

***Virola parvusligna*, a New Species of Myristicaceae from the Cordillera Azul National Park, Peru**

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Abstract: In one of expeditions realized by Missouri Botanical Garden in May 2019, we found a small tree as part of the project "Diversity of flora and its relationships with the soil, in the wild area of Cordillera Azul National Park"; examining the botanic samples be carefully and realizing respective comparisons, we arrived to conclusion that it has different characteristics from the others species of *Virola*. Therefore it would be a new species for science; the new species is described and illustrated in the present article; it is characterized because generally they are small trees 2.0 m highest; the terminal twigs with persistent indument, terete; leaves, ovate-elliptical to oblong-elliptical, with 10–15 pairs of secondary veins; pistillate inflorescences, axillary 1.5–1.6 cm long, with 6–12 flowers; fruits 1–4, obovate-elliptical, carinate, acute apex $2.0 - 2.2 \times 1 - 1.2$ cm, densely ferruginous tomentose. On the other hand, we present the discussions regarding the relations with other species, for which we include illustrations, images, and data on its ecology, phenology, geographical distribution, geological location and its current state of conservation.

Keywords: Amazon Forest, New Species, Protected Area, Peru, *Virola*

1. Introduction

Myristicaceae [1], are classified within Order Magnoliales [2], and consist of approximately 21 genera and 500 species, which are distributed mainly in the tropics of the Old and New World [3]. In the Americas, the family is currently represented by 101 species [4], with five endemic genera, among them *Compsoeura*, *Iryanthera* [5], *Osteophloeum* [6], *Otoba* [7] and *Virola* [8, 9].

Gentry [9], indicates that this family is easier to recognize by sterile characters than by fertile ones. For example; *Compsoeura*, recognized by the parallel tertiary venation; *Virola* by stellate trichomes; *Iryanthera* and *Otoba* by T-shaped trichomes, the latter with a glaucous or tanned surface on the lower surface of the leaf; *Osteophloeum* has straw-colored latex and a characteristic leaf shape with a wedge base and relatively long petiole.

The Myristicaceae Family has great economic importance in the world, which is mainly related to the use and great acceptance of *Myristica fragrans* [10], "nutmeg", as a condiment in food preparation; and in traditional medicine as

a rejuvenator, aphrodisiac and to calm the nerves [11]. In the Peruvian Amazon, some species are timber, mainly those belonging to the genus *Virola*. Its selective extraction ends up in products such as round wood, sawn wood, mainly tongue and groove and construction [11]. Some species of this same genus were used by some Peruvian cultures, mainly the "Bora", as a hallucinogen, due to the high content of alkaloids (tryptamines and tetrahydroxycarboxyls); on the other hand indicates that some indigenous peoples in the country of Brazil, the bark dust is insufflated through long tubes into the nostrils [12]. Other authors indicate they are used to counteract some intestinal disorders, colic, erysipelas, even the healing of wounds and certain inflammations [11].

The genus *Virola*, is one of the main members of the Myristicaceae family that was drawn and described for the first time by Aublet in the year 1775, based on the type species *Virola sebifera* [8, 13]. This plants are mostly woody, exuding a red latex, typically astringent [9, 14], they are dioecious, never monoecious, they present trichomes on young twigs and petioles, the trichomes are stellate, in some, they are microscopic like in *Virola calophylla* [6] and *V. coelhoi* [15, 13].

