Rare or Overlooked? — Two Species of *Lyromma* (Lyrommataceae, Lichenized Ascomycota) are New for Africa

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Rare or overlooked? – Two species of *Lyromma* (Lyrommataceae, lichenized Ascomycota) are new for Africa

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Abstract: Farkas, E. & Flakus, A. 2015. Rare or overlooked? – Two species of *Lyromma* (Lyrommataceae, lichenized Ascomycota) are new for Africa. – Herzogia **28**: 204–211.

Two species of the foliicolous lichenized genus *Lyromma* so far known only from the Neotropics are reported for the first time from Africa. *Lyromma multisetulatum*, described from Bolivia and Brazil, was found recently in Kenya and Tanzania, and *L. pilosum* in Tanzania. Tanzanian specimens were discovered in lowland rainforest collections from 200 to 500 m altitude. The Kenyan collection originates from moist montane forests at c. 2000 m elevation. Both species are characterized by both perithecia and pycnidia observed on the same thallus. The distribution and frequency of these taxa are briefly discussed, and compared to other taxa with similar distribution patterns.

Zusammenfassung: Farkas, E. & Flakus, A. 2015. Rar oder übersehen? – Zwei Arten von *Lyromma* (Lyrommataceae, lichenisierte Ascomycota) neu für Afrika. – Herzogia **28**: 204–211.

Die foliikole lichenisierte Gattung *Lyromma* wird zum ersten Mal aus Ostafrika mit zwei Arten gemeldet, die bisher nur aus der Neotropis bekannt waren. *Lyromma multisetulatum* wurde aus Bolivien und Brasilien beschrieben und wird jetzt aus Kenia und Tansania nachgewiesen. *L. pilosum* wurde in Tansania gesammelt. Die tansanischen Exemplare wurden in Aufsammlungen aus Tieflands-Regenwäldern in 200 bis 500 m Höhe entdeckt. Das Exemplar aus Kenia stammt aus feuchtem Hochland-Regenwald in 2000 m Höhe. Beide Arten sind dadurch gekennzeichnet, dass Perithecien und Pyknidien auf dem gleichen Thallus vorkommen. Die Verteilung und Häufigkeit dieser Taxa werden kurz diskutiert und mit ähnlichen Verteilungsmustern anderer Taxa verglichen.

Key words: East Africa, foliicolous lichens, Kenya, Pantropical, Tanzania.

Introduction

Lichenized fungi were recently pointed out as a group with an extensive, and still partly undiscovered global diversity (Lumbsch et al. 2011). Foliicolous lichens form a relatively well known group of tropical organisms and their biogeography has been studied in detail (Lücking 2003). Still, there are huge gaps in our world-wide knowledge. Recently, two species new for science were described (Flakus & Farkas 2013) in the foliicolous lichenized genus *Lyromma* Bat. & H. Maia, classified in the Lyrommataceae Lücking (Lücking 2008).

According to the most recent concept, the genus contains seven species (Flakus & Farkas 2013). All species were described from Brazil or Bolivia and so far most species are known exclusively from South America. *Lyromma nectandrae* Bat. & H.Maia (as *L. confusum* Lücking & Sérus. in Lücking 2008: 187) is the only exception. It was previously discovered in Africa (Democratic Republic of the Congo, Ethiopia, Kenya, Senegal, Uganda; Aptroot et al. 1997,

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Yeshitela 2008, Van den Broeck et al. 2014) and the eastern Palaeotropics (Papua New Guinea; Aptroot et al. 1997), and was also mentioned from Australia (Lücking et al. 2001). The genus has been characterized by a "nearly exclusively" Neotropical distribution so far. However it is now revealed that the genus is represented by two further species in African material. We discovered two *Lyromma* species in relatively old collections of leaves of vascular plants from Kenya and Tanzania, East Africa. Their discovery in African collections changes our knowledge of their distribution patterns.

Material and methods

The morphology and anatomy were studied by using a NIKON Eclipse/NiU (DIC, epifluorescence) compound microscope, as well as Olympus SZX9 and Olympus BX50 (DIC) microscopes. Anatomy, measurements and number of setae were examined in squash preparations or sections mounted in water under a compound research microscope.

Micrographs were prepared by Olympus E450 camera (with Quick Photo Camera 2.3 software) and Nikon DS-Fi1c camera (with NIS-Elements BR software) with the above-mentioned microscopes. The descriptions of species are based on the African collections exclusively.

