



***Camellia annamensis* (Theaceae), a new species from central Vietnam**

**Ngọc-Sâm LÝ^{1,2,*}, Văn-Dũng LUÔNG³, Thị-Hương LÊ⁴, Ngọc-Đài ĐỖ⁵, Ninh TRẦN⁶, Anh-Đức NGUYỄN⁶,
Thị-Liễu NGUYỄN^{3,7}, Chiyomi UEMATSU⁷, Hironori KATAYAMA⁸**

1. Institute of Tropical Biology, Vietnam Academy of Science and Technology (VAST), 85 Trần Quốc Toản, District 3, Hồ Chí Minh City, Vietnam. **2.** Graduate University of Science and Technology, VAST, 18 Hoàng Quốc Việt, Cầu Giấy District, Hà Nội City, Vietnam. **3.** Department of Biology, Đà Lạt University, 1 Phù Đồng Thiên Vương Road, District 8, Đà Lạt City, Lâm Đồng Province, Vietnam. **4.** Faculty of Biology, College of Education, Vinh University, 182 Lê Duẩn, Vinh City, Nghệ An Province 4300, Vietnam. **5.** Nghe An College of Economics, 51 Lý Tự Trọng, Vinh City, Nghệ An Province, Vietnam. **6.** VNU University of Science, 334 Nguyễn Trãi Str., Thanh Xuân, Hà Nội, Vietnam. **7.** Graduate School of Science, Botanical Gardens of Osaka City University, Osaka 558-8585, Japan. **8.** Food Resources Research and Education Center, Graduate School of Agricultural Science, Kobe University, Kobe 657-8501, Japan. *Corresponding author's: Phone No. : + 84 902670857; email-address: lysamitb@gmail.com

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ABSTRACT: *Camellia annamensis*, a new species of *Camellia* sect. *Piquetia* (Theaceae) from central Vietnam is described and illustrated. It is most similar to *Camellia longii*, but differs by its mature leaves sparsely appressed puberulous abaxially and leaf margins shallowly and widely denticulate, lateral veins 10–13 pairs, sparsely appressed puberulous petioles, sepals 5, petals 20–22, flattened-globose ovary and styles tomentose and free to base. Information on distribution, ecology, phenology, vernacular name, uses and conservation assessment of this new taxon, along with a key to distinguish the species of *Camellia* sect. *Piquetia* in Vietnam are also provided.

KEY WORDS: Annamite range, *Camellia honbaensis*, *C. longii*, *C. piquetiana*, endemism, sect. *Piquetia*, sect. *Lecomzia*, taxonomy.

INTRODUCTION

Camellia L. is the largest genus of Theaceae with more than 120–300 species that recognized in eastern Asia and throughout East and Southeast Asia, ranging from Nepal, Bhutan, Northeastern India, Myanmar, China, Japan, to Southeast Asia (Chang and Bartholomew, 1984; Gao *et al.*, 2005; Ming and Bartholomew, 2007; Orel and Wilson, 2010; Mabberley, 2017). The highest species richness is found in China and Vietnam (Chang and Bartholomew, 1984; Tran, 2002; Orel and Curry, 2015). The genus is characterized by an evergreen habit, imbricate bracteoles and sepals, basally connate petals, numerous stamens in 2–6 whorls, generally large, and apically dehiscent capsules, and wingless semi-globose or polygonal seeds (Sealy, 1958; Ming and Bartholomew, 2007; Orel and Wilson, 2010). Currently, more than 95 species of *Camellia* have been reported in Vietnam with many localized endemic species (Le *et al.*, 2020). However, this number is expected to rise in the future with the description of new taxa (Le and Luong, 2016; Do *et al.*, 2019b).