The leaves are distichous, simple with entire margin, leathery, oblong or elliptical; sometimes the petioles are short and thick that seem to be sessile as in the case of *Virola sessilis* [6]. Inflorescences, solitary, subterminal or axillary but never cauliflower or ramiflower, the staminate inflorescence in panicles, pistillate inflorescences always smaller than the staminate flowers [14]. Flowers with short pedicels, bracteoles usually absent [13, 14]. The perigonium is membranous or slightly fleshy, infundibuliform, with 3 or 4 (rare 5) lobes from less than 1/3 to almost the base of its total length; often these lobes can typically have a visible midrib; the androphore are spongy, others are fleshy, some are characterized by a sudden strangulation in the distal part, as in *V. calophylla* and *V. malmei* [16]; the anthers (2) 3 (4–6) can be apiculate or obtuse at the apex, welded or distally divergent, but never totally free [13, 14]. The ovary is sessile monocarpellar, densely tomentose the stigma bifid, short and almost sessile [13]. The fruits are capsules, subglobose, elliptical or oblong, generally carinate, others are smooth, the pericarp varies from very fine to thick and woody as in *V. albidiflora* [17]; other fruits, such as *V. calophylla*, are initially densely hairy, to later become glabrescent over time [13]. The seeds are surrounded by a reddish and lacinate aril [13, 9]. According to Poinar & Steeves

[18]; the genus *Virola*, ecologically speaking is dominant, the same one that is represented by 60 species in the world of which 26 are found in Peru [19, 14].

The Cordillera Azul National Park (PNCAZ), a protected natural area located in the Loreto, San Martín, Huanuco and Ucayali regions; occupies 1 353 190.85 ha, and is the fourth largest national park in Peru. It was established on May 21, 2001, and is located between the Huallaga and Ucayali Rivers. Among its objectives is the protection of a unique series of species, biological, communities and geological formations, typical of the montane and pre-montane forests of the Cordillera Azul complex, and unique geological formations [20] that emerged during Cenozoic and Mesozoic. One of them, the Sarayaquillo formation, where the study area is located, exhibits an abrupt and steep morphology that contrasts with the adjacent areas [21].

In one of the botanical explorations carried out by the Missouri Botanical Garden to the north side of Cordillera Azul National Park, we found a small tree with morphological characteristics that clearly indicates that it is a new species for science in *Virola* (Myristicaceae), the description for which is formally presented here.

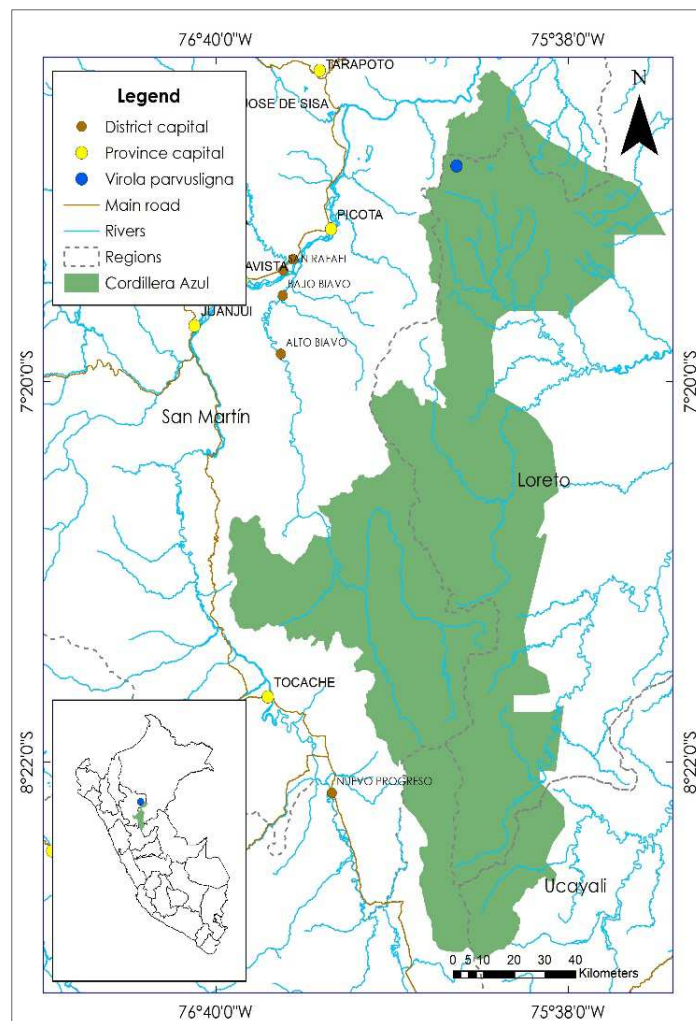


Figure 1. Distribution of *Virola parvusligna* in Cordillera Azul National Park, Peru.

