



New tuberous *Araceae* from Binh Thuan Province (South Vietnam)

M. Serebryanyi¹, T. Trinh², W. Hetterscheid³

Key words

Amorphophallus
Araceae
Areace
Binh Thuan Province
Thomsonieae
Typhonium
Vietnam

Abstract Two species of the *Araceae* family, *Typhonium praelongum* (having tuber of blunt cone shape, very long (about 30 cm) sterile appendix of the spadix, horizontal yellow-orange staminodes with tops turning upwards and a glossy entirely papillate upper surface of the simple leaf blade) and *Amorphophallus opalinus* (having narrow rhizome-like tuber with enlarged basal part, staminodes at the base of male zone of the spadix, narrow spathe, large, broadly-conical with rounded apex, opalescent stigmas and white, one-seeded berries), are described as species new to science from South Vietnam. Detailed morphological descriptions, colour plates of the species and their habitats, phenology, distribution map, provisional conservation status, taxonomic comments and overview of the genera *Typhonium* and *Amorphophallus* in the Flora of Vietnam are provided.

Citation: Serebryanyi M, Trinh T, Hetterscheid W. 2023. New tuberous *Araceae* from Binh Thuan Province (South Vietnam).

Blumea 68 (1): 39–48. <https://doi.org/10.3767/blumea.2023.68.01.03>.

Effectively published online: 6 March 2023.

INTRODUCTION

In 2021–2022 the second author extensively and intensively travelled in Binh Thuan Province (11 field trips altogether), making photos and collecting living plants in low (below 900 m altitude) mountain forests of the region. Being particularly attentive to members of the *Araceae* family, he came across many rare and interesting species, some of them never recorded for the region before: *Amorphophallus crinitus* A.Galloway, Luu, Malkm.-Huss., Prehler & Claudel, *A. latifolius* (Serebryanyi) Hett. & Claudel, a new record for Vietnam, *A. pusillus* Hett. & Serebryanyi, *A. scaber* Serebryanyi & Hett., *A. synandriifer* Hett. & V.D.Nguyen, *A. umbrinus* A.Galloway, Luu, Malkm.-Huss., Prehler & Claudel, *Typhonium dongnaiense* Luu, Nguyen-Phi & H.T.Van. Thus, the region may be considered as a very important territory because of its rich aroid flora, like two other locations in South Vietnam: Binh Tiau-Phuok Byu (Binh Châu-Phước Bửu) National Park (also known as Xuyen Moc; the type locality of *A. kuznetsovii* (Serebryanyi) Hett. & Claudel, *A. lanceolatus* (Serebryanyi) Hett. & Claudel, and *A. pusillus*) and the Vung Tau port vicinity (type locality of *A. fallax* (Serebryanyi) Hett. & Claudel and *A. scaber*).

In 2022 Tan Trinh discovered two populations of tuberous aroids of the genera *Typhonium* Schott and *Amorphophallus* Blume ex Decne. The collected living plants were grown and subsequently flowered at Mr. Tan Trinh's residence (address below). They are new to science and described here as *Typhonium praelongum* Serebryanyi & Hett. and *Amorphophallus opalinus* Serebryanyi

& Hett. The plates in this paper are prepared from photos of the second author, unless stated otherwise.

The region of the field studies is located in the Southeast region (Dong Nam Bo) of the Socialist Republic of Vietnam. It covers the southernmost part of the Tây Nguyên Plateau (Fig. 1a), one of the most important geological formations in Indochina, roughly 2/3 of which is located in Vietnam, the other parts in adjacent territories of southern Laos and north-eastern Cambodia. In fact, the Tây Nguyên Plateau is not a single geological structure but rather a series of contiguous plateaus with heights of 500–1000 m altitude surrounded by the high mountain ranges and mountains of the South Annamite Range. The southern subregion of the Tây Nguyên Plateau is called Trung Tây Nguyên and it is characterized by lower altitudes and therefore has higher temperatures than the other two sub-regions. Forest vegetation in the region of the field studies is formed on granite hills and mountains which is different from the other territories with rich aroid floras mentioned above (dipterocarp forests on sands in Binh Tiau-Phuok Byu and secondary forests on limestone in the Vung Tau port vicinity). Binh Thuan province is reported to have about 45 % of forest cover (Statistical Yearbook of Vietnam 2020), which is high compared to most other provinces of South Vietnam. The forest communities of the region of the field studies can be classified as high polydominant leafy evergreen low mountain forest of complex vertical structure (Kuznetsov pers. comm. in 2022).

