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RESEARCH COMMUNICATION

Plant Taxonomy

Two new additions and one confirmation of the occurrence of Lamiaceae (Lamiales) species from Northern dry zone in Sri Lanka

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Abstract: Sri Lanka abounds with a rich plant diversity, comprising 3087 species of flowering plants, of which 863 are endemic to the island. In Sri Lanka, the Lamiaceae plant family represents 70 indigenous species in 22 genera, distributed throughout the country in varied habitats. Since many of the species of the family are herbaceous and seasonal, less attention had been paid in field collections during the past. Here we document *Leucas diffusa* Benth. and *Orthosiphon pallidus* Royle ex. Benth. for the first time in Sri Lanka and further we confirm the existence of *Endostemon viscosus* (Roth) M.R. Ashby, a species that was included doubtfully in Sri Lankan flora, with field collected specimens. Each of these species is presented with a detailed taxonomic description, its ecology, places of occurrence in Sri Lanka, field photographs, and other relevant notes. All of these species were reported from the Northern dry zone of Sri Lanka, an area that was not accessible for botanists for 30 years due to civil war. This area has highly seasonal, rich herbaceous vegetation during the North Eastern monsoonal period. These findings, made during just two years, highlight that botanical explorations conducted in a timely manner in these seasonal habitats will reveal more undocumented herbaceous species.

Keywords: *Endostemon viscosus*, *Leucas diffusa*, new records, *Orthosiphon pallidus*.

INTRODUCTION

The family Lamiaceae is represented by more than 7000 species worldwide, being the sixth largest family after adding several species from the traditionally recognized family Verbenaceae, inferred by molecular studies (Harley *et al*., 2004, Li *et al*., 2016). Until then it was considered to be consisting of around 3500 species (Li & Hedge, 1994). This cosmopolitan family is currently represented by 236 genera (Royal Botanic Gardens, Kew, 2019), which are mainly concentrated in temperate zones and with a particular diversity in the Mediterranean region (Fernandes, 2005). In Sri Lanka, there are 70 indigenous species representing 22 genera, 13 of which are endemic (MOE, 2020). In addition, there are several cultivated species (Cramer, 1981; Moldenke & Moldenke, 1983).

In Sri Lanka, the genus *Leucas* R.Br. is represented by 6 species and the genus *Orthosiphon* Benth. is represented by 2 species (Cramer, 1981). No species of *Endostemon* N.E.Br. is represented in current Sri Lankan checklists or in recent family reviews (Cramer, 1981; Senaratna, 2001; MOE, 2020), though *Endostemon viscosus* (Roth) M.R. Ashby was included as a doubtful entry under the name *Orthosiphon diffusus* (Benth.) Benth. in Hooker (1885) and in Trimen (1895) based on a collection made by Walker, which is now deposited at Kew (Bar code: K000674643). Moreover, a specimen collected between 1973 and 1980 by Fagerlind and Klackenberg from Sri Lanka, deposited in the herbarium of the Swedish Museum of Natural History, was later identified as *E. viscosus* (Roth) M.R.Ashby (Emanuelsson & Klackenberg, 2001).

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Here we provide for the first-time evidence for the occurrence of *Leucas diffusa* Benth. and *Orthosiphon pallidus* Royle ex. Benth. in Sri Lanka, where the first species was previously considered to be endemic to India and the latter was reported from other South-West Asian countries, including the Arabian peninsula, to Africa (The Royal Botanic Gardens, Kew, 2019; Sasidharan *et al.,* 2020). Moreover, the existence of *E. viscosus* (Roth) M. R. Ashby is further confirmed in Sri Lanka through field collected samples.

MATERIALS AND METHODS

Field surveys were conducted during the North-East Monsoon seasons of 2018 and 2019 in various parts of the Northern dry zone of Sri Lanka with the aim of recording the species diversity of less botanized parts of the country, especially focusing on the seasonal herbaceous species. Sampling sites were selected on an *ad hoc* basis, and the species of interest including many rare and data deficient species were collected. Plants that could not be identified in the field were also collected. All the collected specimens were deposited at National Herbarium, Peradeniya (PDA). Plants were photographed in detail in the field using a Canon 100 mm IS macro lens, fitted to a Canon 7D Mark II body. Relevant field notes were taken including morphological characters. Coordinates of the locations were taken from a Garmin 64S GPS. Specimens were identified from relevant publications (Hooker, 1885; Li & Hedge, 1994; Fernandes, 2005) and examining specimens online at Royal Botanic Gardens, Kew (K), Naturalis Biodiversity Center, Leiden (L), Royal Botanic Garden, Edinburgh (E), and Meise Botanic Garden (BR) [herbarium acronyms based on Thiers (2020)]. Collecting sites of three newly recorded Lamiaceae species are shown in Figure 1.