Results

Lyromma multisetulatum Flakus & Farkas, Mycotaxon 124: 130 (2013) (Figs 1, 2)

Thallus foliicolous, epiphyllous, ecorticate, formed by rounded patches, smooth, 1–2 mm wide, olive-green; photobiont *Phycopeltis*, cells rectangular, 8.5–13 × 5.5–7 µm, arranged in radiate plates. Perithecia sessile, subglobose to globose, 70–80 µm in diam., and 70–90 µm high, dark brown, setose around the ostiole with up to 20 setae; setae dark brown, septate, strongly recurved, composed of individual hyphae, 30–40 µm long and 3–4 µm broad (2–3 µm broad in apical part); peridium dark brown, lower part slightly paler, 3–4 µm thick, composed of rectangular cells (3–4 µm wide), thick-walled (c. 1 µm thick), arrangement irregular to almost parallel; asci bitunicate, 8-spored, 25–33 × 8–11 µm; ascospores fusiform, hyaline, 3-septate, with slight constrictions at septa, 12–14 × 3.5–4(–4.5) µm. Two young pycnidia were seen in the Tanzanian specimen, barrel-shaped with tapering top, 30–40 µm high and 20–40 µm wide, dark brown, upper part around ostiole without or with a few short setae; setae dark brown, composed of individual hyphae, 10–15 µm long and 3–4 µm broad; conidia (microconidia) bacilliform, non-septate, 2.5–3.5 × 0.8–1.2 µm.

Remarks: *Lyromma multisetulatum* is characterized by the presence of numerous [(10–)15–20] perithecial appendages composed of single hyphae. Perithecia of the most closely related *L. pilosum* clearly differs in forming less number of appendages [6–10], which are almost two times shorter (10–15 µm long) and comparatively less curved (cf. Lücking 2008) than those of *L. multisetulatum*. Both species produce very similar pycnidia, however the pycnidial appendages of *L. pilosum* observed by us are less numerous [5–8] than those of *L. multisetulatum* normally. Only juvenile pycnidia with characteristic microconidia were found in the present material of *L. multisetulatum*.

Distribution and habitat: The species is found in a moist montane forest just below the summit of Mt. Ol Donyo Sabuk (Ol Doinyo Sapuk, Kilima Mbogo) in Kenya and in lowland semi-deciduous forest and secondary dry vegetation of East Usambara Mts. in Tanzania, East Africa (Fig. 2). Furthermore it grows on leaves of vascular plants in lowland Amazon forest (Bolivia) and in Atlantic submontane rainforest (Brazil) in South America. These records suggest a disjunct African and Neotropical distribution, but further pantropical collections need to be examined in future to confirm this.

Specimens examined: Kenya. Eastern Province. Machakos District. Eastern "Ol Doinyo Sapuk" National Park, SE of city Thika, 1980–2140 m, 01°08′S, 37°15′E, August 1974, R. B. & A. J. Faden & F. Ng'weno 74/1309 (PRA-V 09082!, filed under *Bacidia apiahica*); Tanzania. Tanga Region. East-Usambara Mts, Mtai Forest Reserve, on the E slopes of Mtai ridge, W of Maramba village, 250–500 m, 13 Nov 1986, E. Farkas 86245 (VBI 06052!).