2. Materials and Methods

The plant under study was collected in one of the expeditions carried out by the scientific team of the Missouri Botanical Garden in a place called "lost world", located on small mountains known as the Andean tepuis over the Amazon forest of Peru to north side of Cordillera Azul National Park between the districts of Pampa Hermosa, Ucayali Province and Loreto Region (Figure 1). The beginning of the study was carried out by the district of Chazuta, population centres of Ramon Castilla, Siambal and Pampas, located in the province of San Martín (Tarapoto). The botanical collections were made in May 2019 as part of the project "Diversity of flora and its relationships with the soil, in the wild area of Cordillera Azul National Park". The samples collected in this project, were studied in detail using specialized bibliography such as the keys of Smith [22], Rodrigues [13] and Santamaría [3]. The distribution map was produced using geographical coordinates registered in the field, and the points of occurrence of the new species were used to determine in what type of geological formation it occurred, for which we used the maps developed by Sánchez [21] from the Geological Mining and Metallurgical Institute of Peru (INGEMMET).

3. Result and Discussion

3.1. Taxonomy

Virola parvusligna Vásquez & L. Valenz., *sp. nov.* Type: —PERU. Loreto Region, Prov. Ucayali, Dist. Pampa Hermosa, Cordillera Azul National Park, Amazon forest, sclerophyllous, on sandy reddish clay soil; 06°44'51.4" S 075°57'38.6" W; 687 m, 24 May 2019. L. Valenzuela, J. Flores & R. Zehnder 35939 (Holotype HOXA!; Isotypes USM!, MO!). Figures 1–4.

3.1.1. Diagnosis

Similar to *Virola coelhoi* Rodrigues [15] but it differs because are small trees of 1.30–2.0 m, terminal twigs terete; petioles 1.2–1.8 × 0.1–0.2 cm, terete, ferruginous tomentose; the leaves are ovate-elliptical to oblong-elliptical with 10–15 pairs of secondary veins; fruits 1–4, obovate-elliptical, carinate, sharp apex of 2.0–2.2 × 1.0–1.2 cm, densely ferruginous tomentose, with persistent stellate indument. While the other specie generally are large trees 25–30 m, terminal twigs laterally flattened, petioles slender ribbed, short 0.4–1.2 × 0.1–0.2 cm, rough puberulent when young, then glabrescent; the leaves linear-oblong to obovate-oblong with 20–46 pairs of secondary veins; fruits 5–20, subglobose 0.7–1.7 cm, rounded towards the apex, carinate, around the upper suture, slightly ferruginous puberulent and glabrescent.

Small tree up to 2 m tall, dioecious; terminal twigs terete, densely tomentose ferruginous, with persistent indument, slightly puberulent. Petioles 1.2–1.8 × 0.1–0.2 cm,

