

# Rediscovery of the Sculptured Toadstool, *Amanita sculpta* (Amanitaceae) in Singapore

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**ABSTRACT.** *Amanita sculpta* Corner & Bas was first collected from Bukit Timah Nature Reserve, Singapore, in 1939 and 1940 and then described as new in 1962. Since then, there have been no sightings or collections of this fungus in Singapore until recently when it was observed and recollected at Bukit Timah Nature Reserve after a hiatus of more than 80 years.

**Keywords.** Bukit Timah Nature Reserve, fungal biodiversity

## Introduction

Over a period of about 15 years between 1929 and 1945, E.J.H. Corner made extensive collections and observations of the macrofungi in the rain forests of the Singapore Botanic Gardens (SBG), MacRitchie Reservoir, Bukit Timah Nature Reserve (BTNR), Thomson and Mandai, all in Singapore, and to a lesser extent elsewhere in Peninsular Malaysia (e.g., Gunung Pantii and Cameron Highlands). The genus *Amanita* Pers. has the largest representatives of the macrofungi in the Southeast Asian tropical rain forests and specimens are well-represented in Corner's collections. These collections formed the basis of a monograph on the genus *Amanita* in Singapore and Malaya (Corner & Bas, 1962). This seminal work included description of 29 species, of which 22 species were described as new to science. More significantly, 27 species described in the monograph were mainly based on collections from the SBG rain forest, MacRitchie, BTNR and other parts of Singapore, including 23 species of which the type specimens are from one of these localities.

## Taxonomy

*Amanita sculpta* Corner & Bas, *Persoonia* 2(3): 255 (1962); Bas, *Persoonia* 5: 483 (1969); Yang, *Biblioth. Mycol.* 170: 147 (1997); Cui et al., *Fung. Diversity* 91: 172 (2018). – TYPE: Singapore, Bukit Timah, 9 July 1940, *Corner s.n.* (holotype L [L0053718]). (Fig. 1–3).

**Pileus** convex, sometimes with depressed centre, then plane, not striate at margin, 10–27 cm wide, with a margin that slightly exceeds the gills. **Gills** free, crowded,



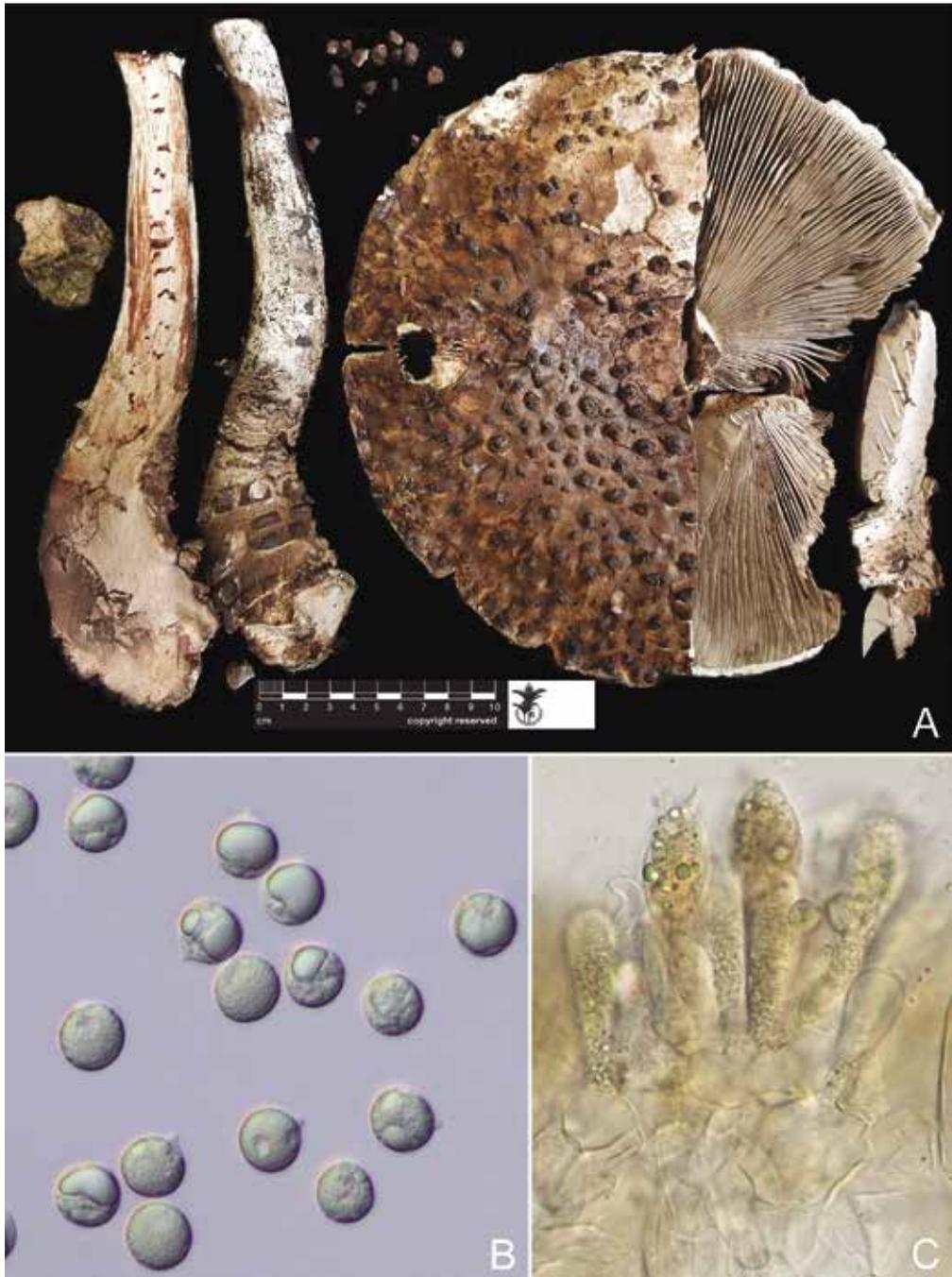
**Fig. 1.** Fruiting body of *Amanita sculpta* showing the underside of the pileus revealing the gills. Inset: Close up of warts on its bulbous base. (Photos: K.B.H. Er; inset: S.M.L. Lee).