MATERIALS AND METHODS

The measurements and descriptions of the species were based on examination of living specimens and photographic images of plants *in situ* and cultivation. The point map (Fig. 1b) is produced with <https://www.simplemappr.net> (Shorthouse 2010).

¹ Herbarium (MHA), Tsitsin Main Botanical Garden, Russian Academy of Sciences, Botanicheskaya Str., 4, Moscow, 127276, Russia; corresponding author e-mail: misha@florin.ru.

² 3/5 Phu Qui 1 Hamlet, La Nga commune, Dinh Quan district, Dong Nai Province, 76714, Vietnam.

³ Heidelberg 9, 6721 CK Bennekom, The Netherlands; e-mail: hetter@xs4all.nl.

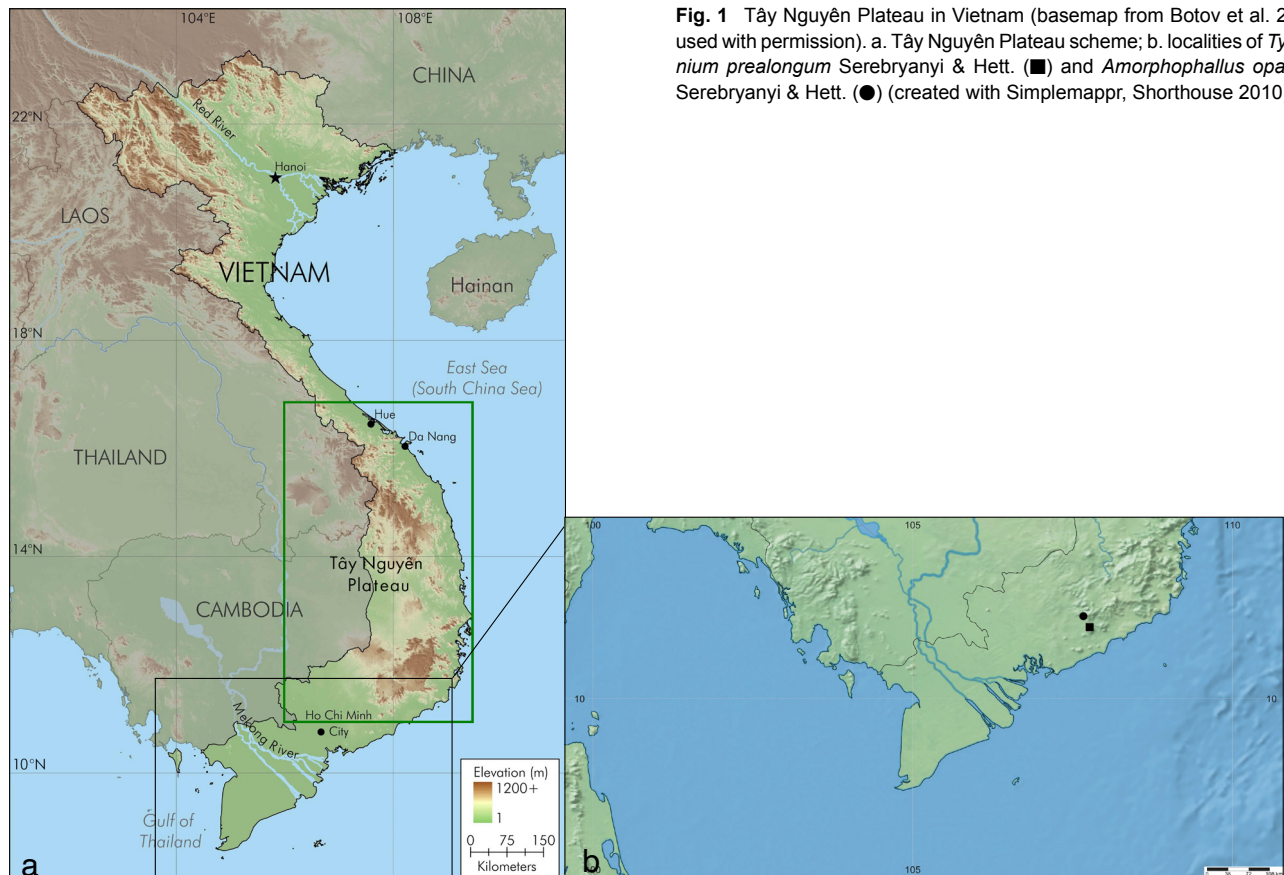


Fig. 1 Tây Nguyên Plateau in Vietnam (basemap from Botov et al. 2015; used with permission). a. Tây Nguyên Plateau scheme; b. localities of *Typhonium praelongum* Serebryanyi & Hett. (■) and *Amorphophallus opalinus* Serebryanyi & Hett. (●) (created with Simplemappr, Shorthouse 2010).

