

New species of *Ophiopogon* Ker Gawl., *Peliosanthes* Andrews and *Tupistra* Ker Gawl. (Asparagaceae) in the flora of Laos and Vietnam

Leonid V. AVERYANOV

Komarov Botanical Institute, Russian Academy of Science,
St. Petersburg, Prof. Popov Str. 2, 197376 (Russia)
av_leonid@mail.ru
av_leonid@yahoo.com

Noriyuki TANAKA

98-11, Otsuka, Hachioji, Tokyo 192-0352 (Japan)
yukinofude@yahoo.co.jp

Khang Sinh NGUYEN

Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology,
18 Hoang Quoc Viet, Cau Giay, Ha Noi (Vietnam)
and Key Laboratory of Plant Resources Conservation and Sustainable Utilization (South China),
Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650 (P. R. China)
and University of Chinese Academy of Sciences, Beijing 100049 (P. R. China)
khangnguyensinh@yahoo.com

Hiep Tien NGUYEN

Center for Plant Conservation, No 25/32, lane 191,
Lac Long Quan, Nghia Do, Cau Giay District, Ha Noi (Vietnam)
hiep.nguyen@cpcvn.org

Eugene L. KONSTANTINOV

Kaluga State University, Kaluga,
Stepan Razin str., 26, 248023 (Russia)
nepentes@list.ru

Published on 26 June 2015

Averyanov L. V., Tanaka N., Nguyen K. S., Nguyen H. T. & Konstantinov E. L. 2015. — New species of *Ophiopogon* Ker Gawl., *Peliosanthes* Andrews and *Tupistra* Ker Gawl. (Asparagaceae) in the flora of Laos and Vietnam. *Adansonia*, sér. 3, 37 (1): 25-45. <http://dx.doi.org/10.5252/a2015n1a4>

ABSTRACT

KEY WORDS

Asparagaceae,
new species,
Ophiopogon,
Peliosanthes,
Tupistra,
eastern Indochina,
plant diversity,
new combination,
new status,
new species.

Six new species, *Ophiopogon fruticosus* Aver., N.Tanaka & K.S.Nguyen, sp. nov., *O. petraeus* Aver. & N.Tanaka, sp. nov., *Peliosanthes densiflora* Aver. & N.Tanaka, sp. nov., *P. hexagona* Aver., N.Tanaka & K.S.Nguyen, sp. nov., *P. lucida* Aver., N.Tanaka & K.S.Nguyen sp. nov. and *Tupistra breviscapa* Aver. & N.Tanaka, sp. nov. (Asparagaceae) discovered in Laos or Vietnam are described and illustrated. *Ophiopogon bockianus* Diels is newly recorded for the flora of Vietnam. *Ophiopogon mairei* H.Lév. is regarded as a synonym of *O. bockianus*. The name *Ophiopogon bayatae* (N.Tanaka) N.Tanaka, Aver. & T.Koyama, comb. nov., stat. nov. is proposed as a new nomenclatural combination and status. Except for *O. bockianus* (= *O. mairei*), the other seven species here reported are endemic either to Vietnam (five species) or Laos (two species).

RÉSUMÉ

Nouvelles espèces d'Ophiopogon Ker Gawl., Peliosanthes Andrews et Tupistra Ker Gawl. (Asparagaceae) dans la flore du Laos et du Vietnam.

Six nouvelles espèces, *Ophiopogon fruticulosus* Aver., N.Tanaka & K.S.Nguyen, sp. nov., *O. petraeus* Aver. & N.Tanaka, sp. nov., *Peliosanthes densiflora* Aver. & N.Tanaka, sp. nov., *P. hexagona* Aver., N.Tanaka & K.S.Nguyen, sp. nov., *P. lucida* Aver., N.Tanaka & K.S.Nguyen, sp. nov. et *Tupistra breviscapa* Aver. & N.Tanaka, sp. nov. (Asparagaceae) découvertes au Laos ou au Vietnam sont décrites et illustrées. *Ophiopogon bockianus* Diels est nouvellement enregistré pour la flore du Viêt-nam. *Ophiopogon mairei* H.Lév. est considéré comme un synonyme de *O. bockianus*. Le nom *Ophiopogon hayatae* (N.Tanaka) N.Tanaka, Aver. & T.Koyama, comb. nov., stat. nov. est proposé comme combinaison nouvelle sous un nouveau statut. En excluant *O. bockianus* (= *O. mairei*), les sept autres espèces concernées ici sont endémiques, soit au Viêt-nam (cinq espèces) ou au Laos (deux espèces).

MOTS CLÉS

Asparagaceae,
espèces nouvelles,
Ophiopogon,
Peliosanthes,
Tupistra,
Indochine orientale,
diversité des plantes,
combinaison nouvelle,
statut nouveau,
espèces nouvelles.

INTRODUCTION

The genera *Ophiopogon* Ker Gawl., *Peliosanthes* Andrews. and *Tupistra* Ker Gawl. of the family Asparagaceae Juss. (Convallariaceae Horan, s.str.) occurring in eastern Indochina have hitherto been investigated by many botanists like Decaisne (1867-68), Bois (1906), Rodriguez (1928; 1934a, b), Gagnepain (1934a, b), Jessop (1976), Tanaka (1998; 1999a-c; 2003a, b; 2004a, b; 2010a-c), Averyanov (2011), Averyanov & Tanaka (2012, 2013), and Averyanov *et al.* (2013, 2014). Judging from the results of these studies, eastern Indochina seems to be a territory very suitable for the occurrence and growth of the three genera and very rich in their species. The past frequent discoveries of novelties in these genera imply that there still are not a few undescribed species particularly in little or poorly explored areas. The number of their species is expected to further increase if closer investigations are carried out over a wider range of that territory in the future.

The present paper provides the result of our latest taxonomic investigation on the three genera in eastern Indochina.

MATERIAL AND METHODS

Most of the specimens mentioned in this paper were collected in the field in eastern Indochina during the year 2013. A few living plants previously collected in that territory and cultivated at the Komarov Botanical Institute, as well as several dried herbarium specimens previously collected there and kept in several herbaria (HN, Herbarium of the Center for Plant Conservation, LE, MO), were also used. Besides preparing dried herbarium specimens, portions of living samples of almost all species here reported were fixed and stored in 65% ethanol. Line drawings and descriptions were made mainly from fresh and/or fixed materials in alcohol. In the both cases is noticed that during the drying process of making herbarium specimens, fleshy parts reduce by approximately 20 to 30% compared with the original. This reduction was taken into account when identification is attempted on dried herbarium specimens. Photographs were taken with Canon cameras and lenses. The abbreviation "CPC" is accepted (as an expected

Herbarium acronym) in the paper for Herbarium of the Center for Plant Conservation of the Vietnam Union of Science and Technology Associations (Hanoi, Vietnam). Digital plates with analytical images of authentic specimens prepared at the Herbarium of the Komarov Botanical Institute (LE) used for illustrations are cited in the paper as d-EXSICCATES OF VIETNAMESE FLORA with appropriate number.

SYSTEMATICS

Ophiopogon bockianus Diels (Fig. 1)

Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie 29, 2: 254 (1900). — *O. mairei* H.Lév. *Repertorium Specierum Novarum Regni Vegetabilis* 11: 493 (1913). — Type: China. Yunnan. Bord des torrents sous bois à Ku-Long-Tchang, 800 m, VI.1911, *E.E.Maire s.n.* (holo-, P[[P00753592](#)]; iso-, E!)

TYPUS. — **China.** Sichuan. Nanchuan: Chang ling kang, Aug., *C.Bock & A.v.Rosthorn 641* (syntypus-, W?); Talu chih, IX. *C.Bock & A.v.Rosthorn 984* (syntypus-, W?).

HABITAT AND PHENOLOGY. — Primary and secondary broad-leaved evergreen dry forest on cliffs and on very steep slopes of remnant hill composed of highly eroded limestone at elevations 900-1000 m a.s.l., usually in shady places on rocky slopes. Flowers in October-November. Locally common. Expected IUCN Red List status – LC.

DISTRIBUTION. — **Vietnam** (Son La province, Van Ho district). **China** (Yunnan, Sichuan, Guizhou, Hubei, Hunan, Guangxi). **Laos** (Xiangkhoang, recorded by Newman *et al.* 2007).

MATERIAL EXAMINED. — **Vietnam.** Son La province, Van Ho district, Xuan Nha municipality, Muong An village, territory of Xuan Nha natural reserve, remnants of primary and secondary broad-leaved evergreen dry forest on cliffs and on very steep slopes of remnant hill composed of highly eroded limestone at elevations 900-1000 m a.s.l. around point 20°44'50.1"N, 104°47'54.5"E, terrestrial herb on shady rocky slope, flowers white, locally common, 16.XI.2013, *L.Averyanov, N.T.Hiep, N.S.Khang, N.D.Thang, L.D.Qui, CPC 7217* (CPCI, LE!).

REMARKS

The plant here concerned has comparatively small flowers and free anthers. In these respects and other characters, it

