known from Poland (Siemińska & Wołowski 2003). *Navicula simplex* Krasske is known from the Baltic coastal zone (Rumek 1948; Mańkowski & Rumek 1975; Ringer 1985), the Mazurian area (Chudyba 1979), the Vistula River near Warsaw (Wysocka 1952; Tyszka-Mackiewicz 1983) and a fish pond in Mydlniki near Kraków (Siemińska 1947). The last diatom that can be mistaken for *Craticula buderi* is *Navicula halophila* [= *Craticula halophila* (Grunow *ex* Van Heurck) Mann]. *Craticula buderi* was regarded as a synonym of *Navicula halophila* by Krammer and Lange-Bertalot (1986). Now these two species are treated as separate taxa, *Craticula buderi* and *C. halophila*, which differ considerably in valve shape and size (Lange-Bertalot 2001). *Craticula halophila* is well known from saline springs and waters of high to very high electrolyte content.

This publication discusses the distribution of *Craticula buderi* in Poland and provides brief information about its morphological variability in LM and SEM, observed in the samples collected from the Chechło River.

Craticula buderi (Hustedt) Lange-Bertalot
Figs 1–14

in Rumrich, Lange-Bertalot & Rumrich 2000; *Navicula buderi* Hustedt 1954; *Navicula pseudohalophila* Cholnoky 1960; *Navicula adsidua* R. E. M. Archibald 1971.

The observed valves (n = 27) are 15.2–27.7 (21.29 ± 3.15) µm long and 4.9–6.6 (5.93 ± 0.47) µm wide, and are ornamented with 16–22 (19.58 ± 1.49) striae in 10 µm. They are lanceolate with short protracted rostrate apices (Figs 2–9, 12). The axial area is linear and very narrow (Figs 2–9, 12). The central area is only slightly wider than the axial area and elliptic in shape (Figs 9, 10, 12, 13).

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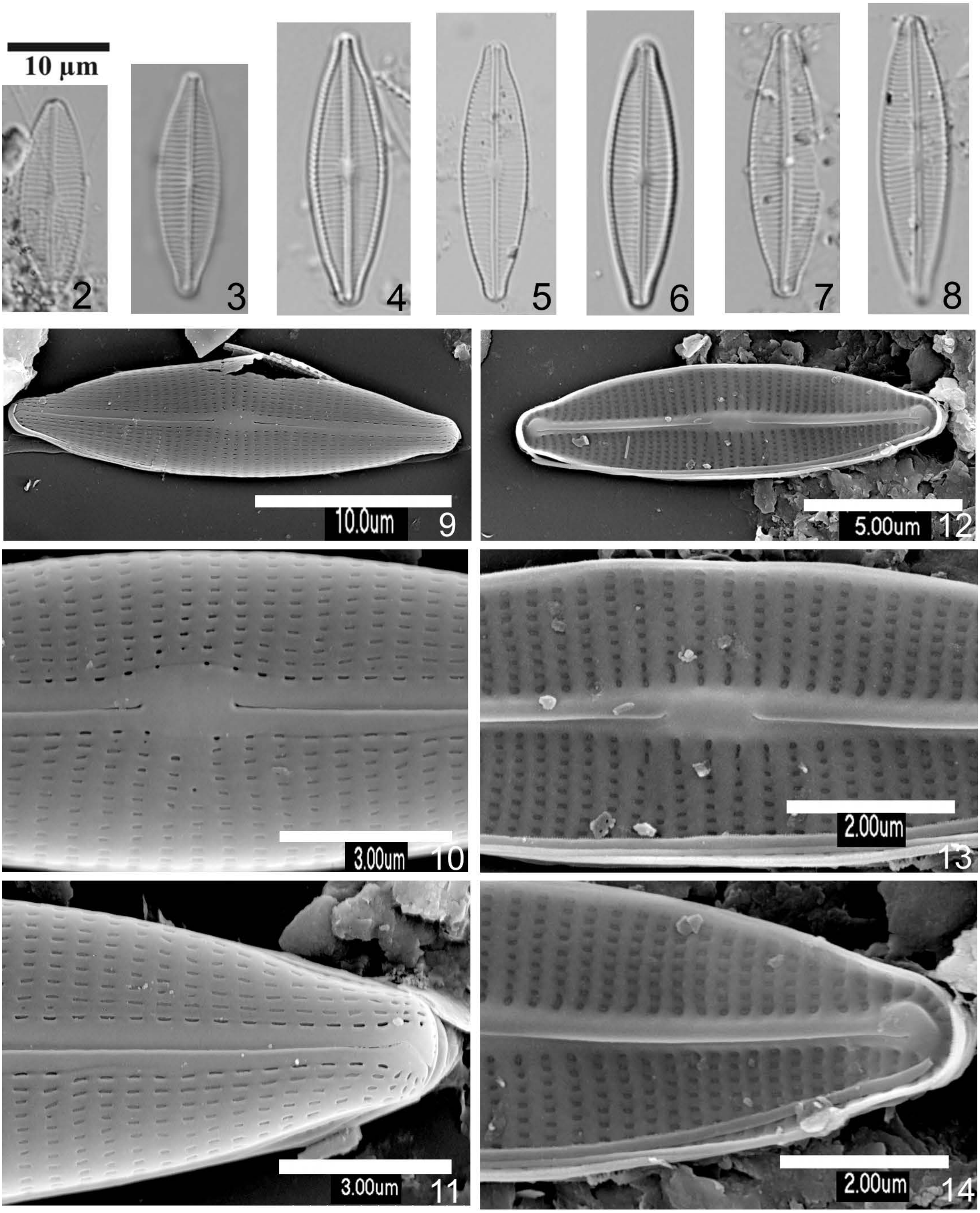
Fig. 1. Distribution of *Craticula buderi* (Hustedt) Lange-Bertalot in Poland. Grey dots show the known localities given by Dziengo (2003) and Żelazna-Wieczorek (2011). Black dot shows a new locality in the Chechło River given here.