ferruginous tomentose, terete, slightly ribbed only towards the apex. Leaves 4.6–13.2 × 1.3–3.7 cm; ovate elliptical to oblong elliptical, obtuse base, acuminate apex; adaxial surface glabrous, lustrous; the middle vein broad, slightly ribbed in young leaves, regularly emerging on adult leaves, ferruginous tomentose to slightly puberulent; abaxial surface, ferruginous tomentose, with persistent indument, stellate trichomes sessile with 5–6 arms 0.11–0.12 mm in diameter, mostly grouped towards the middle vein and the proximal half of the secondary veins; middle vein strongly emerging; secondary veins 10–15 pairs, separated by 0.5–1.0 cm, straight to slightly oblique, anastomosing towards the edge, imprinted towards the adaxial surface and protruding on the abaxial surface; tertiary venation the same. Staminate inflorescences not seen; pistillate inflorescences axillary in small panicles 1.5–1.6 cm long; peduncle, erect, terete 1.00–1.20 × 0.25–0.30 cm, bracts persistent, strongly ferruginous tomentose, covered by persistent and sessile stellate trichomes; inflorescence with 3 branches, the basal ones opposite to sub-opposite with 6–12 flowers, mostly reflexing in a similar manner, 2–4 flowers per branch; pedicels terete, 1.2–1.8 × 2.3–3.0 mm, persistent bracteoles turned into small protruding calluses close to the pedicel when in fruit; ovary sub-globose, elliptical, densely ferruginous, puberulent 2.0 × 1.2 mm thick; stigma covered irregularly by stellate trichomes, obliquely capitate, bilobed; perigonium 5.0–6.0 × 2.0–3.0 mm, cylindrical-tubular, 3 (4) lobed, split to 1/3 of the perigonium; tepals 2.0 × 1.2 mm, obtuse, externally ferruginous tomentose, covered with stellate hairs. Infrutescence 3.5–4.0 cm long; peduncle 1.5–2.0 cm long, pedicels 0.3 × 0.2 cm, (1–) 2 (–4) fruits, obovate elliptical, carinate, acute apex 2.0–2.2 × 1.0–1.2 cm, densely ferruginous tomentose, with persistent stellate hairs, pericarp 0.6–0.9 cm thick; seeds 1.3 × 0.6 cm, glabrous, with lacinate aril only up to 0.9 cm (3/4 of the seed).

3.1.2. Comparisons with Similar Species

The keys from Smith [22], Rodrigues [13] and Santamaría [3], suggest that *Virola parvusligna* is found within the *Sebiferae* Group and closely more similar to *Virola coelhoi* than to *Virola elongata* [23] because the fruit in *V. elongata* are deciduously tomentose to glabrescent while that in *V. coelhoi* are tomentose and puberulent like *V. parvusligna*. However, we believe it is necessary to carry out the discussions in the order of similarities, in such a way that we can establish the respective differences from the morphological characteristics that we present in detail below. *Virola parvusligna* is similar to *V. coelhoi*, in its always petiolate adult leaves that are densely puberulent abaxially, tomentose with sessile stellate trichomes, the inflorescence branched, the perigonium split up to 1/3 of its total length, the fruits ellipsoid tomentose or puberulent; but it differs because the individuals of *V. parvusligna* are generally small trees of 1.30–2.0 m high (versus large trees 25–30 m); the terminal twigs terete (versus twigs laterally flattened), petioles 1.2–1.8 × 0.1–0.2 cm, densely

ferruginous-tomentose, terete (versus petioles slender ribbed $0.4\text{--}1.2 \times 0.1\text{--}0.2$ cm, rough puberulent when young, then glabrescent); leaves $4.6\text{--}13.2 \times 1.3\text{--}3.7$ cm, ovate elliptical to oblong elliptical, obtuse base, acuminate apex, the medium vein broad slightly ribbed in young leaves, emergent, ferruginous-tomentose underside with sessile stellate trichomes $0.11\text{--}0.12$ mm in diameter with 5–6 arms; secondary veins 10–15 pairs (versus leaves $3.3\text{--}23$ cm \times $1.0\text{--}4.7$ cm, linear oblong, obovate oblong, acute or obtuse at the base, apex obtusely cuspidate, acuminate, on the underside with stellate sessile trichomes $0.10\text{--}0.20$ mm, sparsely dotted yellow, midrib by bundle immersed or appressed; secondary veins 20–46 pairs); the fruits are obovate elliptical, carinate, $2.0\text{--}2.2$ cm acute apex, tiny and densely ferrugineous tomentose, with persistent stellate indument, pericarp $0.6\text{--}0.9$ cm thick (versus fruits subglobose, $0.7\text{--}1.7$ cm long, rounded towards the apex and shortly stipitate, carinate, around the upper suture, slightly ferrugineous puberulent, glabrescent, pericarp $0.1\text{--}0.3$ cm). We must indicate that to make the morphological comparison with the *V. coelhoi* species we take the description and mainly the measurements established by Rodrigues [13].

