Pseudotaxiphyllum annii sp. nov., a new species of Plagiotheciaceae from Philippines

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Abstract: Schwarz, U. (2020): *Pseudotaxiphyllum annii* sp. nov., a new species of Plagiotheciaceae from Philippines. *Frahmia* 18:1-8.

During the exploration of the bryoflora of the Philippines one new, propagule bearing species of *Pseudotaxiphyllum* was discovered. The taxon is described and illustrated as *P. annii*. The relation to other propagule bearing taxa of the *P. pohliaecarpum* – complex is discussed. The critical review of recent works on *Psuedotaxiphyllum*, together with the current study led to a species concept based on propagule morphology, recognizing 6 species in East and Southeast Asia.

1. Introduction

More than 20 taxa of *Isopterygium* and *Pseudotaxiphyllum* have been described with propagules that are meanwhile placed as valid species or synonyms under *Pseudotaxiphyllum*. Based on different concepts the number of taxa have been reduced to 5 to 7 species. The most common species is *P. pohliaecarpum* (SULL. & LESQ.) IWATS., widely distributed in East and Southeast Asia. ALFONINA et al. (2019) reported *P. subfalcatum* (AUSTIN) X.Q. LI, Q. ZUO & Y.F. WANG from the far east of Russia. *P. obtusifolium* Z. IWATS. & B.C. TAN, *P. densum* (CARDOT) Z. IWATS. and *P. maebarae* (SAKURAI) Z. IWATS. are reported from China and Japan.

The holarctic *P. elegans* (BRID.) Z. IWATS. and the macaronesian *P. laetevirens* (DIXON & LUSIER EX. F. KOPPE & DÜLL) HEDENÄS do have a somehow disjunct distribution.

LI et al. (2015) didn't find propagules in the probably related species of *P. fauriei* (CARDOT) Z. IWATS. from Japan and *P. distichaceum* (MITT.) Z. IWATS. from the Himalayas. If those 2 species produce propagules has still to be investigated.

The attempt by LI et al. (2015) to clarify the relation of propagule bearing species is unfortunately unsatisfactory as no genetic data of *P. densum*, *P. distichaceum* and *P. fauriei* were available for the phylogenetic analysis. Until further studies are on hand I will follow a more traditional concept manly based on the morphology of propagules.

TAN & IWATSUKI (1991) mention 2 species of *Pseudotaxiphyllum* in Philippines, namely *P. arquifolium* and *P. pohliaecarpum*. *Isopterygium textorii* reported by BARTRAM (1939) was synonymized to *P. pohliaecarpum* by IWATSUKI & DEGUCHI (1981). *P. arquifolium* was transferred to *P. pohliaecarpum* by MÜLLER & WYNNS (2020), which leaves the later one as the only species to be found in Philippines. The newly discovered *P. annii* is now the second *Pseudotaxiphyllum* species in Philippines.

2. Collection Area

Figure 1 Collection Areas in the Philippines 1999 - 2001

During the late 1990s and early 2000s DR. FELIX SCHUMM and the author visited the Philippines several times to explore the bryophyte and lichen flora of the archipelago. Primary target was the study of the flora in mountainous, rather undisturbed areas. One of the locations was Mt. Apo, the highest mountain of the Philippines. It was approached from the west side via Ilomavis, Marbel River and Lake Venado. From there, the Lake Venado trail was followed to reach the top of the mountain.

Mt. Apo is a dormant stratovolcano reaching an elevation of 2,954 meters above sea level. There are signs of volcanic activities along the trail, mostly in form of hot springs. Historical eruptions are not known.

Mt. Apo enjoys a tropical climate with rainfall almost evenly distributed during the whole year. Weather data are only available from distant meteorological stations that just allow calculated temperature data, which reach from 5 degrees during the night up to around 15 degrees during the day. Temperature rarely drops below zero degrees. Precipitation data from the mountain side are not available.

The summit of Mt. Apo consists of basaltic to basaltic-andesitic stone runs intermixed with grassland and small shrubs. Taler vegetation is lacking.

3. *Pseudotaxiphyllum annii* U. Schwarz, sp. nov. – Plate 1-3

Holotype: – PHILIPPINES, Mindanao Island, North Cotabato Province, Summit Region of Mount Apo, on stone, 6° 59' 16.33" N, 125° 16' 11,71" E, 2900 m, 12 August 1999, *U. Schwarz, s.n.* (hb. Schwarz 4850!)