During recent extensive floristic surveys in the Central coastal region of Vietnam, several interesting species of *Camellia* were collected by one of us (N.D.Đỗ) and colleagues in 2018–2020 (e.g. Nguyen *et al.*, 2018; Do *et al.*, 2019; Do *et al.*, 2020; Nguyen *et al.*, 2020). 5 taxa of *Camellia* were described from this region, namely *C. vuquangensis* Luong, Tran & L.T.Nguyen and *C. hatinhensis* Luong, Tran & L.T.Nguyen (Nguyen *et al.*, 2018), *C. pukhangensis* D.N.Do *et al.* (Do *et al.*, 2019),

C. ngheanensis N.D.Do *et al.* (Do *et al.*, 2020) and *C. puhoatensis* N.S.Lý *et al.* (Nguyen *et al.*, 2020) while some other collections are still awaiting description. This present paper, a further red flower species of *Camellia* from Pù Hoạt Nature Reserve (NR), Nghệ An Province and Xuân Liên NR, Thanh Hóa Province, Vietnam is described. The overall plant habit, elliptic leaf blades, shape and color of flower of these plants show similarities with *C. longii* Orel & Luu (Orel *et al.*, 2014), *C. piquetiana* (Pierre) Sealy (Sealy, 1958), and *C. honbaensis* Luu, Q.D.Nguyen & G.Tran (Luu *et al.*, 2018). However, it shows significant differences in vegetative and floral structures (see Table 1) and we describe and illustrate it here as a new to science, *C. annamensis*, based on the Chang and Bartholomew's (1984) taxonomic system and confirm its placement of the new species within Section *Piquetia* Sealy of *Camellia* (Pierre, 1877; Sealy, 1958).

MATERIALS AND METHODS

The descriptions are mainly based on measurements from flowering and fruiting individuals of living plants, liquid preserved material (in 70% ethanol), supplemented with measurements from herbarium specimens. Type specimens of the most related species from the sect. *Piquetia* were examined from the following herbaria: DLU, HN, P, NSW and VNM (herbarium codes follow Thiers 2021+), as well as digitized specimen images of *Camellia* species available on the web from the Muséum National d'Histoire Naturelle (<https://science.mnhn.fr/>), Chinese Virtual Herbarium (<http://www.cvh.org.cn/>),



Australian Virtual Herbarium (<https://avh.ala.org.au/>), and Jstor Global Plant (<https://plants.jstor.org/>). All morphological characters were described using the general terminology by Beentje (2016) and standard works of Sealy (1958), Chang and Bartholomew (1984), Ming and Bartholomew (2007). A distribution map was created using SimpleMappr (<http://www.simplemappr.net/>) (Shorthouse, 2010). Conservation status was assessed, based on field observations in accordance with the IUCN Red list Categories and Criteria version 3.1 (IUCN, 2019). The extent of occurrence (EOO) and the area of occupancy (AOO) were estimated using the web Geospatial Conservation Assessment Tool or GeoCAT (<http://geocat.kew.org/editor>) with an auto-value cell width of 2 km (Bachman *et al.*, 2011).

TAXONOMIC TREATMENT

Camellia annamensis N.S.Lý, V.D.Lương, N.Đ.Đỗ, T.H.Lê & T.L.Nguyễn, *sp. nov.*

Figs. 1 & 2

Type: VIETNAM. Nghệ An Province: Quế Phong District, Đồng Văn Commune, Pù Hoạt NR, 240 m elev., 15 January 2019, Đỗ Ngọc Dài, Lý Ngọc Sâm, Lê Thị Hương, Nguyễn Danh Hùng, DLHH-1028 (holotype VNM!; isotypes P!, DLU!).

Diagnosis: Most similar to *C. longii* in shape and coloration of leave and flower, glabrous stamens and hairy ovary, but differing in having mature leaves sparsely appressed puberulous abaxially with leaf margins shallowly and widely denticulate (vs. glabrous, somewhat serrate), lateral veins 10–13 pairs (vs. 14–16(–18)), petioles sparsely appressed puberulous (vs. glabrous), sepals 5 (vs. 2–3), petals 20–22 (vs. 5–6), flattened-globose ovary (vs. diamond shape) and styles tomentose and free to base (vs. finely pubescent, distally glabrous, compound, proximally fused for ca. 5.0 mm).

