

New species of *Peliosanthes*, *Rohdea* and *Tupistra* (Asparagaceae) from Laos and Vietnam

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We describe and illustrate four new species, *Peliosanthes choriandra*, *P. tatianae* and *Tupistra orlovii* from central to northern Laos, and *Rohdea filosa* from northern Vietnam. These are all very local in distribution and endemic to the respective countries. We also report new localities and their ecological conditions for five other species of *Peliosanthes* (*P. argenteostriata*, *P. hirsuta*, *P. irinae*, *P. micrantha* and *P. nivea*) recently described from Laos and/or Vietnam. Furthermore, *Peliosanthes nivea* is recorded as new to the flora of Laos.

Peliosanthes Andrews, *Rohdea* Roth and *Tupistra* Ker Gawl., which are currently usually referred to Asparagaceae (APG 2016), are indigenous to Asia. Within Asia, *Peliosanthes* and *Tupistra* occur mainly in subtropical to tropical regions (Jessop 1976, Tanaka 2010a), and *Rohdea* in warm temperate to subtropical regions (Tanaka 2010b). Taxonomic studies on these genera in subtropical or tropical regions have been conducted by many botanists (Baker 1879, Hooker 1892, Ridley 1898, 1924, Rodriguez 1934, Larsen 1966, Jessop 1976, Tanaka 1999, 2003a, 2003b, 2003c, 2004a, 2004b, 2010a, 2010b, 2010c, 2010d, Shaw 2009, Averyanov 2011, Averyanov and Tanaka 2012, 2013, Averyanov et al. 2013, 2014, 2015a, 2015b, 2016a, 2016b, Vislobokov 2016, Nguyen et al. 2017, Odyuo et al. 2017, Roy et al. 2017). Their results mostly included the discovery of new taxa. Judging from the recent rapid increase of new taxa especially in *Peliosanthes* and *Tupistra*, our knowledge of the three genera in the regions still seems fairly insufficient.

With the aim to elucidate their diversity, principally in eastern Indochina, we have been conducting both field and laboratory studies. In our recent surveys in Laos and Vietnam, we encountered four unusual plants belonging to *Peliosanthes*, *Rohdea* or *Tupistra*. After a close examination, we found that they are new species. In this paper we describe and illustrate them under the name of *P. choriandra*, *P. tatianae*, *T. orlovii* or *R. filosa*. The first three species (two *Peliosanthes* and one *Tupistra*) are from central or northern Laos, and the last one (*Rohdea*) is from northern Vietnam. We also report here new localities and their ecological conditions

for five other species of *Peliosanthes*, *P. argenteostriata*, *P. hirsuta*, *P. irinae*, *P. micrantha* and *P. nivea*, recently described from Laos and/or Vietnam. There is no doubt that these data improve the accuracy of our knowledge of the distributional range and conservation status of the respective species.

Methods adopted in this research are the same as stated in our previous paper (Averyanov et al. 2016a).

Peliosanthes argenteostriata Aver. et N. Tanaka (2012, p. 153, Fig. 1, 2A, B) (Fig. 1)

Type: Central Vietnam “Vietnam, Quang Binh province, Minh Hoa district, Thuong Hoa municipality, about 1.0–1.5 km to southwest of Ban On village, Ca Xach Mountain around point 17°39′20″N, 105°57′42″E (Phong Nha–Ke Bang national park), primary closed evergreen broad-leaved gnarled stunted forest along rocky ridge composed of solid marble-like highly eroded crystalline limestone at elevations 600–800 m a.s.l., terrestrial or lithophytic herb on very steep rocky slope, 20 Jan 2005, L. Averyanov et al., HAL 5975” (holotype: CPC!, isotypes: HN!, LE!, MO!).

Habitat and phenology

Primary or secondary humid evergreen broad-leaved or mixed forests on any parental rocks at elevations 150–1000 m a.s.l. Terrestrial or lithophytic herb in shady palaces, common on steep rocky slopes and cliffs. Flowering in January–April, fruiting in August–October.



Figure 1. *Peliosanthes argenteostriata*. Digital specimen, 0284/LA-VN 288. Photos, correction and design by L. Averyanov.

Distribution and conservation

Laos (Kham Mouan province: Bounlapha district; Luang Prabang province: Ngoy and Pon Xay districts; Vientiane province: Vang Vieng district), Vietnam (Quang Binh province: Minh Hoa district). In observed locations locally common. Estimated IUCN red list status: ‘Least concern’ (LC).

Notes

Peliosanthes argenteostriata was earlier reported only from Vientiane province of central Laos and Quang Binh province of central Vietnam (Averyanov and Tanaka 2012). Lately we have found it also occurring in Khan Mouan province and Luang Prabang province in central or northern Laos.

The flowers of our earlier collections (including the type) are subsessile (Averyanov and Tanaka 2012), while our new collections from Kham Mouan province have shortly pedicellate flowers (Fig. 1). Thus, local variation exists at least in the pedicel character of this species.

Additional specimens studied

Laos, Kham Mouan Prov., Bounlapha Distr., Thong Sam village, Hinnam No Protected Area, Pu Pha Song Mt. composed of sandstone, around point 17°35'13.2"N, 105°47'49.8"E, primary evergreen broad-leaved and mixed forest on west macroslope at elevation from 600 m to the mountain top elevated to 1420 m. Terrestrial herb on shady slopes at elevations 600–1000 m. Leaves very rigid, glossy green, rarely with unclear broad silverfish stripe. Common. LA-VN 288 10 March 2013, flowered in 10 Feb. 2017. L. Averyanov et al. © 2013 CC BY-NC-ND 4.0 International license. LA-VN 288-289

white, corona dark violet, fruits ovoid to 1 cm in diameter, glossy blue, common, 9 Mar 2013, L. Averyanov et al., LA-VN 288, flowered in cult at 10 Feb 2017 (FOF, LE). d-Exsiccates of Vietnamese flora 0284/LA-VN 288 (Fig. 1). Laos, Luang Prabang prov., Ngoy distr., Nong Khiew village, Ta Nang Non Mountain around point 20°33'29.2"N, 102°36'54.5"E, secondary semideciduous or evergreen dry forest on very steep rocky mountain slopes composed of solid marble like highly eroded limestone at elevations 600–650 m a.s.l., terrestrial herb to 1 m tall in shady place of rocky mountain slope, flowers white with greenish tint, common, 31 Mar 2017, L. Averyanov et al., LA-VN 1933 (FOF, LE). Laos, Luang Prabang prov., Ngoy distr., Ngoy village, Pha Noi Mountain, around point 20°42'53.6"N, 102°40'34.7"E, remnants of primary evergreen forest on very steep rocky mountain slopes composed of solid marble like highly eroded limestone at elevations 400–450 m a.s.l., clustering terrestrial herb in shady place between rocks near mossy rocky mountain top, not rare, 1 Apr 2017, L. Averyanov et al., LA-VN 1989 (FOF, LE). Laos, Luang Prabang prov., Pon Xay distr., between Houay Man and Nam Bo villages, Phou Hua Ben Toc Mountain, around point 19°57'33.1"N, 102°25'25.8"E, degraded primary evergreen or semideciduous forest on very steep rocky mountain slopes composed of solid marble like highly eroded limestone at elevations 500–650 m a.s.l., terrestrial rosulate herb on shady rocky mountain slope, flowers light green, corona dull brown, occasional, 5 Apr 2017, L. Averyanov et al., LA-VN 2120 (FOF, LE). Laos, Luang Prabang prov., Pon Xay distr., along the way to Bane Phou Souong village, Pha Hiua Bin Toc Mountain, around point 19°57'37.0"N, 102°25'03.0"E, degraded primary evergreen and semideciduous forest on very steep rocky mountain slopes composed by solid marble like highly eroded limestone at elevations 600–850 m a.s.l., terrestrial rosulate herb on shady rocky slope, flowers light green, corona dull brown-olive, occasional, 5 Apr 2017, L. Averyanov et al., LA-VN 2141 (FOF, LE).

