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New Species of *Ophiopogon* and *Peliosanthes* (Asparagaceae) from Laos and Vietnam

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ABSTRACT: Three new species of *Ophiopogon*, *O. alatus*, *O. erectus* from N. Vietnam and *O. patulus* from NE. Laos, and three new species of *Peliosanthes*, *P. inaperta* from central Laos and *P. kenhilloides*, *P. splendens* from NW. Vietnam, are described with illustrations. These taxa are regarded as local endemics of the respective countries. *Peliosanthes macrostegia* is recorded as new to the flora of Vietnam. Data on distribution and ecological aspects of *O. hayatae* is added with photographic illustrations, because our knowledge on this species in Vietnam is still insufficient.

KEY WORDS: Laos, New taxa, *Ophiopogon*, *Peliosanthes*, Plant diversity, Plant taxonomy, Vietnam.

INTRODUCTION

Three genera, *Ophiopogon* Ker Gawl. (Ker Gawler, 1807), *Peliosanthes* Andrews (Andrews, 1808) and *Liriope* Lour. (Loureiro, 1790), share several unique features. For example, they develop a terminal raceme that appears to have been derived from a panicle or compound raceme through the reduction of lateral branchlets. After anthesis, their carpels soon rupture and expose comparatively large globose or ovoid seeds coated with a fleshy blue to black testa. Because of sharing these specialized character states, the three genera are regarded as monophyletic, and often classified into a single suprageneric category such as the tribe Ophiopogoneae (Endlicher, 1836–40, Bentham, 1883, Dahlgren *et al.*, 1985), Liriopeae (Baker, 1879), or the subfamily Ophiopogonoideae (Engler, 1887; Takhtajan, 2009). They occur in the temperate to tropical zone of east, south and southeast Asia. *Ophiopogon* and/or *Peliosanthes* of eastern Indochina were/was studied previously by such botanists as Decaisne (1867–1868), Rodriguez (1928, 1934a, b) and Jessop (1976). By more recent surveys it has become evident that the two genera are highly diversified in Laos, Vietnam and Cambodia (Tanaka, 1998, 1999a–d, 2000a–e, 2001, 2004a–b; Ho, 2000; Nguyen, 2005; Averyanov, 2011; Averyanov and Tanaka, 2012, 2013; Averyanov *et al.*, 2013, 2014, 2015a, b, 2016). In the Table 1 below, we list the names of taxa of the two genera, which have hitherto been confirmed by us to occur in the three countries.

Considering the fact that there still are many areas botanically little explored, we expect that more new species of the two genera will be discovered in the three countries if further field surveys are carried out.

While botanizing in Laos and Vietnam, we found six unusual plants of *Ophiopogon* and *Peliosanthes*. After a close survey, they proved to be new taxa. Their names and approximate provenances are as follows: — *O. alatus*, *O. erectus* from N. Vietnam, *O. patulus* from NE. Laos, *P. inaperta* from central Laos, and *P. kenhilloides*, *P. splendens* from NW. Vietnam. All of them are regarded as local endemics of the respective countries. In this paper, we describe these new taxa with illustrations and other relevant taxonomic records. Further, *P. macrostegia* is recorded for the first time as a member of the flora of Vietnam. Data on distribution and ecological aspects of *O. hayatae* is also added with photographic illustrations, because our knowledge on this species in Vietnam appears still insufficient.

TAXONOMIC TREATMENT

Ophiopogon alatus Aver. & N.Tanaka, ***sp. nov.***

Fig. 1

Plant was collected in northern Vietnam ("Nghe An province, Ky Son district, Na Ngoi municipality, eastern slopes of Phu Xai Lai Leng Mountain, very humid primary broad-leaved forest on steep mountain slopes composed of sandstone and gray shale at elevations 2000–2300 m a.s.l. around point 19°11′58.2″N 104°11′38.6″E, 24 October 2013, *L.Averyanov, N.T.Hiep, N.S.Khang, L.M.Tuan, N.A.Trang, L.H.Dan, CPC 6151*"). Herbarium type specimen was prepared from cultivated plant (grown from seeds) in July 2015. Type ("27 July 2015, *L.Averyanov, CPC 6151a*") – LE (holotype).

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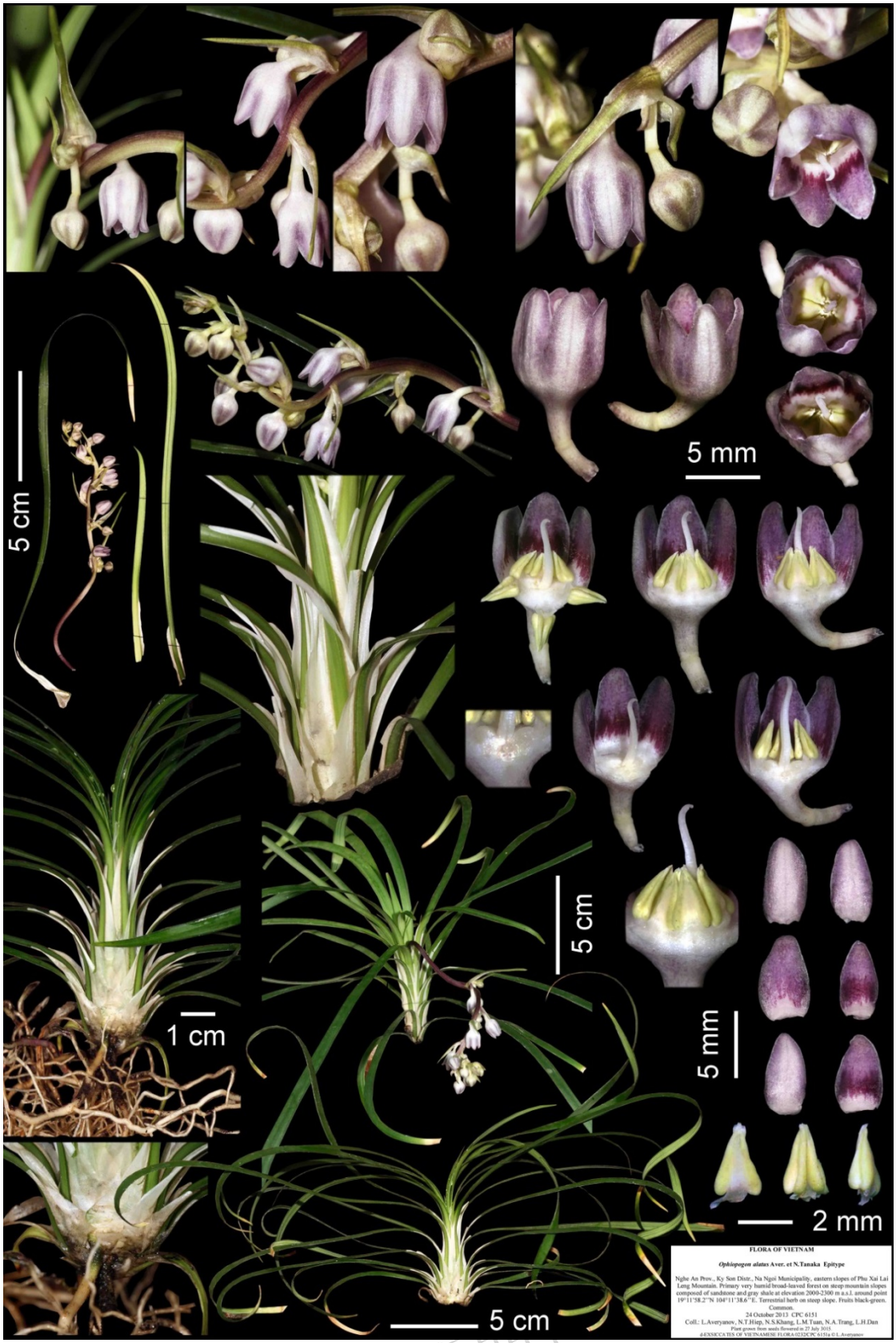


Fig 1. ***Ophiopogon alatus*** *sp. nov.* Digital epitype, *L. Averyanov CPC 6151a*. Photos, correction and design by L. Averyanov.