Description: Small to medium evergreen shrub 3–5 m tall, sometime multi-stemmed, semi-upright habit, sparsely branched, branches slender; **young branches (twigs)** light brown, smooth, hirsute then glabrous, obliquely upward then flexuous; **semi-mature branches** cinnamon brown, smooth, leaf scars prominent; **mature branches and trunk** light grey to dull grey-white, with longitudinally fissured bark/ slightly furrowed. **Leaf buds** pale greenish then turning pale brown, puberulous, slightly falcate with sharp, slightly curved apex; **young leaves** soft and pendulous, pale purple to greenish-purple tinted; **mature leaves** elliptic to broad elliptic, 15–20.5 × 5–9 cm, apex attenuate or narrowly acuminate, base acute to partially obtuse and slightly asymmetric, margin shallowly and widely denticulate; **laminae** coriaceous, adaxially dark green, shiny and glabrous, abaxially dull and pale green with sparsely appressed puberulous; **petiole** curved and concave, slightly flattened, thick, light

green both sides, 10–15 × 2–2.5 mm, sparsely appressed puberulous; **primary veins** [partially obstructed by laminae abaxially] continues as a shallow channel on the adaxial side of the petiole, 1.5–1.7 mm wide proximally, less than 1 mm wide distally, adaxially light green, abaxially yellowish-green; secondary venations pinnate, with 10–13 pairs of veins, indistinctly brochidodromous, partially eucamptodromous on some leaves; midribs and lateral veins sunken above, protruding below; veins distinct proximally but less so towards the apex and the margins; tertiary venation loose, inconspicuous craspedodromous, more prominent at leaf margins. **Flowers** solitary or geminate (2(–3) flowers), born on short shoot in the axils of the leaves, 4.5–6 cm in diameter, flowers pedicellate, nodding; **pedicels** 0.7–1 cm long, 0.3–0.4 cm wide, wider distally, glabrous, pale greenish-cream [pale yellowish]; **flower buds** slightly curved downward, somewhat circular/globe, ca. 1.4 × 1.5 cm, bright red. **Bractlets** 3–4, broad triangular to semi-orbicular, 1.5–2.5 × 2–3 mm, glabrous, margins ciliate, persistent. **Sepals** 5, persistent, semi-orbicular, 4–8 × 6–10 mm, abaxially pale yellow tinged reddish and sparsely appressed velutinous, adaxially pale yellow and glabrous, margins entire/ciliate, arranged in 2 whorls forming a rather loose spiral, outer whorl of 2 sepals and inner whorl of 3 sepals. **Petals** 20–22, arranged in 3 whorls, bright red, shiny, with a distinct and intense white margin 1.5–2 mm wide; outermost whorl comprising 7–8 petals, semi-orbicular, 1.5–2.4 × 1.2–1.8 cm, concave, margins entire, sometimes ruffled, abaxially velutinous at tips; middle whorl comprising 11 petals, broadly obovate, 2.7–3.7 × 2–2.5 cm, concave, margins ruffled, abaxially pubescent at tips or glabrous; innermost whorl of 2–3 petals, elliptic, 3.3–3.5 × 1.3–2.2 cm, glabrous, ruffles, basally united with outermost filaments for 5–10 mm. **Androecium** ca. 350 stamens, arranged in 4 or 5 series, light yellow, 2.4–3 cm long, glabrous; outer filaments basally united to each other for 1.5–1.8 cm long and forming a cup, inner ones basally united for 4–7 mm long; **anthers** yellow, narrowly ovate, 2.5–3 × ca. 1 mm, with two longitudinal striations, dorsifixed. **Ovaries** superior, flattened-globose, terminating into 4 or 5 styles, strongly 4–5-lobed, yellow, tomentose, 4–5-carpellate, 2.5–3 × 3–3.5 mm, 1–2 ovules per locule. **Styles** 4 or 5, free to the base, 1.8–2.3 cm long, 0.5–0.7 mm wide at base, ca. 0.5 mm at apex, yellow, tomentose, persistent; **stigma** indistinct. **Mature Capsules** flattened-globose, with persistent sepals and styles, 4–5 irregularly lobed, 4–5.5 cm in diam., 2–2.3 cm high, dehiscing distally into 4–5 valves with 1–2 seeds per valve; **fresh pericarps** 3–4 mm thick, furfuraceous and sparsely white hairs. **Seeds** spherical, hemispherical or wedge-shaped, 1.6–1.8 × 1.2–1.5 cm, brown, pubescent.