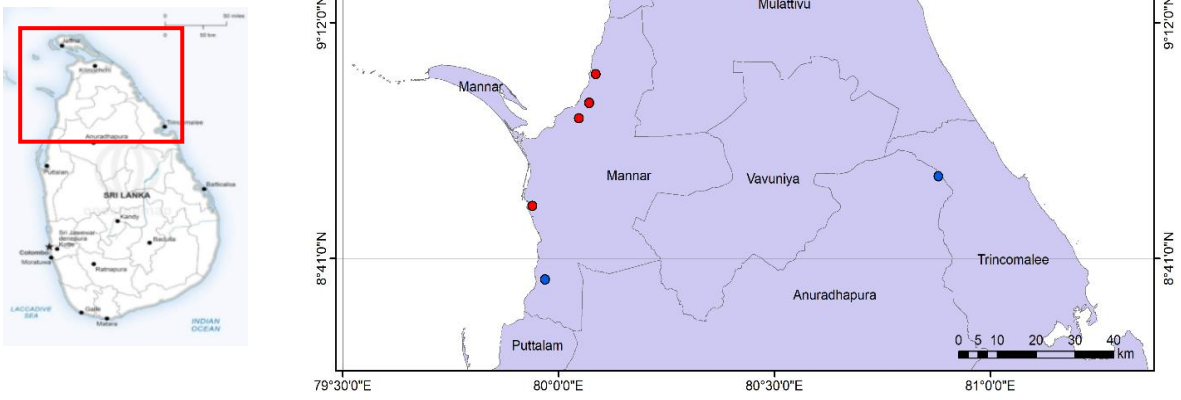

Figure 1: Distribution of the three newly recorded Lamiaceae species in the Northern dry zone, Sri Lanka.

RESULTS AND DISCUSSION

Taxonomic descriptions and photographs for all 03 newly recorded species are provided below.

(1) *Leucas diffusa* Benth. in Labitarum Genera et Species (1834), pp. 615 — *Phlomis diffusa* Rottler ex Hook.f., nom. inval., Fl. Brit. India 4: 689 (1885), pp. 689; Figure 2

Taxonomic description: Decumbent herbs with radiating branches on sandy beaches, stem distinctly quadrangular with shallow longitudinal striation along each side, sparsely hirsute; leaves opposite, 1.2–2.5 × 0.3–0.8 cm, mostly pseudo-whorled, lanceolate to narrowly elliptic, obtuse, base cuneate, tapering to indistinct petiole, hirsute on both surfaces, more so along the midrib beneath, glandular-punctate, margin entire to faintly undulate, recurved, lateral veins (2) 3 pairs, ascending, prominulous, mid rib impressed above, obscurely raised below; inflorescences congested at pseudo-whorls of leaves, sessile, flowers almost sessile; calyx green, hirsute outside, tubular, 5–6 mm long, gradually expanding and curved towards the throat with almost equal, shortly triangular lobes tipped by a spinose hair, calyx throat ciliate, indistinctly longitudinally ridged; corolla white, 1–2 cm, densely long hirsute outside, glabrous inside, strongly 2-lipped, upper lip short, in-rolled and concealing the stamens, lower lip 3-lobed, lateral lobes small, acute, median lobe large, spathulate, slightly emarginate; stamens inserted, placed near the upper corolla lobe; filaments white; anthers reddish orange; nutlets oblong with a rounded apex, ca. 2 mm long, smooth, grey-brown.

Distribution and ecology: This species was found to be very common on the coastal, open sandy grounds at Pooneryn (9.5518 N, 80.1326 E). These plants were in healthy condition and most of them were in the flowering stage. The soil was full of moisture at the observation on January 29th, 2019, which provided a habitat for many other seasonal herb species such as *Utricularia* spp., *Drosera burmanni* Vahl, *Lindernia srilankana* L.H. Cramer & Philcox, *Murdannia striatipetala* Faden and *Eriocaulon quinquangulare* subsp. *quinquangulare* L. There were no other *Leucas* species occurring in this habitat, but *Leucas zeylanica* (L.) W.T. Aiton was found to be very common in adjacent inland habitats. Probably this species may be dying out at the onset of the dry season when the sand becomes very hot, a condition which usually last for about nine months until late November.