Morphological description – *Plants* medium sized; up to 2 cm long; yellowish-green; glossy; irregularly branched; complanate-foliate; forming dense mats. *Stem* 300 µm in diameter; in cross section without hyalodermis; outer layer consisting of 1-3 rows of substereid cells; inner cells with wider lumen and thinner cell walls; central strand indistinctly developed by a few smaller cells.
Paraphyllia and Pseudoparaphylla absent.
Axillary hairs 130 µm long, with a single, brown basal cell and 1 elongated hyaline distal cell.
Stem leaves ± crowded; wide-spreading; dry hardly shrunken; ovate; dorsal leaves symmetric; lateral leaves curved and asymmetric; 1.9 – 2.3 mm long and 0.8 – 1.0 mm wide. *Costa* short and double, reaching $^1/_4$ of the leaf length; margin entire at the apex serrate; not decurrent. *Apical cells* rhomboid, firm walled, 3 – 4 times a long as wide, 32 – 42 x 10 – 11 µm. *Mid leaf cells* linear, firm walled

slightly prorate, not porose, 13-16 times as long as wide, 90 – 160 x 10 – 11 µm. *Basal cells* shorter, forming a row of short, ovate cells at the leaf insertion, firm walled, porose. *Alar cells* not developed. *Marginal cells* not developed.
Branch leaves similar to stem leaves; 1.7 – 1.8 mm long and 0.7 – 0.8 mm wide; costa and cells like those of the stem leaves.
Propagules in clusters of 7-10 in the leaf-axils at the branch ends; hyalin, cell becoming brownish with age; not twisted or becoming weakly twisted with age; 4 – 7 times as long as wide; 140 – 390 x 40 – 60 µm; .apical with leaf like projections reaching up to $^1/_3$ of the propagule length; Cells thin walled irregular quadrate to rectangular, 10 – 50 x 11- 15 µm.
Sexual organs not observed.

Distribution and ecology. – Only known from the type location. Ecological data were not collected.

Distinguishing characters. – *Pseudotaxiphyllum annii* shows on the one hand side relations to *P. pohliaecarpum* and on the other hand to *P. densum*. From the first it differs mainly in the non-twisted propagules, from the latter in the number of propagules per leaf axil as well as in the size of the mid cells.

	P. pohliaecarpum	*P. annii*	*P. densum*
Propagules per leaf axil	5-20	7-10	1-2
Propagule size	350 – 700 x 25 µm	140 – 390 x 40 – 60 µm	150 – 350 x 25 – 60 µm
Cell arrangement	Strongly twisted	Weakly twisted	Weakly twisted
Propagule color	Green to yellowish green	Hyalin, brownish with age	Green to yellowish green
Cell size of mid leaf	90 – 135 x 8 – 10 µm	90 – 160 x 9 – 11 µm	40 – 50 x 4 – 4.5 µm

Table 1 Comparison of distinguishing features of *P. poliaecarpum*, *P. annii* and P. *densum* (data compiled from own measurements, IWATSUKI & DEGUCHI [1981] and NOGUCHI [1994])