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Table 1: Taxa of ***Ophiopogon*** and ***Peliosanthes*** (including *Neolourya* L. Rodr.) hitherto confirmed to occur in Laos, Vietnam and/or Cambodia*

Ophiopogon Ker Gawl.	
1. *O. alatus* Aver. & N.Tanaka	**11a. *O. longifolius*** Decne. (including *O. humilis* L. Rodr.; *O. subverticillatus* Gagnep. ex L. Rodr.)
2. *O. bockianus* Diels (including *O. mairei* H. Lév.)	**11b. *O. longifolius* f. *albostriatus*** N.Tanaka (in cult.)
3. *O. chingii* F.T.Wang & T.Tang (including var. *glaucifolius* F.T.Wang & L.K.Dai)	**12. *O. ogisui*** M.N.Tamura & J.M.Xu
4. *O. dracaenoides* Hook.f.	**13. *O. patulus*** Aver. & N.Tanaka
5. *O. erectus* Aver. & N.Tanaka	**14. *O. petraeus*** Aver. & N.Tanaka
6. *O. fruticulosus* Aver., N.Tanaka & K.S.Nguyen	**15. *O. pierrei*** L.Rodr.
7. *O. griffithii* (Baker) Hook.f. (including *O. revolutus* F.T.Wang & L.K.Dai)	**16. *O. regnieri*** Bois (including *O. marmoratus* Pierre ex L. Rodr.)
8. *O. hayatae* (N.Tanaka) N.Tanaka, Aver. & T.Koyama (*O. platyphyllus* Merr. & Chun var. *hayatae* N.Tanaka)	**17. *O. rupestris*** Aver. & N.Tanaka
9. *O. intermedius* D.Don	**18. *O. tonkinensis*** L.Rodr.
10. *O. latifolius* L.Rodr.	**19. *O. tristylatus*** Aver., N.Tanaka & Luu
	20. *O. vietnamensis* N.Tanaka
Peliosanthes Andrews	
1. *P. aperta* Aver., N.Tanaka & Vuong	**14. *P. kenhilloides*** Aver. & N.Tanaka
2. *P. argenteostriata* Aver. & N.Tanaka	**15. *P. lucida*** Aver., N.Tanaka & K.S.Nguyen
3. *P. cambodiana* Aver. & N.Tanaka	**16. *P. macrostegia*** Hance
4. *P. densiflora* Aver. & N.Tanaka	**17. *P. micrantha*** Aver. & N.Tanaka
5. *P. divaricatanthera* N.Tanaka	**18. *P. nivea*** Aver. & N.Tanaka
6. *P. elegans* Aver., N.Tanaka & Vuong	**19. *P. nutans*** Aver. & N.Tanaka
7. *P. gracilipes* (Craib) N.Tanaka (including *Ophiopogon peliosanthifolius* L. Rodr.)	**20. *P. retroflexa*** Aver. & N.Tanaka
8. *P. grandiflora* Aver. & N.Tanaka	**21. *P. sinica*** F.T.Wang & T.Tang
9. *P. griffithii* Baker var. ***griffithii***	**22. *P. splendens*** Aver. & N.Tanaka
10. *P. hexagona* Aver., N.Tanaka & K.S.Nguyen	**23. *P. subcoronata*** N.Tanaka
11. *P. inaperta* Aver. & N.Tanaka	**24. *P. triandra*** Aver. & N.Tanaka
12. *P. irinae* Aver. & N.Tanaka	**25. *P. weberi*** (L.Rodr.) N.Tanaka (including *Neolourya pierrei* L. Rodr.)
13. *P. kenhillii* Aver., N.Tanaka & K.S.Nguyen	

*Data based on: Tanaka, 1998, 1999a–d, 2000a–e, 2001, 2004a–b; Averyanov, 2011; Averyanov and Tanaka, 2012; Averyanov *et al.*, 2013, 2014, 2015a, b, 2016, and this paper.

Etymology. The specific epithet refers to the prominent, proximal marginal wings of the leaves.

Description. Herb terrestrial, perennial. Stem short, erect, unbranching, (3)5–7(10) cm tall, (0.8)1–1.5(2.2) cm in diam., covered with spirally arranged, imbricate leaf sheaths with prominent wings. Roots few from basal part of stem, rigid, fleshy, whitish, (1.5)2–3(3.5) mm in diam. near base. Leaves many, tufted, spirally and densely arranged on apical part of stem, arching, crinkled, linear, slightly narrowed and winged proximally; the wings white, scarious-papyraceous, to 5–8(10) mm wide; acute at apex, entire along margins, leathery, glabrous, (15)20–25(30) cm long, (3)4–5.5(6.5) mm wide; adaxially uniformly dark grass-green; abaxially light green-glaucous, with 4–6(8) narrow white parallel stripes; main longitudinal veins many, indistinct; secondary veins hardly visible. Inflorescence a lax raceme with distant fascicles of (1)2–3(4) pedicellate flowers; peduncle (scape) and rachis straight or flexuose, finely ridged, dull greenish to dull pale brownish-purple; peduncle (3.5)4.5–6(7) cm long, (1.5)2–2.5(3) mm in diam., ebracteate or with 1(2) small, brownish, papyraceous, sterile bracts; rachis (5)6–7(8) cm long; the pedicels arising from bracteal axils, usually antrorse to subperpendicular (to rachis), arching, terete, light violet to white, (2)2.5–4(4.5) mm long, (0.6)0.8–1(1.2) mm in diam., as long as or a little longer than stalky part of floral base, terminally slightly broadened and jointed to floral base forming a distinct articulation; the outermost (lowermost) bract within a fascicle of floral bracts narrowly triangular, acute or acuminate, light greenish, white and scarious along margin, sometimes with light violet tint, (0.6)1–3(3.5) cm long, (1)1.5–3(3.5) mm wide; the inner bract laterally subtending each pedicel, twice-thrice smaller, narrowly triangular, light greenish to whitish, scarious. Flowers drooping, campanulate, not much broadly opening, odorless, (5.5)6–7(7.5) mm long, (6)7–8(8.5) mm across; floral base funnel-form, pale violet to white, (1.4)1.6–2(2.2) mm long, 0.8–1(1.2) mm in diam. Perianth segments subsimilar, narrowly ovate, blunt to rounded at apex, straight, slightly concave, somewhat thick, (4.8)5–6(7) mm long, (1.8)2–2.2(2.4) mm wide, externally pale violet, medially paler and whitish, internally violet-purple; inner

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segments (petals) slightly wider. Stamens 6, located at base of each perianth segment, subsessile; anthers broadly triangular, subconic, slightly dorsiventrally flattened, shallowly cordate at base, shortly truncate at apex, introrse, light pale yellow-greenish, (1.9)2–2.2(2.3) mm long, (1.3)1.4–1.5(1.6) mm wide; filaments very short, thin, flat and wide, 0.2–0.3 mm long, 0.5–0.6 mm wide. Ovary inferior, 3-locular; (1)2–4 ovules on basal placenta in each locule; style purely white, erect, straight or curved apically, narrowly pyramidal to sub-cylindric, (4.8)5–5.2(5.4) mm long, basal part cylindric, (0.5)0.6–0.7(0.8) mm wide; stigma almost negligibly minute, acute to obtuse. Seeds ovoid, glossy, black-green.

Distribution. N. Vietnam: Nghe An province (Ky Son district). Endemic.

Habitat, phenology and conservation status. Terrestrial herb usually on humid steep mountain slopes covered with primary or secondary broad-leaved evergreen forests on sandstone or shale at elevations 2000–2300 m a.s.l. Plants grown from seeds flower in July – August in cultivation. Locally common. IUCN Red List status tentatively assessed as LC.

Notes. *Ophiopogon* alatus appears close to O. longifolius Decne (Decaisne, 1867–1868) s.l., which is widespread all over south and southeast Asia and very variable, in its somewhat thick fibrous roots, inflorescence exceeding the peduncle in length, position of joint between a pedicel and a floral stalky base, flowers not broadly open, somewhat concave (navicular) perianth segments, and the moderately thick style (Tanaka, 1998). It is, however, distinguishable from the latter by the prominent, proximal white wings of the leaves, long bracts exceeding the flowers in the proximal part of an inflorescence, internally deeply violet-purplish tepals, and somewhat wider deltoid anthers.

