Lichen genus Porina in Vietnam

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Abstract: An identification key to twenty-nine species of Porina known from the country is provided. In addition, new records of Porina interstes, P. nuculastrum, and P. rhaphidiophora are described from the protected rain forests in southern Vietnam. A detailed taxonomic account of each species is provided and supported by its ecology, distribution, and illustrations.

Keywords: corticolous; Dong Nai; Nam Cat Tien National Park; Porinaceae; taxonomy

1. Introduction

The cosmopolitan genus, Porina (Porinaceae: Ostropales), with more than 320 species worldwide, is most diverse in rather shaded habitats of tropical and subtropical regions [1–9]. The tropical climate of Vietnam is supported by prolonged humid conditions because of the large coastline surrounded by the South China Sea in the east and the Pacific Ocean in the south. These conditions are favorable to the growth of Porina on a range of substrates in tropical rainforests, seasonal forests, and wet lands in the country. The present study on this genus is a continuation of previous studies [10–15], and was conducted in Nam Cat Tien National Park (Figure 1). The national park includes one of the largest areas of lowland tropical rainforests in southern Vietnam and is comprised mainly of Dipterocarpus alatus, D. intricatus, Dalbergia alata, D. mammosa, Afzelia xylocarpa, Pterocarpus macrocarpus, Lagerstroemia calyculata, Tetrameles nudiflora, Anogeissus acuminata, Bambusa proccera and Gigantochloa sp.

The checklist and preceding works on Vietnamese lichens reflect the great diversity of foliicolous species of Porina in the country (ca. 25 species), while a few were also reported on rock and bark [16,17]. Two species stated in the earlier account have now been accommodated in the genus Strigula as S. phyllogena (Müll. Arg.) R. C. Harris (=Porina phyllogena Müll. Arg.) and S. platypoda (Müll. Arg.) R. C. Harris (=Porina platypoda Müll. Arg.), whereas the previous report of Porina consanguinea Müll. Arg. from the country was uncertain in subsequent studies [16]; hence, it was not included in the current account.

The salient taxonomic features of Porina species are mostly shiny (corticate or ecorticate) thallus in different shades of greenish grey to olivaceous grey, containing algae either Trentepohlia (for bark and rock inhabiting species) or Phycopeltis (for leaf inhabiting species); perithecia present on thallus or immersed in thallus-dominated verrucae [Harada [6] proposed the term ‘prominent thalloid exciple’ replacing the ‘thallus-dominated verrucae’, applied previously to categorize the perithecial morphology by McCarthy [1]]; pale brown to reddish brown or black, vestigial to well-developed involucellum and hyaline, transversely three or more septate to muriform ascospores [1]. The genus is usually devoid of chemical compounds, but some species can give a K+ reddish or yellowish reaction on the thallus or on the fruiting bodies.
2. Materials and Methods

The study is based on collections made by one of the authors (JSH) from the three provinces (Dong Nai, Lam Dong and Binh Phuoc) that circumscribed the national park in December 2015. The field trip was organized by Dr. Nguyen Thi Thanh at Tay Nguyen University, Vietnam. The trip was conducted in the frame of internal joint program between Korea and Vietnam, supported by Korea National Research Foundation. The field studies did not involve any endangered or protected species. The material was preserved in the herbarium of the Korea National Arboretum, Korea (KH). The material was made available for taxonomic treatment in the Lichenology laboratory of CSIR-National Botanical Research Institute, Lucknow, India. The standard protocols were followed for identification. The morphological and anatomical characters were studied using a Leica S8APO stereo-zoom microscope and Leica DM500 compound microscope, respectively. Thin, hand-cut sections (10–15 sections) of perithecia, initially mounted in water, were studied for a range of structures and measurements. Cotton blue, 5% KOH and Lugol’s iodine solution were used wherever required. Thin layer chromatography was performed in solvent system A according to the report by Orange et al. [18]. Illustrations were prepared using Corel Draw (ver. 12).