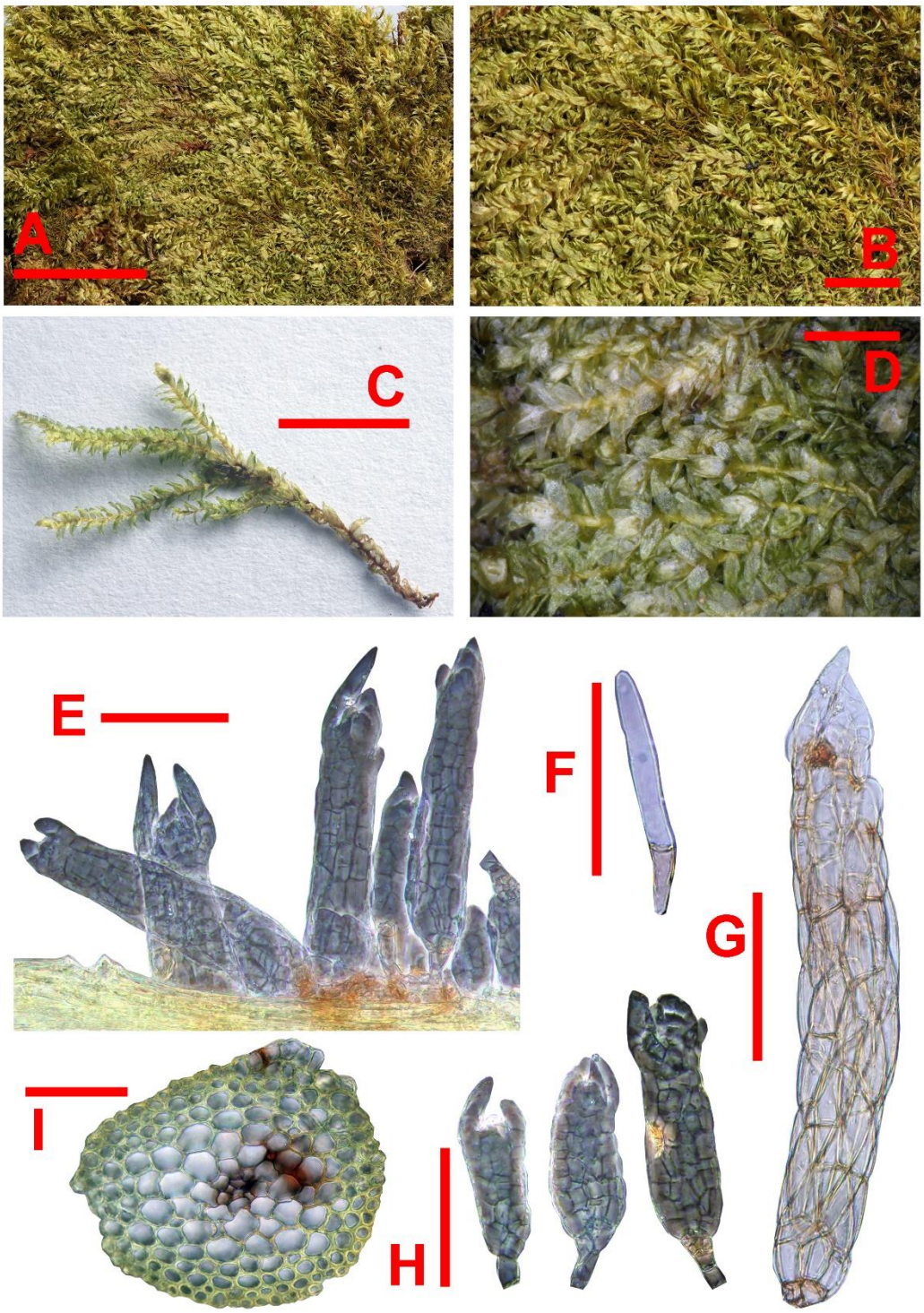
Associated species. – *Pseudotaxiphyllum annii* was intermixed with a sterile *Microdus* species.

Etymology. – Named after ANNI AREND (Rochlitz, Germany) on the occasion of her 80th birthday, who supported the author patiently during decades of his bryological studies.

