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The Recent Collection of *Climacodon roseomaculatus* (*Hydnum roseomaculatum* Henn. & E. Nyman) from The Type Locality (Indonesia)

Ivan Permana Putra[1,*], Oktan Dwi Nurhayat[2]
[1]Department of Biology, Faculty of Mathematics and Natural Sciences, IPB University, Darmaga Campus, Bogor 16680, Indonesia.
[2]Research Center for Applied Microbiology, National Research and Innovation Agency (BRIN), Bogor, West Java, 16914, Indonesia.

Corresponding author*
ivanpermanaputra@apps.ipb.ac.id

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Abstract

Climacodon roseomaculatus is a fleshy species of Polyporales with a hydnoid hymenophore. The species's distribution in Indonesia was reported six times from 1923 to 1961 from West Java and East Java collection. To date, there have been no following updates on the collection and occurrence status of *C. roseomaculatus* in Indonesia. During a fungus foray in 2023, some red to pink basidiomata of *Climacodon* were spotted in Semarang, Central Java, Indonesia. The current study aimed to determine the taxonomical position of *Climacodon* BO24632 based on morphological evidence. Fresh materials were used for the investigation of macro- and micromorphological characters. The result showed that *Climacodon* BO24632 was identified as *C. roseomaculatus* based on distinctive features of stipe and gleocystidia. *Climacodon roseomaculatus* BO24632 is closely related to *C. sanguineus* with blood-red to pink basidiomata, cylindrical spines of hymenophores, and ellipsoid basidiospores. However, the former species lacks a well-developed stipe and has thin to thick-walled gloeocystidia. This study is the first report on the distribution of *C. roseomaculatus* from Central Java, Indonesia. In addition, the current work is the latest information and herbarium collection of *C. roseomaculatus* after more than fifty years of hiatus in Indonesia. We expect that the same species also occur in many different locations in Indonesia; thus need a warrant of collections.

Keywords: Macrofungi; Morphology; Polyporales; Rediscovery; Central Java.

INTRODUCTION

The genus *Climacodon* was proposed by Karsten (1881) based on the type species of *Hydnum septentrionale* (Gorjón 2020). This genus is acknowledged both as the hydnaceous fungi (Maas Geesteranus 1971; Moreno et. al. 2007; 2017) and corticoid fungi (Gorjón 2020). *Climacodon* is recognized by simple pileate basidiomata white, pink, or blood red when fresh, with a hydnoid hymenophore covered with spines on the underside of the pileus, lignicolous, with or without stipe (sessile, sometimes with effused base) (Maas Geesteranus 1971). *Climacodon* has monomitic system of hyphae, cystidia encrusted-thick walled, clamp connections simple, and only the older portions of the pileus (Maas Geesteranus 1971). In addition, Maas Geesteranus (1971) described that *Climacodon* poses 4-spored calavate basidia, no ornamentation, colorless, ellipsoid basidiospores. Morphologically, to some extent, the genus *Climacodon* is identical to *Hericium*, but the latter displays amyloid basidiospores and is phylogenetically nested in the Russulales (Larsson 2007).

Currently, *Climacodon* is placed in Meruliaceae, Polyporales, and Agaricomycetes (Kirk et al. 2008; Index Fungorum 2024). A previous study (Binder et al. 2005; 2013) revealed that *Climacodon* was placed in the Phlebioid clade. Based on Index Fungorum (2024) there are eleven species of *Climacodon*, namely *C. septentrionalis* (Fr.) P. Karst., *C. annamensis* (Har. & Pat.), *C. chlamydocystis* (Maas Geest.), *C. dubitativus* (Lloyd) Ryvarden., *C. efflorescens* (Maas Geest.), *C. javanicus* (Pat.) Decock & Ryvarden., *C. ochraceus* (Pers. ex J.F. Gmel.) P. Karst., *C. pudorinus* (Fr.) P. Karst., *C.pulcherrimus* (Berk. & M.A. Curtis) Nikol., *C. sanguineus* (Beeli) Maas Geest., and *C. roseomaculatus* (Henn. & E. Nyman) Jülich. Of those, *C. roseomaculatus* is the only species noted without stipe and has a bright rose-pink color. This species is identical to *C. sanguineus* on the basis of the morphological features. However, *C. sanguineus* produce the prominent stipe which absent in *C. roseomaculatus* (Maas Geesteranus 1971; Moreno et al. 2017).