Specimens examined: Sri Lanka: Poonaryn, 2021 Dec 23, Himesh Jayasinghe *et al*., HDJ 1327 **Other:** B. Heyne 605 (K!); Siliguri, North Bengal, C.B. Clarke 27035 (K!); Madras, India, s. coll. 60 (K!); India, N. Wallich, s.n. (K!), seen online.

Figure 2: *Leucas diffiusa* A) habit; B) flower: front view; C) flower: lateral view; D) ventral view of leaf (Jayasinghe H. D.)

Revised taxonomic key to *Leucas* species in Sri Lanka.

1 Leaves linear to lanceolate, sessile to sub-sessile; calyx teeth not more than 1 mm long

2 Verticils throughout the length of flowering stem, lax; calyx mouth straight, villous-annulate within; limb 10-toothed ..... ***L. longifolia***

2 Verticils towards ends of flowering stem, dense; calyx mouth oblique, glabrous within; limb generally 7-8-toothed

3 Stem decumbent; leaves less than 2.6 cm long, glandular punctate, margin revolute; lateral veins prominulous …… ***L. diffusa***

3 Stem erect; leaves more than 2.6 cm long, eglandular, margin flat; lateral veins prominent ..… ***L. zeylanica***

1 Leaves ovate, distinctly petiolate; calyx teeth at least 1.5 mm long

4 Leaves lanate-tomentose beneath; calyx softly villous on nerves

5 Stem + procumbent, straggling; verticils 6-10-flowered; leaves to 3 cm long; corolla tube exannulate within ..... ***L. decemdentata***

5 Stem erect, verticils more than 10-flowered; leaves generally more than 3 cm long; corolla tube villous-annulate within ..... ***L. marrubioides***

4 Leaves scabrid or hirtellous beneath; calyx strigose, hirtellous or hirsute on nerves

6 Verticils lax, generally 2-4-flowered ..... ***L. biflora***

6 Verticils dense, generally more than 4-flowered ..... ***L. angularis***

(2) *Endostemon viscosus* (Roth) M.R.Ashby in Journal of Botany (1936), vol.74, pp. 126 — *Ocimum viscosum* Roth, Nov. Pl. Sp. (1821), pp. 274 — *Plectranthus viscosus* Spreng., Syst. Veg., ed. 16 [Sprengel] (1825), pp. 2: 691 ; Figure 3

Ocimum menthoides B.Heyne ex Roth, Nov. Pl. Sp. (1821), pp. 274.

Ocimum diffusum Benth., Pl. Asiat. Rar. (Wallich) (1830), 2: pp. 14 — *Orthosiphon diffusus* (Benth.) Benth., Prodr. [A. P. de Candolle] (1848), 12: pp. 50.

Orthosiphon tomentosus Benth., Pl. Asiat. Rar. (Wallich) (1830), 2: pp. 14.

Orthosiphon hispidus Benth., Prodr. [A. P. de Candolle] (1848), 12: pp. 50.

Ocimum adscendens Wight ex Hook.f., Fl. Brit. India [J. D. Hooker] (1885), 4(12): pp. 614.

Ocimum glaucum B.Heyne ex Hook.f., Fl. Brit. India [J. D. Hooker] (1885), 4(12): pp. 614.