TYPHONIUM Schott

The genus *Typhonium* (Araceae-Aroideae-Araeae) currently comprises c. 70 described species.

Prior to Cusimano et al. (2010) *Typhonium* numbers were higher because of the inclusion of the genera *Sauromatum* Schott and *Lazarum* A.Hay, which are since recognized as separate from *Typhonium*.

Typhonium is widely distributed in tropical and subtropical Asia; Indochina is one of the most important centers of diversity: 34 species are recorded for Thailand, 21 for Vietnam, while the aroid floras of Laos and Cambodia remain poorly known.

The genus comprises small seasonal geophytic herbs; underground part a (sub)globose tuber or a very short rhizome; leaves one or several; lamina simple, cordate, hastate, elliptic or lanceolate, or decompound, with few to many leaflets, variable in shape; inflorescence usually appearing after leaf development; peduncle short or long; spathe ovate, elliptic-ovate, narrow or broadly triangular or lanceolate, base and limb separated by a more or less conspicuous constriction just below the staminate zone of the spadix, limb often with a pale or deep purple inside, more rarely whitish or pinkish; spadix with a small basal pistillate zone, then a sterile zone with a staminode-bearing lower part and a smooth upper part (rarely with vestigial staminodes) and then a staminate zone topped by a sterile appendix; appendix short or very long, erect, oblique or pendulous, elongate, narrowly conical or long, thin tail-like.

The genus was revised by Sriboonma et al. (1994; with 40 species treated), but quite a number of species have been discovered since that publication, see Hetterscheid et al. 2001, Hetterscheid & Nguyen 2001, Hetterscheid & Galloway 2006, Nguyen 2008, Nguyen & Croat 2010, Galloway 2012, Hetterscheid & Sookchaloem 2012, Hetterscheid 2013, Van et al. 2017, 2021, Naive et al. 2020, Naive & Hein 2021, Hein & Naive 2021, Nguyen et al. 2022.

Typhonium is considered the third largest genus of *Araceae* in Vietnam (after *Amorphophallus* with at least 37 species and *Arisaema* with more than 20 species) but its knowledge is very far from satisfactory. The number of recorded species increased from 13 in 2017 (Nguyen 2017) to 19 in 2021 (Van et al. 2021) and to 20 in 2022 (Nguyen et al. 2022); there are very scanty data on the variation between and within *Typhonium* species, geographic distributions and ecology. With the description of *T. praelongum* we conclude that the number of *Arisaema* and *Typhonium* species recorded for Vietnam is about equal which may change any time due to new discoveries and progress in taxonomic research.

***Typhonium praelongum* Serebryanyi & Hett., sp. nov.** — Fig. 2, 3, 4

Etymology. The epithet '*praelongum*' refers to the extremely long sterile appendix of the spadix.

Typhonium praelongum is diagnosed by a tuber of blunt cone shape, a very long (about 30 cm) sterile appendix of the spadix with filiform upper part, rod-shaped, horizontal yellow-orange staminodes with tops turning upwards, swollen at the apex and a glossy entirely papillate upper surface of the leaf blade with impressed veins. — Type: *Tan Trinh* s.n. (holo MHA), South Vietnam, Nui Ong Nature Reserve, Tanh Linh District, Binh Thuan Province, prepared from a cultivated plant originally collected in the type locality.

Seasonally dormant, small tuberous herb, flowering with leaves, up to 30–(35) cm high. *Tubers* of almost perfect blunt cone shape, up to 4 cm high, bottom diam 3–4 cm, top diam 1–1.5 cm, root mass forming at the top, offset development scattered throughout the length of the tuber (Fig. 3f). *Petiole* whitish green in basal part, changing to light-green at the top, with circular horizontal whitish stripes, the ones at the base part of the petiole sometimes dark green in mature leaves, smooth, 20–25–(30) cm long, c. 4 mm diam at the base, gradually and slightly tapering towards the apex. *Leaf blade* ovate to oblong-ovate, up to 20 by 12–13 cm, base deeply cordate, apex long acuminate (acumen



Fig. 2 *Typhonium praelongum* Serebryanyi & Hett. *in situ*. a–b. Leaves; c. granite rock; d. inflorescence. — Photos by Tan Trinh.

to 2.5 cm long), margin somewhat undulate (especially the basal lobes); upper surface lucid glossy green, entirely papillate, lower surface paler, also papillate, with all the veins impressed adaxially; venation reticulate, with primary lateral veins (to 12 in total; half of them in basal lobes, half in the anterior lobe) not in perfect pairs, their ends running upwards and forming an inner collective vein 0.5–0.7 cm from the margin, outer collective

vein obscure and located closer than 1 mm from the margin, veins of lower orders anastomosing; midrib and posterior costa strong, especially at the base, becoming distinctly thinner towards the apex; posterior costa naked/free at least for 0.5 cm from the petiole junction (forming open sinus). *Posterior lobes* up to 6 by 4–5.5 cm, slightly to strongly introrse (rarely slightly overlapping). *Inflorescence* appearing after leaf development.