***Peliosanthes choriandra* Aver., N. Tanaka et K. S. Nguyen sp. nov. (Fig. 2–3)**

Type: Laos, Luang Prabang province, Pon Xay district, Houay Man village, Phou Pak Sang Mountain, around point 19°59'03.8"N, 102°25'09.0"E, degraded primary evergreen or semideciduous forest on very steep rocky mountain slopes composed of solid marble like highly eroded limestone at elevations 1000–1150 m a.s.l., terrestrial herb on steep shady rocky mountain slope, occasional, 4 Apr 2017, L. Averyanov, N. T. Hiep, N. S. Khang, C. Q. Ngan, T. Maisak, Vichith Lamxay, Koudkeo Phommachanh, Phizar Sayalath, Keooudone Souvannakhoummane, LA-VN 2059 (holotype: LE, isotype: FOF, HN). d-Exsiccates of Vietnamese flora 0282/LA-VN 2059 (Fig. 2).

Etymology

The epithet refers to the free state of stamens in fully open flowers.

Description

Terrestrial or occasionally lithophytic, rhizomatous perennial herb. Rhizome subterranean, ascending or suberect, simple or

few-branched, (2.5)3.0–5.0(6.0) cm long, (2.5)3.0–4.5(5.5) mm in diameter, distinctly inflated at nodes, bearing few rigid, light gray-brown wiry roots. Stems erect, (4)6–8(10) mm long, covered with fibrous, papyraceous or scarios, whitish or brownish remnants of scales (cataphylls) to 12 cm long, 1 cm wide. Leaves petiolate; petioles erect to suberect, rigid, (25)30–40(45) cm long, adaxially canaliculate; blades elliptic, (16)18–22(24) cm long, (3.5)4.0–6.0(6.5) cm wide, entire, distally shortly acuminate with acute apex, glabrous, glossy, uniformly green on both sides; longitudinal veins many, prominent, secondary transversal veinlets hardly visible. Flowering stem axillary, bearing a raceme; peduncle and rachis green to olive-green, sometimes with light dull gray-violet tint; peduncle erect, straight or slightly curved, (3)4–5(6) cm long, 2.5–3.0 mm in diameter, bracteate; sterile bracts on peduncle several, narrowly triangular, acuminate, light greenish to almost whitish, scarios, (1.0)1.4–2.0(2.4) cm long and (1.0)1.2–3.0(3.5) mm wide; rachis much longer than the peduncle, (16)18–22(24) cm long, laxly many-flowered. Floral bracts usually 2 (bract and bracteole) per flower; bract located below flower, reducing in size upward, whitish, scarios, narrowly lanceolate-triangular or subulate, (1.6)2.0–6.0(8.0) mm long, (0.2)0.3–1.4(1.6) mm wide, slightly concave toward base, distally acute or acuminate; bracteole subulate, scarios, much smaller than bracts, caducous and somewhat obsolete. Flowers solitary in bracteal axil, pedicellate, broadly open, (5.8)6.0(6.4) mm across, nutant; pedicel arising from short, somewhat broader node on rachis, ascending to horizontal, straight or very slightly decurved, terete, (2.0)2.2–4.8(5.2) mm long, (0.4)0.6–0.8(0.9) mm in diameter. Perianth funnellform, distally 6-cleft, green, deeper distally; basal syntepalous part narrowly funnellform, (2.4)3.0–4.0(4.2) mm long, (1.6)1.8(2.0) mm across at apex; segments 6, obliquely expanded, the inner 3 slightly smaller than the outer 3, ovate, (2.2)2.4–2.6(2.8) mm long, (1.4)1.5–1.6(1.8) mm wide, entire and sometimes whitish at margin, obtuse. Stamens 6, strongly connivent forming a broadly ovoid or dome-shaped, corona-like structure (1.4)1.6–1.8(2.0) mm high, (2.2)2.4–2.6(2.8) mm broad at base; filaments narrowly triangular-ovate, (1.4)1.6–1.8(2.0) mm long, (0.6)0.7–0.8(0.9) mm wide at base, proximally connate in bud stage or at earliest stage of flowering, but becoming free in fully open flowers, distally free, rounded at apex, fleshy, green to dark green, the outer 3 distinctly shorter and often slightly incurved than the inner 3. Anthers 6, dorsally affixed to apical inside of coronal segment, ovoid, (0.8)1.0(1.2) mm long, 0.7–0.8 mm wide, introrse, light dull yellowish to almost white, the outer 3 anthers sometimes largely hidden under coronal segment. Ovary inferior; apically nearly flat, concave at center, (1.2)1.4–1.5(1.6) mm in diameter; the interior imperfectly partitioned into 3 locules by 3 septa; 2 ovules borne on axial base of each locule; style cylindrical, usually twisted, (1.8)2.0–2.2(2.4) mm long, 0.4–0.5 mm in diameter at base; stigma small, tripartite.

Habitat and phenology

Shady, primary or secondary, evergreen or semideciduous broad-leaved forests on very steep rocky mountain slopes composed of solid marble like highly eroded limestone at elevations 1000–1200 m a.s.l. Terrestrial or occasionally lithophytic herb. Flowering in March–April.

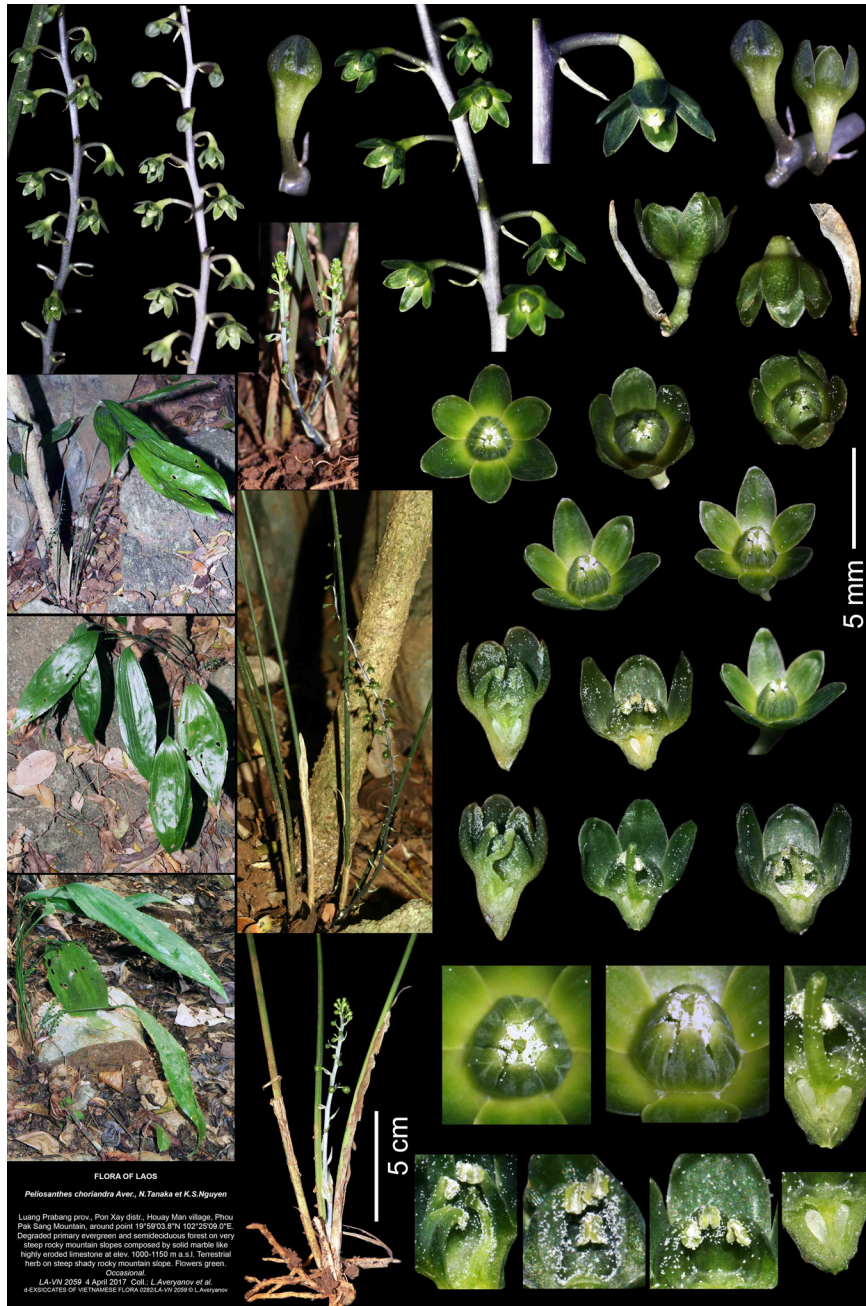


Figure 2. *Peliosanthes choriandra* sp. nov. Digital epitype, 0282/LA-VN 2059. Photos by L. Averyanov and K. S. Nguyen, correction and design by L. Averyanov.