Distribution and ecology: This new species is found from two localities in the provinces of Nghệ An and Thanh Hóa in central Vietnam where it grows along the sides of the stream, wet ground or on hill slopes in mixed

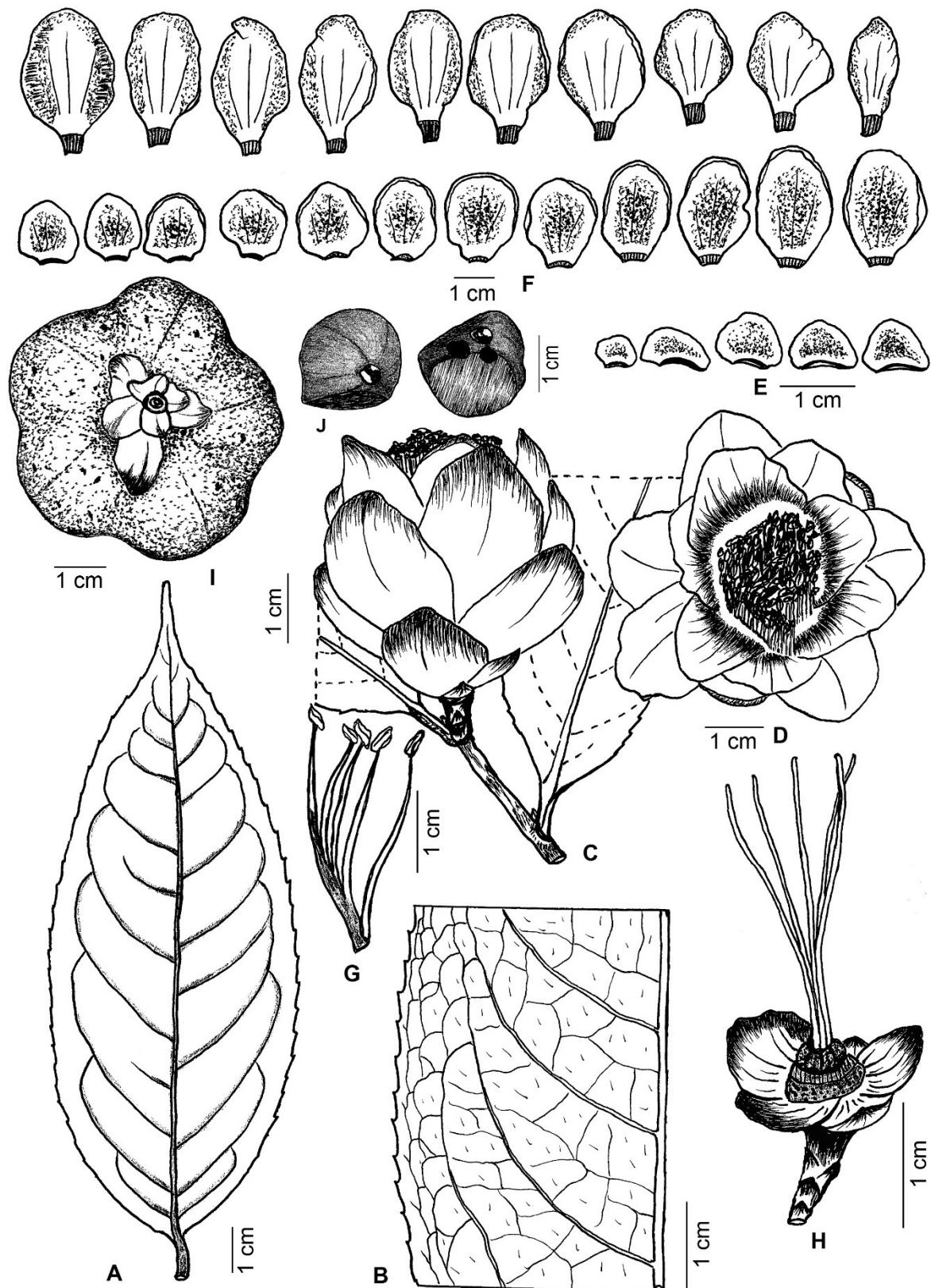


Fig. 1. *Camellia annamensis* N.S.Lý, V.D.Lương, N.Đ.Đỗ, T.H.Lê & T.L.Nguyễn. **A.** Leaf (adaxial view); **B.** Venation detail of leaf (abaxial view); **C.** Flower (lateral view); **D.** Flower (top view); **E.** Perules (adaxially shown); **F.** Petals (adaxially shown); **G.** Androecium; **H.** Gynoecium (other floral parts removed); **I.** Dried fruit. **J.** Seeds. Drawn from type materials by Văn-Dũng Lương.