Ophiopogon erectus Aver. & N.Tanaka, ***sp. nov.***

Fig. 2

Plant was collected in northern Vietnam ("Thanh Hoa province, Thuong Xuan district, Bat Mot municipality, Duc village, Xuan Lien natural reserve, primary broad-leaved evergreen forest on rocky, highly eroded, crystalline limestone at elevations 800–1000 m a.s.l. around point 20°01′11.6″N 104°57′47.5″E, 4 November 2013, *L.Averyanov, N.T.Hiep, N.S.Khang, N.D.Thang, L.V.Tien, CPC 6716b*"). Type specimen was prepared from cultivated plant originally collected in the wild. Type ("10 September 2015, *L.Averyanov, CPC 6716b / 13258*") – LE (holotype).

Etymology. The epithet refers to the erect stem of this plant.

Description. Herb terrestrial. Stem usually erect, normally unbranched, to about 50 cm high and 1 cm in diam., distally bearing numerous crowded leaves; basal leafless part covered imbricately with pale dull yellowish-brown, partially disintegrated, papyraceous remnants of leaf bases, with almost straight, rigid, woody, grayish prop roots. Leaves numerous, sub-distichous, arching, sessile, (35)40–50(55) cm long, (0.8)1.2–1.6(1.8) mm wide; basal part dilated, strongly recurved, winged; wings pale dull light yellowish-brown, scarious, to 8(10) cm long, (3)4–6(7) mm wide near leaf base, straight, flat and entire along margins, soon disintegrating into fragmentary papyraceous remnants; leaf blades coriaceous, lorate, linear to oblong, or narrowly lanceolate, tapering to obtuse apex, entire along margins, glabrous, adaxially uniformly glossy grass-green, abaxially light green-glaucous, with many parallel narrow whitish stripes; longitudinal veins numerous, indistinct, secondary veins hardly visible. Inflorescence a lax short raceme with dense fascicles of pedicellate flowers in axils of bracts; each fascicle consisting of (3)4–5(7) flowers; peduncle bending or arching, light green, glaucous, ebracteate, flattened, (3.5)4–6(8) cm long, (4)4.5–5(5.5) mm wide; rachis of inflorescence straight or slightly arching, flattened and obscurely ridged, (5)6–8(10) cm long. Bracts subtending each fascicle of pedicels narrowly triangular, acuminate, pale yellow-brown, scarious, (6)10–15(16) mm long, (2)3–4(5) mm wide; the inner bract laterally subtending each pedicel, similar, but much smaller. Pedicels terete, straight, white, (1.5)2–3(3.5) mm long, 0.5–0.6 mm in diam., shorter than basal stalky part of perianth. Flowers ascending, suberect, odorless. Perianth 6-lobed distally, campanulate, not widely opening, white, (6)7.5–8.6(9) mm long (excluding basal stalky part), (7)8–9(10) mm wide; proximally syntepalous, stalky perianth part, narrowly conoid, slightly curved, (1.5)2–3(3.5) mm long, 1–1.5 mm across; perianth segments 6 in 2 whorls, subsimilar, rather fleshy, narrowly ovate, cymbiform, (5.5)6–7(7.5) mm long, (2)2.2–3.2(3.5) mm wide, blunt to obscurely obtuse at apex. Stamens 6; anthers dorsifixed, introrse, narrowly conoid, slightly complanate, apically acute with short apiculus, yellowish-green, (3.2)3.5(4) mm long, (1.3)1.4–1.5(1.6) mm wide; filaments shortly cylindrical, fleshy, 0.4 mm long and 0.8 mm across. Pistil 1; ovary inferior, almost flat or slightly convex at apex, 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 normally 4 ovules on a basal placenta. Style erect, straight to slightly curved, narrowly conic, terete in cross section, (3.8)4–4.2(4.5) mm long, 0.6–0.8 mm in diam. at base, slightly exceeding anthers, but shorter than tepals in length; stigma truncate, entire.

Habitat, phenology and conservation status. Terrestrial, erect herb. Usually on shady, very steep rocky slopes in primary broad-leaved evergreen submontane forests on highly eroded crystalline limestone at elevations 800–1000 m a.s.l. Flowers in September in cultivation. Locally very common. IUCN Red List status tentatively assessed as LC.

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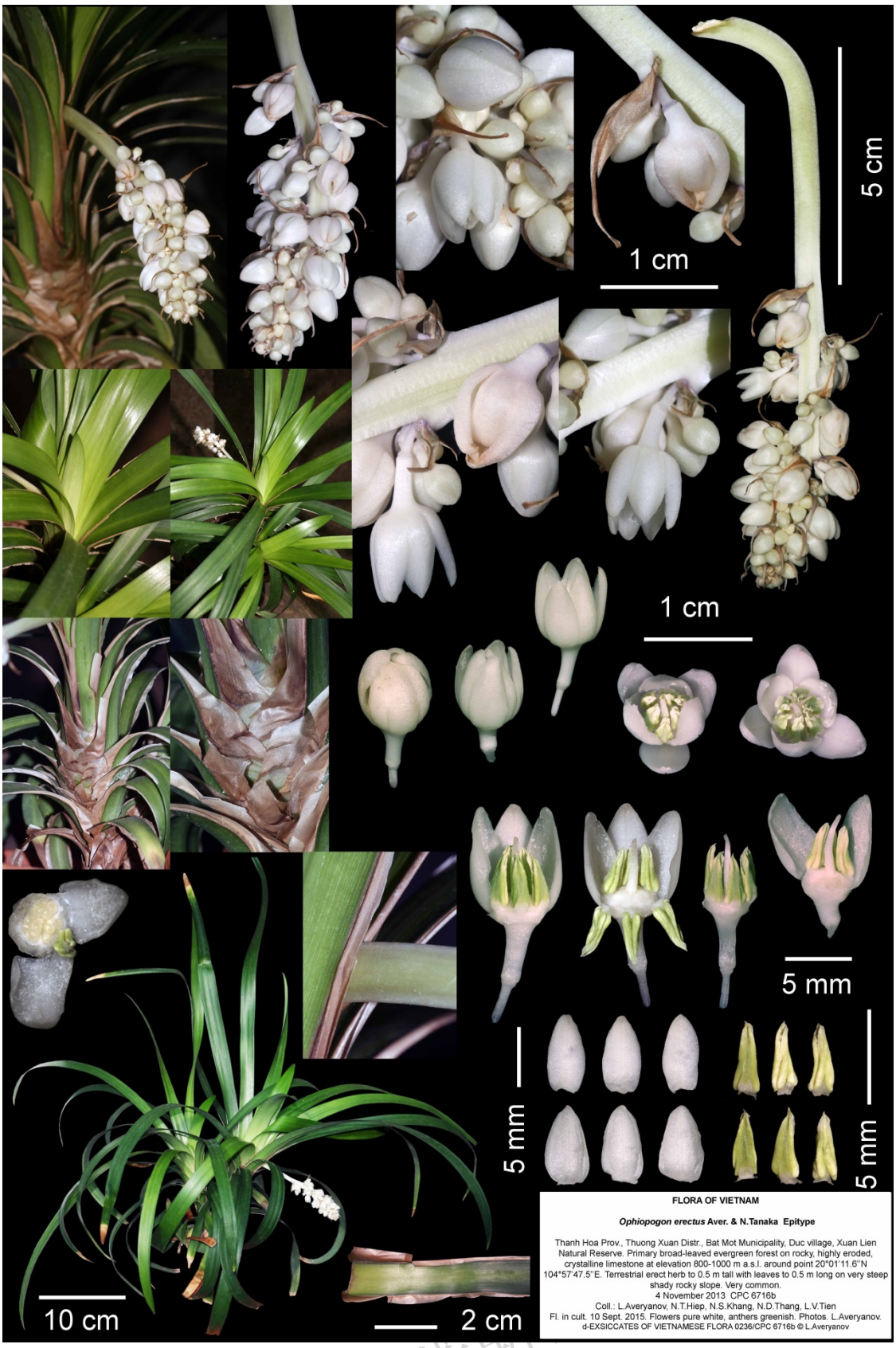


Fig 2. ***Ophiopogon erectus*** *sp. nov.* Digital epitype, *L. Averyanov CPC 6716b / 13258*. Photos, correction and design by L. Averyanov.

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Distribution. N. Vietnam: Thanh Hoa province (Thuong Xuan district, Xuan Lien natural reserve). Endemic.

