Proceedings of the 1st Central European Diatom Meeting 2007
Kusber, W.-H. & Jahn, R. (ed.)
Botanic Garden and Botanical Museum Berlin-Dahlem, Freie Universität Berlin
ISBN 978-3-921800-63-8, © BGBM, Berlin 2007.
doi:10.3372/cediatom.108 (available via http://dx.doi.org/)

Halophilous diatoms in Czech running waters: *Pleurosira laevis* and *Bacillaria paxillifera*

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INTRODUCTION

Salt marshes and saline waters, natural habitats of halophilous and halobiontic algae, belong to endangered biotopes of the CR. Their worldwide distribution is mainly restricted to coastal zones and inland regions with extremely dry climate. In the Central Upland ecoregion, covering the majority of the surface of the CR, such biotopes occur only locally in surroundings of mineral springs. The nature reserve Soos near Františkovy Lázně is the most famous one. Far less known are salt marshes, once widely distributed in South Moravia, a small territory pertinent to the Hungarian ecoregion. Studies on its halophilous and halobiontic microflora were carried out since the beginning of the 19th century. In one of the oldest studies, Nave (1864) pointed out the similarity of South-Moravian small water bodies with the Lake Neusiedler See. Some additional information was published by O. Richter and R. Fischer, but the most important data originated from Julius Bílý. His collection of diatom samples and preparations is deposited in the herbarium of the Moravian Museum and contains over 2000 items (Skácelová & Konečná 2001). *Scoliopleura peisonis* Grunow and *Nitzschia peisonis* Pant., two mesohalobous diatoms characteristic for this region, reach here the northern limit of their distribution area (Bílý 1930, 1945).

Following the increasing anthropogenic impact, the majority of the classical South-Moravian locations with their specific diatom flora have disappeared. The salt marsh Brod, locus classicus of *Amphiprora incerta* J.Bílý non Grunow (better known under the name *Entomoneis costata* (Hust.) Reimer), became flooded by artificial lakes of the Nové Mlýny Reservoirs. The halophilous microflora of the Nesyt fishpond in the Lednice-Valtice area retreated due to intensive fishery management. Many further localities have been transferred into arable land (Skácelová & Marvan, 2001).

Nevertheless, halophilous diatoms can still survive in artificial (secondary) salines, which at present are more frequent than the original ones. *Caloneis permagna* (Bailey) Cleve, *Nitzschia geitleri* Hust., *N. tryblionella* Hantzsch and other diatoms from saline waters found refuge in shallow waters of the Dyje River floodplain area suffering by lack of water as a consequence of river bed straightening in 1970s. Man-made saline water localities with *Chaetoceros muelleri* Lemmerm., *Pleurosigma angulatum* (E.J.Quekett) W.Sm., *Gyrosigma macrum* (W.Sm.) J.W.Griff. & Henfr. and other numerous halophilous diatoms are already known for a long time from the Ostrava coal mining district in North Moravia/Silesia. Moreover, they occur in the soft-coal mining district at Most and in the surroundings of Oslavany in South Moravia. The Dukovany nuclear power-station contributes to increasing electrolyte concentration in the Jihlava River receiving water from its cooling circuit, as documented by growing occurrence of halophilous species.

In 2006 two remarkable diatoms *Pleurosira laevis* (Ehrenb.) Compère and *Bacillaria paxillifera* (O.F.Müll.) Hendey appeared in the CR in river stretches, where halophilous

diatoms do not normally occur. Well developed population of the first named species occupied bottom of the Bílina River (left-side tributary of Labe/Elbe); this is its first record for the CR. *Bacillaria paxillifera* was found in Ostravice and Odra/Oder Rivers (i.e. in one of the above mentioned territories affected by man-made salinisation), but, at the same time, in several localities in the Labe/Elbe River and its tributary Jizera River (see Fig. 1). In the CR, *Bacillaria* was observed for the last time in 1955.

MATERIAL & METHODS

Analyses of phytobentos samples are part of surveillance monitoring of rivers supported by the Ministry of Environment (concerning sampling localities see Fig. 1). Diatoms were studied in both live preparations (surveyed not later than 48 hours from sampling) and Pleurax mounts, using light microscope Nikon Eclipse E400. At the same time length and width of frustules was measured using software for picture analysis NIS-Elements D 2.3.