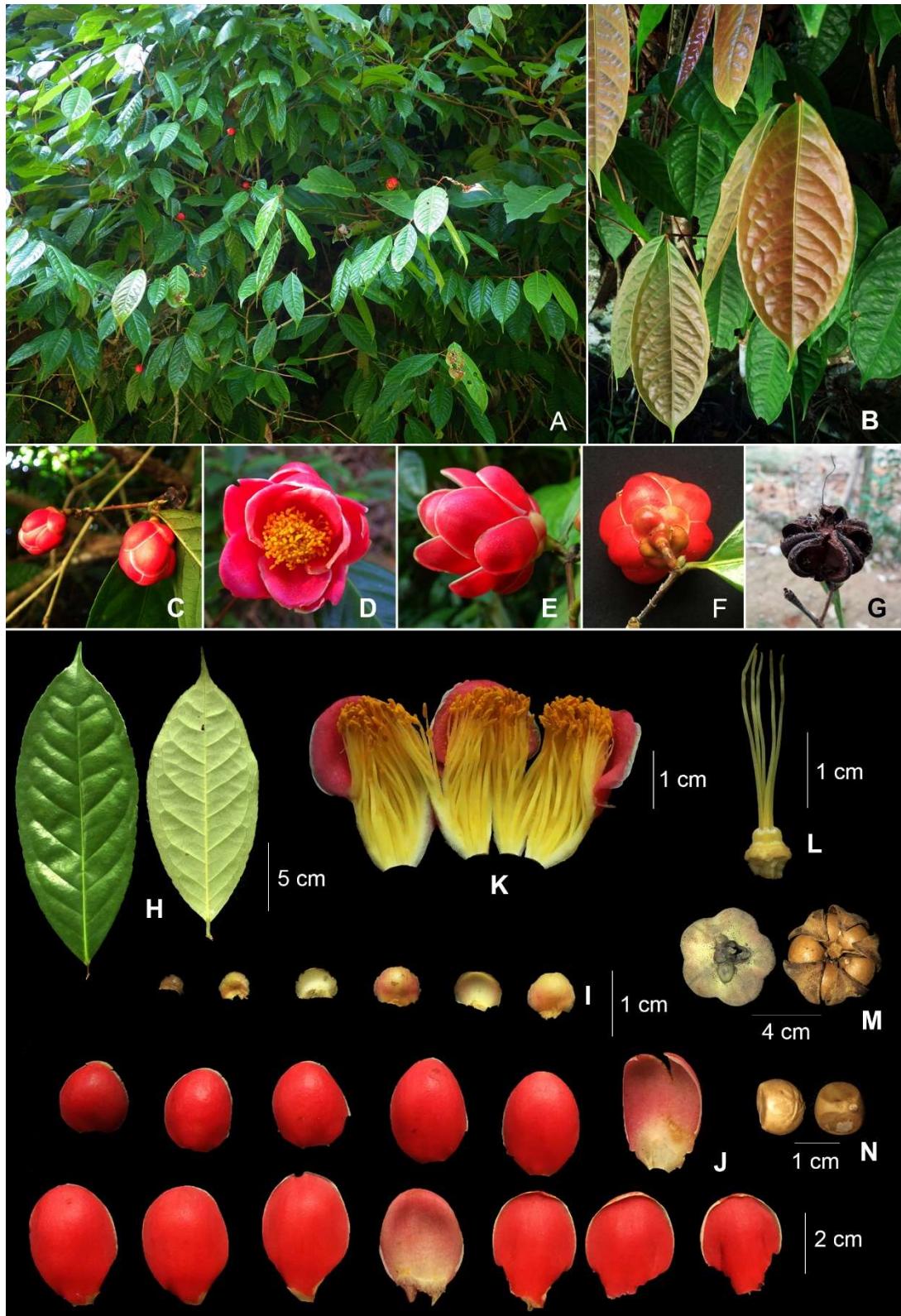


Fig. 2. *Camellia annamensis* N.S.Lý, V.D.Lương, N.Đ.Đỗ, T.H.Lê & T.L.Nguyễn. **A.** Apical part of flowering plant in natural habit; **B.** Juvenile leaves; **C.** Flower buds; **D.** Flower (Front view); **E.** Flower (side view); **F.** Flower (bottom view); **G.** Dried fruit; **H.** Leaves (adaxial and abaxial views); **I.** Sepals (abaxially and adaxially); **J.** Petals (adaxially and abaxially); **K.** Cross-section of androecium showing stamens; **L.** Gynoecium with styles free to the base; **M.** Mature and dried fruits; **N.** Seeds. Photos by Ngọc-Đài Đỗ, the color plate by Ngọc-Sâm Lý.



Table 1. Morphological comparison of *Camellia annamensis* with its closely-related taxa (based on Pierre, 1877; Pham, 2000; Richards et al., 2002, 2003; Orel et al., 2014; Luu et al., 2018).

Characters	<i>C. annamensis</i>	<i>C. longii</i>	<i>C. piquetiana</i>	<i>C. honbaensis</i>
Leaf shape	elliptic to broad elliptic	narrow elliptic to narrow oblong	oblong-elliptic	narrowly lanceolate to oblong-elliptic
Leaf size (cm)	15–20.5 × 5–9	27–31 × 6.0–10.5	29–50 × 9.5–12.5	26–43 × 4.5–10.6
Indumentum of leaf	sparingly appressed puberulous abaxially	glabrous	glabrous	glabrous
Leaf apex	attenuate or narrowly acuminate	cuspidate to acuminate	acuminate, acute, obtusely pointed	acuminate