Distribution and conservation

Endemic of northern Laos (Luang Prabang province, Pon Xay district). In studied locations occasional. Estimated IUCN red list status: ‘Data Deficient’ (DD).

Similar species

Peliosanthes choriandra is most closely allied to *P. weberi* (L. Rodr.) N. Tanaka (Tanaka 2004b), but differs by the longer flowering stem (usually over 19 cm long vs under ca 15 cm long), flowers often subtended by 1 bract (bracteoles caducous or often lacking), deeper green perianths, and filaments free in fully open flowers and forming a somewhat higher dome-shaped coronal structure (vs

filaments at least proximally connate and forming a somewhat low corona).

Additional specimens examined (paratypes)

Laos, Luang Prabang province, Pon Xay district, Houay Man village, Phou Pak Sang Mountain, around point 19°59′03.8″N, 102°25′09.0″E, degraded primary evergreen or semideciduous forest on very steep rocky mountain slopes composed of solid marble like highly eroded limestone at elevations 1000–1150 m a.s.l., terrestrial herb on steep shady rocky mountain slope, occasional, 4 Apr 2017, L. Averyanov, N. T. Hiep, N. S. Khang, C. Q. Ngan, T. Maisak, Vichith Lamxay, Koudkeo Phommachanh, Phizar

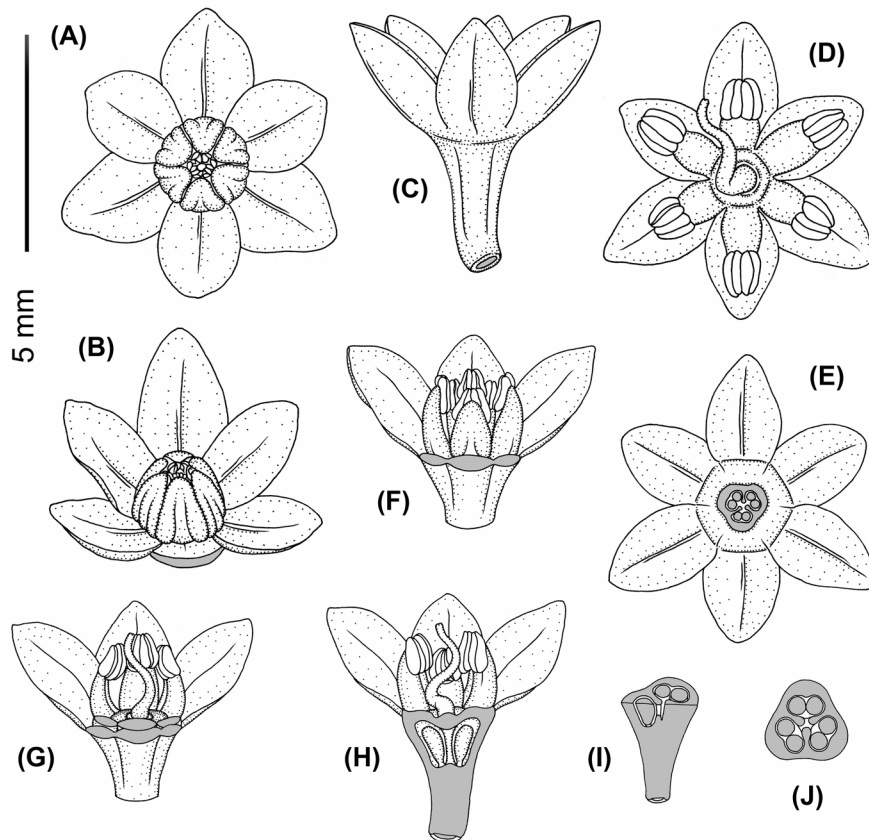


Figure 3. *Peliosanthes choriandra* sp. nov. (A) flower, front view, (B) flower, obliquely upper view, (C) flower, side view, (D) flattened flower, front view, (E) flattened flower cross-sectioned at ovary, rear view, (F) flower with three tepals removed, side view, (G) flower with three tepals and three stamens removed, side view, (H) flowers, sagittal section, side view, (I) sagittal and transversal section of ovary, (J) transversal section of ovary. Drawn from the type LA-VN 2059 by L. Averyanov.

Sayalath, Keooudone Souvannakhoummane, LA-VN 2051 (FOF, HN, LE).

***Peliosanthes hirsuta* Aver. & N. Tanaka in Nguyen et al. (2017, p. 200, Fig. 1–2)**

Type: Laos, “Vientiane province, Kasi town area, about 40 km to the north by old road Kasi – Louangphabang, evergreen shady forest on slope of Nam Kean River at lower western slope of Ph Phaday Mountain at elevation about 700 m a.s.l., 30 Nov 2014, E. Konstantinov, K-305” (LE!).

Habitat and phenology

Primary or secondary broad-leaved evergreen or semideciduous dry forests on limestone at elevations 500–1000 m a.s.l.; terrestrial or lithophytic herb on shady rocky slopes. Flowering in November–December.

Distribution and conservation

Endemic of Laos (Vientiane province, Kasi and Vang Vieng districts). In observed locations locally common. Estimated IUCN red list status: ‘Data Deficient’ (DD). This species was known only from the type locality (Nguyen et al. 2017), but our latest field surveys have found that it is not so rare in the limestone areas of central Laos.

Additional specimens studied

Laos, Vientiane province, Vang Vieng district, Pha Hom village, around point 19°06′52.4″N, 102°22′35.8″E, secondary broad-leaved evergreen and semideciduous dry forest with on very steep rocky mountain slopes composed by solid marble like highly eroded limestone at elevations 550–650 m a.s.l., terrestrial or lithophytic herb on shady rocky steep slope, leaves dark glossy green, often with whitish longitudinal unclear stripe, locally common, 22 Mar 2017, L. Averyanov et al., LA-VN 1514 (FOF, LE), LA-VN 1523 (FOF, LE). Laos, Vientiane province, Vang Vieng district, Patang village, around point 19°04′15.6″N, 102°24′33.2″E, secondary broad-leaved semi-deciduous dry forest on very steep rocky mountain slopes composed by solid marble like highly eroded limestone at elevation about 670 m a.s.l., terrestrial and lithophytic herb in shady place, leaves dark glossy green with indistinct central whitish stripe, not common, 23 Mar 2017, L. Averyanov et al., LA-VN 1577 (FOF, LE). Laos, Vientiane province, Kasi district, Si Sang Vone village, around point 19°06′10.9″N, 102°10′46.1″E, secondary and primary evergreen dry forest on very steep rocky mountain slopes composed by solid marble like highly eroded limestone at elevations 600–750 m a.s.l., terrestrial herb on rocky mountain top, leaves dark uniform green or with whitish central longitudinal stripe, not rare, 28 Mar 2017, L. Averyanov et al., LA-VN 1813 (FOF, LE).

***Peliosanthes irinae* Aver. & N. Tanaka (2015, p. 87)**

Type: Laos, “Vientiane province, Vang Vieng district, Nathong village, about 5 km to the west of Vang Vieng town, Tham Kang Mt, around point 18°55′51.4″N, 102°23′50.6″E at elevations 300–400 m a.s.l., 14 Mar 2013, N. T. Hiep, L. Averyanov, N. S. Khang, P. V. The, S. Lorphengsy, LA-VN 421” (LE).

Habitat and phenology

Primary or secondary broad-leaved evergreen or semideciduous dry forests on any kind of rocks at elevations 300–700 m a.s.l.; terrestrial or lithophytic clustering herb on shady rocky slopes. Flowering in February–May.

Distribution and conservation

Endemic of northern and central Laos (Bolikhamsai province, Thaphabat district; Luang Prabang province, Ngoy district, Vientiane province, Kasi and Vang Vieng districts). In observed locations locally common. Estimated IUCN red list status: ‘Least Concern’ (LC). Previously only known only from the type locality (Averyanov et al. 2015b), but our latest field surveys have shown that it is not so rare in the limestone areas of central Laos.

