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ECOLOGY AND DISTRIBUTION OF *NEOLENTINUS SCHAEFFERI* (POLYPORACEAE) IN POLAND*

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Abstract. The current distribution of *Neolentinus schaefferi* (Weinm.) Redhead & Ginns in Poland is presented, based on literature data and the results of mycocoenological investigations in floodplain forest associations in the Warta River valley. Localities in natural riverine forest associations are pointed out. The importance of parks and other secondary habitats for survival of this taxon is stressed.

Key words: *Neolentinus schaefferi*, fungi, Polyporales, Polyporaceae, distribution, ecology, Poland

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INTRODUCTION

The genus *Neolentinus* Redhead & Ginns (Basidiomycota, Polyporaceae) comprises 11 species of worldwide distribution (Kirk *et al*. 2008). This genus is characterized by leathery or woody, tricholomatoid fruitbodies with smooth or scaly, whitish to brown caps, sinuate or decurrent, dentate gills, central or sometimes eccentric stems, and white spore deposit. Hyphal system dimitic, generative hyphae hyaline, thin-walled, with clamps, skeletal hyphae hyaline and thick-walled. Lamellar trama regular, cystidia absent, basidia with four sterigmata, basidiospores cylindric or allantoid, inamyloid. Other characteristic features are a bipolar mating system and the ability to cause brown rot of wood (Redhead & Ginns 1985; Knudsen 2008). In the literature this genus is placed in the Polyporaceae family (e.g., Wojewoda 2003; Kirk *et al*. 2008) or in Gleophyllaceae (Hibbett *et al*. 2007).

The species currently included in the genus *Neolentinus* previously were grouped in the genus *Lentinus* Fr., which lacks skeletal hyphae, and in *Panus* Fr., which has an irregular lamellar trama. Both of those genera cause white rot of wood.

The *Checklist of Polish Larger Basidiomycetes* (Wojewoda 2003) lists three species of this genus: *Neolentinus adhaerens* (Alb. & Schwein.: Fr.) Redhead & Ginns [as *Lentinus adhaerens* (Alb. & Schwein.: Fr.) Fr.], *Neolentinus lepideus* (Fr.: Fr.) Redhead & Ginns [as *Lentinus lepideus* (Fr.: Fr.) Fr.] and *Neolentinus schaefferi* (Weinm.) Redhead & Ginns [as *Lentinus cyathiformis* (Schaeff.) Bres.].

Kotlaba and Pouzar (1996) maintain that the proper name for this species is *Lentinus degener* Kalchbr. in Fries. We share the opinion of Redhead and Ginns (1985) that species of the genus *Lentinus* Fr. that have the common features mentioned above should be placed in separate genera, so we use the name *Neolentinus schaefferi* (Weinm.) Redhead & Ginns.

Here we outline what is currently known about the ecology and distribution of *N. schaefferi* in Poland.

MATERIALS AND METHODS

This paper is based on the literature and on our unpublished data. In the course of mycocoenological studies conducted since 2008 in floodplain forest communities in the Warta River valley we found sporocarps of this

* This paper is dedicated to Professor Tomasz Majewski on the occasion of his 70th birthday.

fungus at three permanent observation plots established in phytocoenosis of the *Populetum albae* Br.-Bl. 1931 association. Two of these plots were located in the Krajkowo Nature Reserve, and the other in the vicinity of Rogalin. Specimen descriptions are based on material collected from the Warta River valley. Fresh fruitbodies were measured and micromorphological characters were observed under a Zeiss Jenaval light microscope in 25% NH_4OH. Names of plants follow Mirek *et al.* (2002) and Ochyra (2003). Names of geographical regions used in the list of localities follow Kondracki (2009).

Description of specimens

Neolentinus schaefferi (Weinm.) Redhead & Ginns

Trans. Mycol. Soc. Japan **26**: 357. 1985. – *Lentinus schaefferi* (Weinm.) Rauschert, Haussknechtia **4**: 53. 1988. – *Lentinus degener* Kalchbr. *in* Fries, Hymenomyc. eur. (Upsaliae): 482. 1874. – *Lentinus cyathiformis* (Schaeff.) Bres., Iconogr. Mycol. **11**(Tabs 501–550): tab. 511. 1929. – *Neolentinus degener* (Kalchbr.) Hrouda, Czech Mycol. **53**(1): 54. 2001.