On the other hand, *V. parvusligna* is also similar to *Virola elongata*; but it differs because the lower surface the leaves of *V. parvusligna* are ferruginous tomentose, with persistent indument, stellate trichomes sessile with 5–6 arms $0.11\text{--}0.12$ mm in diameter, 10–15 pairs of secondary nerves (versus leaves often glandular-punctate, $12\text{--}32 \times 4.0\text{--}11$ cm long, lower surface with hairs sessile-stellate, about 0.1 mm. in diameter, often sparse, glabrescent, the secondary nerves 9–20 per side); the fruits in *Virola parvusligna* are obovate elliptical, carinate, acute apex $2.0\text{--}2.2 \times 1.0\text{--}1.2$ cm, densely ferruginous tomentose, with persistent stellate hairs, pericarp $0.6\text{--}0.9$ cm thick, 1–4 fruits per infructescence (versus fruits ellipsoid or subglobose, $1.1\text{--}1.6 \times 0.8\text{--}1.2$ cm in diameter, the pericarp brittle, $0.1\text{--}1.3$ mm thick, glabrescent, at first densely tomentellous, hairs on young fruits about 0.2 mm long, with numerous short lateral spurs, 5–20 fruits per infructescence); finally the pistillate inflorescences in *V. parvusligna* are axillary in small panicles $2.5\text{--}2.8$ cm long with 6–12 flowers, covered by persistent and sessile stellate trichomes; inflorescence with pedicels terete, $1.2\text{--}1.8 \times 2.3\text{--}3.0$ mm (versus pistillate inflorescences up to 7 cm long, tomentellous as the staminate inflorescences, soon glabrous; with many flowers, the pedicel stout, $1\text{--}2$ mm long).

3.2. Etymology

Referring to the small size of the individuals trees, from the Latin words "*parvus*" that means small and "*lignus, ligna*" which means wood, woody; that putting both words together would mean small tree.

3.3. Ecology

Virola parvusligna is known only from the Cordillera Azul National Park, located near the "lost world", where the small mountains stand out from the great green and intact landscape,

away from anthropic pressure. This complex of mountains from the Upper Jurassic, the Sarayaquillo formation, which ranges from $536\text{--}687$ m. A small population of 3 individuals was recorded in an approximate distance of $300\text{--}400$ linear meters, located on the top of the mountain, on Amazon forest, sclerophyllous, on a clay-sandy soil; with rocks of fine-grained red sandstones, composed of mudstones, siltstones, clearly distinguishable by coloration and coarse stratification (Figure 2), with a rugged and irregular morphology [21].