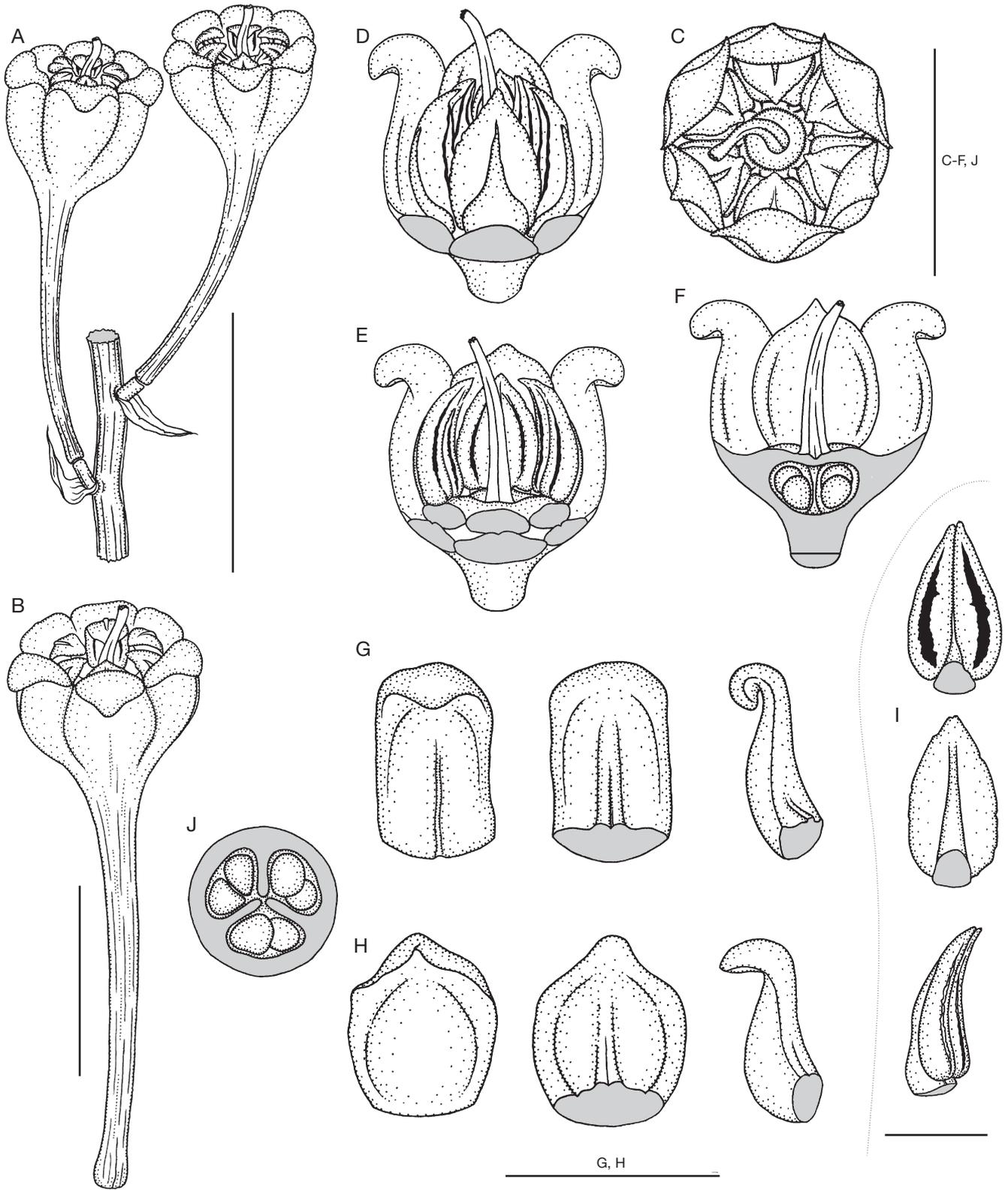


FIG. 1. — *Ophiopogon bockianus* Diels: **A**, upper portion of inflorescence; **B**, flower, side view; **C**, intact flower, frontal view; **D**, flower with 3 frontal tepals removed, side view; **E**, flower with 3 frontal tepals and stamens removed, side view; **F**, sagittal section of flower with stamens removed; **G**, sepal; (from left to right) abaxial, adaxial and side views; **H**, petal; (from left to right) abaxial, adaxial and side views; **I**, stamen; (from upper to lower) adaxial, abaxial and side views; **J**, ovary, cross section. Drawn from specimen - CPC 6586 by L.Averyanov and T.Maisak. Scale bars: A, 1 cm; B-H, J, 5 mm; I, 2 mm.

agrees with *Ophiopogon mairei* H.Lév. described from Yunnan, China. Handel-Mazzetti (1936), who examined the type specimens of *O. bockianus* Diels described from southeastern Sichuan, regarded *O. mairei* as the synonym of *O. bockianus*. A specimen from Hunan, China, which Handel-Mazzetti himself collected and identified as *O. bockianus* (no. 11195 preserved at E!) has slightly larger flowers and connate anthers, but in many other respects it is very close to *O. mairei*. A specimen from Guizhou, China (*E. Bodinier* 2293 at E!), has comparatively large flowers but free anthers. The anthers of *O. mairei* (e.g. isotype at E!) are free but very closely situated side by side. Surveys of several specimens of this plant group lead us to regard *O. bockianus* and *O. mairei* as conspecific, although they locally vary to some extent in the length of basal stalky part of perianth, flower size, and the degree of cohesion between adjoining anthers. *Ophiopogon bockianus sensu lato* (including *O. mairei*, but excluding *O. bockianus* var. *angustifolius* W.F.Wang & Tang) has an ascending, somewhat thick, elongate, estoloniferous stem becoming rhizome-like with age, somewhat thick roots, proximal sheath(-like) leaves with transversally rugulose, scarious wings, slightly falcate leaves, antrorse floral bracts with conspicuous hyaline marginally, pedicels usually significantly shorter than the basal stalky part of perianth, somewhat broad, ovate anthers located closely side by side or connate between adjoining ones, and ovary slightly concave at the apical center.

Ophiopogon bockianus here recircumscribed (i.e. including *O. mairei*) has hitherto not been recorded from Vietnam. The discovery of this species may imply a strong floristic relation between northern Vietnam, Laos (Newman *et al.* 2007), and southwestern China.

Ophiopogon fruticulosus

Aver., N.Tanaka & K.S.Nguyen, sp. nov.

(Fig. 2)

Haec species *Ophiopogoni chingii* W.F.Wang & Tang var. *glaucofolius* W.F.Wang & L.K.Dai *proxima est, sed ab eo habitu robustiore et fruticuloso, caulibus erectis, floribus in quoque fasciculo pluribus, perianthiis sub-urceolatis, percariosis et inferne 6-costatis, segmentis perianthii, antheris, stylisque longioribus est distinguenda.*

TYPUS. — **Vietnam.** Tuyen Quang province, Na Hang district, Sinh Long municipality, Khuoi Phin village, around point 22°38'21"N, 105°20'28"E, remnants of primary forest along stream, on wet very steep shady humid travertine river valley, erect subshrub to 1.2 m tall in shady wet place, flowers white with light violet tint, locally abundant, 30.IX. 2013, *L.Averyanov, N.T.Hiep, L.M.Tuan, N.S.Khang, D.V.Cuong, N.V.Truong, T.Maisak, L.Osinovets, CPC 5345* – (holo-, LE!; iso-, CPC!, LE!).

ETYMOLOGY. — The specific epithet refers to the suffrutescent habit of the new species.

HABITAT AND PHENOLOGY. — Terrestrial and lithophytic undershrub, usually in shady humid ravines, particularly on steep slopes composed of wet travertine deposits or on rocky mossy mountain tops, covered by primary evergreen broad-leaved forests on limestone at elevations 500-1200 m a.s.l. Flowers in August-October, fruits in January-March. Rare, but locally abundant. Expected IUCN Red List status – LC.

DISTRIBUTION. — **Vietnam** (Ha Giang province, Bac Me district; Tuyen Quang province, Na Hang district). Endemic to limestone areas of the central part of northern Vietnam.

MATERIAL EXAMINED (PARATYPI). — **Vietnam.** Ha Giang province, Bac Me district, Phiang Luong municipality, around Phiang Luong village about 4 km to SW of Phiang Luong municipality head-quarter 22°39'29"N, 105°19'35"E, slightly logged primary closed evergreen broad-leaved forest on slopes of remnant mountains composed of solid highly eroded crystalline and partially shale limestone at elevations 1000-1200 m a.s.l., subshrub 0.5-1.5 m tall on rocky top of ridge, fruits deep blue, locally very common, 5.III.2005, *L.Averyanov, P.K.Loc, N.T.Vinh, A.Averyanova, HAL 6489* (HN, MO). — Herbarium specimen *HAL 6489a* (LE) prepared on 9.VII.2014 by L.Averyanov from cultivated plants grown from seeds originally collected in Northern Vietnam, Ha Giang province, Bac Me district, Phiang Luong municipality, 5.III.2005, *L.Averyanov, P.K.Loc, N.T.Vinh, A.Averyanova, HAL 6489*.

AFFINITIES

This species is closely allied to *Ophiopogon chingii* W.F.Wang & Tang var. *glaucofolius* W.F.Wang & L.K.Dai, but distinguished from it in the more robust, suffrutescent habit, erect stems, more flowers in each fascicle, very fleshy, sub-urceolate perianths which are 6-ribbed proximally, and longer perianth segments, anthers and styles.

DESCRIPTION

Lithophytic and occasionally terrestrial undershrub. Stem erect, straight or slightly flexuose, normally unbranched, to (0.6)0.8-1.5 m tall and 1-2 cm in diam., distally bearing numerous leaves; middle leafless part covered imbricately with pale dull yellowish-brown, partially disintegrated, papyraceous remnants of leaf bases; older more proximal leafless part almost naked, with numerous annular leaf-scars and several almost straight, rigid, woody, thick prop roots 1-1.5 cm diam. Leaves numerous, concentrated on distal 15-25 cm of stem, spirally arranged or sub-distichous, erect, suberect or arching, indistinctly petiolate, 30-45 cm long; the petiole-like proximal part broad, thick, firm, (4)5-8(10) cm long, 0.8-1.2 cm wide; basal part dilated, strongly recurved, 1.2-1.8 cm wide, winged; wings pale dull light yellowish-brown, scarious, 4-8 cm long, 0.8-1.5 cm wide, finely pleated transversally, flat and entire along margins; leaf blades narrowly oblong-oblancheolate, shortly acuminate with obtuse apex, entire along margins, often slightly oblique, (25)30-35(40) cm long, (1.5)2-3(3.5) cm wide, glabrous, rather fleshy, coriaceous, adaxially uniformly dark grass-green, abaxially light green-glaucous, with many parallel narrow whitish stripes; longitudinal veins numerous, indistinct, secondary veins hardly visible. Inflorescence a lax raceme with shortly distant fascicles of pedicellate flowers in axils of bracts, each fascicle consisting of (1-2)3-6(8) flowers; peduncle straight, slightly flexuose or arching, finely grooved, ebracteate or with 1-2 sterile bracts being dark green to green with violet tint, (5)8-12(15) cm long, 3-4 mm in diam.; rachis of inflorescence straight or slightly flexuose, finely ridged, (8)10-16(18) cm long. Bracts subtending each fascicle of pedicels narrowly triangular, acuminate, pale yellow-brown, rather scarious, (0.8)1-1.5(1.8) cm long, (2.5)3-6(6.5) mm wide; floral bracts each subtending a pedicel triangular



FIG. 2. — *Ophiopogon fruticulosus* Aver., N.Tanaka & K.S.Nguyen, sp. nov.: **A**, flowering plant; **B**, **C**, leaf (upper) and leaf base (lower), adaxial surface; **D**, portion of inflorescence with cluster of flowers; **E**, floral bracts; **F**, intact flower (left) and flower with 3 frontal tepals removed (right), side views; **G**, flower with 3 frontal tepals and 3 frontal stamens removed (upper) and flower with sagittal section of the ovary (lower), side views; **H**, cross section of lower sterile part of ovary; **I**, sepals (from left to right) abaxial, adaxial, and side views, and view from below; **J**, petals; (from left to right) abaxial, adaxial, and side views, and view from below; **K**, stamens; (from left to right) side, abaxial and adaxial views; **L**, stamen, view from below; **M**, style (left) and apical part of style (right); **N**, style, cross section at base and in lower part; **O**, cross section of fertile part of ovary, view from below (upper figure) and from above (lower figure); **P**, mature fruit. Drawn from the holotype *L.Averyanov et al.*, *CPC 5345* by *L.Averyanov*. Scale bars: **A**, 20 cm; **B**, 10 cm; **C**, 5 cm; **D**, 1 cm; **E**-**G**, **I**, **J**, **P**, 5 mm; **H**, **K**-**O**, 2 mm.

ovate, acuminate, light yellowish-brown, scarious, (2)3-8(12) mm long, (1)1.5-2.5(3.5) mm wide. Pedicels terete, straight, longitudinally ridged, light green to almost white, sometimes with light violet tint, (1.5)2-6(7) mm long, 1-1.5 mm in diam., in flower usually about half or slightly shorter than the length of the basal stalky part of perianth, in fruit elongating. Flowers antrorse, odorless. Perianth 6-lobed distally, campanulate or sub-urceolate, narrowly expanded, white with light violet tint, (6)6.5-8(8.5) mm long (excluding basal stalky part), 4-7 mm wide; proximal part syntepalous, narrowly funnel-shaped and stalky, slightly flattened, usually curved distally, (3)4-10(11) mm long, 1-1.5 mm across, fluted and narrowly 2-winged; wings fleshy, slightly incised; distal (perianth) segments 6 in 2 whorls (outer and inner), very fleshy, cymbiform, (5.5)6-7(8) mm long, shortly recurved apically, apical margins narrowly scarious and revolute; outer 3 oblong, rounded at apex, 2-3 mm wide; inner 3 ovate, 3-4 mm wide, obliquely truncate apically, external central part thickly keeled toward base. Stamens 6; anthers dorsifixed, introrse, narrowly (sub) conic, slightly complanate, apically acute with short apiculus, light yellowish-green, 4-4.5 mm long, 1.4-1.6 mm wide; filaments shortly cylindrical, very fleshy, 2 mm long and 1.5 mm across. Pistil 1; ovary inferior, almost flat at apex, externally prominently 6-ribbed, internally 1-locular, partitioned into 3 chambers by 3 septa almost touching along inward edges; each chamber adaxially slightly open with narrow longitudinal slit, containing (2)3-4(5) ovules on a basal placenta; style erect, straight to slightly curved, narrowly conic, trigonous in cross section, 5.5-6.5(7.5) mm long, 0.8-1(1.2) mm in diam. at base, slightly exceeding anthers and tepals in length; stigma entire to minutely 3-lobed. Seeds oblong-ovoid, dark blue, glossy.