3. Results and Discussion


Thallus epiperidermal, greenish grey to pale greenish grey, smooth to slightly verruculose, ± glossy, delimited by brownish black prothallus, 50–100 µm thick, ecorticate; algal layer *Trentepohlioid*, 20–50 µm thick, medulla white, crystalline, ≤50 µm thick; ascomata perithecioid, emergent, subglobose, 0.2–0.3 mm in diam.; ostiole pale brown 0.03–0.05 mm in diam.; involucrellum covered completely by a prominent thalloid exciple, brownish; proper exciple hyaline to pale brown, 15–20 µm thick; centrum clear, 0.2–0.4 mm wide; asci 8-spored, 120–150 × 20–25 µm; ascospores hyaline, fusiform, transversely 7-septate, 40–57 × 7–9 µm, perispore lacking.

**Chemistry:** No lichen substances detected by thin layer chromatography.

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*Figure 1.* Map of Vietnam showing the study area (Nam Cat Tien National Park).
**Known distribution:** In Vietnam, this species was found growing on tree twigs and most commonly associated with *P. internigrans* in the wet tropical complex of the national park. Species are also found in New Guinea, Caledonia and South Asia (India) [19].

**Material examined:** Vietnam, Dong Nai Province, Tan Phu district, Nam Cat Tien National Park, 11°26′37″N 107°24′56″E, alt. 148 m on bark, 19 December 2015, Hur & Woo VN150369 (KH).

**Notes:** The Vietnamese specimen closely matches the original description of *Porina interstes*, except that the examined sample has slightly larger ascospores, which were measured to be 34–46 × 4–7 μm in the first description provided by Nylander as *Verrucaria interstes* Nyl. in 1873. Upreti [19] recorded the same species with ascospores measuring 32–48 × 4–7 μm. *Porina internigrans* (Nyl.) Müll. Arg. is comparable but produces 11–14 μm wide ascospores with (7–)9–11(–13)-septation [1].

**Porina meridionalis** P. M. McCarthy, Nova Hedwigia 58: 397. 1994.

**Material examined:** Vietnam, Dong Nai Province, Tan Phu district, Nam Cat Tien National Park, 11°27′27″N 107°22′11″E, alt. 174 m, on bark, 19 February 2015, Hur & Woo VN150389 (KH).

**Notes:** This species is distinct in producing elongate fusiform transversely 11–17(–21)-septate ascospores usually broader towards the distal end. McCarthy [1] reported the species with an inconspicuous ostiolar region, which is slightly conspicuous (0.01–0.03 mm in diam.) in this specimen. Although such minor variations may be acceptable within the broad concept of species delimitation, more collection is needed to observe the actual variations between the Vietnamese sample and the only report of this species from Tasmania. The Vietnamese sample is close to *Porina rhaphidiophora* (Nyl.) Müll. Arg., which differs mainly in the size of the perithecia and ascospores [1].


**Material examined:** Vietnam, Dong Nai Province, Tan Phu district, Nam Cat Tien National Park, 11°26′35″N 107°24′19″E, alt. 150 m on bark, 18 December 2015, Hur & Woo VN150198 (KH).

**Notes:** This species was found growing in small and irregular patches on rough barked trees of the protected rainforests in Vietnam. The species has a common occurrence on tree bark as well as on rocks. Worldwide, it is distributed in the Neotropics, Madagascar, the Philippines, Hong Kong and neighboring countries [1].

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with an inconspicuous ostiolar region. In contrast to the Australian specimens with an inconspicuous ostiole, the Vietnamese sample contains perithecia with a rather conspicuous ostiolar region. The ostiole conspicuity in the present sample may be the result of over maturity because only a single specimen from Vietnam was observed.