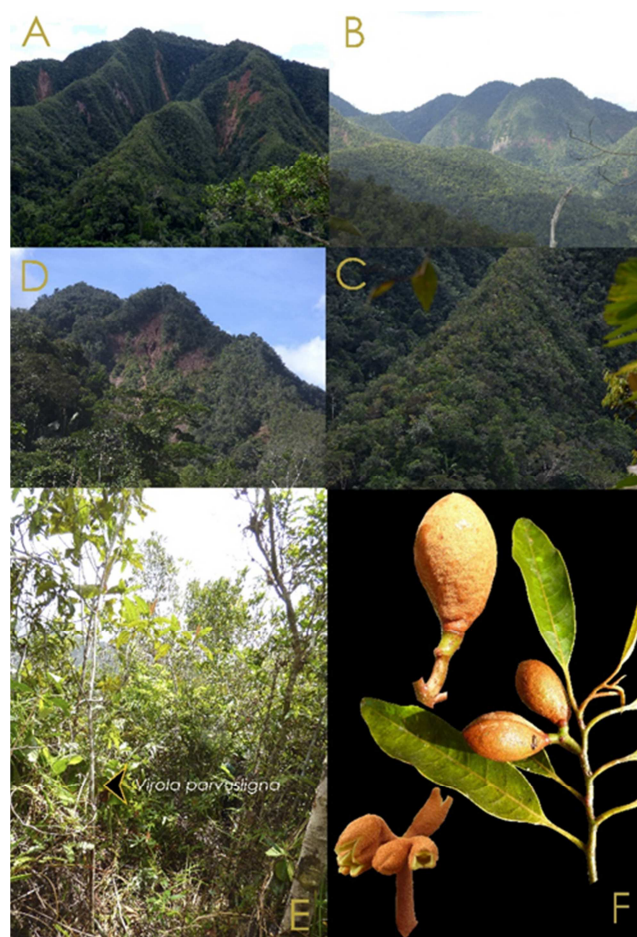


Figure 2. Habitat of *Virola parvusligna*. A–B. Small mountains called the "Andean tepuies"; in the Amazon forest north of the PNCAZ. C. View of the sclerophyllous forest. D. Sarayaquillo geological formation. E. Forest structure and adult individual of *V. parvusligna*. F. *V. parvusligna* adult segments of pistillate individual. (Photographs L. Valenzuela).

3.4. Notes

The new species shares its habitat with other tree species: *Stenopadus andicola* Pruski (Asteraceae), *Calycophyllum megistocaulum* (K. Krause) C. M. Taylor (Rubiaceae), *Hortia* sp. (Rutaceae), *Tachigali* sp. (Fabaceae), *Clethra* sp. (Clethraceae), *Podocarpus* sp. (Podocarpaceae), *Bonnetia paniculata* Spruce ex Benth. (Bonnetiaceae), *Bejaria* sp. (Ericaceae), *Sterigmatopetalum* sp. (Rhizophoraceae), *Vochysia* sp. (Vochysiaceae). It also with *Syagrus smithii* (H. E. Moore) Glassman (Arecaceae), *Ocotea* spp. (Lauraceae), *Protium* spp. (Burseraceae), *Lissocarpa uyat* B. Walln. (Ebenaceae), which

are all small trees, 1.30–7.00 m tall. At the moment, the species is apparently secure, because it is inside a protected area, which guarantees its conservation; however, we believe that the data are insufficient to determine the conservation status. Regarding its phenology, more details still need to be known. It was collected in May, 2019, when individuals with fruits and pistillate flowers were found, but no individuals with staminate flowers were found. More research being necessary to understand its ecology in greater depth.

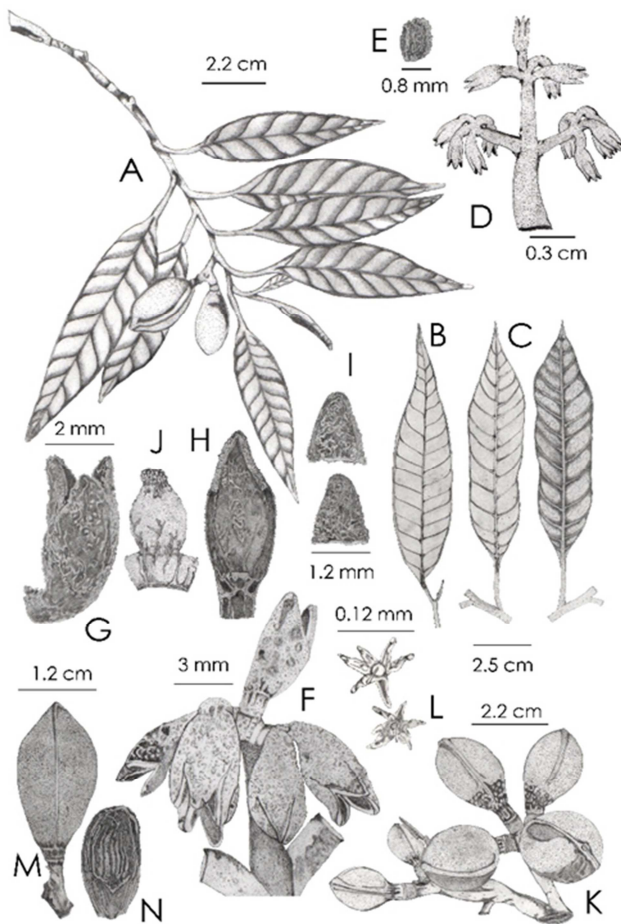


Figure 3. *Virola parvusligna*. A. Terminal twig. B. Ovate-elliptical leaf (adaxial side). C. Leaf, oblong-elliptical (adaxial & abaxial sides). D–F. Inflorescence (peduncle, twigs, and reflex flowers). E. Bract. G. Perigonium. H. Longitudinal section of the perigonium. I: Tepals (adaxial & abaxial). J. Ovary, Stigma and Pedicel. K. Infrutescence. L. Stellate trichomes. M. Fruit. N. Seed. Drawings by L. Valenzuela from samples Valenzuela 35939 (pistillate) and Valenzuela 35829–35937 (fruits).