Climacodon roseomaculatus was originally described as *Hydnum roseomaculatum* from the type locality, West

Java Indonesia (Maas Geesteranus 1971). This species is known to be distributed in the high latitude of tropical areas and has recently been reported as a newly recorded species to China (Hai-Sheng and Wen-Juan 2016). From 1923 to 1961, there were six herbarium collections of *C. roseomaculatus* in Indonesia. Hitherto, there has been no following report of this species in Indonesia. Therefore, the attempt to investigate the distribution of this species in another location on Java Island was made in Central Java, Indonesia. Some hydnoid basidiomata that grew on the dead tree branch were collected. At a glance, the specimen was initially suspected as *Climacodon* cf. *roseomaculatus*. This study aimed to justify the taxonomical position of the specimen based on macro- and micromorphological evidence and contribute to recollection of the certain species from type locality (Indonesia).

MATERIALS AND METHODS

Specimens Collection.

The specimens were collected in February 2023 in Indonesia, Central Java, Semarang, Perantunan 7°11'40.6"S 110°21'21.2"E (Figure 1). The basidiomata were photographed *in situ* and the laboratory. The habitat, growth pattern, and surrounding vegetation were noted. The Following observation was done in laboratory of Mycology, Department of Biology, Faculty of Mathematics and Natural Sciences, IPB University, Indonesia. The fruiting bodies were deposited at the Herbarium Bogoriense Indonesia with the collection number BO24632.

Figure 1. Sampling site of *Climacodon roseomaculatus* BO24632 (red spot). Photo modified from google earth.

Morphological Identification

Macroscopic features investigation including basidiomata texture, context, cap attributes (shape, color, ornamentation on surface, wetness, margin), and hymenophore characters (type, color, ornamentation) (Putra 2021). Microscopic observation was performed using a digital bright field microscope Olympus BX-63, Japan. The microscopic examination includes the hyphal system, clamp connection, pileipelis, context (trama), and spines (basidia, basidiospores, and cystidia). The specimens were identified using some related references, including Maas Geesteranus (1971), Moreno et al. (2017), and Gorjón (2020).

RESULTS AND DISCUSSION

Taxonomy

Climacodon roseomaculatus (Henn. & E. Nyman) Jülich [as 'roseomaculatum'], Biblthca Mycol. 85: 400 (1982) [1981]

Basionym:
Hydnum roseomaculatum Henn. & E. Nyman [as '*roseo-maculatum*'], in Hennings in Warburg 1899 *Climacodon javanicus* (Pat.) Decock & Ryvarden [as '*javanicum*'] 2021