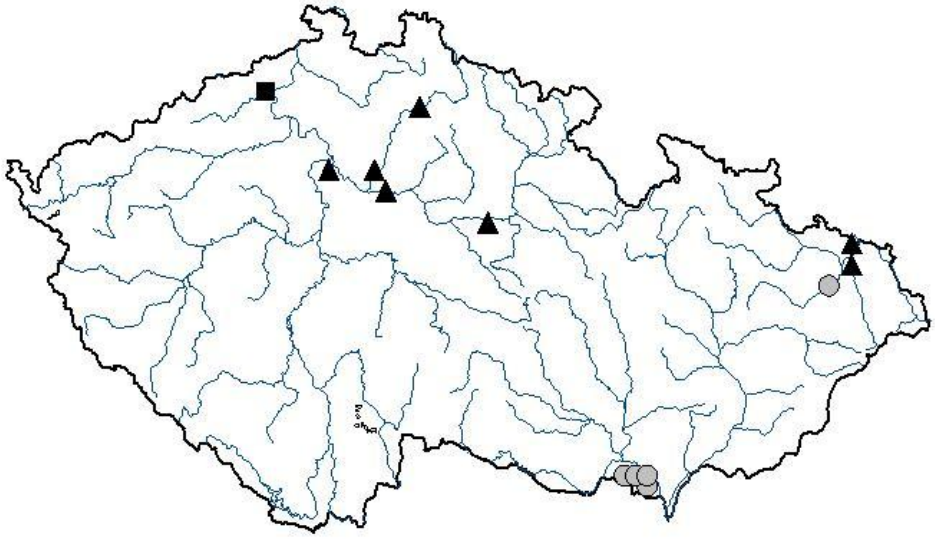

Fig. 1. Localities of *Bacillaria paxillifera* (triangles – new localities, circles – old localities) and *Pleurosira laevis* (square) in the Czech Republic.

RESULTS

***Bacillaria paxillifera* (O.F.Müll.) Hendey**

Main synonyms: *Bacillaria paradoxa* Gmelin 1791, *Nitzschia paradoxa* (Gmelin) Grunow in Cleve & Grunow 1880.

Morphological description of Czech populations

Morphology agrees with usual description as to cell form and structure. Nevertheless in samples from the Rivers Labe and Ostravice only smaller cells were observed while the population from Odra is composed of cells of two different sizes (see Fig. 2). The cell length distribution in Fig. 3 with two to three peaks might point at cryptic taxa which can only be differentiated by SEM (compare Jahn & Schmid 2007). The width of the valves varies in rather narrow limits for both shorter and longer cells.

Ecology and distribution

A benthic (but also planktic) species, cosmopolitan, occurring mainly in standing waters, but reported also from rivers (Hanoi region, Vietnam; Victoria, Australia) and canals (Ashar canal, Iraq); prefers brackish water – Blankenberghe, Ostend, Antwerp, England, Ireland, Japan, California, mainly in regions at a sea shore and in waters with high content of electrolytes in inland as for example Neusiedler lake or less often also in freshwater with more or less average content of electrolytes. (This is the case of its occurrence in the Jizera and Labe-Elbe River.)