Notes. *Ophiopogon* erectus is most closely allied to *O. platyphyllus* distributed in Guangdong, Guangxi and Hainan, China (Dai and Chen, 1978; Li, 1999; Chen and Tamura, 2000; Tanaka, 2000b), but differs from it in the erect, longer stem up to ca. 50 cm high (vs. ascending or inclined stem usually to ca. 17 cm high), later flowering (late August–September vs. April–July), flowering stem usually slightly drooping distally (vs. slightly ascending distally), slightly more flowers in a fascicle (to 7 vs. usually to 4), shorter pedicels and floral stalks, and slightly wider perianth segments (to 3.5 mm wide vs. to ca. 2.2 mm wide; the latter data from Tanaka (2000b)). At present, our material of this species is still not ample, it is hence desirable to collect more samples from a wider area in order to elucidate the taxonomic relationship between the two species.

Ophiopogon hayatae (N.Tanaka) N.Tanaka, Aver. & T.Koyama 2015, Adansonia 37, 1: 30. – *O. platyphyllus* Merr. & Chun var. *hayatae* N.Tanaka, 2001, Journ. Jap. Bot. 76, 1: 14. **Fig. 3**

Described from northern Vietnam ("Vietnam. Tonkin, Tamdao"). Type ("28.VII.1917, *B. Hayata s.n*.") TI (holotype!, isotype!).

Distribution. Vietnam: provinces Vinh Phuc (Tam Dao district) and Thanh Hoa (Thuong Xuan district). Endemic of northern Vietnam.

Habitat, phenology and conservation status. Primary broad-leaved evergreen humid submontane forests on granite, rhyolite 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. IUCN Red List status tentatively assessed as LC.

Studied specimens. **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 July 2013, *L.Averyanov, N.T.Hiep, N.S.Khang, CPC 6586* (CPC!, LE!). Vietnam, Thanh Hoa province, Thuong Xuan district, Bat Mot Municipality, Duc village, Xuan Lien Natural Reserve, primary broad-leaved evergreen forest along narrow ridge composed of shale at elevations 1000–1150 m a.s.l. around point 20°01'40.1"N 104°57'54.9"E, terrestrial herb in shady places along ridge edge, fruits dark glossy green with blue tint, locally very common, 4 November 2013, *L.Averyanov, N.T.Hiep, N.S.Khang, N.D.Thang, L.V.Tien, CPC 6675;* herbarium specimen was prepared from flowered cultivated plant - 29 October 2015, *L.Averyanov, CPC 6675 / 13264* (LE). Vietnam, Thanh Hoa province, Thuong Xuan district, Bat Mot municipality, Vin village, Xuan Lien Natural Reserve, primary broad-leaved evergreen humid forest on shale at elevations 1000–1200 m a.s.l. around point 19°58'51.6"N 104°59'38.08"E, terrestrial herb in shady place, fruits glossy dark green, common. 5 November 2013, *L.Averyanov, N.T.Hiep, N.S.Khang, N.D.Thang, L.V.Tien, CPC 6782*; herbarium specimen was prepared from flowered cultivated plant - 10 September 2015, *L.Averyanov, CPC 6782 / 13263* (LE).

Notes. Ophiopogon hayatae was originally described by Tanaka (2001) on the basis of herbarium specimens collected by Hayata in 1917 in northern Vietnam. There had been no additional record of this species until it was rediscovered by Averyanov *et al.* (2015a). Since our knowledge of this species in Vietnam is still insufficient, additional data on the distribution, habitat, phenology and tentatively assessed conservation status is provided here.

Ophiopogon patulus Aver. & N.Tanaka, ***sp. nov.*** **Fig. 4**

Plant was collected in north-eastern Laos ("Xiangkhouang province, Kham district, Huad village, Phou tat Vinh Mt., around point 19°32'31.6'N 103°39'40.4'E, primary or secondary broad-leaved evergreen forest or semideciduous dry forest on very steep rocky slopes of highly eroded mountains composed of solid marble-like limestone at elevations 1200–1400 m a.s.l., 4 April 2015, *T.Maisak, N.T.Hiep, L.Averyanov, N.S.Khang, N.Q.Hieu, Pheng Phengsintham, LA-VN 1042a / TM 1270*"). Herbarium type specimen was prepared from cultivated plant in July 2015. Type ("27 July 2015, *L.Averyanov, LA-VN 1042a / TM 1270, garden number 15167*") – LE (holotype).

Etymology. The specific epithet refers to the obliquely expanded perianth segments.

Description. Herb terrestrial, rosulate perennial. Stem very short, ascending to erect, occasionally branching, (0.5)1–2(2.5) cm tall, (4)5–6(8) mm in diam., covered with green, rather rigid, overlapping leaf sheaths. Roots few, brownish-green, rigid, thick, 1.5–2.5(3) mm in diam. Leaves (5)6–8(10), tufted at apex of stem, distichous, arching, ensiform or narrowly oblanceolate, proximally narrowing to petiole-like base, acute at apex, entire along margins, leathery, glabrous, (14)20–28(32) cm long, (6)8–12(14) mm wide, adaxially glossy, uniformly dark green, abaxially light green-glaucous, with many parallel white stripes; main and secondary longitudinal veins very indistinct. Inflorescence a lax raceme with distant fascicles of 1–2 flowers; peduncle and rachis straight, rigid, terete, finely ridged, dark violet to almost black; peduncle (6)10–12(14) cm long, (0.8)1–1.5(1.6) mm in diam., ebracteate or with 1(2) linear sterile bract (2)8–10(12) mm long; rachis (4.5)5–7(8) cm long; pedicels very short, arising from bracteal axils, antrorse to subperpendicular to rachis, straight, terete, dark violet, (0.8)1–1.2(1.4) mm long, (0.6)0.5–0.6(0.7) mm in diam., jointed with a distinct articulation to much longer stalky basal part of perianth tube which is slightly broadened above, and straight or curved distally, (2.5)4–6(7) mm long, (0.3)0.4–0.5(0.6) mm in diam.; the outermost (lowermost) bract in each bracteal fascicle narrowly triangular to triangular, acute or acuminate, light greenish to brownish, scarious at margins, sometime with light violet tint, (2)2.2–4(5) mm long, (0.4)0.5–1(1.2) mm wide; the inner bract laterally subtending each pedicel, twice smaller, narrowly triangular, light greenish to whitish, scarious. Flowers pedicellate, slightly drooping,

