Distribution of freshwater red algal family *Lemaneaceae* (Rhodophyta) in the Czech Republic: an update

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Abstract: Macroscopic red algae of the family *Lemaneaceae* are reported from several localities in the Czech Republic. Published data are sparse due to difficulty in species identification and little interest in this group of algae in the past. The *Lemaneaceae* were sampled throughout the Czech Republic. The new localities are reported as follows: 18 for *Lemanea fluviatilis* and 5 for *Paralemanea catenata*. Results from this study suggest that *L. fluviatilis* is widespread and inhabits streams from a wide altitudinal gradient, whereas *P. catenata* has a more restricted distribution. *Lemanea tortulosa* appears to be very rare having been identified from a single site.

Key words: Czech Republic, distribution, *Lemanea*, *Lemaneaceae*, *Paralemanea*, red algae

Introduction

The freshwater red algal family *Lemaneaceae* is a characteristic group in running waters with the world-wide distribution. Although some species are common, others seem to be quite rare and limited to a special biotope or water type (ELORANTA & KWANDRANS 2002). Recently, much of the research on this group has been concentrated in the North America (e.g. VIS & SHEATH 1992, CARMONA & NECCHI 2002) and in Brazil (NECCHI & ZUCCHI 1995). Some studies have been done in Europe: in Sweden by ISRAELSON (1942) and in Poland by STARMACH (1977), in Finland by ELORANTA & KWANDRANS (2002), in the Czech Republic by LEDERER & LHOTSÝ (2001) and KUČERA & MARVAN (2004). However, more detailed studies of taxonomy and distribution for the freshwater *Lemaneaceae* in Europe are still needed.

The freshwater red algae of the family *Lemaneaceae* are characterized by an uniaxial cartilaginous and pseudoparenchymatous gametophyte thallus with internal carposporophytes (VIS & SHEATH 1992). These authors raised the traditionally distinguished subgenera (*Lemanea* and *Paralemanea*) of the genus *Lemanea* to genera. These genera can be separated on the basis of the following characters (VIS & SHEATH 1992, SHEATH et al. 1996): *Paralemanea* includes plants that lack stalks and hair cells in the inner cortex. Axial filaments are surrounded by cortical

filaments. Simple ray cells consist of two layers, the proximal one does not touch the outer cortex and the distal one is generally “Y” branched and connected to the cortex. Nodal spermatangial sori are arranged in rings. *Lemanea* has axial (but not cortical) filaments, hair cells in the inner cortex and T- or L-shaped ray cells, which are closely applied to the outer cortex. Nodal spermatangial sori are arranged in patches.

The first references on the occurrence of *Lemaneaceae* in the Czech Republic were published by HANSRIG (1886, 1892), PASCHER (1903), MALOCH (1937), WÜNSCH (1937) and CYRUS (1947) (POULÍČKOVÁ et al. 2004). LHOTSÝ & ROSA (1955) described 14 localities for *Lemanea fluviatilis* and 8 localities for *Lemanea torulosa*. However, the species descriptions by these authors were not sufficiently detailed to verify these reports using the current taxonomy. A recent systematic investigation of *Lemaneaceae* noted three species in the Czech Republic: *Lemanea fluviatilis*, *L. torulosa* and *Paralemanea catenata* (KUČERA & MARVAN 2004). The *Lemaneaceae* inhabit fast flowing and turbulent water and are rare in the Czech Republic (GARDAVSKÝ et al. 1995), as they are sensitive to levels of pollution. Therefore, the aim of this work is to provide data on the occurrence of the freshwater red algal family *Lemaneaceae* in the Czech Republic, to verify previously published occurrence records and report new localities.

Table 1: Geographical characteristics of localities. The latitude and longitude were obtained using GeoBáze software. New localities (previously not reported) are marked with an asterisk.