Fig. 3 *Typhonium praelongum* Serebryanyi & Hett. a. Habitus (a whole flowering plant); b. leaf (upper surface); c. leaf (lower surface); d. petioles; e. seed; f. tuber; g. infructescence; h. inflorescence (bottom-up): female zone, sterile zone with staminodes, male zone, sterile appendix stipe; i. inflorescence closeup (bottom-up): female zone, staminodes. j. a whole inflorescence with spathe base cut off. — Photos by Tan Trinh.

Peduncle 6–7 cm long, as thick as a petiole, white. *Spathe* up to 17(–19) cm long, erect, completely white outside; base and limb separated by a constriction; base/lower spathe convolute, nearly globose, c. 2 by 1.5 cm diam, intensively pink inside, spathe-limb linear-oblong, open almost to the base, up to 15(–17) cm by c. 1 cm wide at the base, becoming slightly narrower towards the acute apex, completely white. *Spadix* at least twice as long as the spathe, up to 35 cm long, sessile; female zone subglobose to conical, c. 3 mm high by up to 4 mm diam at the base, 2.5–3 mm diam at the top; pistils semi-erect, up to 35 in total; sterile zone 1.3–1.4 cm long, lower 7–8 mm carrying staminodes; male zone broadly fusiform (rarely subcylindric), c. 7 by 5 mm diam at the middle, congested; appendix on a white stipe c. 5 mm long and same diameter as interstice, up to 30(–32) cm by 3 mm diam at the base, cylindric, gradually tapering to the filiform upper part (up to 5 cm from the apex), coiling while drying, pale greenish yellow, with numerous longitudinal shallow grooves throughout. *Ovary* elongate-ovoid, up to 1 by 0.6(–0.7) mm diam, white, one basal ovule; style absent; stigma discoid/orbicular (slightly irregular in outline), 0.3(–0.4) mm diam, c. 0.3 mm high, translucent white, surface minutely echinate. *Stamens* bright yellow-orange, pores apical, pollen yellow. *Staminodes* simple, rod-shaped, horizontally orientated with tops turning upwards, 2–4 by 0.8–1 mm diam, terete, yellow-orange; top swollen, globose, broader than the axis, colour more intense than in rest of the staminode, upper surface verruculose. *Infructescence* with persistent inflated saucer-shaped lower spathe. *Berries* ellipsoid, 4–6 by c. 2 mm diam, dirty white, crested by the old stigma remnant (brownish dot), one-seeded. *Seed* remarkably hard, ovoid-conical with attenuate apex, c. 3 by 2–2.5 mm diam in the thickest basal part, olive to olive-brown when mature, testa more or less smooth.

Distribution — *Typhonium praelongum* is so far only known from the type locality (Fig. 1b). Recently, the second author received photos from Da Huoi district, Lam Dong Province, probably representing another locality of *T. praelongum*. This remains to be confirmed.

Habitat & Ecology — *Typhonium praelongum* grows in dense populations, occurring within full-shade parcels between granite rocks in polydominant leafy ever green low mountain forest of complex vertical structure (2–3 strata within the tree-layer) on a steep SE slope (c. 40°); *Lithocarpus* spp. (*Fagaceae*) predominant in the 1st tree-stratum of 20–25 m high). The dense populations of *T. praelongum* on a steep slope make a strong impression of *Dioscorea*-like vine.

Phenology — Flowering: end of May to beginning of June; fruiting: beginning to mid-June.

Provisional conservation status — *Typhonium praelongum* is so far only known from the single locality in Nui Ong Nature Reserve. Thus, we herein propose this species to be treated as ‘Endangered’ (EN B2ab(iii)) following the Red List criteria of the IUCN (2019). It is to be hoped that Nui Ong Nature Reserve will take measures to protect this species.