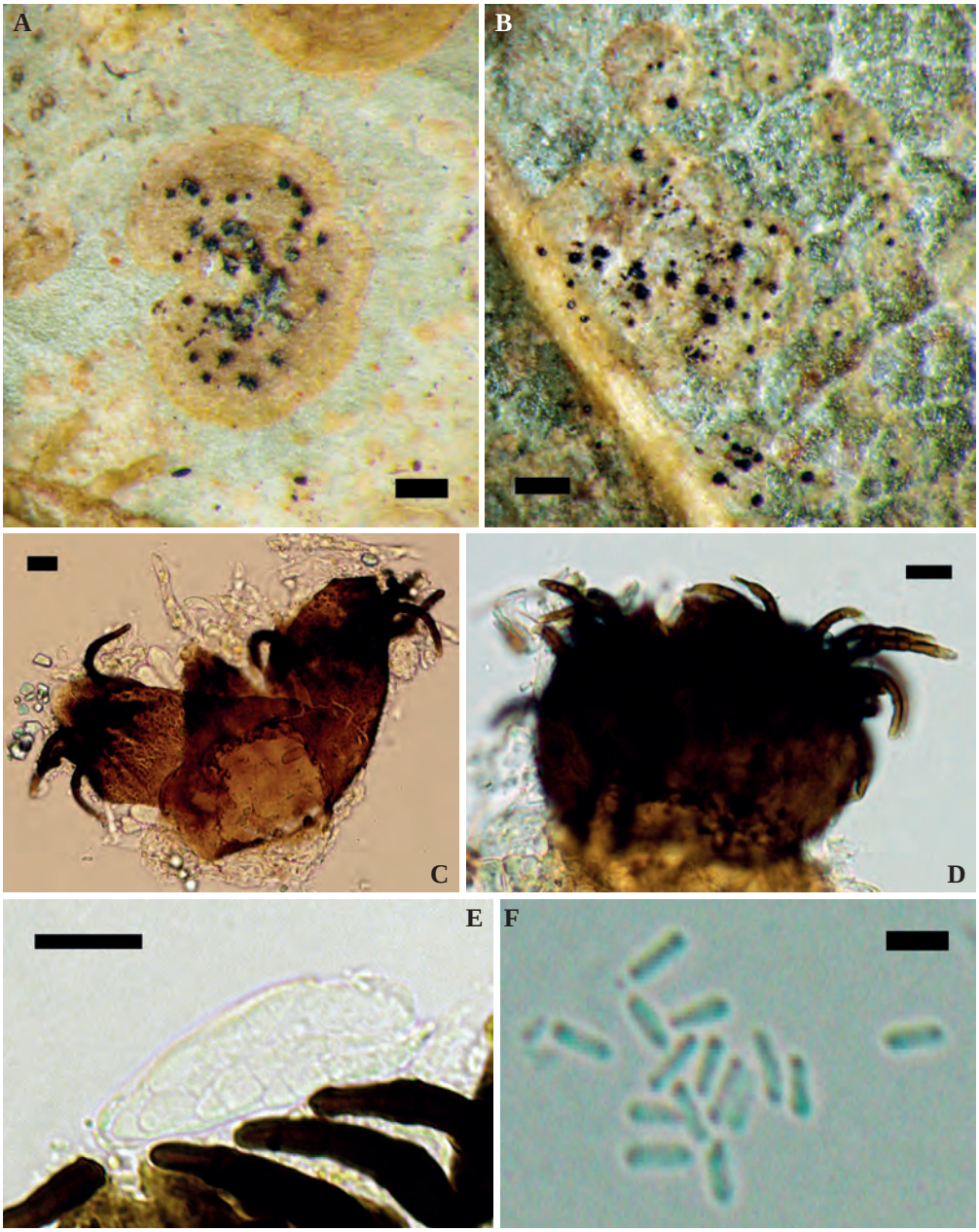

Fig. 1: Habit and morphological details of *Lyromma multisetulatum* on leaves from Kenya (A, C – PRA-V 09082) and Tanzania (B, D–F – VBI 06052). **A**–**B –** Habit. **C**–**E –** Perithecia with setae composed of single, acicular hyphae. **E –** Ascospores (upper median cell slightly enlarged) in ascus. **F –** Conidia. Scale bars: A–B – 200 µm, C–E – 10 µm, F – 2.5 µm.

Fig. 2: Distribution of *Lyromma multisetulatum* in the world based on FLAKUS & FARKAS (2013) and current data.

Lyromma pilosum Lücking, Flora Neotropica 103: 187 (2008) (Figs 3, 4)

Thallus foliicolous, epiphyllous, ecorticate, formed by rounded patches, continuous, smooth, 1–3 mm wide, yellowish green; photobiont *Phycopeltis*, cells rectangular, 8–14 × 4–5 µm, arranged in radiate plates. Perithecia sessile, globose, 60–70(–80) µm in diam., and 70–80 µm high, dark brown, setose around ostiole with 6–10 setae; setae dark brown, septate, slightly recurved, composed of individual hyphae, 10–15 µm long and 3–4 µm broad; peridium dark brown, lower part slightly paler, 2–4 µm thick, composed of rectangular cells (3–4 µm wide), thick-walled (c. 1 µm thick), arrangement irregular to almost parallel; asci bitunicate, 8-spored, 30–35 × 10–12 µm; ascospores fusiform, hyaline, 3-septate, with slight constrictions at septa, upper median cell usually slightly enlarged, 14–16 × 3.5–5 µm. Pycnidia elongated barrel-shaped with tapering at top, 100–110 µm high and 20–40 µm wide, dark brown, upper part around ostiole setose with 5–8 setae; setae dark brown, horn-shaped, strongly recurved, septate, composed of single hyphae, 20–40(–60) µm long, and 3–4 µm broad (2.5–3 µm broad in apical part); conidia (macroconidia) filiform, multiseptate, 40–50(–60) × 0.8–1.2 µm.