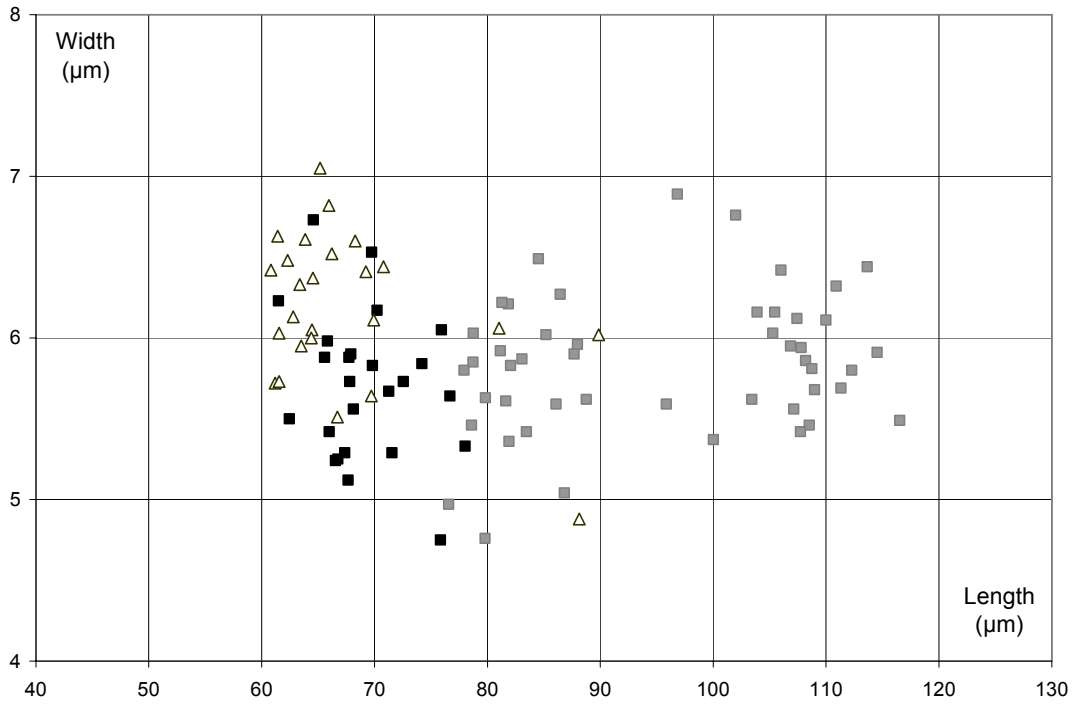

Fig. 2. *Bacillaria paxillifera,* relation between valvar length and width (black squares - Labe, white triangles – Ostravice, grey squares – Odra).

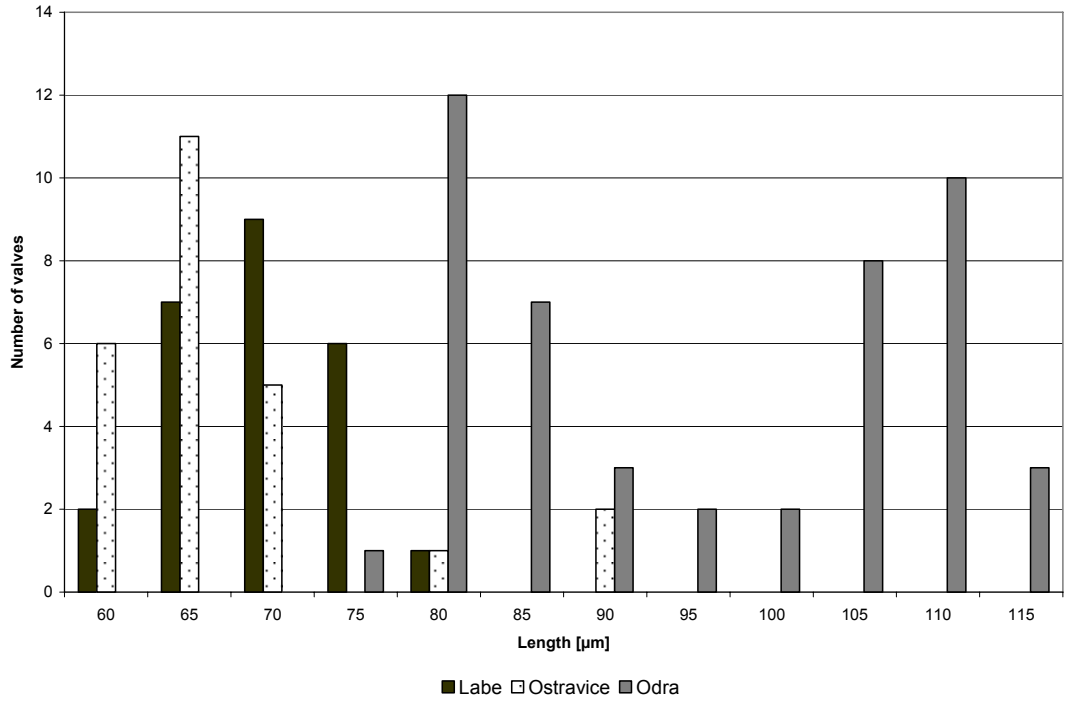

Fig. 3. *Bacillaria paxillifera,* distribution of valvar lengths.

