Aquatic lichens in Lithuania. Lichens on submerged alder roots

Jurga MOTIEJŪNAITĖ

Abstract: MOTIEJŪNAITĖ, J. 2003. Aquatic lichens in Lithuania. Lichens on submerged alder roots. – Herzogia **16**: 113–121.

The results of an investigation of lichens on submerged black alder (*Alnus glutinosa*) roots are reported. 22 lichen species were found, both typically epiphytic and epilithic. *Agonimia allobata, Bacidina delicata, Lecania hutchinsiae* and *Porina chlorotica* are recorded only from this type of habitat in Lithuania. Three overlapping zones of lichen communities could be discerned according to the degree of submergence. One of the most important controlling factors of lichen growth on submerged tree roots is silting of the water.

Zusammenfassung: MOTIEJŪNAITĖ, J. 2003. Wasserflechten in Litauen. Flechten auf überfluteten Wurzeln der Schwarzerle. – Herzogia **16**: 113–121.

Die Flechten auf überfluteten Wurzeln der Schwarzerle (*Alnus glutinosa*) werden behandelt. 22 Arten wurden nachgewiesen, darunter sowohl epiphytische, als auch epilithische. *Agonimia allobata, Bacidina delicata, Lecania hutchinsiae* und *Porina chlorotica* sind bisher in Litauen nur an solchen Standorten gefunden worden. Drei sich überlappende Zonen können entsprechend dem Grad der Überflutung unterschieden werden. Der Schlammgehalt des Wassers ist ein wichtiger, begrenzender Faktor für das Wachstum der Flechten.

Keywords: Lichenized Ascomycotina, ecology, biodiversity.

Introduction

Freshwater aquatic lichens are rather overlooked, especially in eastern Europe. In many floristic works, they are given only sparse attention and their distribution is very much under-recorded even at present (FAŁTYNOWICZ 1992, KONDRATYUK et al. 1998, RANDLANE & SAAG 1999, ZAVARZIN et al. 1999). In Lithuania, the first aquatic lichen species were recorded only during the last decade (MOTIEJŪNAITĖ 1996, 1999, MOTIEJŪNAITĖ & KALINAUSKAITĖ 1998). While investigating freshwater lichens, our attention was attracted by submerged tree roots (almost exclusively black alder (*Alnus glutinosa*), the most common tree growing on the banks of water bodies), often bearing quite rich lichen vegetation. A search of the literature revealed that traditionally, only aquatic lichens that occur on stone substrate have been treated, beginning with SANTESSON (1939) and RIED (1960) and ending with MÜLENHOFF & BÜDEL (1995), GILBERT (1996), GILBERT & GIAVARINI (1996), and KELLER (2000). BARKMAN (1958) mentions inundated epiphytic communities, noting, however, that "many epiphytes, especially lichens, do not endure inundation…"

Thus these aquatic lichens have been neglected up until now, here an attempt is made to discuss them in detail.

Study area

The present studies of lichens on submerged alder roots were carried out in three small streams in southern and south-western Lithuania: Grūda stream in Dzūkija National Park; Viešvilė stream

in Viešvilģ Strict Nature Reserve; Lylava stream in Pagramantis Regional Park (Fig. 1). Apart from these investigations, the results of short cursory visits to thirteen other water bodies are also included. These are situated in the western, southern and eastern parts of Lithuania (Fig. 1).

The climate of the investigated area varies from maritime in the west to subcontinental in the east and south-east, the mean annual temperature being 6 °C (-4.5 °C in January, +17 °C in July), mean annual precipitation 620 mm (of this 75 % is rain, 25 % – snow), and evaporation 520–580 mm. Snow cover persists for three months, and thaws are frequent. The water of the streams studied is naturally alkaline, pH ranging from 7 to 8.9 (KAUŠYLA 1981, KILKUS 1998). The three investigated streams run through a well-wooded area (Figs 2, 3), whereas other visited water bodies are situated either in a mixed wooded and agricultural landscape, or in wooded areas. All three studied streams have sandy or mixed sand-pebble beds with more or less abundant boulders. Silt, rich in organic matter is not perceptible there and water is clear. In these streams, lower parts of alder roots usually bear rather coarse mineral particles on bark surface. Part of the cursory visited streams are similar, though others, especially running in a mixed wooded and agricultural landscape are perceptibly silted: water is muddy, dark silt layers are seen on the edges of the stream beds and the silt is deposited on the lower parts of alder roots, thus preventing lichens from colonising them. In all visited lakes beds are sandy and even if water is clear, submerged parts of alder roots are covered with algae and particles of detritus which make the substrate unsuitable for lichens.