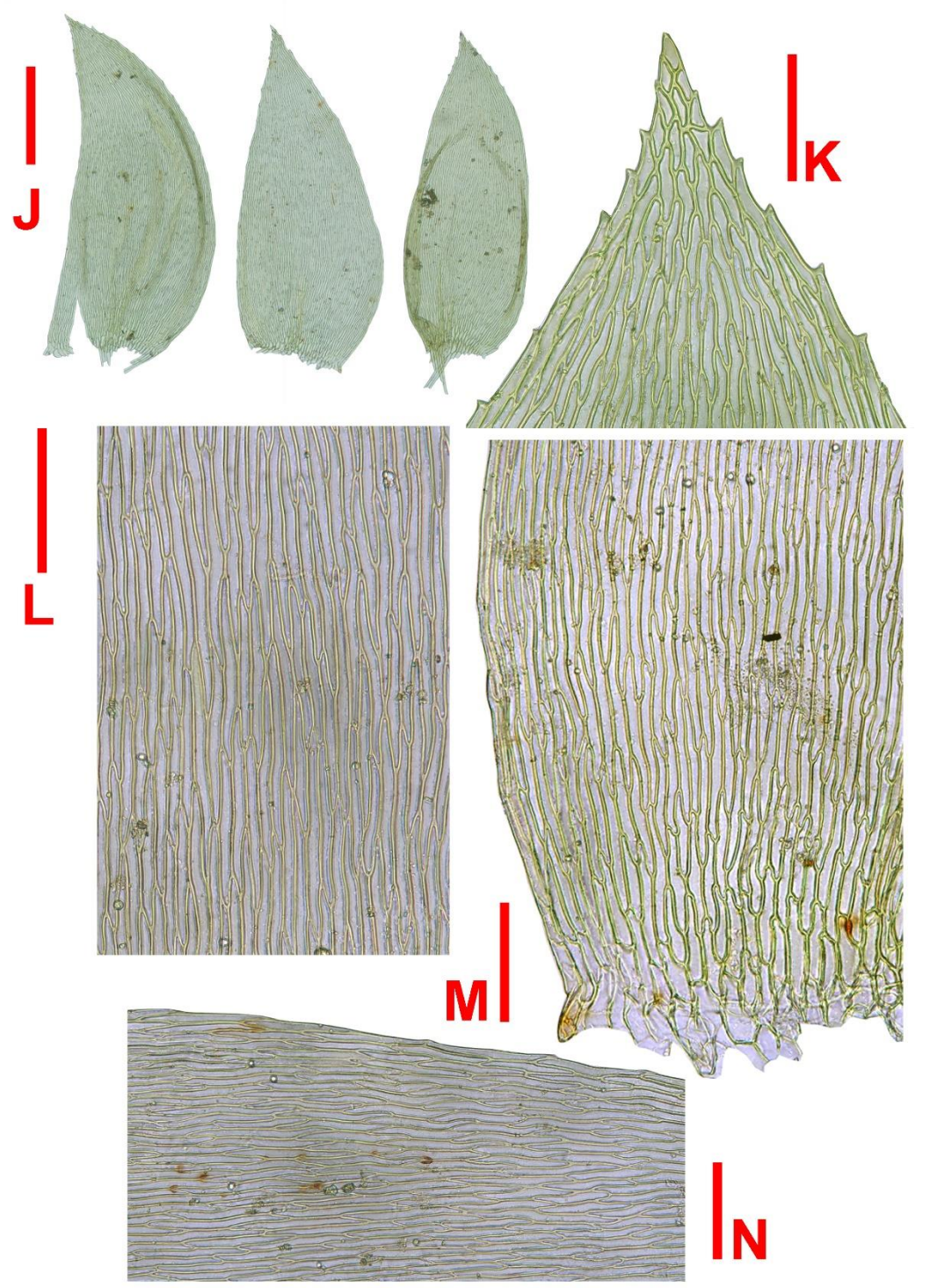
4. Discussion

The definition of species based on the morphology of brood bodies (e.g. propagules, bulbils, rhizoid tubers) is well established or otherwise quite similar taxa (e.g. in *Bryum* and *Pohlia*). The discovery of *P. annii*, as well as the study of *P. pohliaecarpum* and *P. elegans*, indicate that propagule bearing *Pseudotaxiphyllum* species can be separated quite well by the propagule morphology.

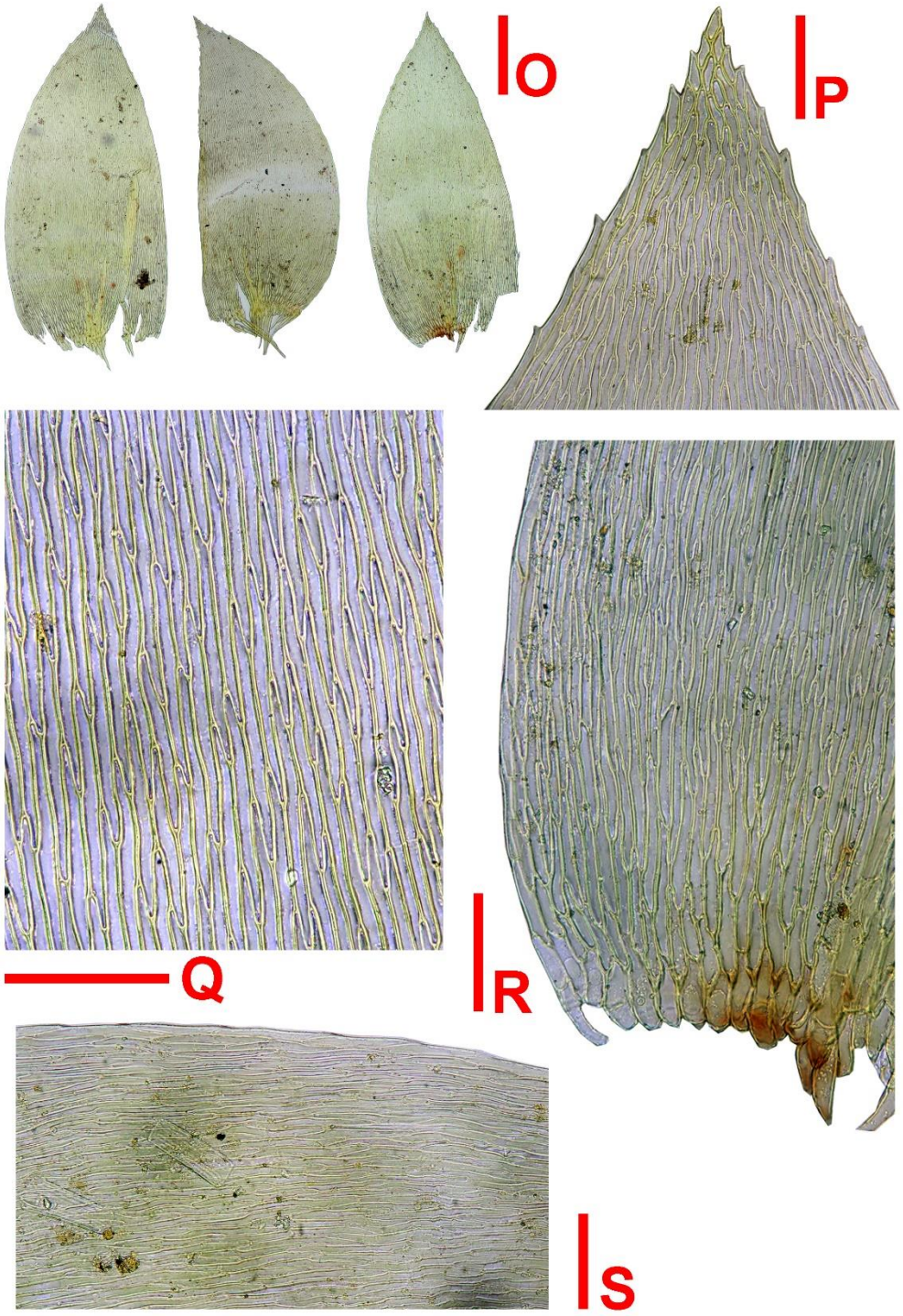
Within the East and Southeast Asian populations 6 groups of propagule bearing species can be identified, namely, *P. annii*, *P. densum*, *P. maebarae*, *P. obtusifolium*, *P. pohliaecarpum* and *P. subfalcatum*. *P. obtusifolium* is well characterized by the obtuse leaves. *P. maebarae* bears ovoid to pyriform propagules with an irregular outline. The remaining 4 species are much closer related.