Additional specimens studied

Laos, Vientiane province, Kasi district, Si Sang Vone village, around point 19°06′10.9″N, 102°10′46.1″E, secondary broad-leaved evergreen dry forest on very steep rocky mountain slopes composed of solid marble like highly eroded limestone at elevations 600–700 m a.s.l., terrestrial herb on shady steep rocky slope, flowers greenish to light dirty violet, spadix axis fleshy, dull olive-violet, fruit glossy blue, locally

common, 28 Mar 2017, L. Averyanov et al., LA-VN 1794 (FOF, LE). Laos, Luang Prabang province, Ngoy district, Don Khun village, near waterfall, around point 20°31′36.9″N, 102°35′15.8″E, remnants of primary evergreen forest on very steep rocky mountain slopes composed of solid marble like highly eroded limestone at elevations 450–550 m a.s.l. along mountain stream, terrestrial herb on shady rocky stream slope, young fruits green, rachis fleshy, dirty violet, occasional, 2 Apr 2017, L. Averyanov et al., LA-VN 2013 (FOF, LE). Laos, Bolikhamsai province, Thaphabat district, Nam Bon village, Phou Khao Khouay national park, Tad Xai Waterfall, around point 18°27′25.9″N, 103°08′17.5″E, degraded primary or secondary evergreen dry forest along river on eroded sandstone at elevation about 340 m a.s.l., terrestrial herb on shady river slope, on sandy soil, old spadix-like inflorescences with sessile flowers, not rare, 11 April 2017, L. Averyanov et al., LA-VN 2201 (FOF, LE).

***Peliosanthes micrantha* Aver. & N. Tanaka (2013, p. 5, Fig. 1) (Fig. 4 A, B)**

Type: Vietnam “southern Vietnam, 24 April 2012, L. V. Averyanov, s.n.” (LE).

Habitat and phenology

Terrestrial clustering herb in shady places of primary or secondary broad-leaved evergreen mountain forests. Flowering in April–June.

Distribution and conservation

Endemic of southern Vietnam (Dak Nong province). There is no verified data on species rarity. Estimated IUCN red list status: ‘Data Deficient’ (DD). This species was known

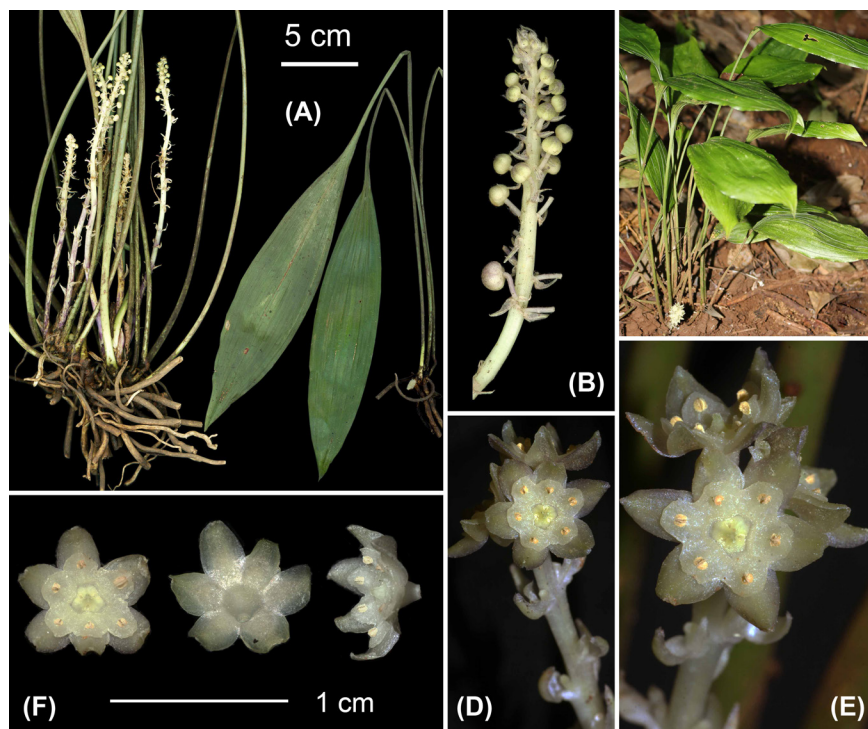


Figure 4. (A)–(B) *Peliosanthes micrantha* from natural habitat (June 2017, Quynh Nga Nguyen, s.n.), (C)–(F) *Peliosanthes tatianae* sp. nov. in and from natural habitat (Type specimen: LA-VN 1607). Photos by L. Averyanov, K. S. Nguyen and Q. N. Nguyen, correction and design by L. Averyanov.

only by the type specimen that was prepared from cultivated plants imported from southern Vietnam (Averyanov and Tanaka 2013). The exact locality of the species had remained unknown. However, we have lately confirmed that it occurs naturally on the Central Highlands in southern Vietnam.

Additional specimens examined

Vietnam, Dak Nong province, June 2017, Quynh Nga Nguyen, s.n. (LE, photo).

***Peliosanthes nivea* Aver. & N. Tanaka (2012, p. 157, Fig. 3) (Fig. 5)**

Type: Vietnam “Quang Tri prov., Huong Hoa distr., Huong Viet municipality around point 16°51’06”N, 106°34’38”E,

partially destroyed primary broad-leaved evergreen forest on very steep rocky slopes of remnant hills composed of solid highly eroded crystalline limestone at elevations 600–700 m a.s.l., terrestrial and lithophytic herb on shady rocky slope and cliffs, 8 May 2011, L. Averyanov, P. K. Loc, N. Q. Hieu, P. V. The, N. T. Vinh, CPC 2953” (holotype: CPC, isotype: LE).

Habitat and phenology

Terrestrial or lithophytic herb in shady humid places of primary or secondary broad-leaved evergreen lowland dry forests with bamboo on basalt and limestone at elevations 150–700 m a.s.l.. Flowering in March–May.

Distribution and conservation

Laos (Khammouane province, Thakhek district), Vietnam. In observed locations locally common. Estimated IUCN