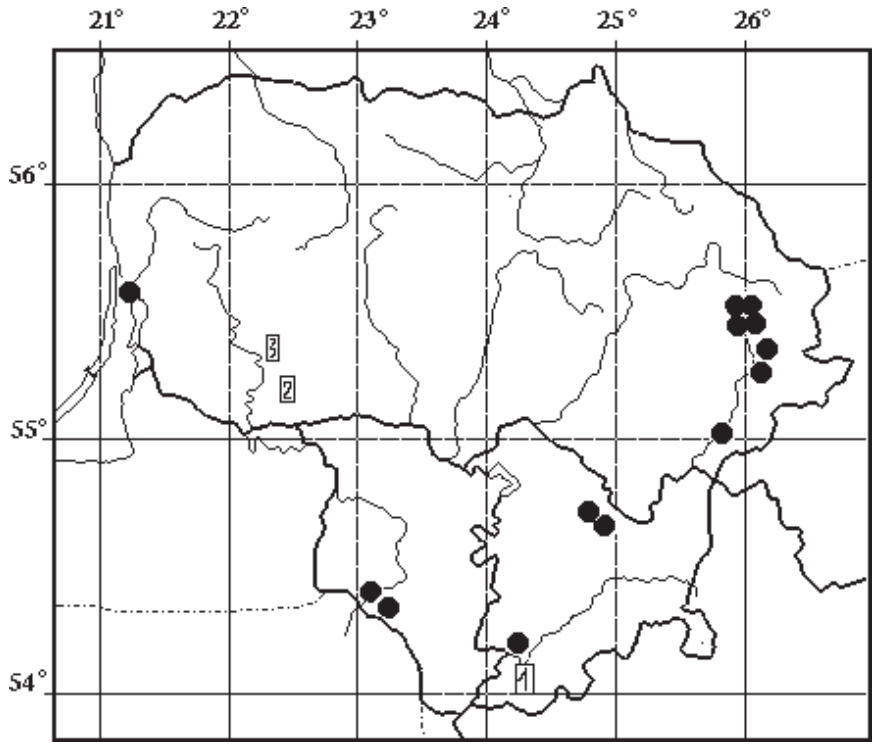

Fig. 1: Localities of study (□) and cursory visits (●): 1. Grūda stream in Dzūkija National Park; 2. Viešvilģ stream in Viešvilģ Strict Nature Reserve; 3. Lylava stream in Pagramantis Regional Park.

Fig. 2: Fragment of Lylava stream.

Fig. 3: Fragment of Viešvilė stream.

Material and methods

All sites were investigated by stream margin surveys from the water side, submerged or partly submerged woody roots were observed (Figs 2–4). For the three studied streams, 1.5–2 km was investigated. Distances at the other sites ranged from c. 100 to 200 m. As most of the observed species needed investigation in the laboratory, specimens of every visually differing species were collected.

Lichens were identified following routine lichenological methods, employing a light microscope and spot reactions. For some species, TLC was performed following WHITE & JAMES (1985). For some groups the assistance of specialists was also obtained (see acknowledgements). Lichen nomenclature follows mainly SCHOLZ (2000); bryophyte nomenclature follows mainly CORLEY et al. (1981) and PATON (1999).

Results and discussion

Twenty-two lichen species were recorded. Although this is not a large number of taxa, it represents an often unique assemblage. Some lichens are absent or only rarely found in other ecological situations in Lithuania; for example, *Lecania cyrtellina, L. hutchinsiae, Porina chlorotica, Bacidina inundata* and *Agonimia allobata*. Of the genuinely aquatic lichens recorded hitherto in Lithuania, only three species – *Verrucaria aquatilis* Mudd, *V. elaeomelaena* (A.Massal.) Arnold and *Collema flaccidum* (Ach.) Ach. were not found on submerged tree roots.