Basidiomata fleshy, sessile (Fig.1A), pileate, solitary, gregarious (1-2 fruiting bodies). Pileus expanding up to 6 cm in length, 4 cm wide, flabelliform with a narrowed thick base, smooth to velutinate, bright red with white veins near the margin, forming the darker and lighter areas (Fig. 1B). Margin entire, concolorous to paler than center part. Hymenophore hydnoid (Fig. 1C), spines (Fig. 1D) not fused, cylindrical, flattened, sometimes branched at the terminal, pink, white apices, smooth, unequal up to 1 cm length, mediumly crowded. Context (Fig. 1D) 3-5 mm thick, homogeneous, concolorous, or paler than spines. Stipe absent. Hyphal system monomitic, consisting of generative and tendril hyphae. Pileipellis trama with dense hyphal knots (fig. 2A) to develop the interwoven tendril hyphae, oleiferous hyphae abundant (Fig. 2B) 1.8-2.9 µm diam, generative hyphae with prominent clamp connection, 5-8 µm diam close to margin (Fig. 2C), unbranched, thin walled, dense cytoplasm, up to 2-2.5 µm diam far-off margin (Fig. 2D), with clamp connection and simple septa, opaque cytoplasm, regularly arranged. Hyphae in the lower part of the context are monomitic, and more loosely arranged. Hyphal context of the spines monomitic, hyaline, septate, branched, 2.2-6.4 µm wide, rather thick-walled in the axis (Fig. 3A), thin-walled near the opposite (Fig.3B), without no clamped hyphae, with oily cytoplasm especially near tips (Fig. 3C), hyphal knots and incipient basidium (Fig. 3D) evident. Basidia (Fig. 4A) clavate, 7-13 × 3.5-5.3 µm, without basal clamp, 4-spored, sterigmata 2.8-3.5 µm in length. Basidiospores 3.3-5.8 × 1.6-2.4 µm, ellipsoid, smooth, hyaline, 1-2 lipid bodies. Gloeocystidia originated from trama, sparse, 40-50 × 4.8-6 µm, subcylindric to clavate, smooth without crystals, sparse, thick-walled, with widely rounded apex. Specimen examined: Indonesia, Central Java, Semarang, Perantunan, S7º12'19.301", E110º21' 13.099", 1700 m

a.s.l, February 2023, collected by Purwadi and ODN, BO24632.

The knowledge of the genus *Climacodon* in Indonesia is poor. In the last decades, reports from Meiliawati and Kuswytasari (2013) claimed to obtain *Climacodon* from Wonorejo (Central Java) however with insufficient data and used it as decoloration agent (Muslimah and Kuswytasari 2013). *Climacodon roseomaculatus* is a member of Hydnaceus fungi poses the hydnoid type of hymenophores and is considered as corticioid macrofungi (Maas Geesteranus 1971; Gorjón 2020). The only published taxonomical works of *C. roseomaculatus* in Indonesia was provided by Maas Geesteranus (1971) from the book of hydnaceous fungi of the Eastern Old World. To date, *C. roseomaculatus* is only to be reported known from Borneo and Java (Indonesia, type locality) (Maas-Geesteranus 1971) and China (Hai-Sheng and Wen-Juan 2016) but without the documentation of basidiomata *in situ*. *Climacodon roseomaculatus* is easily recognized by the bright red color of hydnoid basidiomata. Based on the macroscopic features, *C. roseomaculatus* BO24632 is closely related to *C. sanguineus* in having a bright red to pink fruiting body. These two species are the only species with red color in *Climacodon.* However, the former species lacks stipe and produces prominent thick-walled cystidia (Maas Geesteranus 1971) or known as gleocyctidia as the distinct characters. Moreno et al. (2017) suggest that *C. roseomaculatus* and *C. sanguineus* are close but proved to be a distinct species.

Despite the lack of its stipe, *C. roseomaculatus* reported from type locallity once observed to have a tiny stipe (Maas Geesteranus 1971). However, in line with Hai-Sheng and Wen-Juan (2016), the stipe of our specimen was absent. The spine length was the same as a previous report by Maas Geesteranus (1971) but shorter than *C. roseomaculatus* reported from China (Hai-Sheng and Wen-Juan 2016). Microscopycally, the morphological features of our specimen were more or less the same compared to the prior reports of *C. roseomaculatus.* However, the striking difference is the occurrence of dense hyphal knots on the upper surface of the pileus which only appeared in the lower part of the context of the previous report from West Java (Maas Geesteranus 1971). In contrast, Hai-Sheng and Wen-Juan (2016) did not describe any hyphal knots from their specimen, but they reported the occurrence of the crystals that encrusted the gleocystidia which is absent in the current report and the report of Maas Geesteranus (1971). In addition, in line with aas Geesteranus (1971), we described the oleiferous hyphae of *C. roseomaculatus* which was not investigated by Hai-Sheng and Wen-Juan (2016) from their collection. The difference might be related to the morphological plasticity of *C. roseomaculatus* which remains obscure.