Taxonomic description: Much branched, erect, stunted herbs to 0.3 m tall, appearing as *Ocimum tenuiflorum* L. at a glance; leaves 2 × 1.5 cm, opposite, elliptic, obtuse, broadly cuneate at base, margin crenate to sinuate, sometimes in-rolled; 4 pairs of lateral nerves, arching towards the tip; midrib and secondaries strongly impressed above, distinctly raised below; lamina distinctly glandular hairy on both sides; crushed leaves mint scented; petiole about half as long as the lamina; young stem and petiole covered with glandular hairs; inflorescence a terminal raceme, densely glandular hairy throughout except the corolla; rachis green, quadrangular with a longitudinal groove on middle of each side; bracts obtusely triangular, shorter than the pedicels; calyx tubular, down oriented, strongly 2-lipped, upper lip broadly obtuse, shortly decurrent, lower lip 4 lobed, acute, outer pair shorter than the inner pair; calyx throat densely covered with long, e-glandular hairs; corolla white to bright pink, corolla tube 4.5 x 2.5 cm wide, minutely hirsute outside on the tube, becoming glabrous towards lobes, 3 mm in size; obscurely 2 lipped; upper lip strongly emarginate, 3 mm, lower lip 3-lobed, 3.5 mm, lateral pair small, more long than wide, median lobe large, orbicular; stamens 4, inserted; anthers orangish; nutlets enclosed at the base of the accrescent calyx, oblong, white at immature stage, becoming blackish brown at maturity.

Distribution and ecology: We found this species from Kal Aru (8.6379 N, 79.9678 E) and from one of the resettlement sites of the Yan Oya irrigation project (8.8640 N, 80.8796 E). Both the locations were exposed rocky grounds and the plants were among the splits of these rocks. There were around 30 plants in each of these localities, and it was not a common species. This species was associated with some other seasonal species, which are capable of withstanding quite harsh conditions including *Platostoma menthoides* (L.) A.J. Paton,

Polycarpaea corymbosa (L.) Lam., *Chamaecrista mimosoides* (L.) Greene, and *Rostellularia procumbens* (L.) Nees.

Specimens examined: Sri Lanka: Yan Oya resettlement site H1, HDJ 70 (PDA); Ceylon, Walker s.n. (K!) seen online; **Other:** Tamil Nadu, R. Wight 2717 (K!); India, R. Wight 2494 (K!); Nagalur forest Narukkuparai, D.I. Arockiasamy 8090 (L!); Herb. Wight 2082 (L!), seen online.

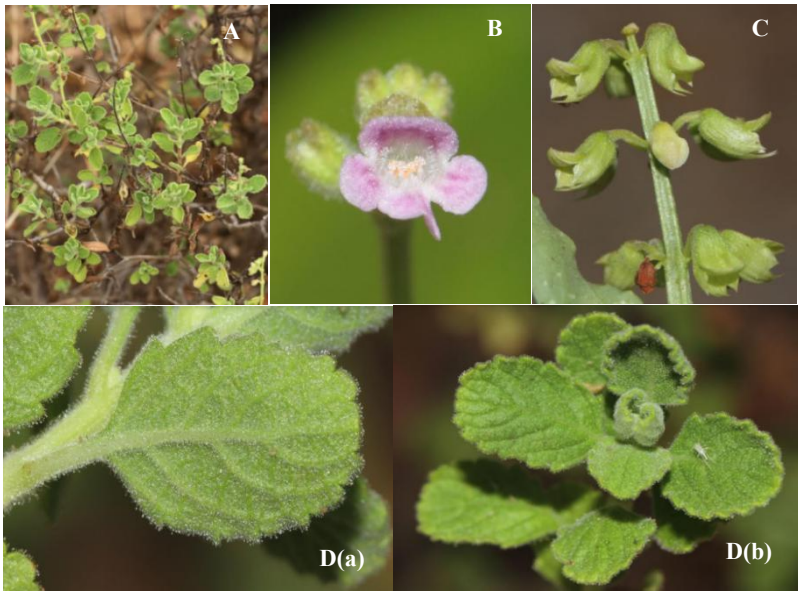

Figure 3: *Endostemon viscosus* A) habit; B) flower; C) inflorescence after anthesis; D (a) ventral side of leaf; D (b) dorsal side of leaf (Jayasinghe H.D.).

(3) *Orthosiphon pallidus* Royle ex. Benth. in Hooker (1833), Botanical Miscellany, vol. 3, pp. 370; Figure 4.