Figure 2. New records from Vietnam. A–C. *Porina interstes*. A. habitus; B & C. ascospores; D & E. *P. meridionalis*; D. habitus; E. asci and ascospores; F & G. *P. nuculastrum*. F. habitus; G. ascospores. Scale bars: A, D, F = 1 mm; B, C, E, G = 50 µm.

**Key to Porina species recorded from Vietnam**

The taxonomic key characters of twenty-nine species are discussed. The previously known taxa were characterized following the descriptions provided by Upreti [19], Lücking & Věžda [22], McCarthy [1] and Harada [6], and presented below with some modifications.

1. Thallus foliicolous; algae *Trentepohlia* or *Phycopeltis* ................................................................. 2
   -Thallus corticolous or saxicolous; algae *Trentepohlia* ................................................................. 23
2. Algae *Trentepohlia*; prothallus broad bluish black to grey black .................................................... 3
   -Algae *Phycopeltis*; prothallus if present translucent or whitish; thallus fertile .............................. 4
3. Thallus sterile, isidiate; isidia abundant, cylindrical to coralloid .......................... **Porina distans**

- Thallus fertile; perithecia applanate, large, 0.6–1 mm in diam.; ascospores broadly fusiform, transversely 7–9-septate, 38–64 × 6.5–10 µm .................................................. **Porina mirabilis**

4. Perithecia immersed in thallus-dominated verrucae (thalloid exciple), mainly pale grey green, pale yellowish green or pale greyish brown ................................................................. 5

- Perithecia ± superficial, yellowish white, in shades of brown or black, not immersed in thallus dominated verrucae (thalloid exciple) ................................................................. 11

5. Ascospores 3-septate, 12–18 × 2–3.5 µm; perithecia 0.15–0.2 mm in diam. ............... **Porina albicera**

- Ascospores 7- or more septate ................................................................. 6

6. Thallus and perithelia furnished with dense cushions of soft hairs; perithecia convex to hemispherical; ascospores 7–15-septate, 45–74 × 4–7 µm ............................... **Porina virescens**

- Thallus and perithelia glabrous; perithecia variously shaped; ascospores exclusively 7-septate (with a few exceptions), mostly less than 50 µm long ........................................ 7

7. Perithecia subconical to conical; apex with a short flat-topped cylindrical extension; ascospores 28–46 × 3–5 µm ................................................................. **Porina conica**

- Perithecia lens-shaped, hemispherical, or wart-shaped; if conical then apex lacking short flat-topped extension .......... 8

8. Perithecia applanately lens-shaped; thallus with whitish short-stalked deeply concave disciform isidia, 0.1(–0.15) mm in diam.; ascospores (35–)40–45 × 3–4.5 µm .................. **Porina epiphylla**

- Perithecia lens-shaped to hemispherical; thallus lacking isidia ............................................. 9

9. Perithecia lens-shaped, 0.2–0.35(–0.4) mm in diam., with a blackish apical spot or a brownish apical cap; ascospores 20–35 × 3–5 µm ................................................................. **Porina octomera**

- Perithecia hemispherical, concolorous or pale reddish brown at apices .................................. 10

10. Perithecia 0.2–0.3 mm in diam.; phycobiont cell rectangular, arranged in radiating rows; ascospores 21–27 × 3 µm ................................................................. **Porina epiphylloides**

- Perithecia 0.25–0.4(–0.5) mm in diam.; phycobiont cells round to angular, irregularly arranged; ascospores 25–35 × 3–4.5 µm ................................................................. **Porina epiphylla**

11. Perithecia very small, 0.08–0.1 mm in diam., yellowish white; ascospores bacillar, 1-septate, 10–12 × 2–2.2 µm ................................................................. **Porina diaphana**

- Perithecia comparatively larger ................................................................. 12

12. Perithecia in shades of brown; involucrellum often containing algae ............................. 13

- Perithecia ± black; involucrellum not or rarely containing algae ................................. 16

13. Perithecia finely and sparsely furnished with cushions of soft hairs, 0.2–0.26 mm; ascospores 7-septate, 25–33 × 3–5 µm ................................................................. **Porina semecarpi**