No.	Locality	River	Substrate	Latitude and longitude
<i>Lemanea fluviatilis</i>				
1	Valšov	Moravice	weir	49;55;25+17;27;03
2	Annín	Hučivá Desná	stones	50;06;52+17;06;30
3	Karlova Studánka	Bílá Opava	stones (waterfall)	50;04;38+17;17;12
4	Kozlov	Otava	stones	49;17;54+13;45;04
5	Čepice	Otava	stones	49;16;02+13;35;55
6	Čeňkova pila	Otava	stones	49;06;30+13;29;33
7	Žichovice	Otava	stones	49;16;24+13;37;05
8	Železná ruda	Řezná	stones	49;08;07+13;13;27
9	Švařec*	Svratka	stones	49;31;10+16;20;38
10	Raškov*	Morava	stones	50;01;51+16;54;07
11	Tuřice / Předměřice nad Jizerou*	Jizera	stones	50;15;03+14;46;28
12	Heřmanův Brod*	Blanice	stones	49;14;18+14;08;14
13	Nemětická*	Volyňka	stones	49;11;50+13;53;08
14	Pěkná*	Vltava	stones	48;51;07+13;55;13
15	Rešovské vodopády*	Huntava	stones (waterfall)	49;52;52+17;12;37
16	Vír*	Bystřice	stones	49;33;04+16;18;32
17	Vír*	Svratka	weir	49;33;40+16;18;28
18	Dalečín*	Svratka	weir	49;35;33+16;14;56
19	Malá Morava*	Malá Morava	stones	50;05;13+16;50;32
20	Velká Úpa*	Javoří potok	stones	50;40;50+15;45;07
21	Pec pod Sněžkou*	Úpa	stones	50;42;00+15;44;11
22	Dolní Malá Úpa*	Malá Úpa	stones	50;40;57+15;48;22
23	Špindlerův Mlýn*	Labe	weir, stones	50;43;31+15;36;22
24	Vrchlabí*	Labe	stones	50;38;45+15;36;24
25	Skoronice*	Malše	stones	48;42;39+14;29;04
26	Černý Kříž*	Studená Vltava	stones	48;51;38+13;51;23
27	Stříbro	Mže	weir	49;44;59+12;59;48
28	Radčice	Mže	weir	49;45;37+13;19;47
29	Plzeň–Kalikovský mlýn	Mže	weir	49;45;02+13;21;53
<i>Lemanea torulosa</i>				
30	Žákava	Bradava	weir	49;38;06+13;31;29
<i>Paralemanea catenata</i>				
31	Kunín - Valcha*	Odra	stones	49;39;48+17;58;59
32	Plasy*	Střela	weir	49;56;08+13;23;13
33	Žlutice*	Střela	stones	50;05;11+13;08;48
34	Štoutov*	Velká Trasovka	stones	50;07;16+13;11;43
35	Náměšť nad Oslavou*	Oslava	stones	49;14;28+16;07;54
36	Čepinec	Bradlava	stones	49;28;09+13;29;15
37	Mlynářovice	Bradlava	stones	49;25;43+13;27;48
38	Hvízdalka	Bradava	stones	49;36;47+13;37;04
27	Stříbro	Mže	weir	49;44;59+12;59;48
28	Radčice	Mže	weir	49;45;37+13;19;47
29	Plzeň–Kalikovský mlýn	Mže	weir	49;45;02+13;21;53
39	Vranov nad Dyjí	Dyje	weir	48;53;37+15;48;48
40	Devět Mlýnů	Dyje	weir	48;49;01+15;58;55
41	Znojmo	Dyje	stones	48;51;12+16;02;36

Material and methods

Stream sites were visited during 2002–2006 in different regions of the Czech Republic. All samples were collected from running water with turbulent flow (weirs and riffles). The samples were preserved in 4% formaldehyde and studied using a microscope equipped with Lucia Image Analysis. For the identification of species, VIS & SHEATH (1992) and KUČERA & MARVAN (2004) were used.

Results and discussion

The *Lemaneaceae* were found on stony substrates in running turbulent waters, on weirs or in waterfalls (Table 1, Fig. 1).

Lemanea fluviatilis (LINNAEUS) C. AGARDH 1824 (bas. *Conferva fluviatilis* LINNAEUS 1753, syn. *Sacheria fluviatilis* (LINNAEUS) SIRODOT 1872) was the most frequently encountered species in the Czech Republic. LEDERER & SOUKUPOVÁ (2002) described this species from mountain streams and rivers. According to our observations, this species occurs not only in mountains. In this investigation, it was found at altitudes ranging from 305 to 888 m. The species was observed on stony substrates (boulders and cobbles) in riffles, on weirs or in waterfalls (Table 1), which were partly shaded or well illuminated. At certain localities, it was growing with *P. catenata* (e.g. locality Stříbro). According to VIS & SHEATH (1992), this species has

the widest range of distribution of *Lemaneaceae* in North America, which could be due to a greater tolerance of conditions. ELORANTA & KWANDRANS (1996) described this species from the wide range of flow velocity (20–190 cm.s⁻¹) without any clear preference. JOHANSSON (1982) recorded this species from small lowland rivers with rather high conductivity, high colour, but small insolation. FILKIN & VIS (2004) recorded the highest percent cover in biotops with high flow velocity and low water depth.

Lemanea torulosa (ROTH) C. AGARDH 1814 (bas. *Conferva torulosa* ROTH 1797) was found only at a single locality in the Czech Republic – Žákava, a stony weir shaded by trees in river Bradava (KUČERA & MARVAN 2004). In the past, this species was collected in the Šumava Mountains (GARDAVSKÝ et al. 1995).

Paralemanea catenata (KÜTZING) VIS et SHEATH 1992 (bas. *Lemanea catenata* KÜTZING 1843, syn. *Lemanea annulata* KÜTZING 1843, *Lemanea nodosa* KÜTZING 1843, *Lemanea pleocarpa* ATKINSON 1931) was found on stony substrates or on weirs (Table 1). The plants grow on stony weirs together with mosses and *Cladophora glomerata*. The species occurred in shaded (localities Čepinec, Mlynářovice, Hviždalka) or well illuminated areas (Vranov nad Dyjí, Devět mlýnů, Znojmo). CARMONA & NECCHI (2002) recorded this species from shallow (depth 1–60 cm), cold (12–16 °C), and moderate to fast

Fig. 1. Map showing the localities of Lemaneaceae in the Czech Republic. Numbers correspond to those in Table 1. ▲ – *Lemanea fluviatilis*, ● – *Paralemanea catenata*, ◆ – *L. fluviatilis* and *P. catenata*, ■ – *Lemanea torulosa*.

flowing waters ($> 35 \text{ cm.s}^{-1}$). All localities in our study have the same characteristics as reported in the literature (e.g. ELORANTA & KWANDRANS 2002, CARMONA & NECCHI 2002).

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