REMARKS

Ophiopogon fruticosus Aver., N.Tanaka & K.S.Nguyen, sp. nov. resembles the large form of *O. chingii* W.F.Wang & Tang var. *glaucofolius* W.F.Wang & L.K.Dai (Dai & Chen 1978; Tanaka 2000a), but differs by the more robust suffrutescent habit as manifested by its stem reaching 1.5 m in height, prop roots 1-1.5 cm in diameter, and leaves to 45 cm long and 3 (occasionally 3.5) cm wide. Further, the new species usually has more flowers within a single fascicle (up to 6, occasionally 8 flowers vs usually up to 3 or 4), longer perianth segments, longer anthers, and longer styles. It is also characterized by the erect stem (vs often prostrate or distally ascending stem), rather narrowly open, sub-urceolate flowers of which the proximal part is prominently 6-ribbed, very fleshy perianth segments, and by the very fleshy, thick filaments.

Ophiopogon hayatae (N.Tanaka) N.Tanaka, Aver. & T.Koyama, comb. & stat. nov.
(Fig. 3)

O. platyphyllus Merr. & Chun var. *hayatae* N.Tanaka, *Journal of Japanese Botany* 76 (1): 14 (2001).

TYPUS. — Vietnam. Tonkin, Tamdao, 28.VII.1917, *B.Hayata s.n.* (holo-, TI!; iso-, TI!).

HABITAT AND PHENOLOGY. — Primary broad-leaved evergreen humid submontane forests on granite and shale at elevations 1000-1200 m a.s.l., usually on rich soils in shady places of small depressions along ridge edges. Flowers in September-November. Locally very common. Expected IUCN Red List status – LC.

DISTRIBUTION. — Vietnam (Vinh Phuc provinces, Tam Dao district; Thanh Hoa province, Thuong Xuan district). Endemic of northern Vietnam.

MATERIAL EXAMINED. — Vietnam. Thanh Hoa province, Thuong Xuan district, Bat Mot municipality, Vin village, Xuan Lien Natural Reserve, primary broad-leaved evergreen wet forest on shale at elevations 1000-1200 m a.s.l. around point 19°58'18.2"N, 104°59'24.0"E, terrestrial herb in shady places along ridge edge, flowers white with green to blue tint, very common, 2.VII.2013, *L.Averyanov, N.T.Hiep, N.S.Khang, CPC 6586* (CPC!, LE!).

REMARKS

Ophiopogon platyphyllus var. *hayatae* (Tanaka 2001), to which our plant is assignable, shares with var. *platyphyllus* (Tanaka 2000a) a comparatively short, suberect or ascending stem which becomes rhizome-like with age and bears many linear leaves in the distal part and a few or several ligneous prop roots in the proximal part, and ovaries slightly concave at the apical center. *Ophiopogon platyphyllus* var. *hayatae* is, however, well distinguishable from var. *platyphyllus* by the slightly more slender stem (becoming rhizome-like with age), narrower leaves, more slender peduncle and rachis of inflorescence, proximal stalky part of the flower (including the jointed pedicel) articulated in the distal part, smaller flowers with shorter perianth segments and stamens. Having many features, var. *hayatae* seems to well deserve an independent specific status. It is Dr. Tetsuo Koyama who first recognized the plant as a distinct new species. He inscribed the name "*O. hayatai*" on the label of the specimen (type of var. *hayatae*) kept at TI (cf. Tanaka 2001: fig. 4), although the name was not published by him. The plant is here published as *O. hayatae* (N.Tanaka) N.Tanaka, Aver. & T.Koyama, comb. & stat. nov. at the specific rank by the authors including Dr. Koyama who agreed with this publication. The specific epithet refers to the collector of the type specimens, Dr. Bunzo Hayata.

Meanwhile, *Ophiopogon hayatae* (N.Tanaka) N.Tanaka, Aver. & T.Koyama, comb. & stat. nov. also resembles *O. stenophyllus* (Merr.) L. Rodr. and *O. pierrei* L. Rodr. (Tanaka 2000b), but differs from the former by the proximal stalky part of the flower (including the jointed pedicel) articulated in the distal part (vs middle or proximal part), free anthers (vs connate anthers), and the ovary slightly concave at the apical center (vs apically slightly convex ovary), and from the latter by the more slender peduncle and rachis of inflorescence, longer pedicels, and the ovary slightly concave at the apical center (vs apically convex ovary).

Ophiopogon petraeus Aver. & N.Tanaka, sp. nov.
(Fig. 4)

Haec species *Ophiopogoni platyphylo* Merr. & Chun *subsimilis est, sed ab eo pedicellis plerumque longioribus, segmentis perianthii ovatis brevioribusque, antheris brevioribus, et stylo basi paulo inflato bene differt.*

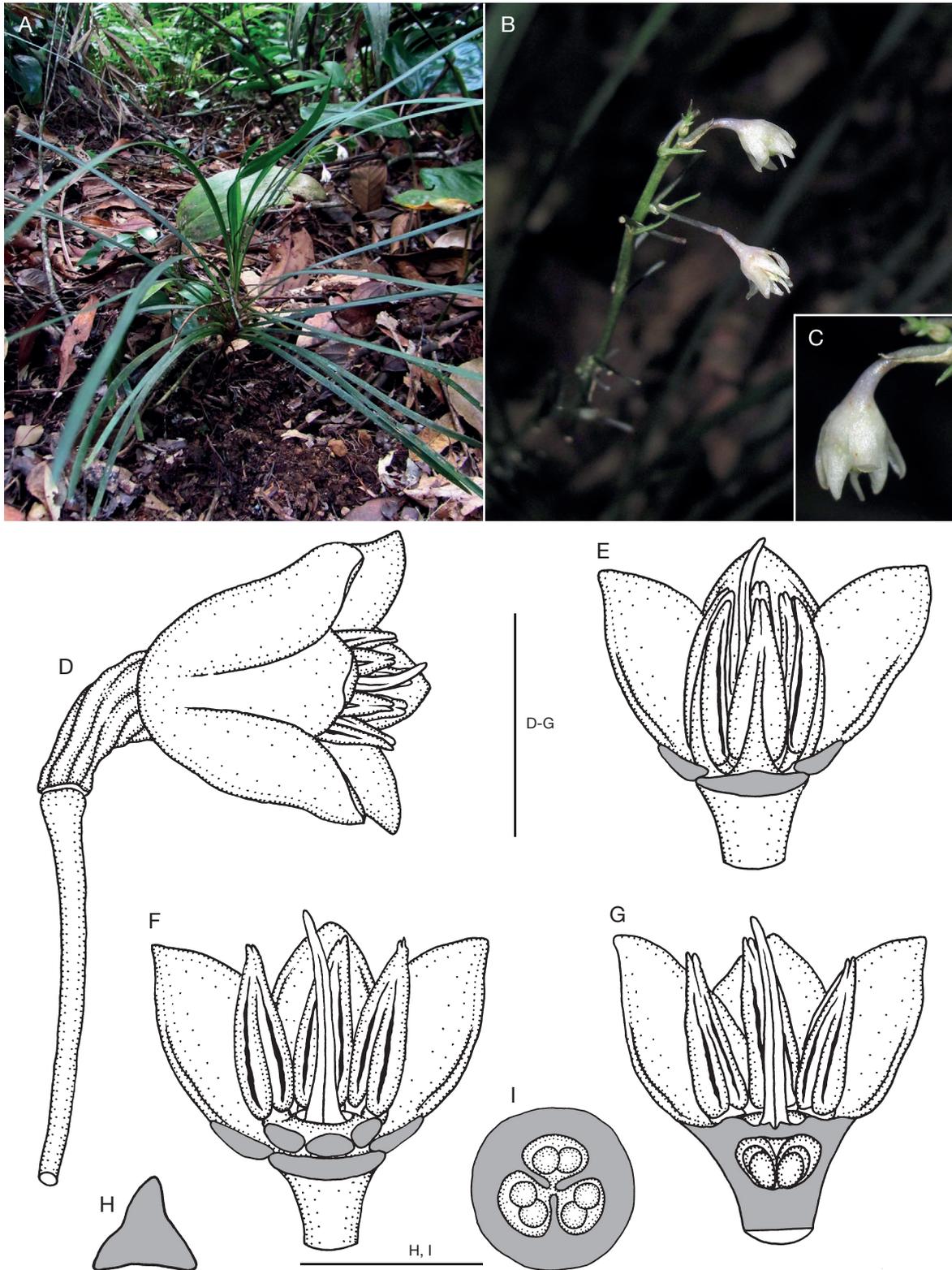


FIG. 3. — *Ophiopogon hayatae* (N.Tanaka) N.Tanaka, Aver. & T.Koyama: **A**, flowering plant in natural habitat; **B**, inflorescence; **C**, flower; **D**, intact flower with pedicel, side view; **E**, flower with 3 frontal tepals removed, side view; **F**, flower with 3 frontal tepals and stamens removed, side view; **G**, sagittal section of flower; **H**, cross section of style; **I**, ovary, cross section. Photos and drawings by N.S.Khang, L.Averyanov and T.Maisak (specimen CPC 6586). Scale bars: D-G, 5 mm; H, I, 3 mm.

TYPUS. — **Vietnam.** Lang Son province, Huu Lung district, Huu Lien commune, Huu Lien Nature Reserve, around point 21°40'28"N, 106°22'34"E", flowered and collected under cultivation in Septem-

ber–October 2013, leaves fleshy, at the base subsucculent, juicy, transversely oval in section, flowers white, anthers light yellow-green, pedicel white with violet tint, *L.Averyanov*, HAL 11220b/1 (holo-, LE!).

EPITYPUS. — **Vietnam**. d-EXSICCATES OF VIETNAMESE FLORA 0207/HAL 11220b/1 (Fig. 4).

ETYMOLOGY. — The specific epithet refers to the stony habit of the species.

HABITAT AND PHENOLOGY. — Lithophytic or terrestrial herb on shady rocky limestone outcrops in primary seasonal lowland forests of mixed and broad-leaved evergreen trees at elevations 400-600 m a.s.l. Flowers under cultivation in September-October. Not rare. Expected IUCN Red List status – LC.

DISTRIBUTION. — **Vietnam** (Lang Son province, Huu Lung district, territory of Huu Lien nature reserve). Endemic of limestone areas of northern Vietnam.