Sporocarps annual. Cap 3–15 cm diameter, in young basidiocarps hemispherical to convex with reflexed margin, in mature ones slightly depressed to cyathiform, cream-colored, ochraceous to pale reddish brown, at the center covered with rusty brown to red brown squamules. Lamellae crowded, deeply decurrent, 1–8 mm wide, whitish, grayish, with denticulate concolorous edge (Fig. 1a). Secondary hymenophore on the cap of one of the sporocarps found near Rogalin (Fig. 1c). Stipe central, more rarely slightly eccentric (2.5–)3–9 × 1–3 cm, in upper part whitish or cream-colored, towards base reddish brown and covered with small reddish brown squamules, at the very base sometimes greyish or blackish. A characteristic feature is the deeply radicant base of the stem, often located deep in the substrate. Labyrinthoid or partly irpicoid hymenophore at the bottom part of some stipes of carpophores collected by the first author near Rogalin (Fig. 1b). Context tough, white in pileus, yellowish in stipe. Taste and smell pleasant. Hyphal system dimitic. Generative hyphae hyaline, thin-walled, 2–5 µm wide, with clamp connections. Skeletal hyphae thick-walled, 2–5 µm wide, clamp connections not seen. Cystidia absent. Basidia (18–)35–50 µm, clavate, with four sterigmata. Spores 10–12 × 4–5 µm, cylindrical, with suprahilar depression, hyaline and thin-walled. Cystidiform, sometimes subcapitate hairs, 2–5 µm wide, present on lamella edges.

The hymenophore which is labyrinthoid or irpicoid, or even present on the cap surface, was mentioned also by Domański (1955) and Szczepka (1988). In the case of the labyrinthoid hymenophore, Domański (1955) stated that the basidia and basidiospores are the same as in typical lamellas, whereas smaller lanceolate spores have also been noted when occurring on the cap. In our collections the spores from the hymenophore were the same as from a normal hymenophore.

Specimens examined. POLAND. Pradolina Warciańsko-Odrzańska valley: Krajkowo Reserve, two permanent observation plots in floodplain forest association *Populetum albae*, forest section 139b, on *Populus alba* log, 22 Aug. 2008, *leg. A. Bujakiewicz* (POZM), 11 May 2009, *leg. M. Stefaniak* (POZM), forest section 125c, on *Populus alba* log, 30 June 2009, *leg. M. Stefaniak* (POZM); *ca* 1 km SW of Rogalin, in floodplain forest association *Populetum albae*, on *Populus alba* log, 8 July 2010, *leg. M. Stefaniak* (POZM).

Ecology

Neolentinus schaefferi is a saprotrophic species which causes brown rot of wood (Redhead & Ginns 1985). Most frequently it was collected on dead trunks of *Populus* spp. (especially *P. alba*) and *Salix* spp., but also on *Betula pendula*, *Tilia* spp., *Fagus* spp., *Alnus* spp., *Malus* spp., and *Fraxinus* spp. (Kotlaba & Pouzar 1967; Pegler 1983; Krieglsteiner 2001; Lechner & Wright 2002). It was also collected on standing living (dying) trees (Kotlaba & Pouzar 1967; Wojewoda 1996; Krieglsteiner 2001), that is why it is regarded by some authors (Boekhout 1990; Wojewoda 2003) as a probable parasite. The literature gives data on other substrates of this species. Pilát (1946), Domański (1955), Pegler (1983) and Bujakiewicz and Lisiewska (1983) stated that *N. schaefferi* was noted also on wood of conifers; other authors (e.g.,

Fig. 1. a – Fruitbodies of *Neolentinus schaefferi* on decayed *Populus alba* log in the Warta River valley near Rogalin. b – Labirynthoid and irpicoid hymenophore on stipe surface. c – Secondary lammelate hymenophore on cap surface. Scale bars: A = 4 cm; B & C = 1 cm. Photo M. Stefaniak.

Kotlaba & Pouzar 1967; Szczepka 1988; Wojewoda 2003) maintain that *N. schaefferi* is strictly limited to wood of deciduous trees. This species is considered thermophilous (Kotlaba & Pouzar 1967; Krieglsteiner 2001), often occurring on sun-exposed logs and trunks (Knudsen 2008). It is also characteristic of lowland; it was found up to 435 m a.s.l. (Krieglsteiner 2001). *Neolentinus schaeferri* is bound up with floodplain forests of the *Alno-Ulmion* Br.-Bl. & R. Tx. 1943 alliance (Szczepka 1988; Krieglsteiner 2001). It seems that its synecological optimum is best realized in alluvial habitats with loose treestand of *Populus alba*, which often provides better light conditions (Kotlaba & Pouzar 1967). This species was also found in parks (Krieglsteiner 2001) and man-made microhabitats (e.g., the woodwork of water cooling towers) (Pegler 1983).