Note — *Typhonium praelongum* possesses a unique combination of diagnostic characters: tuber having a blunt cone shape, an extremely long sterile appendix with filiform upper part, rod-shaped, horizontally orientated yellow-orange staminodes with tops turning upwards, swollen at the apex and a peculiar glossy upper surface of the leaf blade with impressed veins. There are two species comparable to *T. praelongum* but only in a very limited number of characters, e.g., *T. albispatham* Bogner from Peninsular Thailand has a relatively long spathe outside pure white up to 4.5 cm long vs up to 19 cm long in *T. praelongum* and a long filiform sterile violet appendix up to 13.5 cm long vs up to 32 cm long pale greenish yellow appendix in *T. praelongum*. The most similar staminodes could be observed in *T. ramosum* Hett. (Tak province, Thailand) but these

are mostly branched and are pink or orange with a dirty yellow truncate, not or only very slightly swollen top vs always simple yellow-orange staminodes with a globose swollen (capitate) top in *T. praelongum*. The only other species of *Typhonium*, having appendix of similar length (25–26 cm) is *T. digitatum* Hett. & Sookch. from East Thailand, but rest of inflorescence being completely different and incomparable.

AMORPHOPHALLUS Blume ex Decne.

The genus *Amorphophallus* (*Araceae-Aroideae-Thomsonieae*) presently contains 200+ species distributed in tropical and subtropical regions of Africa, Asia and northern Australia (Naive et al. 2022). Recently several species have been described from Vietnam (Galloway et al. 2019a), Laos (Galloway 2015, Galloway et al. 2019c), Thailand (Galloway et al. 2019b), Indonesia (Yuzammi & Hetterscheid 2020) and the Philippines (Bustamante et al. 2020, Hetterscheid et al. 2020, Tamayo et al. 2021).

The genus comprises small to giant, seasonal geophytic herbs; underground part usually a (sub)globose or vertically elongate tuber, more rarely a rhizome; leaf usually solitary, more rarely several, rising from the tuber, with a decompound, horizontal lamina; leaflets few to numerous, variable; inflorescence mostly solitary, rarely accompanied by leaves; peduncle short or elongate; spathe folded around the spadix, with or without a constriction between base and limb, orbicular to narrowly elongate, variously coloured inside and outside; spadix with lower pistillate zone, contiguous or not with an upper staminal zone and above that a sterile appendix (rarely missing); staminodes (when present) between both fertile zones, or within one or both of them; appendix very variable, from subglobose to elongate, erect, horizontal or rarely pendulous; infructescence consisting of sessile berries, these globose or elliptical, red, blue, white, yellow, green or orange at maturity.

With this newly described species included, 37 species of the genus are recorded for the Vietnamese flora, which makes *Amorphophallus* an irrefutable leader in genus size within the *Araceae* (31 species were recorded by Nguyen in 2017). Due to active field work of botanists and enthusiasts, knowledge of geographic distribution, ecology and species’ variation is constantly improving. The current number of species will definitely increase due to new findings, including undescribed species. Important to mention, two inter-species spontaneous hybrids are newly recorded for Vietnam, all from the former genus *Pseudodracontium*, namely *Amorphophallus pseudoharmandii* (Engl.) Hett. & Claudel × *A. fallax*, *A. pseudoharmandii* × *A. macrophyllus* (Gagnep. ex Serebryanyi) Hett. & Claudel.

Amorphophallus opalinus Serebryanyi & Hett., *sp. nov.* — Fig. 4, 5, 6

Etymology. The epithet ‘*opalinus*’ alludes to the colour of the unique stigmas of the species.

Amorphophallus opalinus is diagnosed by a narrow rhizome-like tuber with enlarged basal part, staminodes at the base of the male zone of the spadix, a narrow spathe, large, broadly-conical with rounded apex, opalescent stigmas and white, one-seed berries. — Type: *Tan Trinh* s.n. (holo MHA), South Vietnam, Tanh Linh District, Binh Thuan Province, prepared from a cultivated plant originally collected in the type locality.

Seasonally dormant tuberous herb flowering before the leaf. *Tuber* narrowly elongate, vertically growing, flexible, usually deformed as a result of growing around barriers or through very narrow holes, up to 9(–10) cm long, 2–2.5 cm diam at the top, less than 1 cm diam in the narrowest part, light yellow-brownish when mature, whitish when juvenile, basal part occasionally enlarged. *Cataphylls* narrowly triangular in outline, acute at the



Fig. 4 Forest community in *Typhonium praelongum* Serebryanyi & Hett. type locality. a. *Ficus* sp. reaches 1st tree stratum climbing on *Lithocarpus* sp.; b. canopy density; c. *Cycas* sp. in the 3rd tree-layer; d. fruits of *Lithocarpus* sp. — Photos by Tan Trinh.