Ocimum reflexum Ehrenb. ex Schweinf., Beitr. Fl. Aethiop. (1867), pp. 126 - *Orthosiphon reflexus* (Ehrenb. ex Schweinf.) Vatke, Linnaea (1881), 43(2): pp. 85

Orthosiphon ehrenbergii Vatke, Linnaea (1872), 37(3): pp. 316

Ocimum somaliense Briq., Bull. Herb. Boissier (1903), Ser. 2 (3): pp. 985

Orthosiphon incisus A.Chev., Bull. Soc. Bot. France (1912), 58(Mém. 8d): pp. 199

Orthosiphon macrocheilus M.Ashby, J. Bot. (1938), 76: pp. 45

Taxonomic description: Mostly decumbent herb with many branches when growing in its preferred habitat of grazed mud flats, though it can grow erect at taller herbaceous vegetation. Stem green, sometimes with a dull red tinge at nodes, quadrangular, shortly pubescent; leaves opposite, 1.5–3 × 1–2 cm, coriaceous, oblong to narrowly ovate, obtuse at tip, base attenuate, margin undulate, sessile, midrib slightly impressed above, slightly raised below, lateral veins (2-) 3–4 pairs, upper ones connecting before the margin, prominulous, lamina glandular punctate on both sides; inflorescence a terminal raceme with 3-6 verticils of ca. 6 flowers, raceme 6–7 cm long mostly yellowish green sometimes tinged in dull red on pedicels, shortly pubescent throughout; flowers down oriented, 8 × 3 mm in size, pedicel slightly shorter than the calyx; calyx tubular, strongly 2-lipped, upper lip obtuse to apiculate, upturned, shortly decurrent, lower lip 4-lobed, inner pair longer than the outer, acuminate; outer pair with a straight inner margin and a curved outer margin; corolla white, shortly pubescent outside, tubular part slightly exceeding the calyx, strongly 2-lipped, upper lip much shorter, slightly 3-lobed, each lobe

obtuse, upturned, lower lip in-rolled, concealing the stamens, though the style shortly exceeding, which is white; nutlets orbicular-oblong, obtuse at both ends, pale brown, ca. 1 mm in diameter.

Distribution and ecology: This species was recorded from several places in coastal belt in Mannar district including Arippu (8.7986 N, 79.9389 E), Wedithalathivu (9.0245 N, 80.0703 E), Periyavilankuli (8.9905 N, 80.0465 E), and Iluppakadavai (9.0873 N, 80.0852 E). This is a species of very short vegetated, muddy ground, in flood plains and upper margins of salt marshes. It is a quite regular species in such micro-habitats, although such undisturbed habitats are rare due to paddy cultivation. This species is associated with other species such as *Basilicum polystachyon* (L.) Moench, *Bergia capensis* L., *Ammannia baccifera* L., and *Hydrolea zeylanica* (L.) Vahl etc. Some of the plants that were collected had a thick and deep root system, which is extraordinary when considering the size of the aboveground part, indicating that even though the leafy part is dying off in the dry season, the remaining root system makes sprouts in the next rainy season.

Specimens examined: Sri Lanka: Arippu, HDJ 47 (PDA!); Arippu, HDJ 203 (PDA!); **Other:** India, J.F. Royle s.n. (K!); India, V.V. Jacquemont 1427 (K!); Africa: Ethiopia, J.J.F.E. de Wilde 4659 (L!); Saudi Arabia, Waji Deli, Taku Miyazaki 990817WD5 (E!); s.l., W.G. Schimper 190 (BR!), seen online.

Figure 4: *Orthosiphon pallidus* A) habit; B) flower; C)(a) ventral side of leaf; C(b) dorsal side of leaf (Jayasinghe H. D.).

Revised taxonomic key to *Orthosiphon* species in Sri Lanka.

1 Stamens included in lower lip of the corolla

2 Erect herbs to 100 cm tall; leaves ovate to ovate elliptic, coarsely crenate-serrate, to 7 cm long; raceme to 15 cm long ……. ***O. thymiflorus***

2 Decumbent herbs to 20 cm tall; leaves oblong to narrowly ovate, margin undulate, to 3 cm long; raceme to 7 cm long …… ***O. pallidus***

1 Stamens much exerted beyond the lower lip of the corolla ……. ***O. aristatus***

CONCLUSION

The botanical explorations in the Northern dry zone should be timed appropriately, since most of the herbaceous plant species emerge with the Northeast monsoon and have a relatively short life span of 1-2 months from December to January. We were able to document *Leucas diffusa* Benth. and *Orthosiphon pallidus* Royle ex. Benth. for the first time in Sri Lanka through the explorations carried out at the appropriate time of the year. Further we confirm the existence of *Endostemon viscosus* (Roth) M.R. Ashby, a species that was included doubtfully in Sri Lankan flora. The results presented in our study indicate the need for further botanical explorations within this region as there are potentially other species to be recorded and described.

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