Leaf base	acute to partially obtuse	variably obtuse to rounded	rounded, obtuse	obtuse
Leaf margins	shallowly and widely denticulate	somewhat serrate	entire	shallowly toothed
Lateral veins	10–13 pairs	14–16(–18) pairs	25–30 pairs	17–26 pairs
Petiole	10–15 mm long, sparingly appressed puberulous	8–11(–13) mm long, glabrous	8–10 mm long, glabrous	20–22 mm long, glabrous
Flower	campanulate, bright red	campanulate, red	rotate, pink, suffused with purple	rotate, red to purplish red
Sepals	5, sparingly appressed velutinous on outer surface	2–3, finely hairy on outer surface	5, pubescent on outer surface	5, finely hairy on outer surface
Petals	20–22, velutinous on the top of outer side	5–6, hairy on outer surface	7 or more, finely hairy on outer surface	7–8, finely hairy on outer surface
Stamens	glabrous	glabrous	inner filaments basally puberulous	inner filaments hairy on basal 2/5 part
Ovary	flattened-globose, 4–5 locular	diamond shaped, 4–6 locular	discoid, 5–(6) locular	ovoid, 3–4 locular
Styles	4–5, free to base, tomentose	5 or 6, compound, proximally fused for 5.0 mm, finely pubescent, distally glabrous	4–6, free to base, densely pubescent	3–4, connate at basal 1/5–1/3 part, free above, hairy on basal ¾ part
Fruit	flattened-globose	unknown	discoid	discoid