3.5. Other Specimens Examined

Loreto, Prov. Ucayali, Dist. Pampa Hermosa, Cordillera Azul National Park, Amazon forest, sclerophyllous, clay-sandy soil, 06°44'51.4" S 075°57'38.6" W; 687 m, 24 Mayo 2019. L. Valenzuela, J. Flores, R. Zehnder 35937 (HOXA, USM, MO); Región Loreto, Prov. Ucayali, Dist. Pampa Hermosa, Cordillera Azul National Park, Amazon forest, sclerophyllous, clay-sandy soil, reddish, 06°44'48.9" S 075°57'29.7" W; 639 m, 22 Mayo 2019. L. Valenzuela, J. Flores, R. Zehnder 35829 (HOXA, USM, MO).

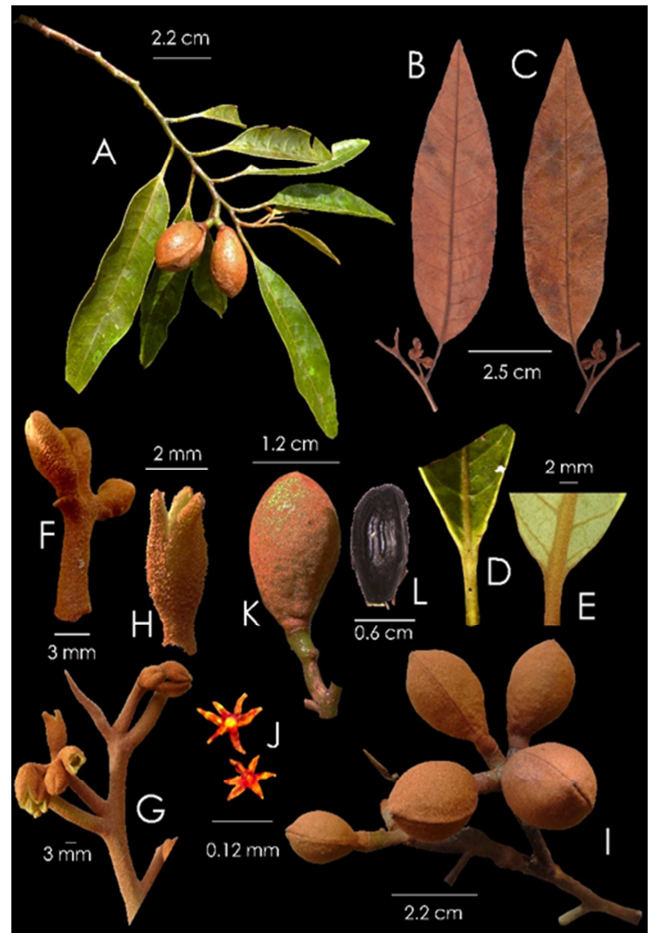


Figure 4. *Virola parvusligna*. A. Terminal twig. B–C: Leaves, ovate-elliptical in dry sample (adaxial and abaxial sides). D–E. Petiole segment, middle vein (adaxial and abaxial sides). F. Bract in inflorescence. G. Inflorescence and peduncle. H. Perigonium. I: Infrutescence. J. Stellate trichomes; K. Fruit. L. Seed. (Images L. Valenzuela).

4. Conclusions

A new species of *Virola* is described and presented to science, with unique morphological characteristics that make it different from other species; up to now, about 3 adult individuals have been registered, in an approximate area of 3 ha, which makes it an endemic species, with a special and very restricted habitat. More research is required to learn about their biology, ecology, evolutionary relationships, and conservation status.

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