Remarks: Both *L. pilosum* and *L. multisetulatum* are characterized by perithecial and pycnidial appendages composed of single hyphae; however the perithecial setae are more numerous and longer in *L. multisetulatum*. The Tanzanian specimen of *L. pilosum* extends 5 × 3 cm (!) on the leaf surface and contains several thalli both with perithecia and pycnidia which are often present on the same thallus. Both the pycnidial and perithecial states are well developed and are in agreement with published data of the species known earlier. The African specimens reported as *L. nectandrae* from Senegal and the Democratic Republic of the Congo (as Zaire) consist of thalli with pycnidia only (APTROOT et al. 1997). The description of their pycnidia refers to the original illustration of the species (BATISTA & MAIA 1965). However it does not contain width of setae (which should be 10–20 µm at base). Macroconidia of *L. nectandre* and *L. pilosum* are reported as rather similar: 36–40 × 1–1.5 µm (BATISTA & MAIA 1965) or somewhat longer at 45–65 × 0.8–1.2 µm (LÜCKING 2008) for *L. nectandrae* and 40–70 × 0.8–1.2 µm for *L. pilosum* (FLAKUS & FARKAS 2013) respectively. Therefore this character is not informative. The structure of setae – whether they consist of single or agglutined hyphae – must be checked to differentiate these two species. Also the number of setae (6–9) would suggest its affinity as *L. pilosum* in the case of Senegal and the Democratic Republic of the Congo specimens. The setae length (70–80 µm in APTROOT et al. 1997) is closer to that of species *L. nectandrae*, as reported by APTROOT et al. 1997, but setae curved downwards is characteristic for both species.

Distribution and habitat: This species has been found in Argentina and Costa Rica (LÜCKING 2008), and Bolivia and Brazil (FLAKUS & FARKAS 2013). In the Neotropics it grows in montane forests,