On the submerged alder roots, three lichen bands were discerned which could be accommodated in the zonation pattern proposed by GILBERT (1996): 1 – submerged zone (part of a root which is permanently under the water, except for extremely dry summers); 2 – fluvial mesic zone (part of a root which is fully submerged only during rising autumn-spring water); 3 – fluvial xeric zone (part of a root which receives only seasonal spraying, rarely being submerged).

The lowest species richness was encountered in the submerged zone, where normally epilithic lichens were found – *Verrucaria hydrela, V. praetermissa* and *Bacidina inundata.* On stone substrata in the corresponding zone, two additional species – *Verrucaria aquatilis* and *V. elaeomelaena* were recorded. *Verrucaria hydrela* was almost always present in this zone, in most cases it was also the most abundant lichen (sometimes covering 20–30 % of submerged part of the root). In the submerged zone *V. hydrela* formed either monospecific community or was accompanied by *V. praetermissa,* or (more rarely) by *Bacidina inundata.* The latter species was also found in a monospecific community on several roots (only in Viešvilģ stream), meanwhile *V. praetermissa* was never recorded growing on roots alone.

With nine species, the fluvial mesic zone is richer, and also contains the most noteworthy species (Tab. 1). Here the flora is a mixture of normally epilithic and epiphytic species occurring together. Most common and abundant species in this zone is *Lecania cyrtellina* – this lichen is present in both insolated and shaded situations, also in both silted and clear water. In most cases *L. cyrtellina* formed monospecific communities with varying degree of cover (from 10 to 80 %) in the fluvial mesic zone – especially along silted rivers or lakes.

Lichen communities growing in the fluvial mesic zone in pristine streams are more variable and complex. Here *L. cyrtellina* was also found, though most often its cover degree never exceeded 20 %. In the fluvial mesic zone it was found accompanied by *Anisomeridium polypori* and *Bacidina delicata*, neither of them being dominant. In such community *Bacidina arnoldiana* was occasionally found, extending from the fluvial xeric zone. In single cases *L. cyrtellina* in

Tab. 1: Distribution of lichen and bryophyte species on submerged alder roots in various zones.

Lichen and bryophyte species	Zones on submerged tree roots		
	Submerged zone	Fluvial mesic zone	Fluvial xeric xeric zone
Lichens			
Agonimia allobata	–	+	–
Anisomeridium polypori	–	+	+
Arthonia spadicea	–	–	+
Arthothelium ruanum	–	–	+
Bacidia beckhausii	–	–	+
Bacidia subincompta	–	–	+
Bacidina arnoldiana	–	+	+
Bacidina chloroticula	–	–	+
Bacidina delicata	–	+	+
Bacidina inundata	+	+	–
Bacidina sp.	–	–	+
"*Biatora*" sp.	–	–	+
Chaenotheca furfuracea	–	–	+
Cladonia sp.	–	–	+
Dimerella pineti	–	–	+
Lecania cyrtellina	–	+	+
Lecania hutchinsiae	–	+	–
Lepraria spp.	–	–	+
Porina chlorotica	–	+	–
Thelidium zwackhii	–	+	–
Verrucaria hydrela	+	+	–
Verrucaria praetermissa	+	+	–
Bryophytes			
Amblystegium serpens	–	–	+
Amblystegium riparium	–	–	+
Amblystegium varium	–	–	+
Amblystegium sp.	–	–	+
Brachythecium sp.	–	–	+
Homalia trichomonoides	–	+	–
Jungermannia leiantha	–	–	+
Lophocolea heterophylla	–	–	+
Fissidens edentoides	–	+	–
Fissidens sp.	–	–	+
Sanionia uncinata	–	–	+
Plagiochila porelloides	–	+	–

Fig. 4: Exposed, seasonally submerged alder roots in Grūda stream.

Porina chlorotica. In two streams communities without *L. cyrtellina* were recorded. In Viešvilģ stream they were composed of *Bacidina inundata* and *Anisomeridium polypori,* or *B. inundata, Verrucaria hydrela* and *A. polypori* (in both cases *B. inundata* was a dominant species). In Lylava stream a community of *Thelidium zwackhii, Lecania hutchinsiae* and *Agonimia allobata* was found, none of these lichens was dominant, their overall cover did not exceed 30 %. Bryophytes were sparse and occasional in the fluvial mesic zone.