According to the literature and our own observations, in Poland *Neolentinus schaefferi* is found primarily on *Populus alba* (Domański 1955, 1957; Wojewoda 1971, 1996; Sałata & Ostas 1975;

Szczepka 1988; Stefaniak & Bujakiewicz 2009) and on unidentified species of the genus *Populus* sp. (Bujakiewicz 1992; Kujawa 2005). Other substrates were a stump of undetermined species of deciduous tree (Kujawa 2009), and probably a stump of *Malus* sp. (Ziętkiewicz 2007). It was collected on *Pinus* sp. three times (Eichler 1900; Teodorowicz 1933; Bujakiewicz & Lisiewska 1983), and only once on living *Populus alba* (Wojewoda 1996).

In Poland it was collected in typical floodplain forests of the *Alnion incanae* Pawł. in. Pawł. *et al*. 1928 alliance (previous *Alno-Ulmion* Br.-Bl. et R. Tx. 1943) (Bujakiewicz 1992; Stefaniak & Bujakiewicz 2009). Recently it was found in the Warta River valley near Rogalin, in a phytocoenosis of the *Populetum albae* association. Its carpophores were noted in the transition patches between the *Pino-Quercetum* Kozł. 1925 and *Betuletum pubescentis* (Hueck 1929) R. Tx. 1937 associations (Bujakiewicz & Lisiewska 1983). Most frequently it was recorded in parks (Domański 1955, 1957; Wojewoda 1971, 1996; Szczepka 1988; Kujawa 2005, 2009) or undetermined habitats (Sałata & Ostas 1975; Wojewoda 2003; Ziętkiewicz 2007).

Global distribution

Neolentinus schaeferri is known from Europe, Asia and South America (Pilát 1946; Pegler 1983; Lechner & Wright 2002). In Europe this species is widespread; so far it has been reported from Austria, Germany, France, the Netherlands, England, Denmark, Sweden, Finland, Belarus, Ukraine, Latvia, Lithuania, Estonia, the Czech Republic, Slovakia, Bulgaria, Croatia, Moldova, Hungary, Romania, Greece (Korfu Island), Spain and Poland (Domanski 1955; Boekhout 1990; Courtecuisse & Duhem 1995; Krieglsteiner 2001; Knudsen 2008). In Asia it was found in China (Yunnan Province) and Western Siberia (Pilát 1946). In South America it is known from only one locality in Argentina (Lechner & Wright 2002).

According to Kotlaba and Pouzar (1967), *Neolentinus schaefferi* is a thermophilous species with its center of distribution in Southern Europe.

Distribution in Poland

In Poland *N. schaefferi* is known from 16 localities (Fig. 2), mainly in southern and central Poland, in lowlands.

1 – Kotlina Sandomierska basin, Kraków – Planty park – parasitizing (?) *Populus alba* (sub *L. cyathiformis*; Wojewoda 1971, 1996), 2 – Kotlina Sandomierska basin, 1 km from Kraków city limits, by the road to Sandomierz, on *Malus*? (sub *L. cyathiformis*; Ziętkiewicz 2007), 3 – Wyżyna Śląska upland, Gliwice – in park, on dying *P. alba* (sub *L. cyathiformis*; Szczepka 1988), 4 – Roztocze, Roztoczański National Park (Wojewoda 2003), 5 – Polesie Zachodnie, Łańcuchów near Łęczna, in Wieprz River valley, on *P. alba* (sub *Lentinus degener* Kalchbr. in Fr.; Sałata & Ostas 1975), 6 – Polesie Wołyńskie, Staw n. Chełm, whitout determined substrate, by road (sub *Lentinus degener* Kalchbr. in Fr.; Sałata & Ostas 1975), 7 – Nizina Południowopodlaska lowland, in vicinity of Międzyrzec Podlaski: on *Pinus* (Eichler 1900), 8 – Nizina Środkowomazowiecka lowland, Puławy, park, on *Populus*? (sub *L. cyathiformis*; Kujawa 2005), 9 – Nizina południowowielkopolska lowland, Siemianice near Kępno – in park, on *Populus alba* (sub *L. cyathiformis* (Schaeff.) Bres.; Domański 1955, 1957), 10 – Pojezierze Leszczyńskie lakeland, Choryń, manorial park, on deciduous stump (Kujawa 2009), 11 – Pradolina Warciańsko-Odrzańska valley, Krajkowo Reserve, on *P. alba*