Plage 1. *Pseudotaxiphyllum annii*. A, B, C, D Plants; E Cluster of Propagules on Stem (Phase contrast); F Axillary hair Hair; G Propagules (Phase contrast), H Propagules; I Stem Cross Section – Scale: A 1cm; B 3 mm; C 5mm; D 2 mm; E, F, G, H, I 100 µm



Plage 2. *Pseudotaxiphyllum annii* – Branch Leaves. J Branch Leaves; K Apical Cells; L Cells Leaf Middle; M Basal Cells; N Marginal Cells at Mid Leaf – Scale: J 0.5 mm; K, L, M, N 100 µm



Plage 3. *Pseudotaxiphyllum annii* – Stem Leaves. O Stem Leaves; P Apical Cells; Q Cells Leaf Middle; R Basal Cells; S Marginal Cells at Mid Leaf – Scale: O 0.5 mm; P, Q, R, S 100 µm

Out of these one group with short (up to 400 µm) and rather wide (up to 60 µm) propagules contain *P. anni* and *P. densum*. *P. subfalcatum* and *P. pohliaecarpum* do have much longer and more twisted propagules. The following key should help to segregate the taxa. Propagules are well illustrated in AFONIA ET AL. (2019), IWATSUKI & DEGUCHI (1981) and IWATSUKI & TAN (2004).

1 Leaves obtuse. Propagules 600 – 750 x 30 – 40 µm ..... *P. obtusifolium*
1* Leaves acute. Propagules 150 – 750 µm long 2
  2 Propagules ovoid to pyriform, irregular in outline ..... *P. maebarae*
  2* Propagules thread-like or cylindric 3
3 Propagules more than 400 µm long, twisted several times 4
3* Propagules less than 400 µm long, hardly or moderately twisted 5
  4 Propagules 2 – 3 cells wide ..... *P. subfalcatum*
  4* Propagules more than 3 cells wide ..... *P. pohliaecarpum*
5 Propagules 1 - 2 per leaf axil, green, mid leaf cells up to 50 µm long ..... *P. densum*
5* Propagules 7 – 10 per leaf axil, hyalin, brown with age, mid leaf cells up to 160 µm long ..... *P. annii*

Until propagule bearing plants of *P. faurii* and *P. distichaceum* (Himalaya plants) have been found their position amongst those species stays unclear.

The discovery of *P. annii* reveals a larger diversity of propagules in the *P. pohliaecarpum* – complex. Further studies on propagule morphology as well as genetic analysis has to be done to come to a better understanding of the group.

5. Acknowledgments

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