Recently, Index Fungorum (2024) accepted *Climacodon javanicus* (Pat.) Decock & Ryvarden as the current name of *C. roseomaculatus*. *Climacodon roseomaculatus* was previously described as *Hydnum roseomaculatum* from Java, Bogor Botanical Garden, Indonesia in 1899 (Maas Geesteranus 1971). The subsequent collection from type locality was done in November 1923 (West Java, Tjibodas, M. L. A. Bruggeman BO 5570), in March 1936 (Jungle Trail between Tjibodas and Tjibereum waterfall, 2409L), in April 1936 (Jungle Trail between Tjibodas and Tjibereum waterfall), in September 1938 (Tjisarua, BO 16455), in 1955 (Mt. Pangrango, 12698 BO), in 1938 (Kediri, West Java, Mt. Wilis, Herb. Donk), and in December 1961 (Jungle Trail between Tjibodas and Tjibereum waterfall). Since then, our work is the only report and or collection of this species from Indonesia. This study revealed evidence of extension on the geographical distribution of *C. roseomaculatus*, more than 300 km away from West Java, located in Central Java, Indonesia. The basidiomata were found in the highland area in this study. Hai-Sheng and Wen-Juan (2016) suggest that this species has a distribution in the high latitude of tropical areas.

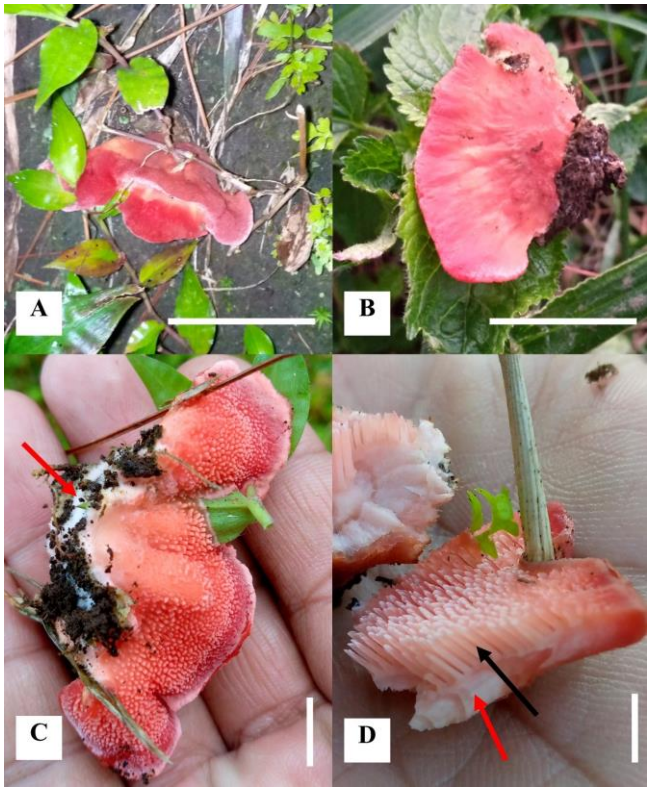

Figure 2. *Climacodon roseomaculatus* BO24632 *in situ*. A-B. Sessile basidioma grow on mixed soil and wood. C. Hynoid hymenophore. D. Details of spines (black arrow) of hymenophore and context (red arrow). Bars: A=5 cm, B= 5cm, C-D=1 cm.