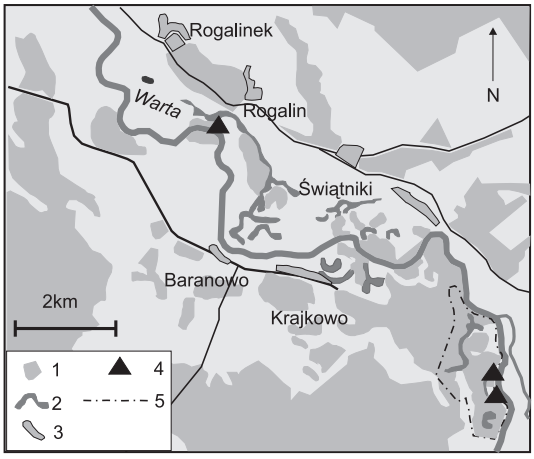

Fig. 2. Localities of *Neolentinus schaefferi* (Weinm.) Redhead & Ginns in the Warta River valley. 1 – forests, 2 – water bodies, 3 – buildings, 4 – localities of *N. schaefferi*, 5 – boundary of Krajkowo Reserve.

logs, in *Populetum albae* Br.-Bl. 1931 (sub *N. schaefferi*; Stefaniak & Bujakiewicz 2009), 12 – PRADOLINA WARCIAŃSKO-ODRZAŃSKA VALLEY, Warta River valley, near Rogalin, on *P. alba* logs, in *Populetum albae* Br.-Bl. 1931, 13 – POJEZIERZE WIELKOPOLSKO-KUJAWSKIE LAKELAND, Poznań, on *Pinus* (Teodorowicz 1933), 14 – DOLINA DOLNEJ WISŁY VALLEY, Wielka Kępa Ostromecka Reserve near Bydgoszcz on *Populus* sp. logs, *Querco-Ulmetum minoris* association (as *Ficario-Ulmetum*) (sub *L. cyathiformis*; Bujakiewicz 1992), 15 – POBRZEŻE GDAŃSKIE, in vicinity of Elbląg (sub. *Panus cyathiformis*; Kauffmann 1891), 16 – POBRZEŻE KOSZALIŃSKIE, Słowiński National Park, on *Pinus sylvestris* (Bujakieiwcz & Lisiewska 1983).

In terms of the ecology and distribution of the species in Poland, three of the mentioned localities are especially worthy of notice. They have the only documented phytocoenological data, which confirm the probable original synecological requirements of the species. In view of the degeneration of natural vegetation in river valleys, these localities should be treated as relict.

One of those localities is Krajkowo Reserve (Figs 2 & 3). The species was found there on two permanent observation plots in a phytocoenosis of the *Populetum albae* association (Table 1) situated in the Warta River valley on the banks of oxbow lakes. Both are characterized by low density of the tree layer (up to 50%) and a high share of species of the *Artemisietea vulgaris* class. Five basidiocarps of *N. schaefferi* were found in August 2008, single fruitbodies were found in May and June 2009, and seven basidiocarps in May 2010. Young fruitbodies were found in May and June, whereas in August they were old and partly eaten by *Diaperis boleti* L. (Tenebrionidae) (*det. S. Konwerski*). In all cases the fruitbodies were growing on *Populus alba* logs. Another locality of this species, clearly related to riverine forests, is again in the Warta River valley near Rogalin (Figs 2 & 3); 23 sporocarps of this species were found in July 2010 on a *P. alba* log in the *Populetum albae* association. On the carpophores the mycetophilous beetle *Mycetophagus quadripustulatus* L. (Mycetophagidae) was found (*det. S. Konwerski*).

Another locality in riverine forest was described by Bujakiewicz (1992) in the Wielka Kępa Ostromecka Reserve in the Vistula River valley. The species was noted on *Populus* logs in the *Querco-Ulmetum minoris* Issler 1924 (*Ficario-Ulmetum campestris* Knapp 1942) association, at two observation plots (Table 1). These phytocoenoses were characterized by high humidity, caused by local conditions, that is, the presence of numerous oxbow lakes and other water bodies (Bujakiewicz 1992).