- Perithecia not pilose; ascospores 3-septate .................................................. 14

14. Perithecia subglobose, 0.17–0.26 mm in diam., constricted at the base; sides often with a slightly rough covering of thallus material; ascospores 17–26 × 3–6 µm .................................. **Porina rubulata**

- Perithecia 0.2–0.4 mm in diam.; ascospores 18–28 × 2.5–4.5 µm .............................. **Porina limbulata**

- Perithecia 0.13–0.21 mm in diam.; ascospores 13–21 × 2–3 µm .............................. **Porina rubulata**

15. Perithecia 0.13–0.21 mm in diam.; ascospores 18–28 × 2.5–4.5 µm .............................. **Porina rubulata**

- Perithecia 0.2–0.4 mm in diam.; ascospores 18–28 × 2.5–4.5 µm .............................. **Porina rubulata**

16. Ascospores muriform, 85–110 × 17–22 µm; perithecia 0.35–0.50 mm in diam. ... **Porina foliculosa**

- Ascospores transversely 3- or more septate .................................................. 17

17. Ascospores 3-septate, 15–24 × 3–4.5 µm; perithecia appplanate towards the margins, but usually with a conical to hemispherical centre, 0.2–0.41 mm in diam. .......................... **Porina chrysophora**
- Ascospores more than 3-septate ........................................... 18
18. Perithecia convex to hemispherical; base usually spreading ........................................ 19
- Perithecia subglobose to globose and attenuated at the base ........................................ 22
19. Perithecia overgrown almost to the apex by a thin layer of thallus; ascospores 5(–7)-septate, 20–32 × 4–5 µm ................................................................. Porina corruscans
- Perithecia not overgrown by the thallus; ascospores 5- or more septate .......................... 20
20. Ascospores 5-septate, 15–30 × 5–7 µm .................................. Porina subnitidula
- Ascospores (5-)7-septate .......................................................... 21
21. Ascospores (5-)7-septate, 20–23 × 3–4 µm ........................ Porina cupreola
- Ascospores 7-septate, 20–35 × 3–5 µm ................................ Porina karntakensis
22. Perithecia 0.14–0.25 mm in diam.; sometimes greyish tomentose, ascospores 5-septate, 20–32 × 3.5–6 µm ................................................................. Porina nitidula
- Perithecia 0.16–0.31 mm in diam.; ascospores mostly 7-septate, 22–42 × 3.5–7 µm 23. Thallus saxicolous; perithecia hemispherical to subglobose, black, 0.23–0.48 mm in diam.; involucrellum uniformly black lacking algal cells; ascospores (3–)5–7(–9)-septate, 22–49 × 3.5–6.5 µm ........................................... Porina guentheri
- Thallus corticolous .......................................................................................... 24
24. Ascospores muriform, 50–76 × 12–20 µm; perithecia convex to subglobose, brown to dark brown, 0.3–0.5 mm in diam. ................................................................. Porina nuculastrum
- Ascospores transversely septate ............................................................................ 25
25. Ascospores elongate fusiform to subacicular, 10–14-septate, 25–52 × 5–84 µm; perithecia hemispherical to subglobose, 0.1–0.3 mm in diam. ................................ Porina meridionalis
- Ascospores fusiform ............................................................................................ 26
- Ascospores consistently 7-septate ........................................................................ 27
27. Perithecia subglobose, 0.2–0.3 mm in diam.; ascospores 40–57 × 7–9 µm .......... Porina intereses
- Perithecia convex to hemispherical, ≥0.3 mm in diam. .................................................. 28
28. Perithecia 0.3–0.6 mm in diam.; ascospores 34–42 × 4–7 µm ........................ Porina tetracerae
- Perithecia 0.3–0.9 mm in diam.; ascospores 20–23 × 3–4 µm ........................ Porina mastoidea

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