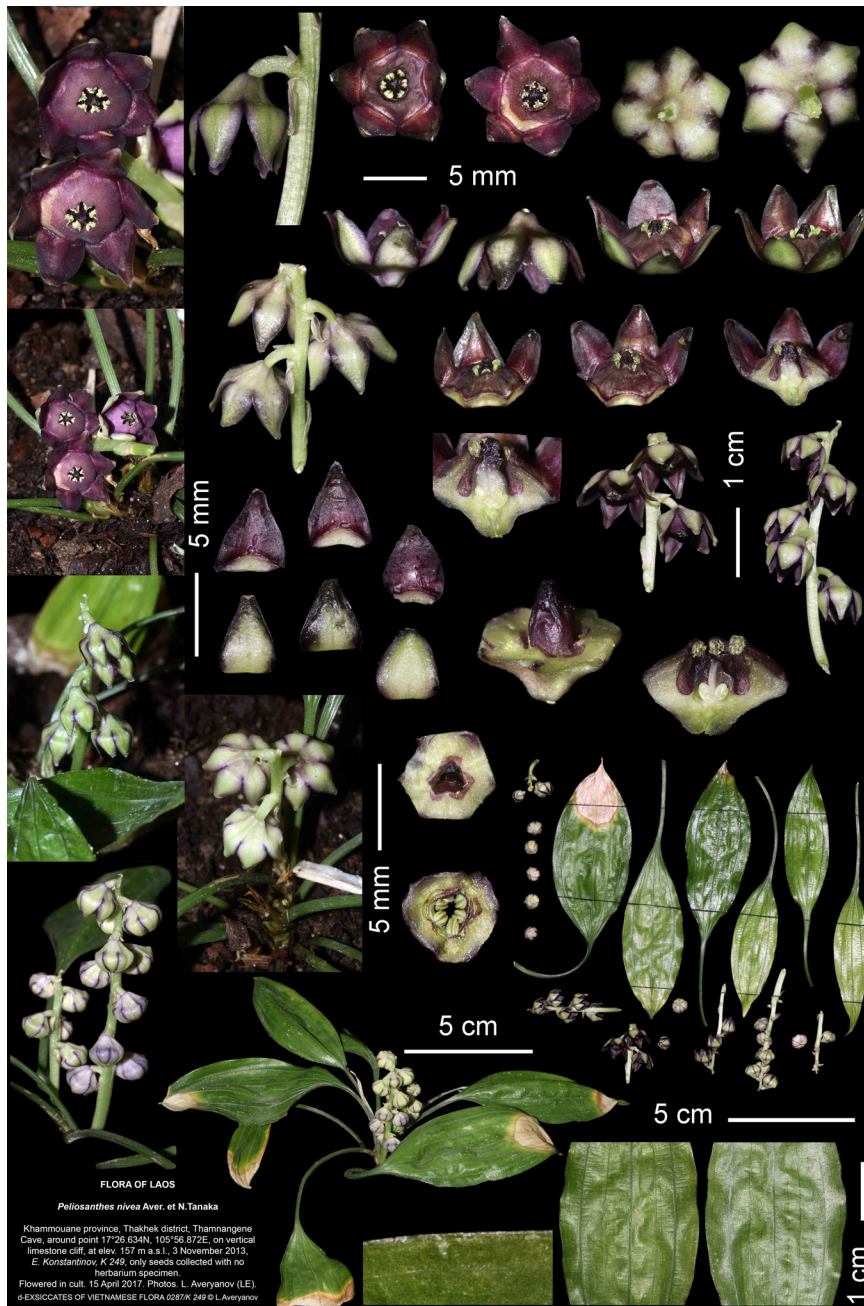


Figure 5. *Peliosanthes nivea*. Digital specimen, 0287/LA-VN 138a. Photos, correction and design by L. Averyanov.

red list status: 'Data Deficient' (DD). *Peliosanthes nivea* was previously known only from central Vietnam, Quang Tri province, Huong Hoa district (Averyanov and Tanaka 2012). However, we have lately confirmed that it also occurs in the central part of Laos.

Notes

Compared with the plants from Vietnam, the plants collected from Laos appear to have an externally less purely white perianth with somewhat more widely expanding segments (Fig. 5).

Additional specimens studied

Laos, Khammouane province, Thakhek district, Thamnan-gene Cave, around point 17°26.634'N, 105°56.872'E, on

vertical limestone cliff, at elevation about 157 m a.s.l., 3 Nov 2013, E. Konstantinov, K 249, seeds collected. Flowered in cultivation, 15 Apr 2017. L. Averyanov (LE). d-Exsiccates of Vietnamese flora 0287/K 249 (Fig. 5).

***Peliosanthes tatianae* Aver., N. Tanaka & K. S. Nguyen sp. nov. (Fig. 4 C–F, 6)**

Type: Laos “Vientiane province, Vang Vieng district, Patang village, around point 19°04'15.6"N, 102°24'33.2"E, secondary broad-leaved semi-deciduous dry forest on very steep rocky mountain slopes composed of solid marble like highly eroded limestone at elevations 600–700 m a.s.l., terrestrial herb on shady steep slope, not rare, 23 Mar 2017,

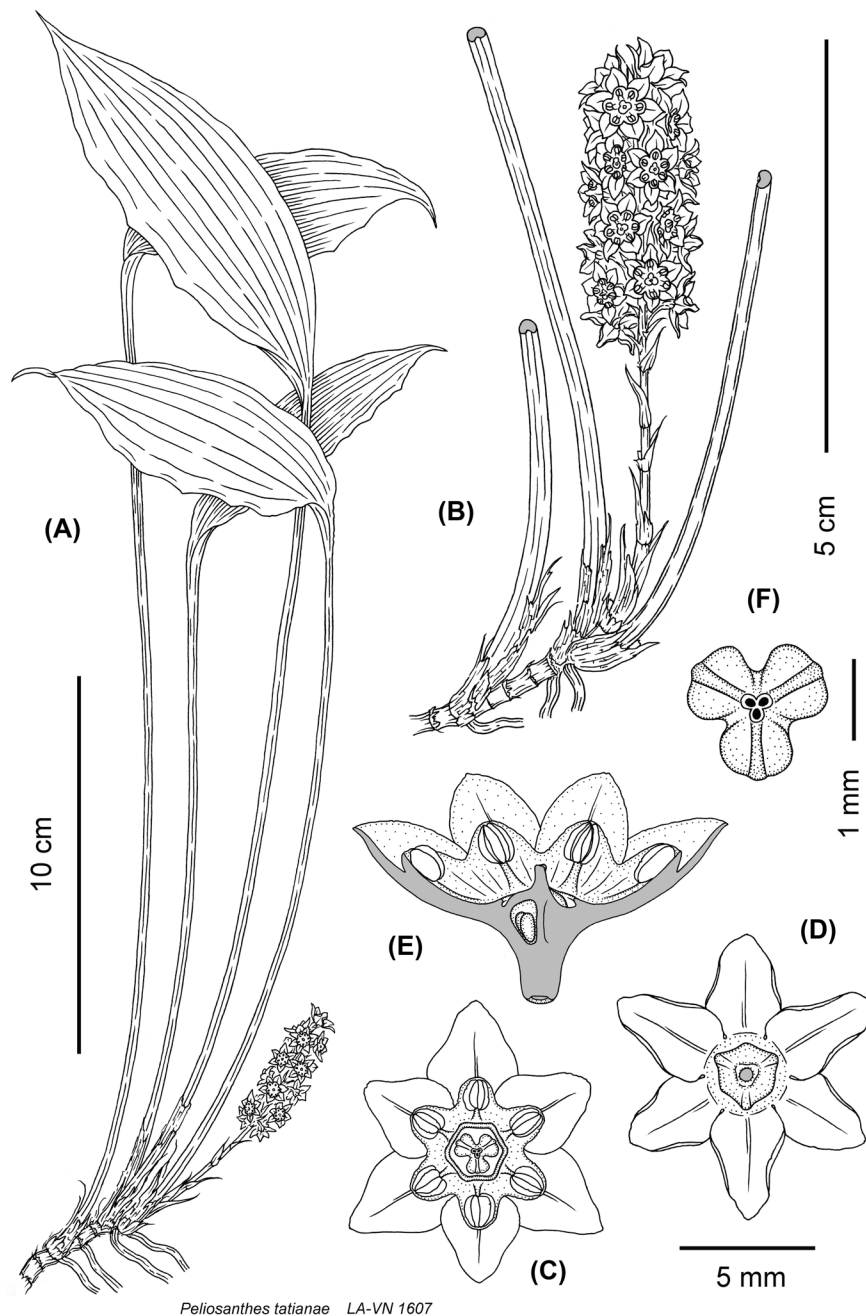


Figure 6. *Peliosanthes tatianae* sp. nov. (A) plant habit, (B) apical portion of rhizome with inflorescence, (C) flower, front view, (D) flower, rear view, (E) flower, sagittal section, (F) pistil, upper (front) view. Drawn from the type LA-VN 1607 by L. Averyanov.

L. Averyanov, N. T. Hiep, N. S. Khang, C. Q. Ngan, T. Maisak, Khamla Inkhavilay, Hongthong Southyvohanh, Pinmany Sisavath, Chanthala Cheuaysamphanh, LA-VN 1607” (holotype: LE, isotype: FOF, HN).

Etymology

The specific epithet honors Mrs Tatiana V. Maisak, the discoverer of the plant and an excellent orchid grower at the Peter the Great Botanical Garden of the Komarov Botanical Institute (Russian Academy of Sciences).