**Fig. 2.** The size of *Amanita sculpta* in comparison to an adult hand, with loose prominent warts on the pileus. Inset: Close up of the pileal warts. (Photos: W.F. Ang; inset: K.B.H. Er).

140–200 primaries, broad, 0.7–1.6 cm wide, thick, white to pale cream, often edged with pale reddish-brown powdery remnants of partial veil. **Remnants of volva on pileus** large, thick, pyramidal to angular, dark brown, 0.3–1.6 cm high, with warts that are 0.2–1.5 cm wide that come off easily. **Stipe** 12–26 cm in height, 1.2–4 cm wide at the apex, 2–6.5 cm wide at the base, more or less thickened downward, with napiform or fusiform bulbous base, stout, solid, fibrous, covered with floccose squamules toward base, below these with firm squarish brown warts (c.  $1.2 \times 0.4$  cm). **Pileus context** when cut oxidises from cream to reddish brown towards margin and a dull reddish brown towards the stipe. **Annulus** a faint dull purple hue, fragile, flat against the stipe. **Basidia** clavate,  $45\text{--}50 \times 12\text{--}13$   $\mu\text{m}$ , 4-spored sterigmata; fresh basidiospores  $8.9\text{--}10.2 \times 8.1\text{--}9.5$   $\mu\text{m}$ ,  $Q = 1.01\text{--}1.11$ , globose to subglobose, with an amyloid reaction in Melzer's reagent. **Marginal cells** numerous along edges of gills,  $18\text{--}40 \times 16\text{--}30$   $\mu\text{m}$ , globose to ellipsoid, terminal on  $1.5\text{--}3(6)$   $\mu\text{m}$  wide hyphae. **Pleuro and cheilo cystidia and clamps** absent. **Remnants of volva on pileus** made up of ellipsoid to globose, mostly terminal cells up to  $80 \times 70$   $\mu\text{m}$  long and  $5\text{--}8$   $\mu\text{m}$  wide hyphae or thin branching elements  $1.5\text{--}2$   $\mu\text{m}$  wide.

**Distribution and habitat.** This species has been found throughout the region from Singapore, Peninsular Malaysia, Borneo, Laos and Japan to as far north as the southwestern subtropical forest zones of China. *Amanita sculpta* Corner & Bas was first collected by Corner on 15 October 1939 (in bud stage) and thereafter observed on



**Fig. 3.** A. Specimen dissection and processing prior to drying. B. Globose spores of *Amanita sculpta* (in water). C. Basidia of *Amanita sculpta* (in water). (Photos: S.M.L. Lee).