apex, up to 5 cm long, drying pale brown, remaining intact. Leaves 1–2 per tuber (when 2, one leaf always bigger); petiole 35–40 cm long, 5–7 mm diam, smooth, green (or olive-green) with irregular brown (or khaki-brown) blotches up to above the middle (sometimes the upper blotches dark green) and numerous tiny whitish and blackish green stripes and spots throughout; lamina up to 35(–40) cm diam, each of the 3 principal segments consists of 5 (rarely 7) leaflets arranged as 2 (or 3) pairs of lateral and one terminal; lateral leaflets often not opposite, especially the basal ones; rhachises narrowly canaliculate, only winged (sometimes broadly so) in their distal parts; leaflets linear- to elliptic-lanceolate (rarely ovate), c. 9 by 2(–2.5) cm long, thin-coriaceous, base more or less broadly cuneate, sometimes shortly decurrent, apex long acuminate, margins undulate, upper surface dull green to green, matte, lower surface paler; primary lateral veins (c. 10 pairs) together with the midrib significantly impressed adaxially, raised abaxially, as well as a prominent collective vein, 3–4 mm remote from

the margin. *Inflorescence* solitary, long-pedunculate; cataphyll similar to those appearing with the petiole but longer, up to 7 cm long; peduncle up to 30 cm long, 5–7 mm diam, smooth, olive-brownish with irregular whitish blotches throughout, paler in the upper 1/3. *Spathe* ovate-oblong, 7–9 by c. 6 cm diam, erect, apex obtuse to rounded (sometimes shortly apiculate), only the basal 1.5 cm convolute, lower spathe/base and limb not differentiated, outside uniformly pale green with slightly darker veins, inside as outside, but with numerous tiny whitish green warts arranged longitudinally in the central part and with a metal-greyish area at the base, 2–3 cm long; margin whitish. *Spadix* sessile, up to 2.5 times longer than the spathe, 21–22 cm long; female zone cylindric, c. 2 by 0.8 cm diam, pistils not congested; male zone elongated, cylindric to slightly obconic, 4.5–5 by 7–8 mm diam at the base, about 1 cm diam at the top, flowers congested, the lowest row(s) consisting of sterile staminodes somewhat bigger than regular male flowers, decaying when the pollen is released; appendix elongate,



Fig. 5 *Amorphophallus opalinus* Serebryanyi & Hett. *in situ*. a. Dau Trau waterfall (Thác Đầu Trâu); b, d. leaves; c. emerging inflorescence. — Photos by Tan Trinh.

to 15 cm long, c. 1.1 cm diam at the base, the thickest part c. 1.4 cm at c. 4 cm from the base, from there tapering to the obtuse or slightly rounded apex, base not constricted, surface with irregular shallow grooves and depressions, ivory-white to creamy pale yellow, developing sewer-like smell at female anthesis, lasting 8–10 hours. Pistils c. 30 per spadix, often not adjacent to each other, leaving open axis areas c. 1 mm²; ovaries of irregular shape, depressed, bluntly angulate in cross-

section, c. 1 by 2 mm diam, dark green, unilocular, one basal ovule. Style prominent, 0.7–0.8 by 0.6–0.7 mm diam, white; stigma large, broadly conical, rounded at the top (mushroom cap-shaped), c. 1.5 mm diam, opaline/pearl-coloured, glossy, surface smooth. *Male flowers* consisting of 3–4 stamens; stamens 3–3.5 mm long, filaments 2–2.5 mm long, base connate; anthers c. 1 by 1.2–1.5 mm diam, truncate, pores apical. Pollen released in strings, coarsely striate, yellow. *Fruiting peduncle*



Fig. 6 *Amorphophallus opalinus* Serebryanyi & Hett. a. Leaf; b. juvenile tuber; c. pistil; d. mature tuber; e. peduncle; f. infructescence; g. inflorescence: male zone with pollen being released; h. a whole inflorescence; i. inflorescence (spathe cut off): female zone and lower part of the male zone with sterile staminodes. — Photos by Tan Trinh.

same size as the flowering one but somewhat thicker; infructescence 5 by 2 cm diam. *Berries* slightly depressed-globose or globose, c. 7 mm diam, milky-white when ripe (green while maturing), crested by the old stigma remnant (a brownish dot), one-seeded.

Distribution — *Amorphophallus opalinus* is only known so far from the close vicinity of the type location (Fig. 1b). Four populations of *A. opalinus* (including that from which the type was derived) were found near each other along the stream near the Dau Trau waterfall.