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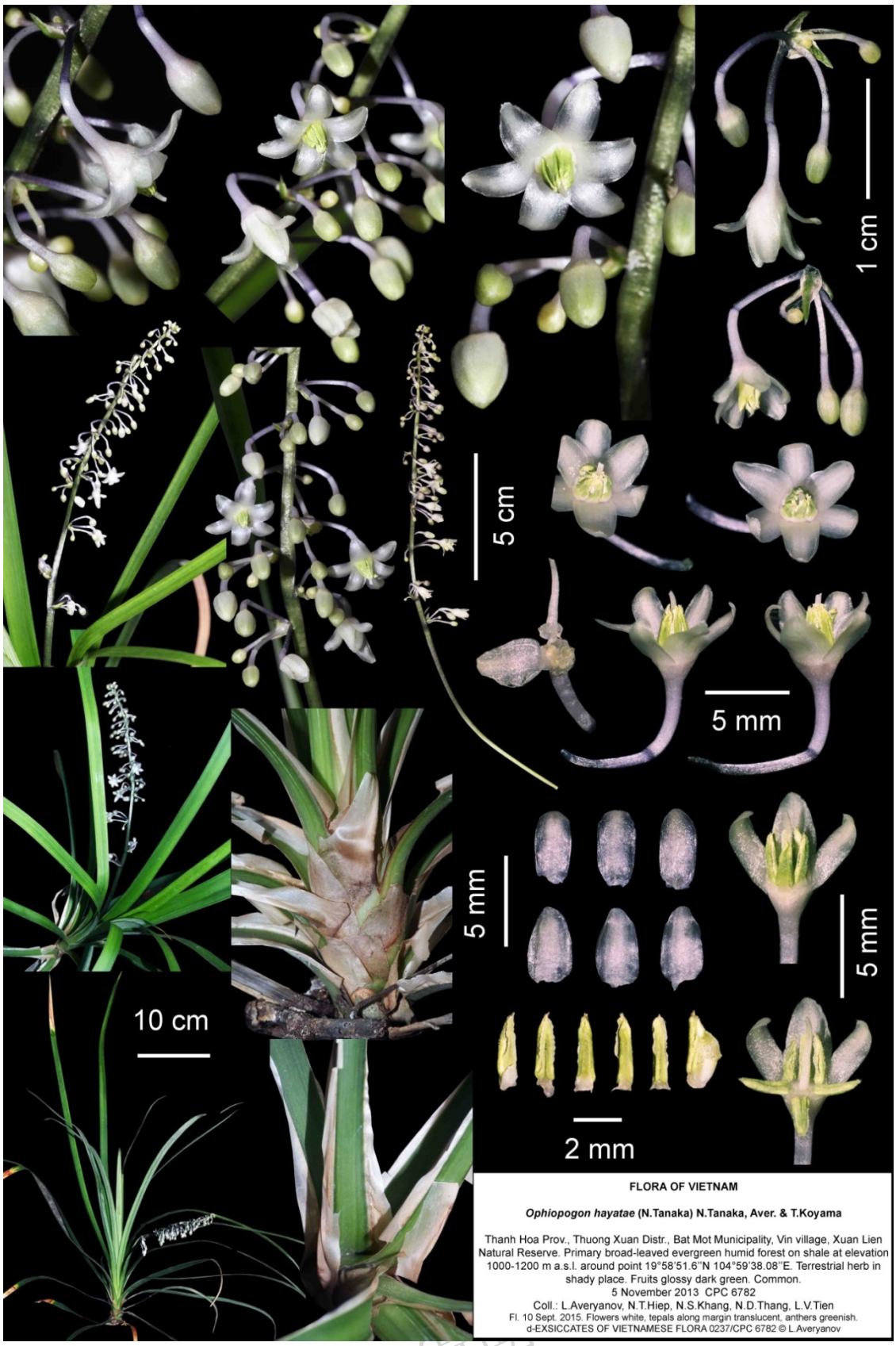


Fig 3. *Ophiopogon hayatae*. Digital herbarium, *L. Averyanov, CPC 6782 / 13263*. Photos, correction and design by L. Averyanov.

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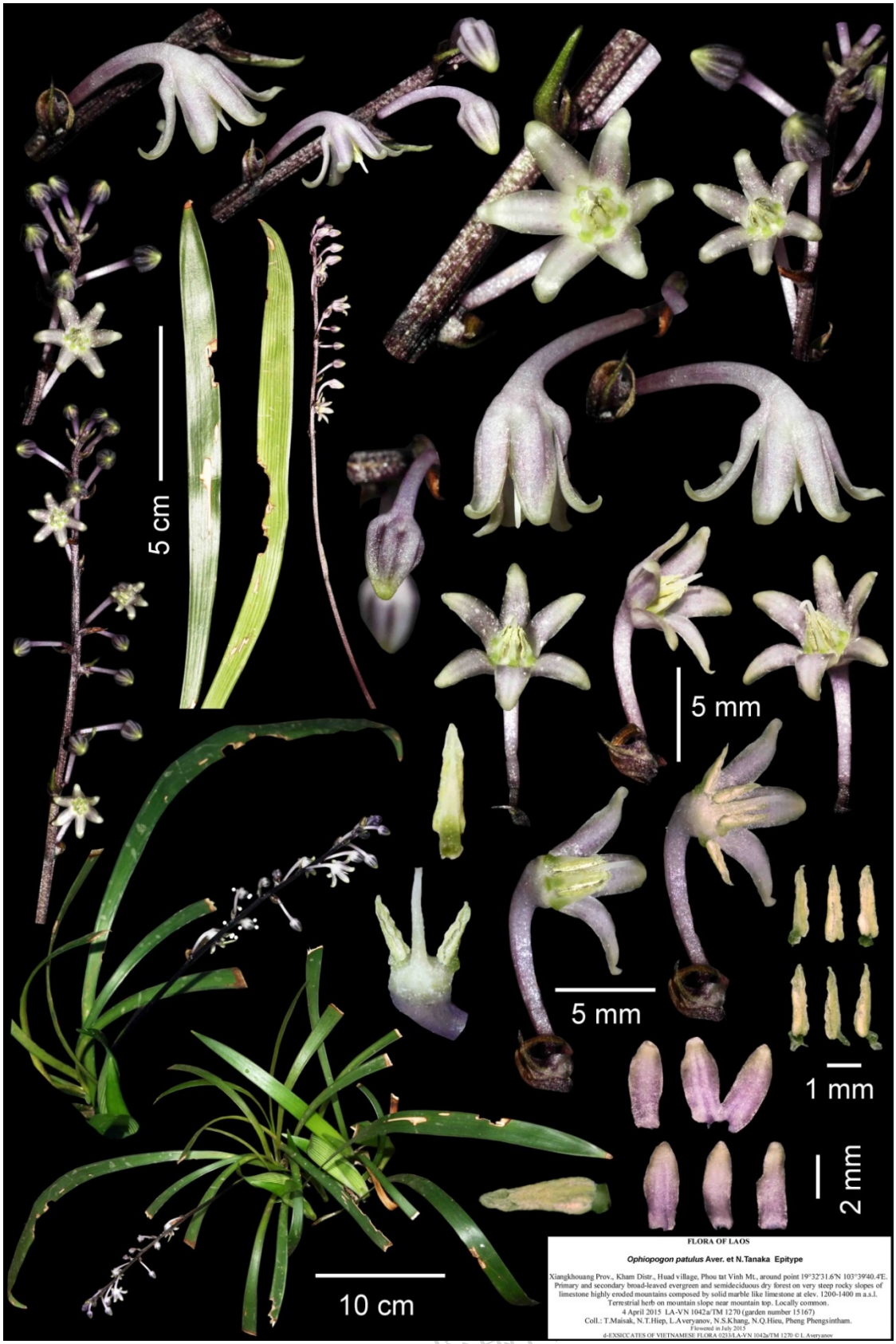


Fig 4. ***Ophiopogon patulus*** *sp. nov.* Digital epitype, *L. Averyanov LA-VN 1042 / TM 1270*. Photos, correction and design by L. Averyanov.

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broadly campanulate, pale light violet to almost white, odorless, (8)9–11(12) mm long, (7)8–9(10) mm across. Perianth segments subsimilar, narrowly ovate, blunt at apex, recurved, more or less flat or slightly convex adaxially, rather thin, (3.5)4–4.5(5) mm long, (0.8)1–1.2(1.3) mm wide. Stamens 6, located at base of each perianth segment; anthers narrowly triangular, subconoid, shallowly cordate at base, acute at apex, introrse, light pale yellow-greenish, (1.7)1.8–2.2(2.3) mm long, (0.3)0.4–0.5(5.5) mm wide; filaments very short, fleshy, inflated, subglobose, 0.3–0.4 mm long and wide. Ovary inferior, 3-locular; (2)4 ovules on basal placenta in each locule; style purely white, erect, straight, narrowly conoid, (2.8)3–3.2(3.2) mm long, basal part broadly pyramidal, 0.6–0.8 mm wide; stigma almost negligibly minute, truncate or blunt. Seeds unknown.

Distribution. NE. Laos: Xiangkhouang province (Kham district). Endemic.

Habitat, phenology and conservation status. Terrestrial, rosulate clustering herb usually on very steep, rocky slopes near mountain tops covered with primary or secondary submontane broad-leaved evergreen forest or semideciduous dry forest on highly eroded, solid marble-like limestone at elevations 1200–1400 m a.s.l. Flowers in July–August in cultivation. Locally common. IUCN Red List status tentatively assessed as LC.

Notes. *Ophiopogon patulus* appears near to *O. longifolius* Decne (Decaisne, 1867–1868) s.l. in its habit, inflorescence subequalling the peduncle in length, and moderately thick style (Tanaka, 1998). However, it differs from the latter in having broadly campanulate flowers with more strongly expanded, recurved perianth segments, a long-stalked floral base, and very short pedicels. The new species occurs in northeastern Laos. It may also be found in adjacent areas of northwestern Vietnam in the future.