MATERIAL EXAMINED (PARATYPI). — **Vietnam**. Lang Son province, Huu Lung district., Huu Lien commune, Huu Lien Nature Reserve, around point 21°40'28"N, 106°22'34"E, primary closed evergreen seasonal tropical mixed forests on rocky limestone at elevations 400-600 m, lithophytic rosulate herb, not rare, 24.IX.2007, P.K.Loc, N.T.Vinh, H.V.Luat, HAL 11220b (HN?).

AFFINITIES

This species somewhat resembles *Ophiopogon platyphyllus* Merr. & Chun, but markedly differs from it in the usually longer pedicels, shorter ovate perianth segments, shorter anthers, and in the style slightly inflated at the base.

DESCRIPTION

Lithophytic or occasionally terrestrial, perennial herb from short semi-epigeous rhizome; stems short, erect, normally unbranching, (2)3-5 cm tall, 1-1.5 cm in diam., covered imbricately with narrowly ovate, papyraceous, dull brownish sheath leaves (2)3-7 cm long, bearing a few, rigid, semi-woody roots 3-4 mm in diam. at base. Leaves (6)8-12(14), tufted at apex of stem, subdistichous, arching, indistinctly petiolate, linear-oblongate, often slightly oblique, gradually narrowed into petiole-like basal part being succulent and transversely oval in cross section, obtuse at apex, entire along margins, fleshy, coriaceous, glabrous, (16)25-35(40) cm long, (1)1.8-2(2.2) cm wide; adaxially glossy, uniformly dark grass-green; abaxially light green-glaucous, with many parallel narrow white stripes; main longitudinal veins indistinct, numerous; secondary veins hardly visible. Inflorescence a lax raceme with distant fascicles of (2)3-4(5) pedicellate flowers; rachis straight, finely ridged, dull greenish to white, 10-15 cm long; the pedicels arising from bracteal axils, sub-perpendicular to rachis, straight or slightly arching, terete, light violet to white, (6)8-14(16) mm long, 0.8-1 mm in diam., terminally jointed to flower base with distinct articulation; in each fascicle, the outermost basal bract narrowly triangular, acute or acuminate, scarious, light greenish or yellowish white, often with violet tint, (2)3-7(8) mm long, 1.5-4 mm wide; the inner bracteoles subtending each pedicel triangular, whitish, scarious, 0.5-1.5 mm long and wide; peduncle ebracteate or with 1-2 small sterile, scarious bracts being light olive-green with light violet tint, straight, 10-15 cm long, 3-4 mm in diam. Flowers slightly drooping, campanulate, not much broadly expanding, white, odorless, 4-4.5 mm long, (8)9-10(11) mm across. Perianth segments subsimilar, ovate, blunt to rounded at apex, distally slightly

recurved, flat or slightly revolute along margins, thick, 4.5-5 mm long, 3-3.5 mm wide. Stamens 6, located at base of each perianth segment, connivent distally; anthers narrowly subconic, slightly complanate, cordate at base, acute at apex, introrse, light greenish, 2 mm long, 0.5-0.6 mm wide; filaments massively thick and wide, 0.4-0.6 mm long and wide. Ovary inferior, 3-locular; each locule containing 2 ovules on a basal placenta; style erect, straight, narrowly pyramidal, 4-4.5 mm long, basal part somewhat inflated, 1-1.2 mm wide, white; stigma almost negligibly minute.

REMARKS

The obtuse, linear-oblongate leaves of *Ophiopogon petraeus* Aver. & N.Tanaka, sp. nov. somewhat resemble those of *O. platyphyllus* Merr. & Chun (Merrill & Chun 1935; Tanaka 2000a). However, the new species differs in the usually longer pedicels, shorter ovate perianth segments (vs lanceolate), shorter anthers, and the style slightly inflated at the base (vs style not particularly inflated basally). It also somewhat resembles *O. pseudotonkinensis* D.Fang (Fang 1998), but is distinguishable in having coriaceous leaves (vs chartaceous leaves) and shorter free anthers.

Peliosanthes densiflora Aver. & N.Tanaka, sp. nov. (Figs 5; 6)

Haec species nova Peliosanthi violaceae Wall. ex Baker var. *violaceae* et var. *princepsi* Baker *subsimilis est, sed ab eis bractea floris ascendenti et breviter distanti e base floris, bracteola juxta basem floris locata, floribus sessilibus cum segmentis perianthii magis valde expansis, et coronis albis est distincta.*

TYPUS. — **Laos**. Vientiane province, 13 km to the NNW of Kasi town along new road to Luang Prabang, on slope of Nam Pong Gnai River, around point 19°21.978'N, 102°09.282'E at elev. about 827 m a.s.l., 22.X.2013, E.Konstantinov, K 141 (holo-, LE!).

ETYMOLOGY. — The specific epithet refers to the compact inflorescence dense with many flowers.

HABITAT AND PHENOLOGY. — Primary and secondary dry broad-leaved evergreen and deciduous forests, usually co-dominated by *Tetrameles nudiflora* R.Br., *Pometia eximia* Bedd., *Croton argyrateus* Blume, *Arenga westerhoutii* Griff. and *Ficus religiosa* L., on highly eroded rocky marble-like limestone and shale at elevations 300-900 m a.s.l., common on shady mountain slopes, rocky outcrops and cliffs in rather humid conditions. Flowers in November-December, fruits in December-January. Locally common. Expected IUCN Red List status – LC.

DISTRIBUTION. — **Laos** (Vientiane province, Vang Vieng and Kasi districts). Endemic of northern Laos.

MATERIAL EXAMINED (PARATYPI). — **Laos**. Vientiane province, Vang Vieng district, Nathong village, about 5 km to the W of Vang Vieng town, Tham Kang Mt., around point 18°55'51.4"N, 102°23'50.6"E, dry broad-leaved primary and secondary evergreen forest on very steep rocky slopes and on vertical cliffs of remnant highly eroded rocky limestone mountains composed of solid crystalline limestone at elevations 300-400 m, clustering terrestrial and lithophytic herb with erect to suberect, ramose rhizome on steep rocky slope, leaves to 80 cm long, petiole 30-45 cm long, leaf blade glossy uniformly green on both sides 25-35 cm long, 6-10 cm wide,



FIG. 4. — *Ophiopogon petraeus* Aver. & N.Tanaka, sp. nov., digital epitype “d-EXSICCATES OF VIETNAMESE FLORA 0207/HAL 11220b (LE)”: **A**, flowering plant; **B**, cataphylls; **C**, portions of inflorescence with flower buds and open flowers; **D**, base of plant; **E**, leaves and cataphylls; **F**, flower buds in bract axil; **G, H**, intact flowers, flowers with 3 tepals removed and sagittal section of flowers; **I**, flowers buds with pedicels; **J**, anthers; **K**, sepals and petals; **L**, abaxial and adaxial surface of leaf; **M**, sagittal section of pistil and ovary. Photos by L.Averyanov. Scale bars: A, B, E, 5 cm; G, H, I, 1 cm; J, 2 mm; K, 5 mm.

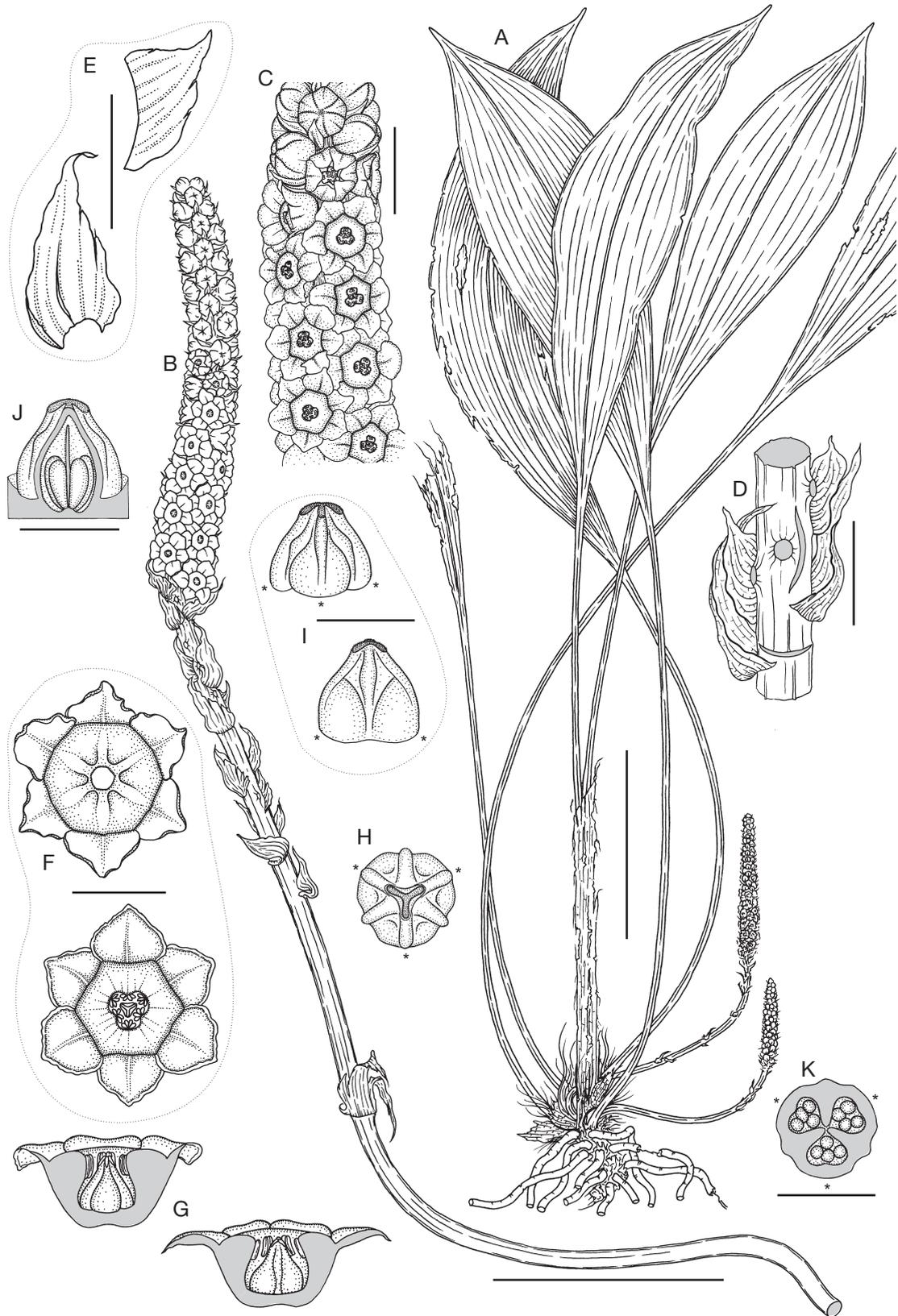


FIG. 5. — *Peliosanthes densiflora* Aver. & N.Tanaka, sp. nov.: **A**, flowering plant; **B**, inflorescence on peduncle; **C**, portion of inflorescence with open flowers, **D**, portion of proximal part of inflorescence with flowers removed, **E**, floral bract (lower) and bracteole (upper), **F**, flower, views from rear (upper) and frontal view (lower); **G**, sagittal sections of flower; **H**, pistil, frontal view; **I**, pistil, side views; **J**, pistil in side view with sagittal section of the frontal locule; **K**, cross section of ovary in middle part. Drawn from the type *E.Konstantinov*, *K 141* by L.Averyanov. Scale bars: A, 10 cm; B, 5 cm; C, 1 cm; D-H, 5 mm; I-K, 3 mm.