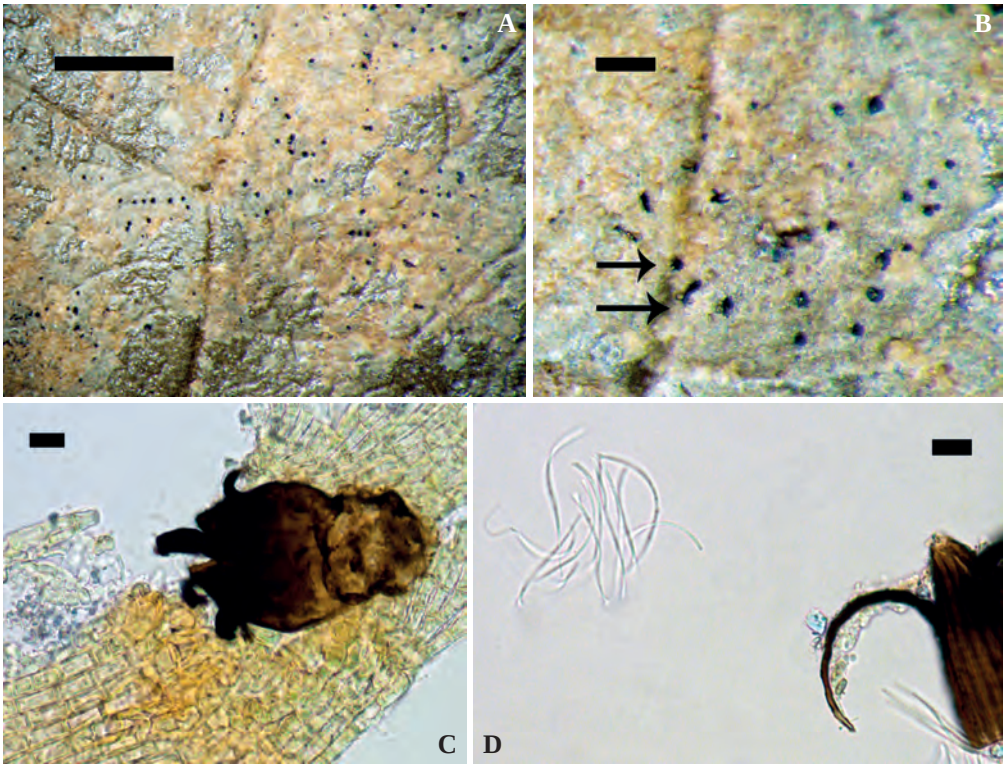

Fig. 3: Habit and morphological details of *Lyromma pilosum* on a leaf from Tanzania (VBI 06053). **A –** Habit. Several thalli with numerous perithecia and pycnidia. **B –** Habit enlarged. A perithecium (upper arrow) and a few pycnidia (lower arrow) on a thallus. **C** – A perithecium and thallus formed by *Phycopeltis* sp., short setae composed of single hyphae. **D** – A pycnidium (of curved setae composed of single hyphae) and long bacillar conidia. Scale bars A – 1 mm, B – 200 µm, C–D – 10 µm.

Fig. 4: Distribution of *Lyromma pilosum* in the world based on Lücking (2008), Flakus & Farkas (2013) and current data.

lowland Amazon forest and in Atlantic submontane rainforest, and now it is also known from lowland evergreen forest of Tanzania (Fig. 4).

If revisions of African *L. nectandrae* specimens confirm the presence of *L. pilosum* from Senegal and the Democratic Republic of the Congo (cf. recent records by VAN DEN BROECK et al. 2014), their habitat is characterized by dense rainforest at 1850 m (on *Asplenium* leaf) and virgin forest at 850 m (on leaf of a Rubiaceae species) in the Democratic Republic of the Congo and dense lowland forest (on leaf) in Senegal. Further African records from Godere (Ethiopia), Budongo (Uganda) and Kakamega (Kenya) are mentioned in a doctoral dissertation without detailed description of the specimens (YESHITELA 2008). Unfortunately these vouchers were unavailable on loan for further examination, despite several requests.

Specimen examined: Tanzania. Tanga Region. East-Usambara Mts, Segoma Forest Reserve, near Segoma village, 220–280 m, 5 May 1987, S. T. Iversen, E. Persson, B. Pettersson, A. Borhidi 87116 (VBI 06053!).

Further specimens to be examined (not seen by present authors): *L. nectandrae* Bat. & H.Maia (as *L. confusum* Lücking & Sérus. in Lücking 2008: 187). Senegal. Ziguinchor Region. "Basse-Casamance" National Park near Oussouye, 8 m, 1982, Vanden Berghen 5481 (LG); Zaire (today Democratic Republic of the Congo). Kivu Province. West side of the Kahuzi range, km "58" of the road Bukavu–Walikale, c. 1850 m, 1978, Lambinon 78319 p.p. (LG). Irangi. Near the Luhoho river, c. 850 m, 1978, Lambinon 78272 p.p. (LG).

Discussion and Conclusions

The pantropical distribution of the genus is clearly confirmed by these new findings, and adds to the pantropical distribution of *L. nectandrae*. According to the above results, three of the seven species recorded earlier from the Neotropics are now known also from the Palaeotropics. Furthermore, the *L. multisetulatum* specimen collected in Kenya in 1974 represents the earliest collection of the genus *Lyromma* from Africa. American–African disjunctions in vascular plants or animals were explained by western Gondwanan origin and subsequent vicariance in the late Cretaceous (RAVEN & AXELROD 1974, NELSON & PLATNICK 1981, CRACRAFT 1988). Lücking and coworkers (LÜCKING et al. 2008) interpreted the distribution patterns of foliicolous *Chroodiscus* (Müll. Arg.) Müll. Arg. species considering the probability of speciation events and possible ways of dispersal (rain splash, "biotic ferry") and postulated it was applicable to other foliicolous lichens as well: "The present-day pantropical distributions of many clades and species of foliicolous lichens might be explained by eastward expansion through continental drift, along with the evolution of modern rain forests starting 120 Ma, rather than by the existence of a hypothetical continuous area of pre-modern rain forest spanning South America, Africa and Southeast Asia during the mid and late Cretaceous" (LÜCKING et al. 2008). An interesting aspect, probably worth further study, is that both *L. multisetulatum* and *L. pilosum* are characterized by setae of single hyphae. So far we have found no previous results in literature sources suggesting whether setae consisting of single or multiple hyphae are considered to be more developed during evolution, but the evaluation of this feature within *Lyromma* might contribute to further clarification of the phylogenetic study of *Lyromma* species and foliicolous lichens in general.