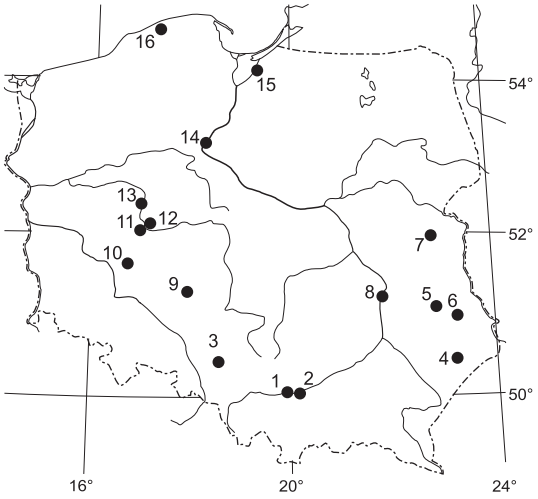

Fig. 3. Distribution of *Neolentinus schaefferi* (Weinm.) Redhead & Ginns in Poland.

DISCUSSION

Neolentinus schaefferi is a widespread but rare species in Poland. It seems clearly confined to floodplain forests of the *Alnion incanae* Pawł. in Pawł. *et al*. 1928 (*Alno-Ulmion* Br.-Bl. & R. Tx. 1943) alliance (Szczepka 1988; Krieglsteiner 2001). Kotlaba and Pouzar (1967) focused attention on its connection with alluvial forests.

It seems that in Poland it is especially confined to forests of the *Populetum albae* association, as shown in the case of the Warta River valley (Krajkowo Reserve and the vicinity of Rogalin). Mycocoenological observations in the Warta River valley are carried out in the floodplain forests of various associations, but the species has been recorded up to now only in phytocoenoses of the *Populetum albae* association. Dead poplar wood is plentiful. Natural forests and thickets in river

Table 1. Phytosociological and floristic diversity on permanent observation plots in Krajkowo and Wielka Kępa Ostromecka Reserves. F – characteristic species within forest formation. Table made by A. Brzeg.

	Krajkowo Reserve		Wielka Kępa Ostromecka Reserve	
No. of plot	12	14	1	2
Date	22.08.2008	22.08.2008	20.05.1976	20.05.1976
Density of tree layer a1	50	40	70	70
Density of tree layer a2	50	–	10	20
Density of shrub layer b	40	10	80	80
Cover of herb layer c	40	80	100	100
Cover of moss layer d	–	–	50	40
Diameter of trees	–	–	50	43
Height of trees	–	–	20	22
Area of record	200	250	400	400
Number of species in one record	47	58	25	22
Ch. and *D. *Populetum albae*				
Populus alba a1	4.2	3.1	–	2.2
Populus alba b	1.1	2.1	–	–
Populus alba c	+	1.1	–	+
**Chaiturus marrubiastrum*	1.1	+	–	–
**Calamagrostis epigejos*	–	1.2	–	–
Populus ×canescens c	1.1	–	–	–
**Crataegus monogyna* b/c	–/–	1.1/r	1.1/–	–/–
**Rhamnus cathartica* b/c	–/r	+/+	–	–
**Cornus sanguinea* c	+	–	–	–
**Veronica longifolia*	–	r	–	–
Ch. and *D. *Salicion albae*				
Salix alba a1	–	2.1	–	–
**Bidens frondosa*	2.2	3.2	–	–
Senecio paludosus (F)	+	+.2	–	–
**Atriplex prostrata* subsp. *latifolia*	–	2.1	–	–
Stachys palustris (F)	+	–	–	–
Achillea salicifolia (F)	–	r	–	–
Ch. *Salicetea purpurae*				
Phalaris arundinacea (F)	1.2	3.2	–	–
Symphytum officinale (F)	+	1.1	–	–
Ch. *Phragmitetea*				
Phragmites australis	+	1.2	–	–
Iris pseudacorus	+	r	–	–
Carex riparia	+	–	–	–
Carex gracilis	r	r	–	–
Ch. *Artemisietea vulgaris*				
Fallopia dumetorum	1.1	2.2	–	–
Impatiens parviflora	1.1	2.1	–	–
Rubus caesius	1.2	1.1	–	–
Urtica dioica	+	2.1	3.3	1.1
Alliaria petiolata	+	+	2.2	–
Cheliodonium majus	–	+	–	–
Elymus repens	–	+.2	–	–
Galium aparine	–	–	2.3	1.2
Ballota nigra	–	+.2	–	–
Arctium lappa	–	–	+	–
Geum urbanum	+	+	1.1	1.1