Peliosanthes inaperta Aver. & N.Tanaka, ***sp. nov.***

Fig. 5

Plant was collected in central Laos ("Khammouane province., Boualapha district, Nam Boua Sam village, Hin Nam No National Biodiversity Conservation Area, Pu Pha Song Mt. composed of sandstone, around point 17°33′43.6″N 105°45′08.3″E, secondary evergreen broad-leaved forest on low mountain slope at elevation about 230 m, 10 March 2013, *L.Averyanov, N.T.Hiep, V.Lamxay, N.S.Khang, P.V.The, S.Lorphengsy LA-VN 330*"). Herbarium type specimen was prepared from cultivated plants originally collected in the wild. Type ("15 June 2015, *L.Averyanov LA-VN 330a*") – LE (holotype).

Description. Herb terrestrial, rhizomatous, miniature perennial. Rhizome short, subterranean, plagiotropic, simple or few branched, 0.5–1(1.5) cm long, producing few, dull gray-brown wiry roots. Stems ascending to erect, about 0.5–1 cm tall, covered with remnants of light yellowish-brown papyraceous scaly leaves. Scaly leaves at anthesis narrowly ovate to oblong lanceolate, (0.5)1–6(7) cm long, (3)4–8(10) mm wide, acute, medially light greenish, marginally whitish and scarious or papyraceous, longitudinally concave to conduplicate, overlapping, loosely embracing base of peduncle and petiole of foliage leaf, later becoming dull brown, disintegrating into fibrous remnants. Leaves petiolate, arching, to (7)9–12(15) cm long; petiole rigid, slightly curved, (2.5)3–4(6) cm long; leaf blade narrowly elliptic, acute, entire along margins, glabrous, glossy, uniformly green on both sides, (5)6–8(10) cm long, (1.2)1.6–2.5(3.5) cm wide; longitudinal veins many, prominent, crossed sub-perpendicularly with many dichotomously branching transversal veinlets. Flowering stem arising axillary, 2–3 cm long, peduncle and rachis dirty green to dull brownish-violet, bearing a sparse raceme of few flowers distally; peduncle rather stout, rigid, straight, erect, (1)1.5–2(2.5) cm long, 1–1.5 mm in diam., usually ebracteate or with 1–2 very small triangular scarious sterile bracts; rachis straight, terete, (3)5–8(10) mm long, with (1)2–4(5) distant flowers. Floral bracts 2, very small, narrowly triangular, acute, conduplicate, scarious, 1–3 mm long, 0.4–0.8 mm wide. Flowers solitary in bracteal axil, shortly pedicellate, not or scarcely open, ovoid, (4.6)5–5.5(6) mm long 4–4.5 mm in diam., horizontal; basal syntepalous part hemispheric, 1.2–1.4(1.5) mm long, 2.5–3(3.5) mm across, jointed with articulation to short pedicel; pedicel cylindrical, 0.8–1 mm long, 0.4–0.5 mm in diam. Perianth segments 6, dark dirty violet to almost black, very fleshy, lunate to subterete in cross section, slightly flattened and longitudinally concave, distally incurved and unguiculate, apically connivent, apex blunt to rounded, margins entire; outer segments narrowly ovate to ovate (3.4)3.5–4(4.2) mm long, (1.6)1.8–2(2.2) mm wide, apically closed or almost so during anthesis; inner segments significantly smaller, narrowly ovate-oblong, involute, (2.4)2.5–3(3.2) mm long, (1.2)1.4–1.5(1.6) mm wide, apically closed. Corona dark violet to almost black, annular, shortly cylindric, conically narrowed towards apex, (1.5)1.8–2(2.2) mm across, (0.5)0.6–0.8(1) mm high. Anthers 6, ovoid, introrse, sessile, attached to apical inner margin of corona, facing upward and slightly recurved, (0.4)0.45–0.5(0.55) mm long and wide, white; pollen white. Ovary half-inferior, free part hemispheric, concave at the center, 0.5–0.6 mm high, 1.5–1.6 mm across, at base almost orbicular in cross section, indistinctly 3-angulate longitudinally, the interior imperfectly partitioned into 3 chambers by 3 septa; each chamber slightly open with narrow longitudinal slit at central axial portion of ovary, containing 4 ovules on basal placenta; style terete, (1.4)1.6–1.8 mm tall, 0.5–0.6 mm in diam.; stigma truncate, obscurely 3–partite, the lobes obovate, glabrous. Seeds unknown.

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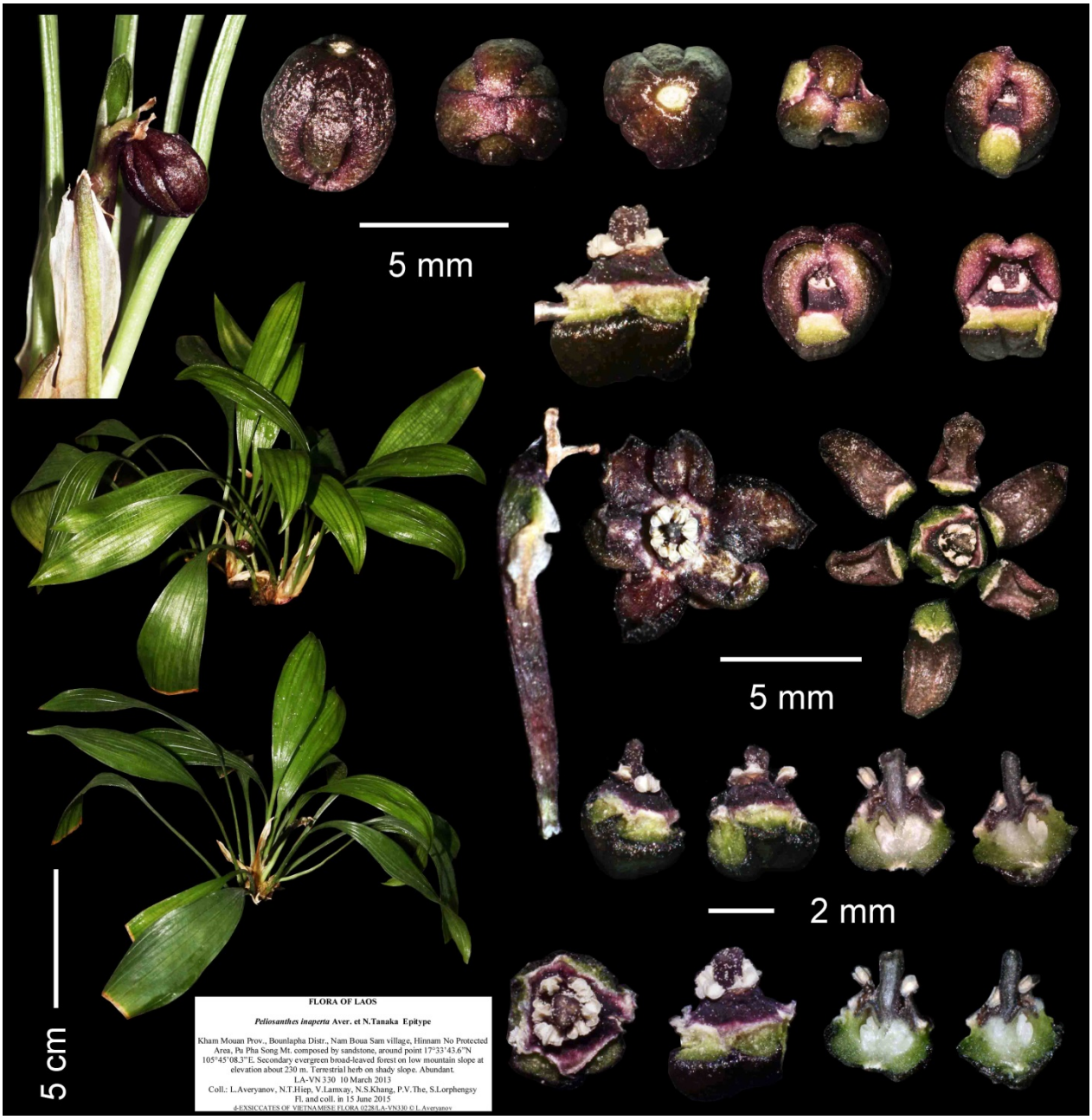


Fig 5. ***Peliosanthes inaperta*** *sp. nov.* Digital epitype, *L. Averyanov LA-VN 330a*. Photos, correction and design by L. Averyanov.