Occurrence in the CR in past: Moravian part of Hungarian Ecoregion (Lednice, especially the Nesyt fishpond near Mikulov, but also the Dyje River), living mainly among other algae associated with aquatic macrophytes, but for the last time found there in 1955 (Heteša, Marvan, in litt.). Retreat of this species, probably not tolerating too high degree of eutrophication, in the Nesyt could partly be related to intensification of fishery management. [Nevertheless, according to O. Skácelová (pers. comm.) this species appeared once again in this region, namely in the wetland locality Pastvisko at Lednice, and was at the same time found in several near-by localities in Marchfeld, Austria.] - Known also from fishponds in surroundings of Ostrava (Northern Moravia; Fott & Komárek 1960).
New localities in the CR: the Labe River - Obříství (02 August 2006), Valy (30 October 2006) and Lysá (24 October 2006), the Jizera River - Příšovice (25 October 2006) and Předměřice (02 November 2006), the Ostravice River - Ostrava 3 (25 October 2006) and the Odra River - Bohumín (25 October 2006), here together with several further halophilous diatoms).

Pleurosira laevis* (Ehrenb.) Compère f. *laevis
Main synonyms: *Biddulphia laevis* Ehrenb. 1843, *Odontella laevis* (Ehrenb.) Kütz. 1849.
Morphological description of Czech population:
Cells with intensively dark brown chloroplasts, mostly in central stellate arrangement (see Fig. 4 a). joint by edges in zig-zag chains. Valves 42–74 µm long and 38–64 µm wide (both proportions of smaller size compared with data in Krammer & Lange-Bertalot 1991), length/width ratio varies from 1.06 in shorter valves up to 1.24 in longer cells (see Fig. 5), the structure is formed by unequally long radial rows of areolae in the density of 14/10 µm, number of areolae in a row 15–16/10 µm, mostly present one or two rimoportulae, ocelli do not lie exactly opposite to each other, so that the valves appear to be slightly asymmetrical (Fig. 4 b, c), present also frustule spines

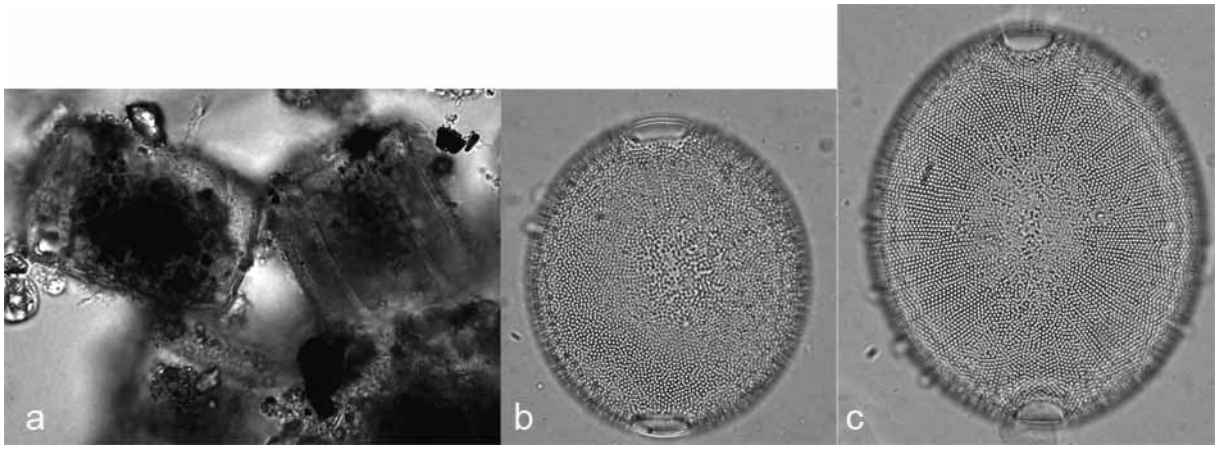

Fig. 4. *Pleurosira laevis* from the River Bílina : a cells, b, c frustules of different Lg/Lt ratio.