Based on the three records of two *Lyromma* species presented here and the scattered records of *L. nectandrae* mentioned in literature from tropical Africa, one might conclude that representatives of *Lyromma* are much rarer in Africa than in other parts of the world. Table 1 summarizes estimated data on total numbers of leaves investigated and their *Lyromma* records by three researchers: Robert Lücking, Adam Flakus and Edit Farkas. The study of these data shows that the calculated frequency values are not necessarily correlated with the number of leaves investigated. The estimated highest number of leaves investigated resulted in the lowest frequency expressed as "*Lyromma* thalli observed/leaves investigated". The lowest number of leaves investigated had the highest values for frequencies expressed both for "*Lyromma* species reported/leaves investigated" and "*Lyromma* species reported/leaves found with *Lyromma* thalli". After all, the frequency of these species was found to be very low in any geographic area.

These researchers are only examples, and the table does not present all collections known from Africa. Several thousand leaves were furthermore studied for the presence of foliicolous lichens by Antonín Vězda, Klaus Kalb, Andreas Frisch, Frank Brusse and others (see publications listed in Farkas 2014). However, these authors have not reported any records of *Lyromma* species. With the increasing number of leaves investigated for foliicolous lichens in Africa, further records of *Lyromma* might be expected, since African rainforests can be regarded as undercollected compared to those in South America.

The species of *Lyromma* are foliicolous lichens of the smallest size. The probability that they remain overlooked in a collection is rather high and this value increases retrospectively, when the quality (magnification, depth of field) of microscopes was less developed. As the resolution of stereo microscopes improves, the observation of these tiny organisms becomes easier and a more precise knowledge on species of the genus *Lyromma* can be expected to be acquired.

After analyzing the revealing conditions of these records and the rough estimations of the frequency of these species it is also interesting to compare species with similar distribution patterns. There have been several species with African–American distribution which turned out to be pantropical after study of further collections (comparing data of Lücking et al. 2000, Lücking & Martínez Colin 2004, Lücking 2008), especially from SE Asia. Most of the restricted African–American species remaining now are rare species (e.g. *Byssoloma absconditum*). Species with a real disjunct African and American distribution, e.g. *Bacidina mirabilis* and *Badimia dimidiata*, which are frequent in these areas but not known elsewhere, are an exception.

There are species where the specimens from the two continents are characterized by smaller or bigger morphological differences. Whether the differences suggest separate taxa needs further study. The differences might not be large enough to separate the taxa at the rank of species; maybe they should be considered as infraspecific categories; (e.g. *Echinoplaca furcata* var. *furcata* and var. *neotropica*).

Specimens of *Lyromma* collected in Africa show slight differences from earlier descriptions, but these are within the variation of these taxa. These records are adequate to justify the presence both of *L. multisetulatum* and *L. pilosum* as new for the continent. We conclude the genus *Lyromma* is rare, overlooked and undercollected in Africa.

Table 1: Frequency of observations – records of *Lyromma* species vs number of leaves investigated by three researchers (Robert Lücking, Adam Flakus, Edit Farkas) in the last decades in the world, in Bolivia and in East Africa. Abbreviations: * – c. 30 selected specimens examined in Lücking (2008); ** – c. 60 selected specimens examined in Flakus & Farkas (2013); *** – current publication.

Researchers, collections in time and geographical range	Estimated **number** of leaves investigated	**Number** of leaves with *Lyromma* thalli observed	**Number** of *Lyromma* species reported	**Frequency:** *Lyromma* thalli observed/ leaves investigated	**Frequency:** *Lyromma* species reported/leaves investigated	**Frequency:** *Lyromma* species reported/leaves with *Lyromma*
Lücking, 1990–2014, World	several 100 thousands	c. 100*	6	10^{-3}	6×10^{-5}	6×10^{-2}
Flakus, 2006–2014, Bolivia	several 10 thousands	c. 200**	7	2×10^{-2}	7×10^{-4}	3.5×10^{-2}
Farkas, 1986–2014, East Africa	several thousands	3***	2	3×10^{-3}	2×10^{-3}	2/3

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