Description

Terrestrial or occasionally lithophytic, acaulescent rhizomatous perennial herb. Rhizome subterranean, subrepent, apically ascending, simple or few-branched, (2)3–5(7) cm long, partially covered with scarious or papyraceous remnants of cataphylls, bearing few, distant, semi-woody, dull light yellowish-brown wiry roots. Leaves (2)3–4(5), arising from apical part of rhizome, foliar internodes elongating up to 2 cm with age, petiolate; petioles rigid, (18)20–24(26) cm long, (2.0)2.2–3.0(3.5) mm in diameter, adaxially canaliculate; blades tend to be somewhat horizontally spreading, elliptic, (8)9–12(14) cm long, (4.0)4.5–5.5(6.0) cm wide, distally shortly acuminate with acute apex, entire, glabrous, uniformly green on both sides, glossy; longitudinal veins many, prominent, secondary veinlets subperpendicular to longitudinal veins, hardly visible. Flowering stem axillary, bearing a terminal raceme, white; peduncle ascending or erect, straight or slightly curved, rather slender, (2.5)3.0–4.0(5.0) cm long, 1.5–2.0 mm in diameter, bracteate; sterile bracts on peduncle several, triangular ovate, (2)3–6(8) mm long, (0.8)1.0–2.0(3.0) mm wide, shortly acuminate, whitish, scarious; rachis many-flowered, (3.0)3.5–5.0(5.5) cm long, finely angulate longitudinally. Floral bracts on rachis diminishing in size upward, 2 per flower (bract and bracteole), pure white, scarious; bracts located below flower, antrorse, narrowly triangular, (1.5)2.0–3.5(4.0) mm long, (0.4)0.5–1.2(1.4) mm wide, acuminate, slightly concave; bracteoles lateral to flower, subsimilar to bracts in shape, twice smaller. Flowers solitary in bracteal axil, more or less antrorse, shortly pedicellate, widely open. Perianth hypocrateriform, distally 6-cleft, (8.5)9.0–10.0(11.0) mm across, white or tinged with light dull yellow-green; proximal syntepalous part shortly hypocrateriform (or broadly funnellform), (0.8)1.0–1.2(1.3) mm long, (1.6)1.8–2.0(2.2) mm across, basally jointed with articulation to erect or suberect terete pedicel 0.8–1.2 mm long, 0.5–0.7 mm in diameter; distal segments ovate, (2.6)2.8–3.2(3.8) mm long, (2.2)2.4–2.6(2.8) mm wide, entire, obtuse, somewhat revolute. Staminal corona patelliform-cupulate, (0.9)1.0(1.1) mm high, (4.8)5.0–5.5(5.8) mm across, proximally shortly raised forming low wall around ovarian base, distally 6-cleft, whitish, dorsally adnate broadly to perianth except distal marginal portion; segments broadly ovate, apically rounded, (0.9)1.0(1.1) mm long, (1.3)1.4–1.6(1.7) mm wide. Anthers 6, sessile, dorsally adnate to middle portion of coronal segments, ovoid, bi-locular, (1.0)1.1(1.2) mm long, (0.7)0.8(0.9) mm wide, introrse, light dull yellow. Pistil 1, tri-carpellate, subconic with abruptly narrowed style, semi-inferior, distal free portion 0.8–1.0 mm high and wide (at base); ovary deeply tri-lobed, tri-locular, each locule bearing

2 ovules at axial base; style conoid, tri-lobed; stigma tripartite with elliptic segments, distally curved downward, finely papillulate.

Habitat and phenology

Terrestrial or occasionally lithophytic herb in shady, primary or secondary, evergreen or semideciduous broad-leaved forests on rocky limestone at elevations 600–800 m a.s.l. Flowering in March–April.

Distribution and conservation

Endemic to lowland limestone areas of central Laos (Vientiane province, Vang Vieng district). In observed locations not common. Estimated IUCN red list status: ‘Data Deficient’ (DD).

Similar species

Peliosanthes tatianae is most closely allied to *P. separata* Vislobokov (2016) described from central Laos in having a staminal corona dorsally adnate broadly to the perianth, but is clearly distinguishable mainly by the more strongly expanded, shallowly cupulate (or patellate), whitish perianth (vs crateriform or turbinate, pale yellowish green perianth), more strongly expanded, more shallowly lobed, whitish corona (vs deeply lobed, pale yellowish corona), anthers attached to the middle portion of the coronal segments (vs anthers attached to the distal portion of the coronal segments), and more deeply trilobed ovary.

Peliosanthes tatianae may also be related to *P. subcoronata* N. Tanaka (Tanaka 1999) described from Laos in having a strongly expanded corona dorsally adnate broadly to the perianth. However, the two species differ in several respects. For instance, the corona of *P. tatianae* is significantly more deeply lobed distally.

The corona that is dorsally adnate broadly to the perianth of *Peliosanthes tatianae* may be viewed as an apomorphy derived from a normal staminal corona shared by many other congeners.

Additional specimens examined (paratypes)

Laos, Vientiane province, Vang Vieng district, Pha Hom village, around point 19°05′57.0″N, 102°23′19.9″E, secondary broad-leaved evergreen and semideciduous dry forest with on very steep rocky mountain slopes composed by solid marble like highly eroded limestone at elevations 650–750 m a.s.l., terrestrial clustering herb on steep shady rocky slope, occasional, 22 Mar 2017, L. Averyanov et al., LA-VN 1551 (holotype: LE, isotype: FOF, HN).

Rohdea filosa Aver. et N. Tanaka sp. nov. (Fig. 7)

Type: Vietnam, Tuyen Quang province “25 Apr 2017, L. Averyanov, CPC 5299a” (holotype: LE, isotype: LE). Type herbarium specimens prepared from cultivated plant originated from northern Vietnam – Vietnam, Tuyen Quang province, Na Hang district, Sinh Long municipality, Khuoi Phin village, around point 22°38′21.9″N, 105°20′43.5″E, primary evergreen mixed humid forest on rocky limestone on highly eroded karstic hills composed of gray solid marble-like limestone at elevations 1100–1200 m a.s.l., terrestrial or lithophytic rosulate herb with ascending rhizome to 0.5 m

long, fruits globular, dark green, 1-seeded, locally very common, 29 Sep 2013, L. Averyanov, N. T. Hiep, L. M. Tuan, N. S. Khang, D. V. Cuong, N. V. Truong, T. Maisak, L. Osinovets, CPC 5299 (paratypes: Herbarium of the Center for Plant Conservation, LE).

Etymology

The species epithet refers to the perianth segments terminating in a thread.

Description

Terrestrial or lithophytic perennial herb. Stem yellowish-brown to brown, to 0.5 m long, terete, proximally rhizomatous, creeping, distally ascending and erect, unbranching,

thick and fleshy, (1.5)2.0–2.5(3.0) cm in diameter; apical part densely covered with foliar bases; older part almost naked, closely annulate with many leaf scars, producing several rigid, woody wiry roots. Cataphylls (sheath leaves) (0)1–3(4) at base of annual tuft of foliage leaves, equitant, narrowly triangular, acute, 7–10(30) cm long, 1.0–1.5 cm wide, abruptly widened at base to 5–6 cm wide. Leaves (6)8–12(14), distichous, equitant, oblanceolate or oblong elliptic, (0.5)0.6–1.0(1.2) m long, (6)7–9(11) cm wide, gradually tapering to thick, petiole-like, conduplicate basal part, acute to shortly acuminate at apex, recurved, leathery, uniformly green, midvein thick and wide. Peduncle axillary in apical part of stem, at base with 1–2 bract-like, narrowly triangular, acuminate sheath leaves (8)12–14(16) cm long and 1.5–2.5 cm