Ecology and distribution
in contradistinction to most centric diatoms a typical benthic species with cosmopolitan distribution, known from eutrophic fresh and brackish waters but mainly near to the coast (in river estuaries) with average to high electrolyte content; according to Hustedt (1927-30) also on wet rock surfaces. Found mainly in warm and tropic waters, known also form Holocene sediments (Argentina, Egypt).

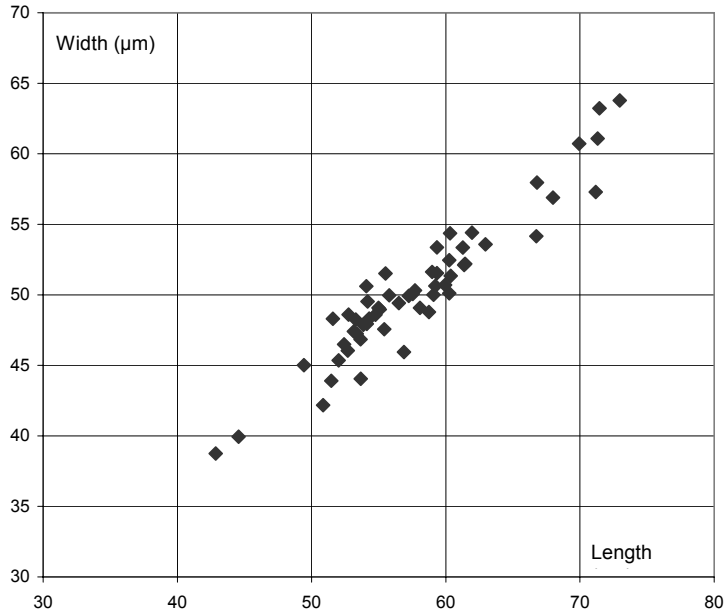

Fig. 5. *Pleurosira laevis,* relation between valvar length and width.

Occurrence in the Czech Republic in past: not known
New locality in the CR: the Bílina River above confluence with Labe/Elbe (01 August 2006), in water with elevated concentration of electrolytes (average conductivity in 2006 about 900 $\mu S \cdot cm^{-1}$) from mineral springs and mining activities, but not accompanied there by any other pronouncedly halophilous diatom!

DISCUSSION

The way of transportation of these algae can be epizoochoric (on animal body surface) or ergastochoric (on a boat). In the Labe River both these ways are possible or can be combined. In the case of *Pleurosira*, introduction could be mediated by salmons in connection with the project of salmon re-introduction in the Labe River basin (Jan Švanyga, pers. comm.).

In the case of *Bacillaria paxillifera* and its occurrence in the Ostrava coal mining district, man-made salinisation is causing a significant deviation from a natural ecological status, apparently supporting the introduction of invasive cells into the river ecosystem.

An evaluation system based on similar principles as Ziemann's halobic index (1999), parallel to saprobic and/or trophic level evaluation, has been recently developed for use as a part of the Water Framework Directive implementation in the CR.

OUTLOOK

The occurrence of organisms commonly accepted as halophilous do not necessarily document an increase of salinity. The bloom of *Actinocyclus normanii* (W.Greg. ex Grev.) Hust. affected probably all European large rivers several decades ago. (Geissler et al. 2006; Kiss et al. 1990). Its short-term invasion in the CR finished without leaving traces (disregarding empty valves still found in phytobentos samples); but it is well established in Berlin rivers and lakes (R.Jahn, pers. comm.). Concerning the above studied taxa, the question might be asked: do we have here a beginning of a similar case of invasion of an

alga into a freshwater habitat as we have seen with *Actinocyclus normanii* and which we can observe nowadays also with *Didymosphenia geminata* (Lyngb.) M.Schmidt (Gágyorová & Marvan 2002), or is it only an example of a short visit of organisms into a not very convenient environment?

ACKNOWLEDGEMENTS

We are grateful to the Ministry of Environment of the Czech Republic for allowing us using data from surveillance monitoring of Czech rivers. We would also like to express our gratitude to Dr. Regine Jahn and to Wolf-Henning Kusber for their valuable remarks and suggestions concerning the manuscript.

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