FIG. 6. — *Peliosanthes densiflora* Aver. & N.Tanaka, sp. nov.: **A**, flowering plant in natural habitat (type – K 141); **B**, flowering plant (paratype – K 140); **C**, **D**, plant with young spike (type – K 141); **E**, **E'**, **F**, inflorescences and flowers (paratype – K 140). All photos by E.Konstantinov, correction and design by L.Averyanov. Scale bars: B-D, 10 cm; E, 5 cm; E', 2 cm; F, 5 mm.

not rare, 14.III.2013, *N.T.Hiep, L.Averyanov, N.S.Khang, P.V.The, S.Lorphengsy, LA-VN 421* (CPC! LE!). — Vientiane province, Vang Vieng district, Phol Xai village, about 8 km to the W of Vang Vieng town, Phar Poon Mt., around point 18°56'11.5"N, 102°20'05.0"E, dry broad-leaved primary and secondary evergreen forest on very steep rocky slopes and on vertical cliffs of remnant highly eroded rocky limestone mountains composed of solid crystalline limestone at elevations 300-900 m, terrestrial clustering herb with ramose rhizome in shady place, leaves glossy light green on both sides, common at elevations 300-800 m, 15.III.2013, *N.T.Hiep, L.Averyanov, N.S.Khang, P.V.The, S.Lorphengsy, LA-VN 433* (CPC! LE!). — Vientiane province, Kasi district, Thong Mout village, Num Pong Mt., around point 19°21'46.9"N, 102°09'29.8"E, primary and second-

ary broad-leaved evergreen forest on steep shale slopes along stream at elevation about 900 m, terrestrial herb with leaves to 1 m long, petiole 30-40 cm, leaf blade glossy uniformly green on both sides, 14-18 cm long, 7-10 cm wide, not rare, 22.III.2013, *L.Averyanov, N.S.Khang, S.Lorphengsy, LA-VN 722* (CPC! LE!). — Vientiane province, Kasi district, in the vicinity of Khuang Lang Cave around point 19°18.198'N, 102°09.031'E, dry semi-deciduous forest with *Tetrameles nudiflora, Pometia eximia, Croton argyratus, Arenga west-erhoutii, Ficus religiosa* on stream slope at elev. about 631 m a.s.l., *E.Konstantinov, K 103* (LE!). — Vientiane province, 13 km to the NNW of Kasi town along new road to Luang Prabang, on slope of Nam Pong Gnai River, around point 19°21.978'N, 102°09.282'E at elev. about 827 m a.s.l., 22.X.2013, *E.Konstantinov, K 140* (LE!).

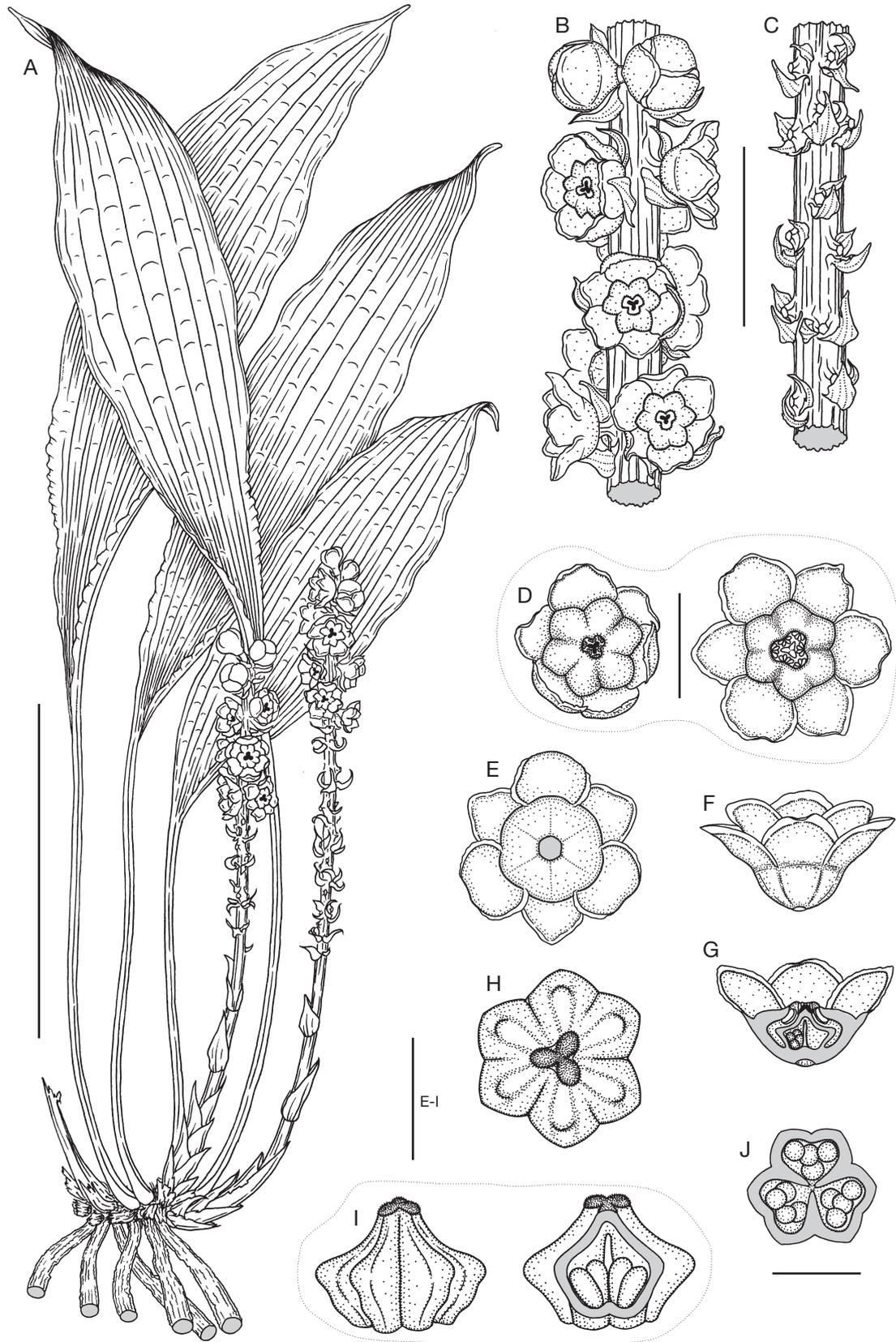


FIG. 7. — *Peliosanthes hexagona* Aver., N.Tanaka & K.S.Nguyen, sp. nov.: **A**, flowering plant; **B**, portion of inflorescence with open flowers; **C**, portion of inflorescence with flowers removed; **D**, flowers, frontal views; **E**, flower, rear view; **F**, flower, side view; **G**, sagittal section of flower; **H**, pistil, frontal view; **I**, pistil in side views, intact (left) and sagittal section showing inside of ovarian chamber (right); **J**, ovary, cross section in middle part. Drawn from the type *N.S.Khang*, *NSK 674* by L.Averyanov. Scale bars: A, 5 cm; B, C, 1 cm; D, 5 mm; E-J, 2 mm.



FIG. 8. — *Peliosanthes hexagona* Aver., N.Tanaka & K.S.Nguyen, sp. nov., digital epitype “d-EXSICCATES OF VIETNAMESE FLORA 0218/NSK 674”: **A, B**, flowering plant; **C**, base of plant and inflorescence; **D, E**, portions of inflorescence with open flowers; **F**, inflorescence with open flowers; **G**, flowers, half side view, frontal view and view from behind; **H, I**, portion of inflorescence rachis with floral bracts and bracteoles; **J**, flower, frontal view and transversal cross section of corona; **K**, abaxial and adaxial surfaces of leaf. Photos by N.S.Khang, correction and design by L.Averyanov. Scale bars: B, 10 cm; C, D, 2 cm; G, J, 5 mm; H, I, 1 cm.

AFFINITIES

This new species somewhat resembles *Peliosanthes violacea* Wall. ex Baker var. *violacea* and var. *princeps* Baker, but is distinct from them by the ascending floral bract shortly distant from the floral base, bracteole located beside the floral base, sessile flowers with more strongly expanded perianth segments, and white coronas.

DESCRIPTION

Terrestrial and lithophytic clustering perennial herb from suberect or ascending, ramose rhizome to 10 cm long, about 0.5-0.8 cm in diam., often apically densely branching, bearing many semi-woody cord-like roots. Stems erect, 1-2 cm tall, covered loosely with broad, papyraceous scaly leaves. Sheath leaves linear-lanceolate, conduplicate, to 18 cm long, 1-1.5 cm wide, fugacious, i.e. soon becoming papyraceous or scarious, eventually disintegrated into fibrous remains. Leaves erect, petiolate, to 0.8 m tall; petiole rigid, curved, shallowly channeled in basal part, 30-45 cm long; blade elliptic, shortly acuminate with obtuse or subacute apex, entire, glabrous, uniformly green and glossy on both sides, (18)22-30(35) cm long, (6.5)7.5-9(10) cm wide; longitudinal veins many, subperpendicularly crossed with many transversal veinlets. Inflorescence a terminal, compact spadix-like spike; peduncle ascending, rigid, (6)8-12(15) cm long, 2.5-3.5 mm in diam., dark green with violet tint, or dark violet to almost black, naked or with 1-2 narrowly deltoid, papyraceous or scarious sterile bract 1-2 cm long, 6-10 mm wide; rachis densely many-flowered, (5)7-12(15) cm long. Floral bracts 2 per flower, antrorse, white, scarious; bract located shortly distant from lower side of flower (proximal bracts distant for 4-7 mm from floral base), cuneate to triangular, (3)5-8 mm long, (2)3-4 mm wide; bracteole situated lateral to flower, obliquely broadly triangular, (2.5)3-4(5.5) mm long, (1.5)2-2.5(3) mm wide. Flowers solitary in bracteal axil, sessile on small knob-like short protuberance (much reduced pedicel), pure white, widely open, (9)10-12(13) mm across; proximal (syntepalous) part cupulate, 3-3.5(4) mm long, 6-7 mm across. Perianth segments subsimilar, triangularly (broadly) ovate, slightly recurved, subobtuse at apex, (2.5)3-3.5 mm long, 3.5-4.5 mm wide, margins scarious, finely irregularly undulate. Corona indistinctly hexagonal, almost flat, 5.5-6 mm across, 0.5-0.6(1) mm high, the distal orifice 3-subdentate, 2.2-2.6 mm in diam. Anthers 6 on apical inner surface of corona, oblong, introrse, 0.8-1 mm long, sessile, dorsifixed. Ovary subsuperior, broadly conic, 3 mm tall and wide, longitudinally 6-ridged, 3-lobed, the interior partitioned into 3 chambers by 3 septa almost touching along inward edges; each chamber adaxially slightly open with narrow longitudinal slit, containing 4-5 ovules on basal placenta; style indistinct; stigma 3-partite, the lobes narrowly oblanceolate, densely papillulate. Young seeds ovoid, drupe-like, glossy, 8-10 mm long; seed coat fleshy, green, flushed with blue.

REMARKS

Comparatively large white flowers of *Peliosanthes densiflora* Aver. & N.Tanaka, sp. nov. somewhat resemble the pale

greenish ones of *P. violacea* Wall. ex Baker var. *violacea* and var. *princeps* Baker (Baker 1879). But, the new species differs in many respects; e.g., the ascending floral bracts lying shortly distant from the floral base, bracteoles lying at the side of the reduced pedicel (vs on the basal part of pedicel), sessile flowers (vs distinctly pedicellate flowers), more strongly spreading perianth segments, and white coronas (vs purplish coronas). The large leaves reaching 0.8 m in height is another characteristic of this species among congeners.