Etymology. The specific epithet refers to the flower staying closed during anthesis.

Habitat, phenology and conservation status. Terrestrial miniature sympodial clustering herb. Usually on shady slopes in primary or secondary lowland evergreen broad-leaved forests on sandstone at elevations 200–300 m a.s.l. Flowers in May – June in cultivation. Locally abundant. IUCN Red List status tentatively assessed as LC.

Distribution. Central Laos: Khammouane province (Boualapha district). Endemic.

Notes. Flowers of Peliosanthes inaperta are very unusual, because their perianth segments stay closed during anthesis. In this respect, they appear to be cleistogamous. Inside the closed segments, anthers dehisce and expose their pollen, and the stigma becomes mature concurrently. The anthers and the stigma are positioned spatially close to each other, but shortly separate. Therefore it appears rather unlikely that the stigma will autonomically be self-pollinated by the anthers within a flower. After anthesis, the flowers drop, without bearing any fruit, under cultivation. Accordingly, the flowers may not to be cleistogamous. The apices of the outer perianth segments (sepals) rarely

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appear to be slightly open. Through this negligibly small opening, some kinds of minute insects might enter into the interior of the flower. If this should happen, pollination will be achieved by the insects. All the floral features noted above were stable under cultivation. It is desirable that further surveys in the field will be conducted in the future in order to elucidate the pollination mechanism of this species.

Meanwhile, globose, scarcely or barely open flowers with very fleshy, strongly incurved, connivent perianth segments of this species are apparently secondarily derived character states. P. inaperta is, therefore, regarded as a rather specialized species. This species is so distinct in floral characters that at present it is difficult to suggest its affinity to other congeners.

Peliosanthes kenhilloides Aver. & N.Tanaka, ***sp. nov.***
Fig. 6

Plant was collected in northern 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, 16 November 2013, *L.Averyanov, N.T.Hiep, N.S.Khang, N.D.Thang, L.D.Qui, CPC 7223a*"). Type specimen was prepared from flowered cultivated plant originally collected in the wild. Type ("10 September 2015, *L.Averyanov, CPC 7223a / 13276*") – LE (holotype).

Etymology. The epithet refers to the close resemblance of the new species to *P. kenhillii* Aver. & N.Tanaka.

Description. Herb terrestrial or occasionally lithophytic, rhizomatous perennial. Rhizome subterranean, plagiotropic, 4–6(8) cm long, (4)4–6(7) mm in diam., simple or few branching, bearing sparse roots; the roots grayish, fleshy, wiry, rather rigid. Stems ascending to erect, (4)5–7(10) mm tall, loosely covered with dark brown sheath leaves (cataphylls), disintegrating into fibrous or papyraceous remnants with age. Cataphylls narrowly triangular-lanceolate, conduplicate, embracing petiole, (5)6–8(12) cm long, (5)6–12(15) mm wide. Leaves suberect to arching, petiolate, to (35)40–60(65) cm long; petiole rigid, erect, almost straight, terete, (8)12–20(25) cm long; leaf blade broadly elliptic, shortly acuminate with subacute apex, rather entire along margins, glabrous, glossy, uniformly green on both sides, leathery, (10)12–32(35) cm long, (5)6–12(14) cm wide; longitudinal veins many, prominent, subperpendicularly crossed with many dichotomously branched transversal veinlets. Scape (flowering stem) axillary, strongly inclined (or prostrately spreading) from near base, bearing a sub-dense to dense raceme; peduncle and rachis dark violet to almost black; peduncle curved, stout, arching, (3)4–5.5(7) cm long, (2)2.5–3.5(4) mm in diameter, ebracteate or with few sterile bracts; rachis many flowered, longitudinally finely ridged, (6)7–14(18) cm long. Floral bracts 2, distally antrorse, dark violet to almost black, scarious; bract located below flower, narrowly triangular, narrowly cordate at base, distally acuminate to subulate, conduplicate, (4)5–9(11) mm long, (1)1.2–2.2(3) mm wide; bracteole lateral to flower, narrowly ovate-triangular, much smaller, (1)1.5–3(3.5) mm long, 0.5–1(1.5) mm wide. Flowers solitary in bracteal axil, pedicellate, broadly open, (10)11.5–12.5(13.5) mm across, directed slightly upward; perianth tube broadly obconical, 4–4.5 mm across, 0.8–1(1.2) mm long, truncate, jointed at base with articulation to pedicel; pedicel almost black, short, terete, longitudinally finely ribbed, slightly upturned, (1.5)2–3(3.2) mm long, 0.8–1 mm in diameter. Perianth segments subsimilar, narrowly ovate-triangular, obtuse, dark violet with olive tint to almost black, spreading, (3.5)4–4.5(5) mm long, (1.8)2–2.2(2.4) mm wide; margins scarious, entire, revolute. Corona white or with light greenish-violet tint on periphery, glaucous, nearly circular or very obscurely hexagonal, flattened, lens-like, slightly convex to almost flat at apex, fleshy at base, (4)4.2–5(5.5) mm across, about 1 mm high, distal margin obscurely 6-subdentate, forming an orifice (1.2)1.5–1.8(2) mm in diameter. Anthers 6, inserted at vertically subtruncate narrow edge of the orifice of corona, sessile, broadly ovoid or subglobular, introrse, white to light yellowish, 0.5–0.6 mm long and wide. Ovary half-inferior, free part light green, broadly conoid to hemispheric, (0.8)1(1.2) mm high, (2)2.2–2.5(2.6) mm wide, broadly 3-lobate in cross section, the interior imperfectly partitioned into 3 chambers by 3 septa; each chamber slightly open with narrow longitudinal slit at central axial portion of ovary, containing 4 narrowly ovoid ovules on basal placenta; stigma sessile, obscurely 3-partite, the lobes narrowly obovate, light violet, glabrous.

Distribution. N. Vietnam: Son La province (Van Ho district, Xuan Nha natural reserve). Endemic.

Habitat, phenology and conservation status. Terrestrial herb on shady very steep rocky slopes covered with primary or secondary broad-leaved evergreen dry forests on remnant hills composed of highly eroded limestone at elevations 900–1000 m a.s.l. Locally common. Plant in cultivation flowers in September. IUCN Red List status tentatively assessed as LC.

Notes. *Peliosanthes kenhilloides* is most closely allied to *P. kenhillii* Aver. & N.Tanaka (Averyanov *et al.*, 2016). It differs from the latter by the leaf blade nearly as long as or slightly longer than the petiole (vs. blade shorter than petiole), strongly inclined (or prostrately spreading) inflorescence (vs. erect, nearly straight or slightly curved inflorescence), usually longer peduncle (up to 7 cm long vs. 4 cm long), obconical floral base with no stalky attenuation (vs. funnel-shaped

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Fig. 6. ***Peliosanthes kenhilloides*** *sp. nov.* Digital epitype, *L. Averyanov CPC 7223a / 13276*. Photos, correction and design by L. Averyanov.

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floral base with a short terete stalk), little lobed, roundish hexagonal corona (vs. slightly 6-lobed corona), almost sessile stigma (vs. shortly stalked stigma), and earlier flowering (September vs. November–December).

Peliosanthes macrostegia Hance, 1885, J. Bot. 23: 328.

Fig. 7

Described from S. China. Type ("In jugo Lo-fau-shan, prov. Cantonensis, *C. Ford s.n.* H.F. Hance's Herbarium no. 22282) – BM000958236 (holotype; digital image!).

Habitat, phenology and conservation status. Terrestrial and lithophytic herb on shady very steep rocky slopes covered with primary or secondary broad-leaved evergreen dry forests on remnant hills composed of highly eroded limestone at elevations 800–1000 m a.s.l. Locally common. Flowers in November–December. IUCN Red List status tentatively assessed as LC.

Distribution. Vietnam (Thanh Hoa province), S. China (Guangdong, Guangxi, Guizhou, Hunan, NE. Sichuan, SE. Yunnan) and Taiwan.