several other occasions by him in September 1940 at the same spot in BTNR. Corner noted that he had not seen it elsewhere in Singapore and Malaya (Corner & Bas, 1962). It has since been recorded from Peninsular Malaysia (Watling & Lee, 1995; Turnbull & Watling, 1999; Lee et al., 2012; collection *Lee FRI 72557*, 9 Dec 2011, Pahang, KEP), Brunei (collection *Corner s.n.*, 15 Feb 1959, E), Sabah (Kota Kinabalu: Bas, 1969; Crocker Range Park: collection *Jaya Seelan BORH0072*, 12 May 2008, BORH; Mt Kinabalu: collection *Jaya Seelan BORH0212*, 22 Oct 2009, BORH), Kalimantan (collection *Corner RSNB 581*, 13 Jun 1961, E), northern Thailand (Sanmee et al., 2008), Laos & Japan (GBIF Secretariat, 2019), and China (Yang, 1997, 2015; Yang & Li, 2005; Cui et al., 2018). A check with the curators of the regional herbaria BO, BRUN, SAN and SAR yielded no further records of the species. Since 1939, when it was collected by Corner in BTNR, however, it has not been sighted or collected in Singapore. It is also to be noted that the few published records of *Amanita sculpta* in Peninsular Malaysia are all based on an observation and illustration by S.-S. Lee (S-S.627) (Watling & Lee, 1995; Turnbull & Watling, 1999; Lee et al., 2012), although there is the additional collection cited above.

*Specimen examined.* SINGAPORE: Bukit Timah Nature Reserve, 30 Aug 2020, *Loo et al. SL1560* (SING [SING0212684]).

*Notes.* On 27 August 2020, the bud of an agaric from BTNR was posted on Facebook. This was noted by Dr Amy Choong (National University of Singapore), who forwarded it to the senior author (SL). The agaric fungus was later spotted by the co-authors (AL, AWF and KE) at BTNR on 30 August 2020, at the base of a *Shorea leprosula* Miq., along the main road to the summit (before Keruing Hut) (Fig. 4). *Amanita sculpta* is relatively easy to identify as none can match its size nor stature. Approaching it in size are perhaps only a few individuals of *Amanita similis* Boedijn and *Amanita princeps* Corner & Bas (Lee, 2019), but these species are 'dainty' compared to *Amanita sculpta*. *Amanita perpastata* Corner & Bas is also robust, but fair in colour compared to the chestnut brown of *Amanita sculpta*.

Corner & Bas (1962) did not record the association of *Amanita sculpta* to any species of plants in Bukit Timah when first described. It has now been observed to be growing near *Shorea leprosula* by the authors, as well as with *Neobalanocarpus heimii* (King) P.S.Ashton in the grounds of the Forest Research Institute of Malaysia (Watling & Lee, 1995). This is the first observation of *Amanita sculpta* growing near *Shorea leprosula*, although dipterocarps are known to have ectomycorrhizal associations with many genera of fungi, including other species of *Amanita* (Lee & Alexander, 1996; Lee et al., 1997). *Amanita sculpta* has also been recorded in forests dominated by Fagaceae in northern Thailand (Sanmee et al., 2008) and in southern and southwestern China (Yang, 1997, 2015; Yang & Li, 2005; Sanmee et al., 2008; Cui et al., 2018). It is interesting to note from current observations and records that *Amanita sculpta* grows in association with plants from families that form dominant stands in tropical old growth forests in Asia. The ectomycorrhizal associations with Dipterocarpaceae help with the establishment and growth of seedlings, and suggest the importance of

these associations to the growth and regeneration of dipterocarp forests (Peay et al., 2010; Brearley, 2012; Corrales et al., 2018).

The long interval between the observations of *Amanita sculpta* in Singapore also suggests that it is possibly more host specific than the other *Amanita* species, being found only in the primary forest patch of BTNR. This is coupled with the fact that the species may require quite specific conditions to form fruiting bodies (i.e. a prolonged dry season, followed by rains) (Corner, 1935), which may explain why it is not more commonly encountered. These conditions could include a specific microclimate that enables the formation of such a large fruiting body, there being a correlation between large fruiting body size and proximity to the equator, coupled with high seasonality and a warm annual mean temperature (Bässler et al., 2021). This suggests that with a combination of ideal microclimatic conditions, and a trend towards increasing seasonality, more species that have not been recorded in many years might begin to form fruiting bodies.

Observations and collections of *Amanita* species have nevertheless been made and are currently being identified and studied. *Amanita* species in the region, most of which are smaller in size, often greyish and with a pileus of less than 3 cm, are not well photo-documented, and they are not as easy to identify as *Amanita sculpta*. These often-overlooked taxa need further attention, not only in Singapore, but also in the wider region. This is especially so in the nature reserves such as BTNR, Central Catchment Nature Reserve, and in pockets of remnant primary forest such as the SBG rain forest (Lee, 2019). A better knowledge of macrofungal diversity could help in our understanding of tropical lowland forest health and resilience and could have profound impacts on the success of forest restoration efforts. Morphological studies on macrofungi will also benefit from accompanying molecular studies for those groups where species delimitations are inconclusive. More generally, DNA sequence data for all species will be useful for phylogenetic studies and, therefore, selected gene regions of the BTNR *Amanita sculpta* will be sequenced and made available.

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