Peliosanthes hexagona

Aver., N.Tanaka & K.S.Nguyen, sp. nov.
(Figs 7; 8)

Haec species Peliosanthes violaceae Wall. ex Baker var. *violaceae* et var. *princeps* Baker *subs similis est, sed a quibus pedicellis brevioribus et leviter descendentes, bracteola juxta basem pedicelli locata, et coronis obtuse 6-angulatis (vel 6-lobatis) distinguitur.*

TYPUS. — **Vietnam.** Hoa Binh province, Lac Thuy district, Phu Thanh commune, Tan Lam village, around point 20°34'55.48"N, 105°40'56.20"E, at elevation about 120 m a.s.l., scattered under secondary closed evergreen broad-leaved lowland forests on limestone, accompanying *Cycas hoabinhensis*, *Cryptolepis dubia*, *Amomum gagnepainii*, *Jasminum annamense*, *Justicia* sp., *Asplenium adiantoides*, *Liparis* sp. and *Microchirita* sp., perennial herb with rhizome, inflorescence about 20 cm, flower pale green, not common, 7.V.2014, *Nguyen Sinh Khang, NSK 674* (holo-, LE!).

EPITYPUS. — **Vietnam.** d-EXSICCATES OF VIETNAMESE FLORA 0218/NSK 674 (Fig. 8).

ETYMOLOGY. — The specific epithet refers to the hexagonal corona of the flower.

HABITAT AND PHENOLOGY. — Shady primary and secondary broad-leaved evergreen forests and scrub on limestone in lowland at elevations 50-120 m a.s.l. Flowers in April-May. Not common. Expected IUCN Red List status – LC.

DISTRIBUTION. — **Vietnam** (Hoa Binh province, Lac Thuy district). Endemic of northern Vietnam.

AFFINITIES

This species may be close to *Peliosanthes violacea* Wall. ex Baker var. *violacea* and var. *princeps* Baker, but is distinguished from them in the shorter, slightly descending pedicels, bracteole located beside the base of pedicel, and obtusely 6-angulate (or 6-lobate) coronas.

DESCRIPTION

Terrestrial perennial herb from simple or a few branched subterranean plagiotropic rhizome 4-6(8) cm long and 4-5 mm in diam., bearing narrowly fusiform, fleshy, almost straight roots. Stems ascending to erect, very short, less than 5 mm tall, covered densely with rather firm scales being distichous, imbricate, ensiform, acute, conduplicate, dark violet, 1-2 cm long, 0.5-1 cm wide. Leaves erect to arching, petiolate, to 30-35 cm tall; petiole rigid, slightly curved to almost straight, terete, (13)15-16.5(17.5) cm long, 3-4(4.5) mm wide; leaf blade elliptic, attenuate at

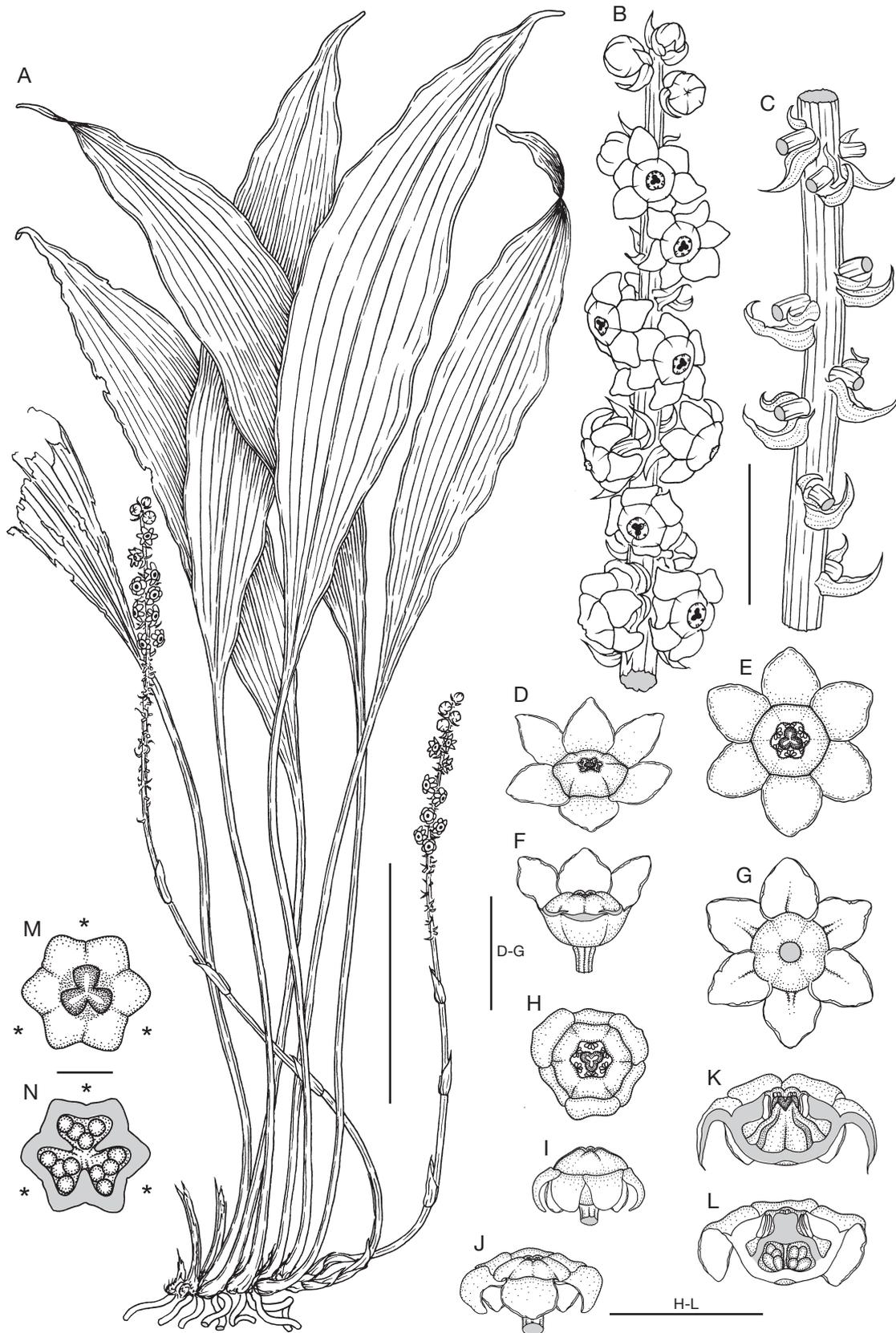


FIG. 9. — *Peliosanthes lucida* Aver., N.Tanaka & K.S.Nguyen, sp. nov.: **A**, flowering plant; **B**, portion of inflorescence with open flowers; **C**, portion of inflorescence with flowers removed; **D**, young (moderately open) flower, obliquely frontal view; **E**, young (moderately open) flower, frontal view; **F**, young (moderately open) flower with 3 frontal tepals removed, side view; **G**, young (moderately open) flower, rear view; **H**, fully open flower with strongly recurved segments, frontal view; **I**, **J**, fully open flowers, side view; **K**, sagittal section of flower with intact pistil; **L**, sagittal section of flower including pistil; **M**, pistil, frontal view; **N**, cross section of ovary. Drawn from the type *N.S.Khang*, *NSK 686* by L.Averyanov). Scale bars: **A**, 10 cm; **B**, **C**, 1 cm; **D-L**, 5 mm; **M**, **N**, 1 mm.

base, shortly acuminate with subacute apex, entire and sometimes undulate along margins, glabrous, glossy, uniformly green on both sides, somewhat firm, (13)15-17(18) cm long, (5.5)6-8(8.5) cm wide, longitudinally often slightly plicated; longitudinal veins many, subperpendicularly crossed with many transversal veinlets. Inflorescence a terminal, sub-dense raceme; peduncle ascending to straight, rigid, 15-18 cm long, 3.0-4.0 mm in diam., dark violet to almost black, bracteate; the sterile bracts (1)2(3), deltoid, acuminate, papyraceous or scarious, 1.5-2 cm long, 6-8 mm wide; rachis many-flowered, longitudinally finely ridged, dark violet, (13)15-17(18) cm long. Floral bracts 2, ascending distally, light violet, scarious; bract located below flower, triangular, distinctively concave, acuminate, (2.5)3-5(6) mm long, 2-3(4) mm wide; bracteole lateral to flower, broadly triangular, twice smaller. Flowers solitary in bracteal axil, pedicellate, campanulate, 7-9 mm across; base of flower shallowly cup-shaped, (3.5)4-4.5(5) mm across, 2-3 mm long, jointed with articulation to short, terete, slightly descending pedicel 1.4-1.8 mm long, 1 mm in diam. Perianth segments subsimilar, obliquely expanded, broadly ovate, rounded at apex, 2.5-3 mm long and wide, light green; the margin white, scarious, irregularly finely undulate. Corona dull brownish purple, proximally obtusely 6-angulate or shallowly 6-lobed, almost flat, 4.5-5 mm across, 0.5-0.6 mm high, distal margin 3-subdentate, the orifice 1.2-1.4 mm in diam. Anthers 6, introrse, oblong, 0.6-0.8 mm long, sessile, light yellowish. Ovary superior, broadly bottle-shaped, 1.8-2.2 mm tall, 2.5-3 mm wide, longitudinally 6-ridged, the interior imperfectly partitioned into 3 chambers by 3 septa almost touching along inward edges; each chamber adaxially slightly open with narrow longitudinal slit, containing 4 ovules on a basal placenta; style broadly conical; stigma 3-partite, the lobes narrowly obovate, densely papillulate.

REMARKS

Peliosanthes hexagona Aver., N.Tanaka & K.S.Nguyen, sp. nov. appears somewhat close to *P. violacea* Wall. ex Baker var. *violacea* and var. *princeps* Baker (Baker 1879) in having flowers with greenish, obliquely expanded perianth segments and purplish coronas. But, it differs by the short, slightly descending pedicels (vs usually longer, ascending pedicels), bracteoles lying beside the base of pedicel (vs on the basal part of pedicel), and obtusely 6-angulate (or 6-lobed) coronas (vs usually rounded coronas). The last character state appears unique among congeners.

Peliosanthes lucida

Aver., N.Tanaka & K.S.Nguyen, sp. nov.
(Figs 9; 10)

Haec planta Peliosanthes hexagonae Aver., N.Tanaka & K.S.Nguyen, sp. nov. *affinis est, sed foliis minoribus, racemis paulo laxioribus, floribus leviter minoribus, segmentis perianthii pallidioribus et valde recurvatis, coronis magis rotundatis (in ambitu basali) et convexis, et ovariiis semi-inferioribus est diversa.*

TYPUS. — **Vietnam.** Hoa Binh province, Lac Thuy district, Phu Thanh commune, Tan Lam village, around point 20°34'55.48"N, 105°40'56.20"E, at elevation about 120 m a.s.l., scattered under secondary closed evergreen broad-leaved lowland forests on limestone, accompanying *Cycas hoabinhensis*, *Cryptolepis dubia*, *Anomum gagnepainii*, *Jasminum annamense*, *Justicia* sp., *Asplenium adiantoides*, *Liparis* sp. and *Microchirita* sp., perennial herb with rhizome, inflorescence about 17-20 cm, flower pale green, common, 7.V.2014, *Nguyen Sinh Khang*, NSK 686 (holo-, LE!).