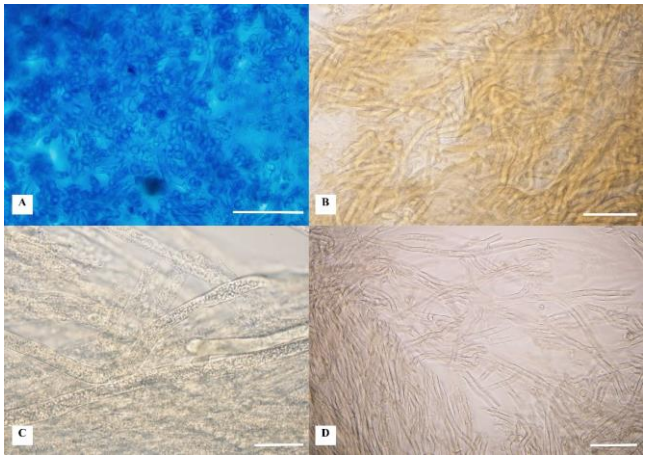

Figure 3. Pileipellis of *Climacodon roseomaculatus* BO24632. A. Prominent hyphal knots on the pileipellis, stained with lactophenol cotton blue. B. Abundance of oleiferous hyphae on the pileipellis. C. Generative hyphae adjacent to the margin. D. Generative hyphae distant from the margin. Bars: A, B, D= 50 µm, C= 20 µm.

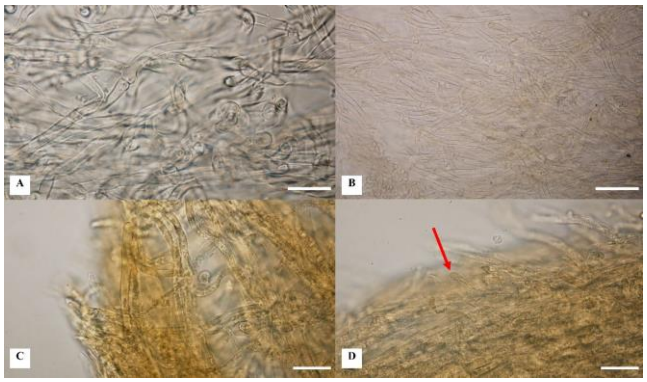

Figure 4. Spines of *Climacodon roseomaculatus* BO24632. A. Generative hyphae in spine axis. B. Generative hyphae adjacent to subhymenium. C. Oil hyphae on the tip of the spine. D. Incipient basidium (red arrow) on spine. Bars: A,C,D=20 µm, B= 50 µm.

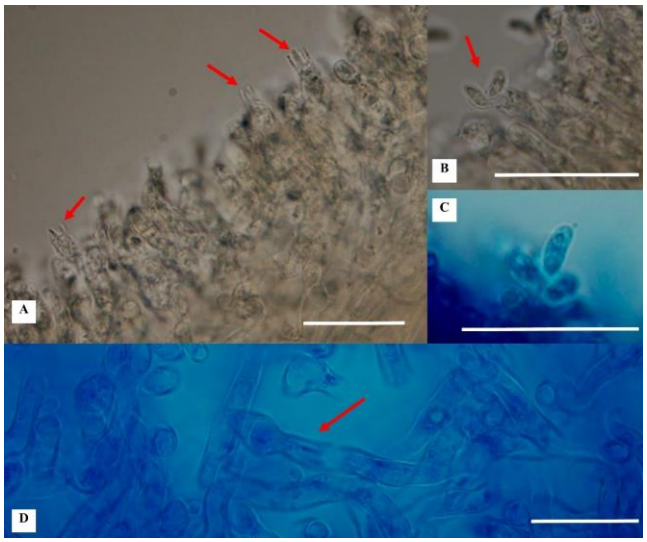

Figure 5. Hymenium of *Climacodon roseomaculatus* BO24632. A. Basidia with four sterigmata (arrows). B. Elipsoid basidiospore (arrow). C. Basidiospore stained with lactophenol cotton blue. D. Thick walled gleocystidia (arrow). Bars: 20 µm.

CONCLUSIONS

In conclusion, *Climacodon roseomaculatus* has been rediscovered in Central Java, Indonesia after more than fifty years of absence in the country. This study provides important information for the distribution and occurrence status of this species in Indonesia. Further research and collection efforts are needed to understand the full extent of the distribution of *C. roseomaculatus* in the country. Re-discoveries of such species highlight the importance of ongoing monitoring and documentation of fungal diversity to better understand and conserve the Indonesian germplasm.

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Authors' Contributions: IPP designed the study. IPP and ODN performed macroscopic and microscopic analyses. ODN provides the specimen description. IPP performed morphological identification. IPP and ODN wrote the manuscript. All authors read and approved the final version of the manuscript.

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