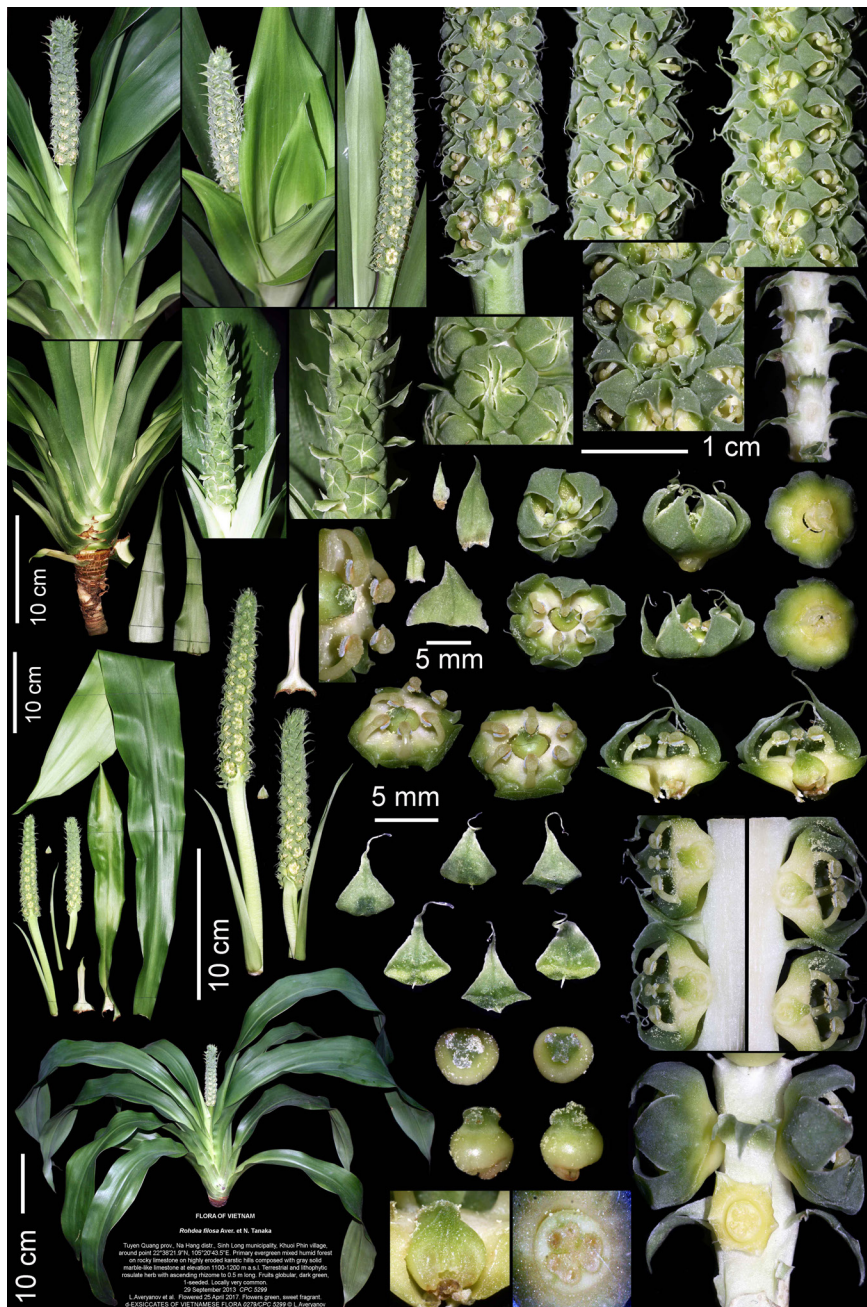


Figure 7. *Robdea filosa* sp. nov. Digital epitype, 0279/CPC 5299. Photos, correction and design by L. Averyanov.

wide, naked, erect, straight, rigid, subterete, irregularly angled in cross section, (4)5–14(16) cm long, (5)6–7(8) mm in diameter. Inflorescence a terminal, cylindrical, densely many-flowered, spadix-like spike (8)10–14(16) cm long and (1.5)1.8–2.0(2.2) cm in diameter, apical part cristate with sterile bracts; rachis fleshy, longitudinally angled, with shallow floral pits. Floral bracts 2 per flower, narrowly triangular, lanceolate- or ovate-triangular, proximally slightly concave, margins entire, apex acute or shortly acuminate; bracts located below flower, (3.5)4.0–7.0(10.0) mm long, (3.0)3.5–8.0(9.0) mm wide, exerted beyond flowers; bracteoles twice smaller, borne lateral to flower. Flowers sessile on shallow pits of rachis, open acropetally, with sweet fragrance, (7)8–11(12) mm across. Perianth broadly biturbinate or depressed spherical, nearly actinomorphic, distally 6-cleft, pale green, somewhat glaucous, densely finely papillulate or verruculate on abaxial side; proximal syntepalous part broadly obconic, inside thickened prominently toward the orifice, forming annular ledge (5.5)6.0–7.0(8.0) mm in diameter, the ledge (1.4)1.6–1.8(2.0) mm wide, inner margin entire, frontal surface flat, smooth, white or light greenish; perianth segments incurved near base, deltoid, (2.4)2.5–3.5(3.8) mm long, (3.8)4.0–4.5(4.6) mm wide, narrowly whitish and finely irregularly denticulate at margins, thickened toward base, terminating in thin, often curled thread (2.5)3.0–6.0(6.5) mm long. Stamens 6, arising from base of perianth segment; filaments incurved, terete, fleshy, (2.2)2.4–2.6(2.8) mm long, 0.6–0.7 mm in diameter, white to light yellowish-green, connective dorsally prominently thickened; anthers strongly confined to abaxial side of connective, introrse, ovoid, (1.2)1.4–1.5(1.6) mm long, sometimes touching stigma. Pistil 1, proximally light green, distally darker; ovary superior, globular, (2.2)2.4–2.8(3.0) mm in diameter, glossy, trilobulate, each locule containing 4 ovoid ovules; stigma subsessile, trisected, 1.0–1.2 mm across, finely papillose. Immature fruits berry-like, globular, dark green, usually 1-seeded.

Habitat and phenology

Primary evergreen mixed humid forest on highly eroded marble-like crystalline limestone at elevations of 1100–1200 m a.s.l. Terrestrial or lithophytic herb on very steep rather open rocky mossy slopes near mountain tops. Flowers in cultivation in April–May. Locally common in the single and very restricted location where it has been found. Estimated IUCN conservation status: ‘Vulnerable’ (VU).

Distribution

Endemic to northern Vietnam (Tuyen Quang province, Na Hang district).

Similar species

Rohdea filosa is closely allied to *R. annulata* (H. Li & J. L. Huang) Yamashita & M. N. Tamura (2004, p. 369) described from Yunnan, China (Huang and Li 1990, p. 51, as *Tupistra annulata*) and *R. verruculosa* (Q. H. Chen) N. Tanaka (2003b, p. 332, 2010b) from Guizhou, China (Chen 1987, p. 69, as *Tupistra verruculosa*) in having an inward annulus at the orifice of the perianth tube, but differs from them by the larger leaves (to 1.2 m long and 11 cm wide vs to 0.7 m long and 8 cm wide), perianth segments terminating in a longer

thread (usually 3–6 mm vs ca 1.5 mm long at most), stamens with a connective more prominently humpy on the dorsal side and anther sacs (thecae) more strongly confined to the abaxial side of the connective (Fig. 7).

***Tupistra orlovii* Aver., N. Tanaka & K. S. Nguyen sp. nov. (Fig. 8–9)**

Type: Laos “Bolikhamsai province, Thaphabat district, Nam Bon village, Phou Khao Khouay national park, Tad Xai Waterfall, around point 18°27′25.9″N, 103°08′17.5″E, degraded primary and secondary evergreen dry forest along river on eroded sandstone at elevation about 340 m a.s.l., lithophytic and occasionally terrestrial large herb on shady mossy boulders and river cliffs, leaves uniform green, fruits glossy green, rare, but locally abundant, 11 Apr 2017, L. Averyanov, N. T. Hiep, N. S. Khang, C. Q. Ngan, T. Maisak, LA-VN 2191” (holotype: LE, isotype: HN, LE).

Etymology

The specific epithet honors Professor Nicolai Orlov, the discoverer of the plant and an eminent Russian herpetologist at the Zoological Institute of the Russian Academy of sciences.