EPITYPUS. — **Vietnam.** d-EXSICCATES OF VIETNAMESE FLORA 0219/NSK 686 (Fig. 10).

ETYMOLOGY. — The specific epithet refers to the lucid leaf blades.

HABITAT AND PHENOLOGY. — Shady primary and secondary broad-leaved evergreen forests and scrub on limestone in lowland at elevations 50-120 m a.s.l. Flowers in April-May. Common. Expected IUCN Red List status – LC.

DISTRIBUTION. — **Vietnam** (Hoa Binh province, Lac Thuy district; Ninh Binh province, Tam Diep district). Endemic of northern Vietnam.

MATERIAL EXAMINED (PARATYPUS). — **Vietnam.** Ninh Binh province, Tam Diep district, Dong Son commune, village No 3, Voi mountain, around point 20°7'46.42"N, 105°55'41.23"E, at elev. about 100 m a.s.l., scattered under scrub in secondary closed evergreen broad-leaved lowland forests on limestone, perennial herb with rhizome, inflorescence about 20 cm, flower pale green, common, accompanying *Cycas hoabinhensis*, *Asplenium prolongatum*, *Dischidia tonkinensis*, *Sterculia* sp., 24.IV.2014, *Nguyen Sinh Khang*, NSK 673a (LE!).

AFFINITIES

This plant is allied to *Peliosanthes hexagona* Aver., N.Tanaka & K.S.Nguyen, sp. nov., but different by the smaller leaves, somewhat laxer racemes, slightly smaller flowers with paler, strongly recurved perianth segments, more roundish (in basal outline) and convex coronas, and half-inferior ovaries.

DESCRIPTION

Terrestrial or lithophytic perennial herb from simple or a few branched, subterranean, plagiotropic rhizome bearing many semi-woody roots. Stems ascending to erect, very short, less than 5 mm tall, covered with a few scales being distichous, imbricate, ensiform, acute, conduplicate, dull violet, 1-2 cm long, 4-8 mm wide. Leaves arching, petiolate, to (30)35-42(45) cm tall; petiole rigid, slightly curved to almost straight, terete, (16)20-22(24) cm long; leaf blade elliptic, shortly acuminate with subacute apex, entire and slightly undulate along margins, glabrous, glossy, uniformly green on both sides, somewhat firm, (16)18-20(21) cm long, (4.0)5-6(7.0) cm wide; longitudinal veins many, prominent, subperpendicularly crossed with many transversal veinlets. Inflorescence a terminal, sub-dense raceme; peduncle ascending to straight, rigid, (8)10-12(14) cm long, 3-4 mm in diam., light to dark violet, bracteate; the sterile bracts (2)3-4(5), deltoid, acuminate, papyraceous or scarious, (5)8-12(15) mm long and 3-6 mm wide; rachis laxly many-flowered, longitudinally finely ridged, white to light violet, (8)10-15(17) cm long. Floral bracts 2, distally antrorse, white to very light violet, scarious; bract located below flower, triangular, acuminate,



FIG. 10. — *Peliosanthes lucida* Aver., N.Tanaka & K.S.Nguyen, sp. nov., digital epitype "d-EXSICCATES OF VIETNAMESE FLORA 0219/NSK 686 (LE)": **A**, plant in natural habitat; **B-D**, inflorescences; **E**, portion of inflorescence with open flowers; **F**, portion of inflorescence rachis with floral bracts and bracteoles; **G**, flowers, frontal view, view from behind and transversal cross section of ovary; **H**, transversal and longitudinal sections of ovary and corona. All photos by N.S.Khang, correction and design by L.Averyanov. Scale bars: D, 10 cm; F, 2 cm; G, H, 5 mm.



FIG. 11. — *Tupistra breviscapa* Aver. & N.Tanaka, sp. nov.: **A**, flowering plant; **B**, inflorescence on peduncle; **C**, inflorescence in front removed; **D**, portion of inflorescence with outer floral bracts and inner bracteoles, flowers removed; **E**, floral bracts and bracteoles from basal and apical part of inflorescence; **F**, flowers in different side views; **G**, flowers, upper and frontal views; **H**, interior of perianth with stamens, cut and flattened; **I**, pistils in different side views; **J**, pistil, frontal view; **K**, transversal section of ovary. All drawn by L.Averyanov and T.Maisak from the type *E. Konstantinov K248*. Scale bars: A, 50 cm; B, C, 1 cm; D-H, 5 mm; I, 2 mm; J, K, 1 mm.

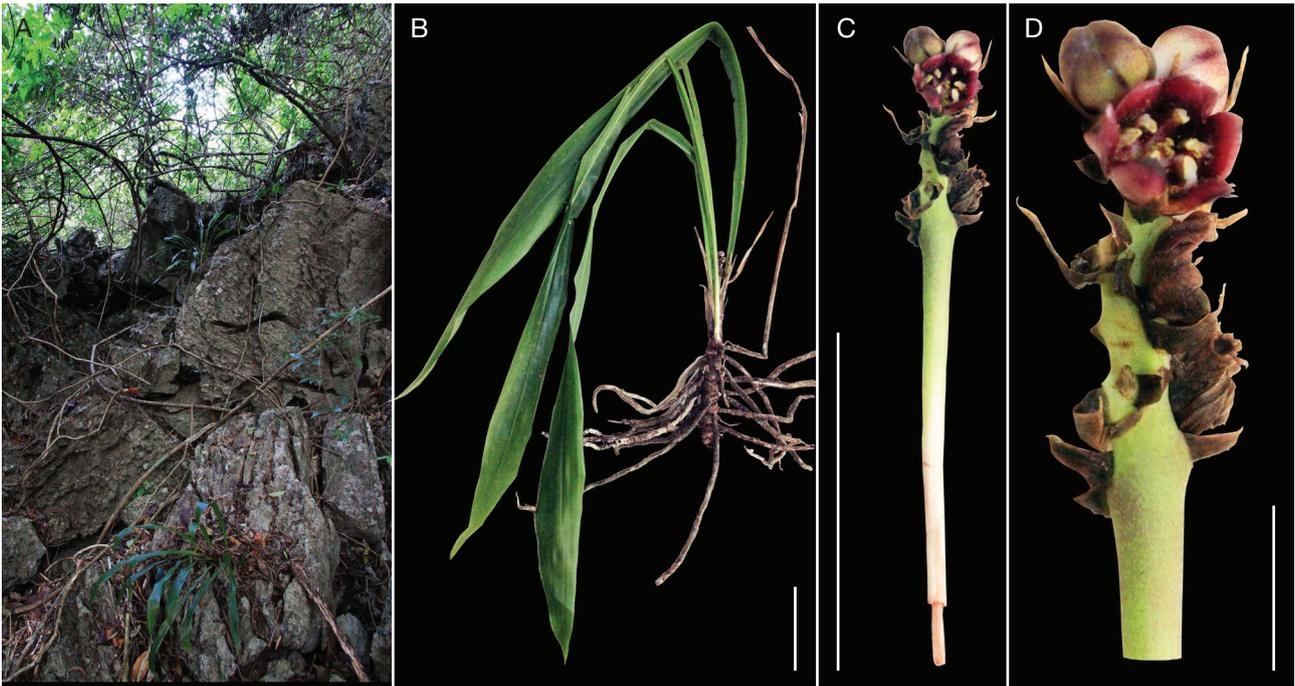


FIG. 12. — *Tupistra breviscapa* Aver. & N.Tanaka, sp. nov.: **A**, plants in natural habitat; **B**, flowering plant; **C**, inflorescence on peduncle; **D**, inflorescence rachis with flowers. All photos from the type specimen *E.Konstantinov K248* by E.Konstantinov, image correction and design by L.Averyanov. Scale bars: B, 10 cm; C, 5 cm; D, 1 cm.

distinctively concave adaxially, (2.5)3-4.5(5) mm long, 1.5-2.5 mm wide; bracteole lateral to flower, broadly triangular, twice smaller. Flowers solitary in bracteal axil, pedicellate, broadly open, 7-8 mm across, often slightly nodding; base of flower hemispheric, 3.5-4 mm across, 2.5-3 mm long, jointed with articulation to short, terete, almost horizontal pedicel 1.4-1.8 mm long, 1 mm in diam. Perianth segments subsimilar, ovate to broadly ovate, obtuse, light green to almost white, brownish at base, margins finely irregularly undulate, revolute, scarious, 2.4-2.6 mm long and 2-2.2 mm wide, becoming strongly recurved. Corona dull brownish purple, circular or obscurely hexagonal, convex, 3.5-4 mm across, about 1 mm high, distal margin 6-subdentate, the orifice 1.4-1.6 mm in diam. Anthers 6, introrse, oblong, 0.8-1 mm long, sessile, light yellowish. Ovary half-inferior, free part hemispheric, 1-1.2 mm tall, 2-2.5 mm wide, 6-angulate longitudinally, the interior imperfectly partitioned into 3 chambers by 3 septa; each chamber adaxially slightly open with narrow longitudinal slit, containing 4 ovules on basal placenta; style broadly conical, 1-1.2 mm tall; stigma 3-partite, the lobes obovate, decurrent, densely papillulate.

REMARKS

Peliosanthes lucida Aver., N.Tanaka & K.S.Nguyen, sp. nov. appears closely allied to *P. hexagona* Aver., N.Tanaka & K.S.Nguyen, sp. nov. (present paper) in having cymbiform (or subcucullate), distally ascending floral bracts, short pedicels, greenish but basally purplish perianth segments, purplish coronas and 6 angulate ovaries. But it differs from the latter by the smaller leaves, somewhat laxer racemes, slightly smaller

flowers with paler, strongly recurved perianth segments, more roundish and convex coronas, and half-inferior ovaries. The petioles of this species look usually longer than the leaf blades, and the scape including the rachis of inflorescence is slender and usually longer than the petiole or the leaf blade. The very shining leaf blades also characterize the new species.

Tupistra breviscapa Aver. & N.Tanaka, sp. nov. (Figs 11; 12)

Haec species nova *Tupistrae* theanae Aver. & N.Tanaka *affinis est, sed ab ea pedunculo multo brevior, floribus in quoque scapo paucioribus, bracteis exterioribus floris flores excurrentibus, et stigmata minore et tripartitis bene differt.*

TYPUS. — Laos. Khammouane province, Thakhek district, environs of Thakhek town around point 17°27.195'N, 104°57.790'E, dry secondary evergreen broad-leaved forest on marble-like limestone at elevation about 161 m a.s.l., lithophytic rosulate herb in crevices of vertical shady cliffs, leaves rigid, up to 1.4 m long, 3.XI.2013, *E.Konstantinov K248* (holo-, LE!; iso-, LE!).

ETYMOLOGY. — The specific epithet refers to the short scape (or sexually reproductive stem) of the species.

HABITAT AND PHENOLOGY. — Primary and secondary dry evergreen broad-leaved forests on eroded marble-like crystalline limestone at elevations 150-200 m a.s.l. Obligate lithophyte on shady vertical limestone cliffs. Flowers in September-October. Rare. Expected IUCN Red List status – DD.

DISTRIBUTION. — Laos (Khammouane province, Thakhek district). Local endemic of southern Laos.