The fluvial xeric zone comprised 16 species, including some from the fluvial mesic zone and others usually found on the shaded lower parts of the tree trunks. This zone was easily discerned when roots were exposed to sunshine where large and conspicuous patches of *Lecania cyrtellina* extended from the fluvial mesic zone, often forming monospecific communities. Another lichen, found in such situations (together with *L. cyrtellina* or growing alone) was *Bacidina chloroticula*. Upper boundaries of the zone were usually well discernible, as they were marked by the presence of foliose lichens, often these of Xanthorion communities. In shaded situations these boundaries were not so clear. A number of lichens characteristic for the tree bases in the terrestrial conditions were found in the fluvial xeric zone, though most of them were occasional and covered small areas. *Lepraria* spp. and *Chaenotheca furfuracea* were found in patches of 5–7 mm, *Cladonia* spp. – in small patches of several squamules. Most abundant species in shaded fluvial xeric zone were *Bacidina arnoldiana, B. delicata* and *Lecania cyrtellina.* Bryophytes were rather common in this zone, albeit not abundant (in case bryophytes overgrew the roots, lichens were not found there).

List of the recorded lichen species

Agonimia allobata (Stizenb.) P.James

Collected once in Lylava stream, this is the first and only record of this species in Lithuania.

Anisomeridium polypori (Ellis & Everh.) M.E.Barr

Collected in Viešvilė and Grūda streams; probably common and usually found on the bases of tree trunks in more or less shaded situations.

Arthonia spadicea Leight.

Collected in three streams; common in deciduous forests on tree and shrub bases.

Arthothelium ruanum (A.Massal.) Körb.

Collected in three streams, common in deciduous forests on tree and shrub bases.

Bacidia beckhausii Körb.

Collected in Grūda stream, rare (known from one other locality in SW Lithuania) and probably overlooked; found on bark of deciduous trees both in shaded and well-illuminated conditions.

Bacidia subincompta (Nyl.) Arnold

Collected in three streams during the present study; otherwise rather common in deciduous forests on hardwood tree trunks.

Bacidina arnoldiana (Körb.) V.Wirth & Vězda

Collected in three streams during the present study; rather common in deciduous forests on tree and shrub bases and on hardwood lignum.

Bacidina chloroticula (Nyl.) Vězda & Poelt

Collected in three localities by stagnant water; otherwise rather common in various habitats and on various substrates (including decaying wood, dead terricolous mosses, fallen leaves, last year *Artemisia* stems, and living shrubs of *Vaccinium myrtillus*).

Bacidina delicata (Larbal. ex Leight.) V.Wirth & Vězda

Collected in two streams; these are the only records of this species in Lithuania.

Bacidina inundata (Fr.) Vězda

Collected in four streams during the present study; found also on inundated stones and old rubber in streams. Not recorded from other localities in Lithuania.

Bacidina sp.

Collected in Grūda stream; only sterile thallus present, lacking both pycnidia and apothecia. Thallus granules are slightly bigger than these of *B. arnoldiana*, and similar to *B. delicata,* but with more greyish tinge. No lichen substances were found by TLC. Probably the same species (also sterile) is found on tree trunks in shaded hardwood forests.

"*Biatora"* **sp.**

Collected in Grūda stream. Sterile species with dark greyish green granular-verrucose thallus and green, punctiform to slightly extending, but never confluent soralia, and no lichen substances (TLC). The species is common on bark and epiphytic mosses on shaded tree trunks in hardwood forests.

Chaenotheca furfuracea (L.) Tibell

Collected in three streams. Common in mixed spruce-hardwood, spruce and deciduous forests on roots of upended trees and in bark crevices of tree bases or decaying wood.

Cladonia sp.

Collected in three streams. Sparse squamules of primary thallus.

Dimerella pineti (Schrad. ex Ach.) Vězda

Collected in four streams. Very common species found mainly on bases of various phorophytes in shaded situations.

Lecania cyrtellina (Nyl.) Sandst.