Habitat & Ecology — All the studied populations were found on a flat slope basis in polydominant leafy evergreen low mountain forest of complex vertical structure (2 strata within the tree-layer). Altitude 450–600 m. *Castanopsis dongnaiensis* Son & Ngoc, *Lithocarpus dahuaiensis* Ngoc & L.V. Dung (both *Fagaceae*), *Anisoptera* sp. (*Dipterocarpaceae*) predominant in the 1st tree-stratum (20–25 m high).

Phenology — Flowering: June; fruiting: November.



Fig. 7 *Amorphophallus linearis* and *A. napiger*. a. Inflorescence of *Amorphophallus linearis*: female zone and lower part of the male zone with sterile staminodes; b. Inflorescence of *A. napiger*: female zone and lower part of the male zone with sterile staminodes (Boyce & Dzu 1275, Vietnam, KeBang, Gia Lai province; = *Hettterscheid collection H.AM.1097*). — Photos a. © A. Galloway/Juniper Level Botanic Garden; b. by W.L.A. Hettterscheid.

Provisional conservation status — *Amorphophallus opalinus* is known from four closely situated localities only, with a type population of several individuals around the top of the Dau Trau waterfall which is visited by many tourists. This place will possibly change due to the development of tourism in the future, which will negatively affect the habitat of the species. We herein propose this species to be treated as 'Endangered' (EN B2ab(iii)) following the Red List criteria of the IUCN (2019).

Notes — *Amorphophallus opalinus* demonstrates a combination of characters suggesting it belongs to a white-berried clade of subg. *Metandrium* Stapf (Claudel et al. 2017): narrow rhizome-like tuber, staminodes at the base of male zone of the spadix, narrow spathe, large, broadly-conical with rounded apex (almost semi-globose) stigmas. *Amorphophallus linearis* Gagnep. and *A. napiger* Gagnep. share that combination of characters, although the latter has yellowish berries. However, the stigmas of those species are strikingly different in comparison to those of *A. opalinus* (Fig. 7).

Amorphophallus sinuatus Hett. & V.D.Nguyen (having blue berries) shares a relatively rare pattern with *A. opalinus*, the peculiar loose arrangement of pistils, often not adjacent to each other, leaving open axis areas about 1 mm². However, the unique pistil of *A. opalinus* with its glossy opaline stigma with large, broadly conical, rounded top and smooth surface, on a prominent thick style (up to 0.8 mm long) differs from the pistil of *A. sinuatus*, the latter being depressed, shallowly three-lobed and sitting on a short style 0.2–0.4 mm long.

Acknowledgements We would like to thank Dr. Andrei Kuznetsov (The Joint Russian-Vietnamese Tropical Research and Technological Center) for valuable discussions on forest communities in the studied region and on vegetation of the Tây Nguyên Plateau. We are also thankful to Mr. Kosta Gusakov for the illustrations design. The second author is thankful to Ms. Thanh Dat Pham Thi for her assistance during the field trips. The first author is thankful to Ministry of Science and Higher Education of Russia for supporting of CCU 'Herbarium MBG RAS (MHA)', grant 075-15-2021-678.

REFERENCES

- Botov A, Phung TM, Nguyen TQ, et al. 2015. A new species of *Dixonius* (Squamata: Gekkonidae) from Phu Quy Island, Vietnam. *Zootaxa* 4040: 48–58.
- Bustamante RAA, Mansibang JA, Hettterscheid WLA, et al. 2020. *Amorphophallus caudatus* (Thomsonieae, Araceae), a new species from Camarines Norte, Luzon island, the Philippines. *Nordic Journal of Botany* 38. <https://doi.org/10.1111/njb.02982>.
- Claudel C, Buerki S, Chatrou LW, et al. 2017. Large-scale phylogenetic analysis of *Amorphophallus* (Araceae) derived from nuclear and plastid sequences reveals new subgeneric delineation. *Botanical Journal of the Linnean Society* 184: 32–45.
- Cusimano N, Barrett MD, Hettterscheid WLA, et al. 2010. A phylogeny of the Araceae (Araceae) implies that *Typhonium*, *Sauromatum*, and the Australian species of *Typhonium* are distinct clades. *Taxon* 59(2): 439–447.
- Galloway A. 2012. New Araceae species from Laos and Thailand. *Aroideana* 35: 51–64.
- Galloway A. 2015. Three new *Amorphophallus* species from Laos. *Aroideana* 38: 3–7.
- Galloway A, Luu HT, Malkmus-Hussein B, et al. 2019a. Three new species of *Amorphophallus* (Araceae) from Vietnam. *Aroideana* 42(1): 41–58.
- Galloway A, Malkmus-Hussein B, Prehler D, et al. 2019b. A new species of *Amorphophallus* (Araceae) from Thailand (Kanchanaburi Province). *Aroideana* 42(1): 70–75.
- Galloway A, Prehler D, Claudel C. 2019c. Another new miniature *Amorphophallus* (Araceae) species from Laos. *Aroideana* 42(1): 59–69.
- Hein KZ, Naive MAK. 2021. Taxonomic studies of Araceae in Myanmar III: *Typhonium aungmyintwinii*, a new species from Mogok Township, Mandalay Region. *Taiwania* 66(4): 455–458.
- Hettterscheid WLA. 2013. New *Typhonium* species from Asia. *Aroideana* 36: 93–97.
- Hettterscheid WLA, Galloway A. 2006. New *Typhonium* (Araceae) species from Thailand. *Aroideana* 29: 80–85.