Table 1. *Continued.*

No. of plot	12	14	1	2
Moehringia trinervia	+	–	1.2	–
Tanacetum vulgare	–	+.2	–	–
Torilis japonica	+	+	–	–
Equisetum arvense	+	r	–	–
Lapsana communis	–	1.1	–	–
Glechoma hederacea	+	+.2	3.3	2.3
Artemisia vulgaris	–	+.2	–	–
Geranium robertianum	+	–	–	–
Humulus lupulus	–	+	–	–
Carduus crispus	+	1.1	–	–
Cirsium arvense	–	+	–	–
Rumex obtusifolius	r	+	–	–
Ch. and *D. *Alno-Padion*				
Ulmus minor a1	–	–	4.4	–
Ulmus minor a2	–	–	–	4.4
Ulmus minor b	–	–	1.1	–
Ulmus minor c	–	–	3.3	1.1
Ulmus leavis a1	–	1.1	2.2	–
Ulmus leavis a2	2.1	r	–	2.2
Padus avium b	–	–	3.3	3.3
Padus avium c	–	–	3.3	1.1
Ficaria verna	–	–	5.5	5.5
Festuca gigantea	+	+	1.2	–
Ribes spicatum	–	–	–	+
**Oxyrrhynchium hians* d	–	–	3.3	2.3
Ch. *Querco-Fagetea*				
Cornus sanguinea b (F)	–	–	2.3	2.2
Cornus sanguinea c (F)	–	–	1.1	1.1
Crataegus laevigata a2 (F)	–	–	2.2	–
Crataegus laevigata b (F)	–	–	–	1.1
Euonymus europaea b (F)	–	–	1.1	–
Euonymus europaea c (F)	–	–	+	+
Dactylis polygama	–	–	–	–
Scrophularia nodosa	–	+	–	–
Rumex sanguineus	+	–	–	–
Aegopodium podagraria (F)	–	–	4.4	2.2
Acer platanoides c	–	–	+	+
Brachypodium sylvaticum	+	+.2	–	–
Fraxinus excelsior c	–	–	–	+
Accompanying species				
Sambucus nigra b	+	–	4.4	4.4
Sambucus nigra c	r	–	2.2	–
Stellaria media	–	+	2.2	–
Lamium maculatum	–	–	2.2	2.2
Ribes uva-crispa b/c	–	–	2.2	1.1
Veronica hederifolia	–	–	1.1	1.1
Fissidens taxifolius d	–	–	1.2	1.2
Quercus robur a2	2.2	–	–	–
Quercus robur c	+	r	–	–
Agrostis stolonifera	–	1.2	–	–
Chenopodium album	r	+.2	–	–

(cont.)

Table 1. *Continued.*

No. of plot	12	14	1	2
Acer negundo	r	–	–	–
Atriplex patula	–	1.2	–	–
Poa palustris	–	1.2	–	–
Bromus benekenii	r	–	–	–
Conyza canadensis	–	+	–	–
Chenopodium polyspermum	–	+	–	–
Deschampsia caespitosa	r	+.2	–	–
Erysimum cheiranthoides	–	2.1	–	–
Frangula alnus c	+	–	–	–
Hypericum perforatum	r	–	–	–
Lysimachia vulgaris	r	–	–	–
Mentha arvensis	+.2	–	–	–
Oxalis fontana	–	+.2	–	–
Plantago major	–	r	–	–
Polygonum hydropiper	+	+	–	–
Ranunculus repens	–	+	–	–
Rorripa palustris	–	r	–	–
Vincetoxicum hirudinaria	r	–	–	–

valleys are primary habitats for this species, which shows a requirement for high humidity and temperature, especially during development of fruitbodies (Domański 1955). Because this type of vegetation is severely reduced in Poland, and locally threatened (Brzeg & Wojterska 2001), it also affects the occurrence of *N. schaefferi* in Poland. Krieglsteiner (2001) stated that this species is endangered by loss of its natural habitat but that on the other hand it has recently been found more often in parks and cities. In Poland parks also appear to be important secondary habitats. This could be due to the availability of its main substrate (*Populus* sp.) which is often found in parks and cities, where the tree canopy is thin and allows direct access to sunlight. The occurrence of *N. schaefferi* in secondary habitats such as parks shows its ability to adapt. These localities are extremely important for survival of the species.

Although widespread in Europe, this species is certainly rare. It has been red-listed in several countries including Croatia, the Czech Republic, Slovakia, Switzerland and Poland (Holec & Beran 2006; Wojewoda & Ławrynowicz 2006; Senn-Irlet *et al*. 2007; Tkalčec *et al*. 2008).

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