Collected in all visited localities. Common lichen, found almost exclusively in this particular habitat. Many authors do not recognise *L. cyrtellina* as a species (SANTESSON 1993, VITIKAINEN et al. 1997), putting it in synonymy of *Lecania cyrtella* (Ach.) Th.Fr. However, this requires more investigation. When compared to typical *Lecania cyrtella,* which is very common in *Xanthorion* communities, a number of differences (apart from ecological requirements) were noted: spore size in *L. cyrtellina* was 8–15 × 2–4 µm (9.5–16.5 × 3–5 µm in *Lecania cyrtella*, n = 50), the thalline exciple was often eroded

and the epithecium was not or only very slightly pigmented. Macroconidia, reported in *L. cyrtellina* by JAMES & PURVIS (1992) were not seen.

Lecania hutchinsiae (Nyl.) A.L.Smith

Collected once in Lylava stream, this is the first and only record of this species in Lithuania.

Lepraria spp.

Collected in five streams. Minute thalli, probably belonging to several species.

Porina chlorotica (Ach.) Müll.Arg.

Collected in Alnaja stream (eastern Lithuania); the only record of this species in the country.

Thelidium zwackhii (Hepp) A.Massal.

Collected in Lylava stream, rather rare (five localities), and found mainly on disturbed clay soil; probably more common.

Verrucaria hydrela Ach.

Collected in seven streams; one of the commonest aquatic lichens (known from six additional localities), growing mainly on siliceous and calcareous stones in stream beds.

Verrucaria praetermissa (Trevis.) Anzi

Collected in Grūda and Lylava streams, rather common, and growing mainly on siliceous and calcareous stones in stream beds.

Conclusions

Normally epilithic species have been found colonising the roots of alder which are mineral-enriched by water-borne silt, both when stone substrata are abundant, and especially when it is scarce and inaccessible (too deep under the water). The growth of lichens on submerged alder roots is strongly influenced by silting. By lakes, for example, where water silting is higher, only a fluvial xeric zone could be discerned with a rather poor lichen flora, consisting mainly of *Lecania cyrtellina* and *Bacidina chloroticula*. A similar pattern was observed in silted streams, running through an agricultural area, where only *Lecania cyrtellina* in the fluvial xeric zone was found. However, it is noteworthy that aquatic epilithic lichens are less susceptible to silting, and on stones in the same silted streams, two of the most common aquatic epilithic species in Lithuania, *Verrucaria hydrela* and *V. praetermissa* were recorded. *V. praetermissa* is known to colonise the woody roots of alder (*Alnus glutinosa*) and willow (*Salix caprea*) beside streams in the U.K. and this may be widespread, though largely overlooked, phenomenon (Gilbert, pers. comm.).

Acknowledgements

The author expresses her sincerest gratitude to Dr Brian J. Coppins (Royal Botanic Garden, Edinburgh) for determination of *Bacidina chloroticula* and *B. delicata* and for checking the specimens of *Bacidia beckhausii* and "*Biatora*" sp. Dr Ilona Jukonienė (Institute of Botany, Vilnius) is thanked for determination of bryophyte species. I am also indebted to an anonymous reviewer for valuable comments on the manuscript.

References

KAUŠYLA, K. 1981. Klimatas ir jo ištekliai [Climate and its resources]. – In: ANONYMOUS: Lietuvos TSR atlasas [Atlas of Lithuanian SSR]. – Maskva: Vyriausioji geodezijos ir kartografijos valdyba prie TSRS Ministrų Tarybos.

BARKMAN, J. J. 1958. Phytosociology and ecology of cryptogamic epiphytes. – Assen: Van Gorcum.

CORLEY, M. F. V., CRUNDWELL, A. C., DÜLL, R., HILL, M. O. & SMITH, A. J. E. 1981. Mosses of Europe and the Azores; an annotated list of species, with synonyms from the recent literature. – J. Bryol. **11**: 609–689.

FAŁTYNOWICZ, W. 1992. The lichens of western Pomerania (NW Poland) an ecogeographical study. – Polish Bot. Stud. **4**: 1–182.

GILBERT, O. L. 1996. The lichen vegetation of chalk and limestone streams in Britain. – Lichenologist **28**: 145–159.