- Hettterscheid WLA, Medecilo MD, Callado JRC, et al. 2020. New species of *Amorphophallus* (Araceae) in the Philippines and an updated key. *Blumea* 65: 1–9.
- Hettterscheid WLA, Nguyen VD. 2001. Three new species of *Typhonium* (Araceae) from Vietnam. *Aroideana* 24: 24–29.
- Hettterscheid WLA, Sookchaloem D. 2012. *Typhonium*. In: Boyce PC, Sookchaloem D, Hettterscheid WLA, et al. (eds), *Araceae*. In: Santisuk T, Larsen K (eds), *Flora of Thailand* 11(2): 298–321. Forest Herbarium, Bangkok.
- Hettterscheid WLA, Sookchaloem D, Murata J. 2001. *Typhonium* (Araceae) of Thailand: New species and a revised key. *Aroideana* 24: 33–55.
- IUCN. 2019. The IUCN Red List of threatened species, v. 2018-1. IUCN Red List Unit. www.iucnredlist.org/ (accessed 22 Aug 2022).
- Naive MAK, Hein KZ. 2021. Taxonomic studies of Araceae in Myanmar II: *Typhonium edule*, a remarkable new aroid species from Monywa District, Sagaing Region. *Phytotaxa* 513(2): 159–165.
- Naive MAK, Hein KZ, Hettterscheid WLA. 2022. Taxonomic studies of Araceae in Myanmar IV: A new species, a new record and a new synonym for the genus *Amorphophallus*. *Blumea* 67 (2): 123–128.
- Naive MAK, Hein KZ, Ma ZX, et al. 2020. Taxonomic studies of Araceae in Myanmar I: *Typhonium sagaingense*, a new Araceae species from Sagaing Region. *Phytotaxa* 471: 47–53.
- Nguyen VD. 2008. *Typhonium stigmatilobatum* (Araceae tribe Araceae), a new species from Vietnam. *Kew Bulletin* 63 (3): 491–493.
- Nguyen VD. 2017. *Araceae* Juss. *Flora of Vietnam* 16. Publishing House for Science and Technology, Hanoi.
- Nguyen VD, Croat TB. 2010. A new species of *Typhonium* (Araceae) from Vietnam. *Novon* 20(2): 195–197.
- Nguyen VD, Toan Le C, Diep Dinh Q, et al. 2022. *Typhonium kbangense*, a new species of Araceae (Aroideae-Areae) from Central Vietnam. *Nordic Journal of Botany* e03601. <https://doi.org/10.1111/njb.03601>.
- Shorthouse DP. 2010. SimpleMappr, an online tool to produce publication-quality point maps. [Retrieved from <https://www.simplemappr.net>. Accessed 27 August 2022.]
- Sriboonma D, Murata J, Iwatsuki K. 1994. A revision of *Typhonium* (Araceae). *Journal of the Faculty of Science, University of Tokyo, Section III, Botany* 25(4): 255–313.
- Statistical Yearbook of Vietnam 2020. 2020. Hanoi, Statistical Publishing House.
- Tamayo M, Magtoto LM, Sumalinog MS, et al. 2021. *Amorphophallus calciculus* (Thomsonieae, Araceae), a new species from the Bohol island, Central Visayas, Philippines. *Phytotaxa* 489 (2): 229–235.
- Van HT, Nguyen PN, Vu NL, et al. 2017. *Typhonium dongnaiense* (Araceae), a new species from Vietnam. *Annales Botanici Fennici* 54: 405–408.
- Van HT, Van SL, Nguyen PN, et al. 2021. A new species and a new record of *Typhonium* (Araceae) from southern Vietnam. *Phytotaxa* 527: 201–208.
- Yuzammi, Hettterscheid WLA. 2020. A new species of *Amorphophallus* (Araceae-Thomsonieae) from Sulawesi, Indonesia. *Phytotaxa* 461 (4): 295–300.