Studied specimens. **VIETNAM**: Thanh Hoa province., Thuong Xuan district, Bat Mot Municipality, Duc village, Xuan Lien Natural Reserve, primary broad-leaved evergreen forest on rocky limestone at elevations 800–1000 m a.s.l. around point 20°01′11.6″N 104°57′47.5″E, terrestrial and lithophytic herb with leaves to 20(30) cm high on shady very steep rocky slope, flowers dirty violet, locally common. 3 November 2013, *L. Averyanov, N.T. Hiep, N.S. Khang, N.D.Thang, L.V.Tien, CPC 6658a* (CPC!, LE!). Vietnam, Thanh Hoa province., Thuong Xuan district, Bat Mot Municipality, Duc village, Xuan Lien Natural Reserve, primary broad-leaved evergreen forest on rocky limestone at elevations 800–1000 m a.s.l. around point 20°01′11.6″N 104°57′47.5″E, terrestrial herb with leaves to 40(45) cm high on shady very steep rocky slope, flowers greenish, locally common. 3 November 2013, *L.Averyanov, N.T.Hiep, N.S.Khang, N.D. Thang, L.V. Tien, CPC 6658b* (CPC!, LE!). Vietnam, Thanh Hoa province, Thuong Xuan district, Bat Mot municipality, Vin village, Xuan Lien Natural Reserve, primary broad-leaved evergreen forest on rocky, highly eroded, crystalline limestone at elevations 900–1000 m a.s.l. around point 20°00′00.4″N 104°59′00.7″E, terrestrial herb with large petiolate, glossy leaves on shady, rocky, steep slope, among rocks, locally common, 2 November 2013, *L.Averyanov, N.T.Hiep, N.S. Khang, CPC 6517a*, flowered in cultivation on 18 November 2013. Flowers dirty violet (LE!).

Notes. *Peliosanthes macrostegia* has been known from southern China and Taiwan. Chen and Tamura (2000) reported that it occurs on the border between Yunnan (China) and Vietnam, but its occurrence in Vietnam has actually not been recorded. The flowers in Vietnam vary from dull greenish to dark dirty violet.

Peliosanthes splendens Aver. & N.Tanaka, ***sp. nov.***

Fig. 8

Plant was collected in northwestern Vietnam ("Thanh Hoa province, Thuong Xuan district, Van Xuan municipality, Hang Cao village, Xuan Lien nature reserve, remnants of primary or secondary broad-leaved evergreen forest on highly eroded, rocky limestone hills at elevations 100–200 m a.s.l. around point 19°50′47.2″N 105°14′42.7″E, 8 Nov. 2013, *L. Averyanov, N.T. Hiep, N.S. Khang, N.D. Thang, L.D .Qui CPC 6893*"). Herbarium type specimen was prepared from cultivated plants in July 2015. Type ("10–20 July 2015, *L. Averyanov CPC 6893a*") – LE (holotype).

Description. Herb terrestrial, clustering, perennial. Rhizome plagiotropic, short, (1)2–3(4) cm long, (4)5–6(8) mm in diam., often apically few branching. Roots many, cord-like, rigid. Stems ascending to sub-erect, (5)8–10(12) mm tall, covered loosely with narrowly triangular-lanceolate, papyraceous sheath leaves. Sheath leaves oblong-lanceolate, greenish, often with violet tint, conduplicate, (1.5)2–5(6.5) cm long, (3)5–8(12) mm wide, soon becoming papyraceous or scarious, eventually disintegrating into fragmented remains. Leaves ascending to suberect, petiolate, 25–35(40) cm tall; petiole rigid, slightly curved to almost straight, shallowly channeled in basal part, (6)7–11(12) cm long; blade narrowly elliptic to elliptic, shortly acuminate, entire, glabrous, uniformly green and glossy on both sides, (12)14–20(24) cm long, (4)4.5–5.5(6.5) cm wide; longitudinal veins many, crossed subperpendicularly with many transversal veinlets. Inflorescence a terminal, dense spadix-like spike, about 1–1.5 cm in diam.; peduncle proximally shortly subprocumbent, then ascending, stout and rigid, (2)3–4(5) cm long, (3.5)4–4.5(5) mm in diam., dark brown-violet to almost black, bracteate; the sterile bracts (2)3–5(6), broadly triangular to ovate, 3–5-veined (midvein quite distinct, lateral veins more or less obscure), acuminate or acute, papyraceous or scarious, greenish or violet, (6)10–18(20) mm long, (4)5–16(18) mm wide; rachis densely many-flowered, (6)8–12(14) cm long. Floral bracts 2 per flower, antrorse, broadly triangular, obtuse to acute, 1-veined, middle part greenish, subherbaceous, marginally scarious, violet; outer bract located below flower, (3)6–8(11) mm long, (2)3–6(8) mm wide; inner bract (bracteole) situated lateral to flower, slightly oblique, twice smaller. Flowers solitary in bracteal axil, sessile or subsessile on short, small knob-like protuberance (much reduced pedicel), dark brownish purple-violet, glossy, widely open, (7.6)8–9(9.5) mm across; proximal (syntepalous) part cupulate, (3.8)4–4.5(4.6) mm across, 0.8–1(1.2) mm long, distinctly 3-lobulate in cross section, 3-sulcate between sepal bases. Perianth segments subsimilar, broadly ovate-triangular, recurved, subobtuse at apex, (2.7)2.8–3(3.2) mm long, (3.1)3.3–3.5(3.6) mm wide; margins revolute, rather scarious, finely irregularly nibbled and undulate; outer segments (sepals) broadly keeled (thickened) dorsally in basal half. Corona nearly hexagonal towards base, slightly convex, (3.8)4(4.2) mm across, (0.4)0.5–0.6(0.7) mm high, the distal orifice obscurely 6-dentate, (1.8)2(2.2) mm in diam. Anthers 6 on apical inner surface of corona, ovoid, introrse, sessile, dorsifixed, dull yellow to almost white, 0.7–0.8 mm long. Ovary half inferior, broadly pyramidal, 1.4–1.6

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Fig. 7. ***Peliosanthes macrostegia***. Digital herbarium, *L. Averyanov et al. CPC 6658a-b*. Photos, correction and design by L. Averyanov.

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Fig. 8. ***Peliosanthes splendens*** *sp. nov.* Digital epitype, *L. Averyanov CPC 6893a*. Photos, correction and design by L. Averyanov.

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mm high, 2.5–2.8 mm across, 3-lobed in cross section, the interior partitioned into 3 chambers by 3 fleshy septa almost touching each other along the inward edges; each chamber adaxially slightly open with narrow longitudinal slit, containing 4 ovules on basal placenta; style broadly conoid, short, 0.5–0.6 mm tall; stigma 3-partite, black, the lobes narrowly oblanceolate, finely papillulate. Fruits unknown.

Etymology. The species epithet refers to the glossy perianth segments.

Habitat, phenology and conservation status. Terrestrial, sympodial, clustering herb. Usually on shady, very steep rocky slopes in primary or secondary lowland broad-leaved evergreen forests on highly eroded limestone at elevations 100–200 m a.s.l. Flowers in July–August in cultivation. Locally common. IUCN Red List status tentatively assessed as LC.

Distribution. N. Vietnam: Thanh Hoa province (Thuong Xuan district, Xuan Lien natural reserve). Endemic.

Notes. *Peliosanthes splendens* appears to be most close to *P. dasystachys* Diels ex L.Rodrig. (Rodriguez, 1934a: 672) in having sterile bracts on peduncle with 3–5 veins, sessile flowers, and pistils similar in shape. However, it differs from the latter in having petioles usually shorter than the leaf blades, peduncles shorter than the inflorescence, slightly thicker (broader) and longer inflorescence, slightly nodding floral buds, and slightly larger flowers. It also somewhat resembles *P. labroyana* Pierre ex L.Rodrig. (Rodriguez, 1934a: 672, b: 96) in having sterile bracts on peduncle with 3 or more veins, sessile flowers, and pistils similar in shape. It is, however, distinguishable by the wider leaf blades, longer and thicker inflorescence, and slightly nodding floral buds. The new species also appears near to *P. macrostegia* Hance (Hance, 1885), but differs by its sessile flowers, and strongly expanded, recurved, lustrous, broadly ovate-triangular perianth segments. Besides these features, the new species is distinct from the above three other species by the broadly bowl-shaped perianth tube that is markedly 3-sulcate abaxially, and only slightly convex, nearly hexagonal corona.

It is not known at present whether the perianth segments of both *P. dasystachys* and *P. labroyana* are adaxially lustrous or not.

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