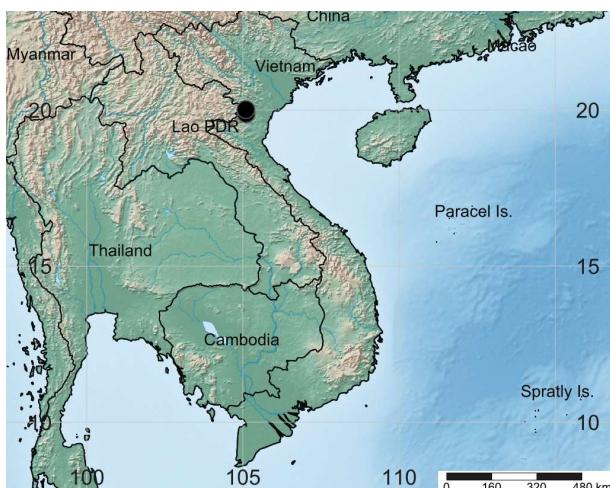


Fig 3. Distribution map of *Camellia annamensis* (●) in Vietnam.

tropical secondary evergreen broad-leaved forests in Pù Hoạt NR at elevations of 260–600 m and Xuân Liên NR at an elevation of around 500 m. The two localities are distanced about 30 km (Fig. 3).

Phenology: Flowering was observed in November to January, fruiting in May to September.

Etymology: The specific epithet “*annamensis*” refers to the former name of central Vietnam.

Preliminary IUCN assessment: At present, three subpopulations of a total of about 120 mature individuals in Pù Hoạt NR were observed and a single population of a total of about 50 mature individuals found in Xuân Liên

NR. The extend of occurrence (EOO) and the area of occupancy (AOO) were calculated to be 7.8 km² and 12 km², respectively. Although the known habitat of the new species is well-protected by Pù Hoạt and Xuân Liên NRs, these populations are highly threatened due to the high market demands for wild flowered camellias which are intensively collected for sale by local people. Based on currently available data, we therefore provisionally assess this species as Endangered (EN B1a,b (i, ii, iii) + 2ab (ii, iii), D) according to the IUCN Red list criteria (IUCN, 2019). Further exploration of the region is required to understand the situation better and amend the conservation status if necessary.

Additional specimens examined (Paratypes):

Vietnam. Nghê An province: Quέ Phong District, Đồng Văn Commune, Pù Hoạt NR, 603 m elev., 05 August 2021, Đỗ Ngọc Đài DND 208; the same locality, 260 m elev., 25 December 2021, Đỗ Ngọc Đài, Lê Thị Hương, Nguyễn Bá Hưng DHH 226 (DLU). Thanh Hóa Province: Thường Xuân District, Yên Nhâm Commune, Xuân Liên NR, 497 m elev., 26 December 2016, Nguyễn Thị Liêu, Đỗ Công Thuận, Lương Văn Dũng, Trần Ninh, Chiyomi Uematsu, Hironori Katayama VN0373 (DLU).

Use: Buds and flowers were harvested to use as tea by the local people and sold in the local market.

Vernacular name (Vietnamese): Chè trung bò.

Taxonomic note: Morphologically, *Camellia annamensis* has characteristics as flowers solitary or geminate on short shoot in the axils of the leaves, flowers pedicellate and nodding, 3–4 persistent bracteoles, 5 persistent sepals, flowers with 20–22 petals that are inner ones basally united with outermost filaments, filaments