GILBERT, O. L. & GIAVARINI, V. J. 1997. The lichen vegetation of acid watercourses in England. – Lichenologist **29**: 347–367.

JAMES, P. W. & PURVIS, O. W. 1992. *Lecania* Massal. (1853). – In: PURVIS, O. W., COPPINS, B. J., HAWKSWORTH, D. L., JAMES, P. W. & MOORE, D. M. (eds.): The lichen flora of Great Britain and Ireland, pp. 285–292. – London: The British Lichen Society, Natural History Museum Publications.

KELLER, C. 2000. Die Wasserflechten der Teigitsch zwischen der Langmannsperre und dem Kraftwerk Arnstein (Steiermark, Österreich). – Herzogia **14**: 49–58.

KILKUS, K. 1998. Lietuvos vandenų geografija [Geography of the Lithuanian water bodies]. – Vilnius: Apyaušris.

KONDRATYUK, S.Y., KHODOSOVTSEV, A. Y. & ZELENKO, S. D. 1998. The second checklist of lichen forming, lichenicolous and allied fungi of Ukraine. – Kiev: Phytosociocentre.

MOTIEJŪNAITĖ, J. 1996. Mycological and lichenological investigations in the former Soviet military forestries in Lithuania. Lichens and allied fungi. – Bot. Lithuanica **2**: 346–363.

MOTIEJŪNAITĮ, J. 1999. Dzūkijos nacionalinio parko kerpės ir su jomis susiję grybai [Lichens and allied fungi of Dzūkija National Park]. – Bot. Lithuanica **5**: 137–153.

MOTIEJŪNAITĮ, J. & KALINAUSKAITĮ, N. 1998. The first locality of *Collema flaccidum* (Ach.) Ach. in Lithuania. – Bot. Lithuanica **4**: 325–327.

MÜLENHOFF, D. & BÜDEL, B. 1995. Vergleich der Wassermoos- und Wasserflechtenvegetation zweier Bachtypen (Waldbäche/Wiesenbäche) im Spessart. – Nova Hedwigia **61**: 525–545.

PATON, J. A. 1999. The liverwort flora of the British Isles. – London: Harley Books.

RANDLANE, T. & SAAG, A. (eds.). 1999. Second checklist of lichenized, lichenicolous and allied fungi of Estonia. – Folia Cryptog. Estonica **35**: 1–132.

RIED, A. 1960. Stoffwechsel und Verbreitungsgrenzen von Flechten I. Flechtenzonierungen an Bachufern und ihre Beziehungen zur jährlichen Überflutungsdauer und zum Mikroklima. – Flora **148**: 612–638.

SANTESSON, R. 1939. Über die Zonationsverhältnisse der lakustrinen Flechten einiger Seen im Anebodagebiet. – Meddel. Lunds Univ. Limnol. Inst. **1**: 1–70.

SANTESSON, R. 1993. The lichens and lichenicolous fungi of Sweden and Norway. – Lund: SBT-förlaget.

SCHOLZ, P. 2000. Katalog der Flechten und flechtenbewohnenden Pilze Deutschlands. – Schriftenreihe Vegetationsk. **31**: 1–298.

VITIKAINEN, O., AHTI, T., KUUSINEN, M., LOMMI, S. & ULVINEN, T. 1997. Checklist of lichens and allied fungi of Finland. – Norrlinia **6**: 1–123.

WHITE, F. J. & JAMES, P. W. 1985. A new guide to microchemical techniques for the identification of lichen substances. – Bull. Brit. Lichen Soc. **57** (Suppl.): 1–41.

ZAVARZIN, A. A., KATENINA, O. A., KOTLOV, Y. V. & SOKOLOVA, S. V. 1999. Lichens of St. Petersburg and the Leningrad region. – In: BALASHOVA, N. B. & ZAVARZIN, A. A. (eds.): Biodiversity of the Leningrad region (Algae. Fungi. Lichens. Bryophytes. Invertebrates. Fishes and Pisciformes), pp. 205–260. – St. Petersburg: St. Petersburg University Press.

Manuscript accepted: 5 February 2002.

Address of the author

Jurga Motiejūnaitė, Institute of Botany, Žaliųjų ežerų 49, LT-2021 Vilnius, Lithuania.