AFFINITIES

This new species is allied to *Tupistra theana* Aver. & N. Tanaka, but differs from it by the much shorter peduncle, fewer flowers per scape, outer floral bracts exceeding the flowers, and the smaller tripartite stigma.

DESCRIPTION

Lithophytic perennial herb. Rhizome erect or suberect, simple or a few branched, terete, stout, slightly woody, dark brown-gray to almost black, 5-10(15) cm long, (1.2)1.5-2(2.2) cm in diam. Roots cord-like, thick, fleshy, covered densely with black root hairs in most part. Stem erect, very short, 1-1.5 cm tall, covered with dilated leaf bases and fibrous remnants of decaying sheath leaves (cataphylls). Sheath leaves straight or slightly recurved, ensiform, conduplicate, green, (3.5)5-15(20) cm long, (0.4)0.6-1(1.4) cm wide, fugacious, becoming soon drying, papyraceous and dull yellowish-brown. Leaves basal, (2)3-5(6), suberect to arcuate, sub-sessile, equitant, indistinctly petiolate, oblanceolate, (0.7)0.9-1.3(1.5) m long, (3.5)4-5(6) cm wide, gradually tapering to rigid, canaliculate, petiole-like base, acute at apex, rigid, leathery, uniformly green, glossy, midvein prominent abaxially. Peduncle arising from top of stem, axillary, erect, straight, rigid, 4-6(8) cm long, (1.5)2-3 mm in diam., naked, fleshy, white to light green, becoming slightly thicker upward. Inflorescence a simple, loose, terminal spadix-like spike of several flowers, 2.5-3(4.5) cm long, 1.2-1.5 cm in diam.; rachis several-angled longitudinally, fleshy, slightly raised around flower pits. Floral bracts 2 per flower, triangular, conduplicate toward base, spreading, becoming drying, papyraceous, dull yellowish-brown to dark brown; outer bract located below flower, acute to acuminate, finely serrulate distally, (6)8-12(14) mm long, (5)6-8(9) mm wide, exceeding the flower; inner bract (bracteole) lying lateral to flower, acute, oblique, (3.5)4-6(7) mm long, 1.5-2(2.5) mm wide. Flowers several, sessile, campanulate or suburceolate, not fully open, 6-8 mm across; perianth (7)8-9(10) mm long, 6-cleft distally, cup or bowl-shaped in proximal half, dark dirty purple, fleshy; segments triangular-ovate, obtuse and often irregularly serrulate apically, 4.5-5 mm long and wide. Stamens 6, opposite to perianth segments; anthers inserted at perianth tube close to base of segments, ellipsoid, introrse, slightly incurved, 1.5-1.8(2) mm long, light dull yellow, dorsifixed on short fleshy filaments 0.5 mm long. Ovary externally very indistinct, 3-lobed, each locule with 1 lens-shaped ovule on an axial placenta; style columnar, slightly broadened toward the base, truncate at apex, 3-ridged longitudinally, yellowish-pink, 4 mm tall, 1-1.5 mm in diam., not exceeding the base of anthers; stigma 3-partite, 1-1.2 mm in diam., almost dull yellowish-brown, lobes rectangular, convex, ventrally grooved longitudinally, densely papillulate. Fruits unknown.

REMARKS

Tupistra breviscapa Aver. & N. Tanaka, sp. nov. is most closely allied to *T. theana* Aver. & N. Tanaka from central Vietnam (Averyanov & Tanaka 2012) in having a similar floral shape, similar coloration of perianth and style, and a relatively small pistil. It differs, however, by the much shorter peduncle (vs

peduncle over 20 cm), fewer flowers per scape, outer floral bracts exceeding the flowers (vs bracts as long as the flowers), and the smaller tripartite stigma nearly as broad as the style (vs indistinctly 3-lobed or nearly entire stigma significantly broader than the style).

The new species appears close to the genus *Rohdea* (Roth 1821; Tanaka 2003a, 2010a) in having a relatively small tripartite stigma, but is assignable to *Tupistra* (Ker Gawler 1814; Tanaka 2003b, 2010b) by the leaf with a more slender petiole-like base, purplish perianth (vs greenish perianth), and the stout style nearly as thick as the ovary. Of the species of *Tupistra* hitherto known, the new species seems to retain the most primitive character state especially as to pistil. In this respect, it may be more primitive than *T. theana*.

Acknowledgements

We cordially thank authorities of the Department of Biology, Faculty of Science, the National University of Laos for organization of field works, which were supported partly by research programs of USA National Geographic Society, under the themes “Flora of relict karstic formation of central Laos (Vientiane province, Vang Vieng and Kasi districts)”, 9141-12 and “Exploration of primary woods along constructed highway Hanoi-Ho Chi Minh for their sustainable conservation (in limits of Ha Tinh and Nghe An provinces of central Vietnam)”, 9129-12 and by Mohamed bin Zayed Species Conservation Fund for the theme “Studies of *Calocedrus rupestris*, *Xanthocyparis vietnamensis*, *Glyptostrobus pensilis*, *Dacrycarpus imbricatus*, *Dacrydium elatum*, *Podocarpus neriifolius*, *Nageia wallichiana* and *Pinus dalatensis* in Laos”. We also thank the director of the Herbarium of Royal Botanic Garden Edinburgh (E) for the loan of relevant (cited) specimens to one of the authors (N. Tanaka), Ms. T. Maisak for her kindest help with the line drawings and Dr Thierry Deroin for his careful correction and scientific editing of this paper.

REFERENCES

- AVERYANOV L. V. 2011. — *Peliosanthes yunnanensis* and *Trichosma yanshanensis* – new additions to the flora of Vietnam. *Taiwania* 56 (2): 143-148.
- AVERYANOV L. V. & TANAKA N. 2012. — New species of *Peliosanthes* and *Tupistra* (Asparagaceae) from eastern Indochina. *Taiwania* 57: 153-167.
- AVERYANOV L. V. & TANAKA N. 2013. — New species of *Peliosanthes* (Asparagaceae) from Vietnam. *Turczaninowia* 16 (2): 5-7.
- AVERYANOV L. V., TANAKA N. & LUU H. T. 2013. — New species of *Ophiopogon* and *Peliosanthes* (Asparagaceae) from Cambodia and Vietnam. *Taiwania* 58 (4): 233-241.
- AVERYANOV L. V., TANAKA N. & NGUYEN S. K. 2014. — New species of *Peliosanthes* and *Rohdea* (Asparagaceae) from eastern Indochina. *Taiwania* 59 (1): 18-25.
- BAKER J. G. 1879. — *Peliosanthes violacea* Wall. ex Baker var. *violacea*, and var. *princeps*. *Journal of the Linnean Society, Botany* 17: 504.
- BOIS D. 1906. — *Ophiopogon regnieri*. *Revue Horticole* 370, 371.
- DAI L. K. & CHEN S. C. 1978. — *Ophiopogon*, in WANG W. F. & TANG T. (eds), *Flora Reipublicae Popularis Sinicae*. Vol. 15. Science Press, Beijing: 130-164, 251-253.

- DECAISNE J. 1867-68. — Sur les *Ophiopogon*. *Flore des Serres et des Jardins de l'Europe* 17: 181-183.
- FANG D. 1998. — Three new species of *Ophiopogon* (Liliaceae) from Guangxi, China. *Journal of Tropical and Subtropical Botany* 6 (2): 97-100.
- GAGNEPAIN F. 1934A. — Quelques Liliacées nouvelles d'Indochine. *Bulletin de la Société botanique de France* 81: 286-289.
- GAGNEPAIN F. 1934B. — Liliacées, in LECOMTE H., HUMBERT H. & GAGNEPAIN F. (eds), *Flore Générale de l'Indo-Chine* 6 (6). Masson, Paris: 753-815.
- HANDEL-MAZZETTI H. 1936. — *Ophiopogon bockianus* Diels. *Symbolae Sinicae* 7: 1218.
- JESSOP J. P. 1976. — A revision of *Peliosanthes* (Liliaceae). *Blumea* 23: 141-159.
- KER GAWLER J. B. 1814. — *Tupistra*. *Botanical Magazine* 40: pl. 1655.
- MERRILL E. D. & CHUN W. Y. 1935. — Additions to our knowledge of the Hainan flora II. *Sunyatsenia* 2: 203-344.
- NEWMAN M., KETPHANH S., SVENGSUKSA B., THOMAS P., SENGDALA K., LAMXAY V. & ARMSTRONG K. 2007. — *A Checklist of the Vascular Plants of Lao PDR*. Royal Botanic Garden Edinburgh, 394 p.
- RODRIGUEZ L. 1928. — *Ophiopogon* nouveaux d'Indo-Chine. *Bulletin de la Société botanique de France* 75: 997-999.
- RODRIGUEZ L. 1934a. — Hémodoracées nouvelles d'Indochine. *Bulletin du Muséum national d'Histoire naturelle, Paris*, ser. 2, 6 (1): 95-97.
- RODRIGUEZ L. 1934b. — Hémodoracées, in LECOMTE H., HUMBERT H. & GAGNEPAIN F. (eds), *Flore Générale de l'Indo-Chine* 6 (5). Masson, Paris: 654-673.
- ROTH A.W. 1821. — *Rohdea*. *Novae Plantarum Species praesertim Indiae orientalis*: 196.
- TANAKA N. 1998. — Taxonomic notes on *Ophiopogon* of South Asia I. *Journal of Japanese Botany* 73 (6): 301-313.
- TANAKA N. 1999a. — Taxonomic notes on *Peliosanthes* (Convallariaceae) I. *Acta Phytotaxonomica et Geobotanica* 50 (2): 147-155.
- TANAKA N. 1999b. — Taxonomic notes on *Ophiopogon* of South Asia II. *Journal of Japanese Botany* 74 (1): 25-33.
- TANAKA N. 1999c. — Taxonomic notes on *Ophiopogon* of South Asia III. *Journal of Japanese Botany* 74 (5): 261-267.
- TANAKA N. 2000a. — Taxonomic notes on *Ophiopogon* of South Asia VI. *Journal of Japanese Botany* 75 (3): 127-136.
- TANAKA N. 2000b. — Taxonomic notes on *Ophiopogon* of South Asia V. *Journal of Japanese Botany* 75 (2): 69-79.
- TANAKA N. 2001. — Taxonomic notes on *Ophiopogon* of South Asia X. *Journal of Japanese Botany* 76 (1): 11-19.
- TANAKA N. 2003a. — New combinations in *Rohdea* (Convallariaceae). *Novon* 13: 329-333.
- TANAKA N. 2003b. — Inclusion of *Tricalistra* and *Gonioscypha muricata* in *Tupistra* (Convallariaceae). *Novon* 13: 334-336.
- TANAKA N. 2004a. — A new species of *Peliosanthes* (Convallariaceae) from Vietnam and China. *Kew Bulletin* 59: 157-159.
- TANAKA N. 2004b. — Inclusion of *Neolourya* in *Peliosanthes* (Convallariaceae). *Novon* 14: 360-364.
- TANAKA N. 2010a. — A taxonomic revision of the genus *Rohdea* (Asparagaceae). *Makinoa New Series* 9: 1-54.
- TANAKA N. 2010b. — A taxonomic revision of the genus *Tupistra* (Asparagaceae). *Makinoa New Series* 9: 55-93.
- TANAKA N. 2010c. — A new species of *Tupistra* (Asparagaceae) from Laos. *Journal of Japanese Botany* 85 (2): 69-73.

Submitted on 17 August 2014;
accepted on 6 November 2014;
published on 26 June 2015.