Description

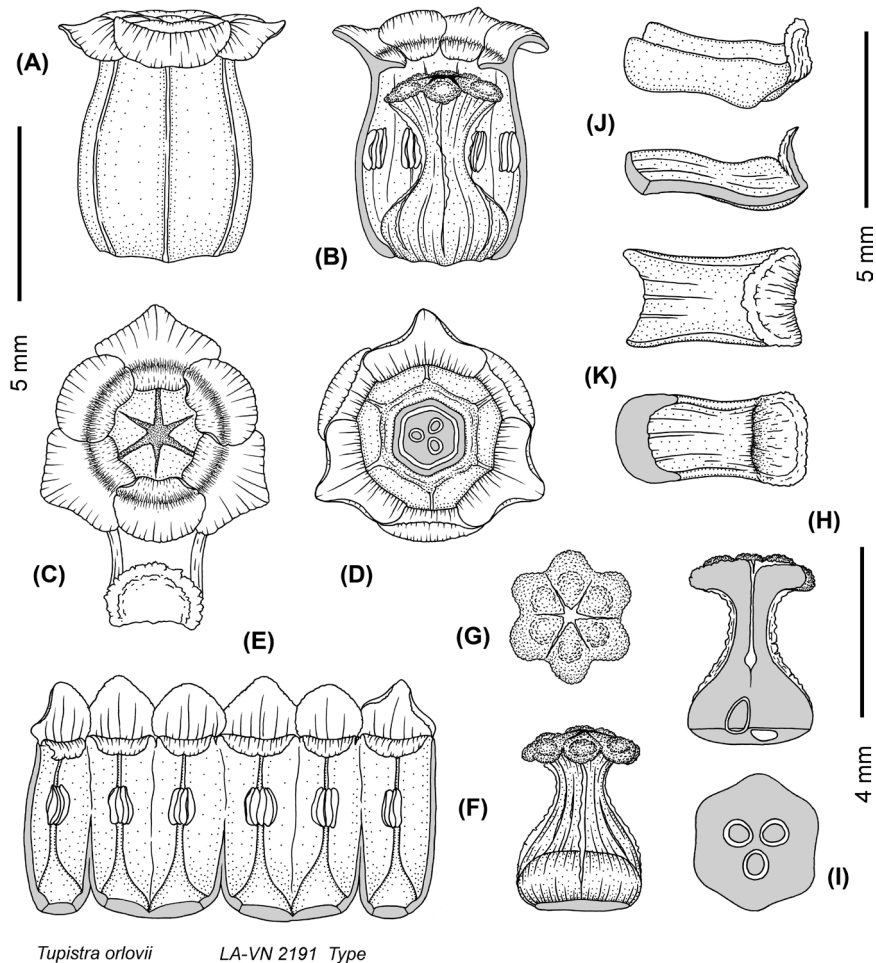
Lithophytic or occasionally terrestrial, entirely glabrous perennial herb. Rhizome erect to suberect, 3–10 cm long, (1.0)1.5–2.0(2.5) cm in diameter, simple or branching, somewhat woody, closely-noded, densely covered with leaf sheaths partially disintegrated into dark dirty brown to almost black fibrous remnants, bearing many rigid, wiry, dirty gray, semi-stilt roots. Stem erect, (1.5)2.0–3.0(4.0) cm tall, covered with leaf sheaths and cataphylls partially disintegrated into fibrous remnants. Leaves (3)5–6(8), basal, subdistichous, nearly straight, narrowly oblanceolate to oblanceolate, (1.0)1.2–1.8(2.0) m long, (4)5–7(9) cm wide, gradually tapering to distinct petiole 6–8 mm wide, acute to acuminate at apex, midvein thick and strongly keeled dorsally, lateral longitudinal veins numerous and prominent, leathery, dark green, glossy. Flowering stem axillary, erect, bearing terminal spike. Peduncle straight, terete (ribbed when dry), (0.5)0.6–1.0(1.2) m long, (2.5)3.0–4.0(5.0) mm in diameter, dark green, stiff, naked. Spike spadix-like, densely many-flowered, cylindrical, (6)8–14(16) cm long, (1.0)1.2–1.5(1.7) cm in diameter; rachis white at anthesis, turning green with age; floral pits shallow, surrounded by ridged bases of bracts. Floral bracts 2 (outer and inner) per flower; outer bract borne under flower, horizontal, oblong, (2.5)3.0–4.0(4.5) mm long, (2.0)2.2–2.6(2.8) mm wide, somewhat cucullate, distally strongly inflexed, apex truncate to obtuse, distal margins usually minutely erose, thick and rigid, nearly as long as flowers, white, turning green later, basal portions ridged on rachis, proximally persistent; inner bract (bracteole) borne lateral to floral base, ovate or oblong ovate, much smaller than bracts. Flowers sessile, perpendicular to rachis, open acropetally. Perianth campanulate or slightly urceolate, (6)7–8(9) mm long, (4.5)5.0–6.0(6.5) mm across, distally 6-lobed, fleshy; proximal syntepalous part tubular, (3.8)4.2–5.0(5.5) mm long, externally white or slightly tinged with purple, internally slightly 6-ribbed longitudinally; distal 6 segments extended both inward



Figure 8. *Tupistra orlovii* sp. nov. Digital epitype, 0283/Orlov s.n. and LA-VN 2191. Photos by N. Orlov, L. Averyanov and K. S. Nguyen, correction and design by L. Averyanov.

and outward, longitudinally substrate; outwardly extended portions obliquely expanded, adaxially pink-purple, purple or purple-violet, obtuse, distal margins membranous, often minutely erose, white; the outer 3 segments broadly (transversely) triangular-ovate, distal margins revolute, slightly broader than the inner 3; the inner 3 segments broadly (transversely) ovate, distally strongly recurved; the 6 inwardly extended portions (inward lamellas) transversely oblong or oblong-ovate, distally sometimes slightly retuse, flat or distally slightly curved downward or upward, adaxially pale purple, narrowing orifice of the tube. Stamens 6, included, not seen from outside flower; anthers sessile, introrse, dorsally adnate slightly above middle of perianth

tube, ellipsoid to ovoid, 1.0–1.2 mm long, light dull yellow. Pistil 1, tri-capellary, 3.5–4.5 mm long, fleshy; ovary superior, subglobular to oblate, 1.0–1.2 mm long, 2.0–2.5 mm across, tri-locular, each locule containing one ovule; style shortly terete, 1.2–2.2 mm long, 2.2–2.6 mm in diameter near base, longitudinally ridged and narrowly alate; stigma pale dull yellow, later orange, nearly round with shallow 6 lobes, frontal surface flat or slightly convex, irregularly finely warty, (2.2)2.4–2.6(2.8) mm across, positioned higher than anthers and lower than lamellae at orifice of perianth tube. Immature fruits spherical, dark green, glossy, finely speckled with white, berry-like, 1–2(3) seeded, with remnants of style (stigma) and perianth.



Tupistra orlovii LA-VN 2191 Type

Figure 9. *Tupistra orlovii* sp. nov. (A) flower, side view, (B) sagittal section of perianth with intact pistil, (C) flower with bract, frontal view, (D) flower cross-sectioned at ovary, view from base, (E) dissected and flattened perianth, (F) pistil, side view, (G) stigma, frontal view, (H) pistil, sagittal section, (I) transversal section of ovary, (J) intact floral bract (above) and its sagittal section (below), side view, (K) floral bract, view from above at different angles. Drawn from the type LA-VN 2191 by L. Averyanov.

Habitat and phenology

Primary or secondary evergreen and semideciduous lowland forests on solid eroded dark brown sandstone at elevations 300–400 m a.s.l. Lithophytic and occasionally terrestrial large herb on shady mossy boulders and rocky cliffs along river. Flowers in October–November, fruits in (April) May–June.

Distribution and conservation

Endemic of central Laos (Bolikhamsai province, Thaphabat district). Rare, but locally abundant; it was found in a single location in the studied area. Estimated IUCN red list status: ‘Data Deficient’ (DD).

Similar species

Tupistra orlovii is most closely allied to *T. laotica* N. Tanaka from Vientiane province, central Laos (Tanaka 2010a, 2010c) in having narrowly oblanceolate leaves with prominent lateral longitudinal veins, long slender peduncles, flowers nearly similar in size, subdiscoid stigmas exceeding the anthers, and bracts somewhat similar in shape. Further, the habitats of both species are comparatively close in central

Laos. The new species is, however, readily distinguishable from the latter particularly by its perianth segments each with an inward lamella (wing) at the base. The perianth segments with such an inward lamella have not been reported in any other congeners. It is therefore highly likely that *T. orlovii* acquired that feature secondarily in the evolutionary course and is more specialized in this respect than *T. laotica*.

Judging from the purplish perianths and the pale dull yellow to orange stigmas, the flowers of *Tupistra orlovii* are zoophilous (probably entomophilous), and presumably adapted to pollen vectors that can discern such colors. Further, the anthers are located lower than the stigma facing upward, indicating that pollination is achieved only when some kind of animal carries the pollen to the spatially distant stigma. The fruit set of this species appears not very high as seen in Fig. 8, implying that it is dependent largely on the visiting frequency of an animal pollen vector to the flowers.

Additional specimens examined (paratypes)

Laos, Bolikhamsai province, Thaphabat district, Nam Bon village, Phou Khao Khouay national park, Tad Xai Waterfall, around point 18°27′25.9″N, 103°08′17.5″E,

degraded primary and secondary evergreen dry forest along river on eroded sandstone at elevation about 340 m a.s.l., 10 Nov 2016, N. Orlov et al., sine n. (LE, photos).

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