The raphe is filiform with near-straight proximal ends (Figs 10, 13) and distal ends hooked in the same direction (Figs 9, 11). The striae are parallel (Figs 13, 14) to very weakly radiate at the valve center (Figs 10, 13), becoming convergent towards the apices (Figs 11, 14). The areolae are of very fine structure, making them difficult to resolve in LM; they are apically elongated, lying in single rows, 46–55 in 10 µm.

Craticula buderi was first mentioned by Dziengo (2003) from northern Poland in the Gulf of Gdańsk, Baltic Sea. The second locality was given by Żelazna-Wieczorek, who noted it in three springs in Łódź, central Poland (2011). The occurrence of this diatom in the Chechło River in southern Poland confirms the tolerance range of *C. buderi*, which is known from habitats polluted by industrial waste. The sample with *C. buderi* was collected in 2015 from sandy bottom in the Chechło River, where pH was 7.5 and ionic composition was as follows: phosphate (PO_4^{3+}) 0.3 mg l^{-1}, nitrate (NO_3^{-}) 0.4 mg l^{-1}, chlorine (Cl^{-}) 58.2 mg l^{-1}, calcium (Ca^{2+}) 72.2 mg l^{-1}, and sulphate (SO_4^{2-}) 105.8 mg l^{-1}. The water was rich in heavy metals such as cadmium (Cd 2.5 µg l^{-1}) copper (Cu 5.0 µg l^{-1}) and zinc (Zn 90.0 µg l^{-1}). The drainage basin of the Chechło River is built partly of tectonically dislocated Triassic dolomite which contains zinc and lead ore, and the river also is polluted by municipal sewage from the town of Chrzanów. The Chechło has a catchment area of *ca* 110 km^2 and drains the southern part of the Silesian-Cracow Upland. It is 23 km long and the mean annual flow in the lower course of the river is 1.5 m^3 s^{-1}. The eastern part of the drainage basin is Jurassic limestone and Permian conglomerates; the remaining part is composed of the mentioned tectonically dislocated Triassic dolomite. The dolomite contains rich deposits of zinc and lead ore; mining began there as far back as the Middle Ages. The landscape is dominated by horst hills 300–400 m a.s.l. high, separated by depressions (*ca* 200–300 m a.s.l.) filled with fluvioglacial sand. The hill slopes are steep and rise 50–100 m above the local ground level (Ciszewski 1997).

The most abundant diatom taxa dominating in the diatom assemblages with *C. buderi* include *Nitzschia capitellata* Hustedt, *Planothidium frequentissimum* (Lange-Bertalot) Lange-Bertalot, *Navicula gregaria* Donkin, *Hippodonta capitata* (Ehrenberg) Lange-Bertalot, Metzeltin & Witkowski, *P. lanceolatum* (Brebisson *ex* Kützing) Lange-Bertalot, *Gomphonema micropus* Kützing, *Achnanthidium minutissimum* (Kützing) Czarnecki, *Cocconeis placentula* var. *placentula* (Ehrenberg) Grunow, *Eolimna minima* (Grunow) Lange-Bertalot, *N. palea* var. *debilis* (Kützing) Grunow, *G. parvulum* (Kützing) Kützing, *Mayamaea atomus* var. *permitis* (Hustedt) Lange-Bertalot, *Lemnicola hungarica* (Grunow) Round & Basson. Bioindicative diatom taxa are: *Parlibellus protractoides* (Hustedt) Witkowski & Lange-Bertalot, *Mayamaea atomus* var. *permitis* (Hustedt) Lange-Bertalot, *Nitzschia amphibia* Grunow, *N. palea*, *Planothidium frequentissimum, Sellaphora pupula, Surirella brebissonii* var. *kuetzingii* Krammer & Lange-Bertalot, *Achnanthidium minutissimum*, *Aulacoseira granulata* (Ehrenberg) Simonsen, *Cyclotella meneghiniana* Kützing, *Cymatopleura solea* (Brébisson) W. Smith, *Gomphonema parvulum*, *Hippodonta capitata*, *Melosira varians* C. Agardh, *Navicula cryptocephala* Kützing, *N. gregaria* Donkin, *N. lanceolata* Ehrenberg



Figs 2–14. *Craticula buderi* (Hustedt) Lange-Bertalot in LM (2–8) and SEM (9–14). 2–9 & 12 – variation of outline and size of the recorded valves, which are lanceolate with short protracted rostrate apices; 9 & 12 – linear, very narrow axial area; 9, 10, 12 & 13 – central area slightly wider than axial area, and elliptic in shape; 10 & 13 – filiform raphe with near-straight proximal ends; 9 & 11 – distal ends hooked in the same direction. 9–11 – exterior view of valve; 12–14 – interior view of valve.

and *Nitzschia linearis* W. Smith. They are diatoms common in eutrophic waters, showing a wide range of tolerance of pollution (Bąk *et al*. 2012). The observed valves of *Craticula buderi* found in the Chechło River fall within the known range of morphological variability of this diatom. They are 15.2–27.7 μm long, 4.9–6.6 μm wide and have 16–22 striae in 10 μm; according to Bąk *et al*. (2012) the range of dimensions of *C. buderi* is wider (10–40 μm long, 5–8 μm wide, 17–21 striae in 10 μm). Slightly narrower valves as well as those having 16 or 22 transapical striae in 10 μm were individual cases.

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