glabrous, gynoecium 4–5 locular and tomentose, styles 4–5 and free to the base. These characteristics are not only identical to species of sect. *Piquetia* (Pierre) Sealy (sensu Sealy, 1958; sensu Chang and Bartholomew, 1984), but also share with species of sect. *Archaeacamellia* Sealy, *Heterogenea* Sealy and *Thea* (L.) Dyer which possess hairy or glabrous ovaries, with *Stereocarpus* (Pierre) Sealy and *Theopsis* Cohen-Stuart in having 5–6 or 3–5 perules, and with sect. *Heterogenea* sensu Sealy by basally united filaments (Sealy, 1958; Chang and Bartholomew, 1984; Gao *et al.*, 2005; Ming and Bartholomew, 2007). As characterized by Sealy (1958), sect. *Piquetia* possesses flowers that borne on short shoot in the axils of the leaves, usually 3–5 flowers on a shoot but sometimes 1 only, flowers pedicellate, nodding, pedicel very stout, thickened upwards, 2–3 persistent bracteoles, 5 persistent sepals, 8 or more petals, stamen free above the union with the petals and puberulous inside, densely hairy gynoecium, and 5 or 6 styles (Sealy, 1958). In Vietnam, at least ten species were currently reported in this section: *C. dalatensis* V.D.Luong, Ninh & Hakoda (Tran *et al.*, 2012), *C. dongnaiensis* Orel (Orel, 2006), *C. honbaensis*, *C. langbiangensis* (Gagnep.) Phamhoang (Pham, 1991), *C. longii*, *C. piquetiana*, *C. proensis* V.D.Luong, Doudkin & V.H.Quach (Quach *et al.*, 2021a), *C. sonthaiensis* Luu, V.D.Luong, Q.D.Nguyen & T.Q.T.Nguyen (Luu *et al.*, 2015), and *C. sphamii* Q.C. Truong & V.S. Le (Truong *et al.*, 2022) (Pierre, 1877; Gagnepain, 1939; Sealy, 1958; Pham, 1991; Tran and Luong, 2012; Orel *et al.*, 2014; Luu *et al.*, 2018; Quach *et al.*, 2021a,b; Truong *et al.*, 2022) and this new species. Of which, *C. annamensis* is most similar to *C. longii* in the characters of general vegetative habit, the shape and color of flower, sepals, petals and stamens. The compared characters between them are given in the above diagnostic and Table 1. *Camellia annamensis* is also similar to *C. honbaensis* and *C. piquetiana* in having somewhat red flower, 5 sepals hairy on the outer surface and hairy ovary. The two latter can be distinguished from the new species by their leaf shape, the laminae that are larger size, glabrous and the numerous lateral veins, the glabrous petioles, the rotate flowers, the inner filaments that are basally hairy, and the mature fruits that are discoid and lobulate (Table 1). *Camellia dalatensis*, *C. sonthaiensis* and *C. proensis* are easily distinguishable from the new species by the light-yellow flower, while *C. dongnaiensis* Orel is distinguished from *C. annamensis* by the flower that are 3 sepals and yellow apricot to intensely pink petals. Moreover, the somewhat elliptic leaves, large campanulate flower, glabrous stamens, free styles and tomentose ovary of the new species also recall to *C. campanulata* Orel, Curry & Luu of the sect. *Lecomtia* Orel (Orel and Curry, 2015) but the latter is different in having larger and glabrous leaves of 30–38 × 7.5–8.5(–9) cm, red to orange flowers with blotched, 3 sepals, and 6 petals with cream margins, arranged in 2 whorls of 3.

Key to the species of *Camellia* sect. *Piquetia*

- | | |
|---|--------------------------|
| 1a. Flowers red or (red-)purple | 2 |
| 1b. Flowers yellow or yellow with pink pigmentation on edges | 5 |
| 2a. Flowers (red-)purple | <i>C. piquetiana</i> |
| 2b. Flowers red | 3 |
| 3a. Ovary 3-carpellate | <i>C. honbaensis</i> |
| 3b. Ovary 4–5-carpellate | 4 |
| 4a. Sepals 2–3; petals 5–6, hairy on outer surface | <i>C. longii</i> |
| 4b. Sepals 5; petals 20–22, velutinous on the top of outer side | <i>C. annamensis</i> |
| 5a. Flowers yellow with pink pigmentation on edges | 6 |
| 5b. Flowers yellow | 7 |
| 6a. Flower campanulate; petals 8 | <i>C. dongnaiensis</i> |
| 6b. Flower rotate; petals 10–11 | <i>C. langbiangensis</i> |
| 7a. Young branches and leaves hairy | <i>C. dalatensis</i> |
| 7b. Young branches and leaves glabrous | 8 |
| 8a. Leaves cordate at base | <i>C. sphamii</i> |
| 8b. Leaves rounded or acute at base | 9 |
| 9a. Leaves narrowly lanceolate; capsular 3.0–3.5 × 1.5–2.0 cm | <i>C. sonthaiensis</i> |
| 9b. Leaves oblong-elliptic; capsular 8.5–10.0 × 4.0–5.5 cm | <i>C. proensis</i> |

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