




Article

Two New Species of *Gomphrena* (Amaranthaceae) from Bolivia

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Abstract: Two new endemic species from Bolivia, *Gomphrena vallegrandensis* T. Ortuño & S. Lozada-Gobilard and *Gomphrena palmariensis* T. Ortuño, J. Gutiérrez. & Montesinos, are described and illustrated. The former only occurs in the native open natural grassland close to the Tucuman forest (Prov. Vallegrande), and the latter is restricted to the areas with rock outcrops in the subpuna close to the inter-Andean dry forest in the El Palmar Integrated Management Natural Area. A full description of these two new species, notes on their distribution, and a key for their identification are provided.

Keywords: *Gomphrena*; Amaranthaceae; Bolivia; endemic species; subpuna; inter-Andean dry forest; taxonomy; new species



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1. Introduction

Gomphrena L. (Gomphrenoideae) comprises over 120 species worldwide, making it one of the largest genera within the Amaranthaceae s. str. [1]. Around 63% of its species are distributed in South America, primarily in Brazil [2], Argentina [3], and the Andean region of Bolivia [4], establishing South America as its center of diversity. An additional 14% are distributed across North America [5], while 23% are native to Australia [6], where the number of newly described species continues to grow [7].

Molecular studies [8–10] have identified the polyphyly of *Gomphrena*, revealing two distinct lineages: one that is close to *Hebanthe* Mart., *Pedersenian* Holub, and *Pfaffia* Mart., and the other containing the bulk of *Gomphrena* species. More recent work, with expanded sampling of Andean taxa, has recognized the “*Gomphrena* clade” [11], which includes the core *Gomphrena* group plus two unresolved basal lineages (the *G. mollis* Mart, *G. rupestris* Nees and the *G. prostrata* Desf., *Guilleminea* Kunth clades). All members of the core *Gomphrena* clade show C₄ photosynthesis [9–11] and metareticulate pollen with strongly reduced tectum columellae freely visible [8,12]. In contrast, the *G. mollis*-*G. rupestris* clade produces pollen with a tectum completely covered by mesoporia with small perforations [12,13],

and displays C₃ photosynthesis, as in, for example, *G. elegans* Mart., *G. vaga* Mart., and *G. prostrata*.

The genus *Gomphrena* (or *Gomphrena* s. str.) was recently redefined using morphological and molecular characteristics [11] and now includes the previously separate genera *Gossypianthus* Hook, comprising most species from North American *Lithophila* Sw., and *Philoxerus* R. Br. from the Pacific coast. Morphologically, the genus *Gomphrena* is supported by a synapomorphy identified through ancestral characteristic state reconstruction and the presence of heteromorphic sepals. The two inner sepals are smaller than the three outer ones and are strongly compressed against the fruit (utricle).

The presence of C₄ photosynthesis allows the species to survive in dry environments [11,14,15]. Most Bolivian species are native to the southern ecoregion of Bolivia in the inter-Andean dry forest, prepuna, and puna [11]. Recent studies indicate that most of these species belong to the “Andean clade” [11], which emerged approximately 1.2 million years ago [11].

The new species described here exhibit the characteristics of the Andean clade and mostly exhibit a similar sepal type. *Gomphrena* is characterized by reduced flower and leaf sizes, an adaptation to arid environments [11]. The flowers and leaves are arranged in a “partial floescence” called paracladia, following the nomenclature of Acosta (2009) [16]. This structure is strongly condensed into a whorl-like terminal arrangement. The paracladia (or synfloescence) is typically surrounded by five (three–six) partial floescences with no visible axes, where each flower is enclosed by two bracteoles and one bract. Here, we use the term synfloescence to describe these new species.

Another differential characteristic is the presence of the apical leaves subtending the synfloescence (such as involucreal leaves) an arrangement of leaves varying in form, size, and the types of indumentum and trichomes of the abaxial or adaxial surface. The presence and shape of trichomes can be useful traits to distinguish species [17]. In *Gomphrena*, trichomes are multicellular and uniseriate, but they differ in basal cell structure, surface ornamentation, color, and the interlocking of cells (union cells) [18–20]. Their characteristics vary depending on their location on the plant.

In recent decades, botanists have conducted extensive fieldwork on various projects in isolated regions of Bolivia, targeting areas where much of the flora remains poorly studied (e.g., refs. [10,21–24]). These efforts have resulted in biodiversity checklists that provide essential baseline knowledge for ecosystem conservation [25]. Within the Amaranthaceae family, previous projects have significantly expanded our understanding of the *Gomphrena* genus in Bolivia, resulting in a comprehensive revision that combined morphological and molecular data (Ortuño and Borsch in prep).

A total of 22 species of *Gomphrena* have been recognized as native to Bolivia (s. st.), with eight endemics listed in Borsch et al. (2014) [4], including three species that were recently described [17]. Many species remain undescribed and undiscovered as they grow in remote regions of the country, especially in the southern Andean region of Bolivia, including the dry inter-Andean valleys and Tucuman–Bolivian forests, as well as the prepuna and high-altitude subpuna ecosystems, reflecting the ecological preferences of the genus.

In this paper, we present complete diagnoses of two new species, describe their distribution, and provide a key for their identification. Further comparison highlights their distinct morphological and ecological adaptations, which justify their recognition as new taxa and emphasize the importance of conserving Bolivia’s unique flora.

2. Materials and Methods

2.1. Study Sites and Specimens

The two new species of *Gomphrena* were discovered after a review of specimens from the “Herbario Nacional de Bolivia” (LPB), “Herbario de Santa Cruz (USZ)”, and “Herbarium del Sur de Bolivia” (HSB) (acronyms according to [26]). Three specimens of the first species (*G. vallegrandensis*), from Vallegrande Province, were located in LPB, USZ, and K. Two specimens from the second species (*G. palmariensis*) were collected from HSB and LPB.

Both new species are morphologically part of the perennial *Gomphrena* native to the Andes. They were identified using the morphological criteria proposed by Pedersen [27] and Ortuño and Borsch [11,19] focusing on bracteole-to-sepal size. Unlike the *G. perennis* group and its allies, which have shorter bracteoles, the new species feature bracteoles equal to or larger than the sepals. This trait aligns them more closely with species such as *G. oligocephala* J. Rémy, *G. bicolor* Mart., *G. potosiana* Suess. & Benl., *G. fuscipellita* T. Ortuño & Borsch, and *G. stellata* T. Ortuño & Borsch. Notably, *G. vallegrandensis* has erect, herbaceous stems similar to *G. oligocephala*, while *G. palmariensis* is a subshrub, resembling *G. stellata* in terms of its sub-woody stems.

2.2. Dissection, Curation, and Identification

Morphological observations and measurements of vegetative and reproductive traits were undertaken on plant material stored in the herbarium collections of LPB, HSB, and USZ. For taxonomic identification, we followed the description and keys provided by Ortuño and Borsch (2020) and [2,11,20,27–30] incorporated observations from additional floristic works as needed. Detailed dissections of flowers were carried out, and we used a stereomicroscope to examine bracts, bracteoles, sepals, and androecium.

Qualitative and quantitative characteristics were recorded to characterize the new taxa and morphologically similar species, enabling the preparation of a dichotomous key [11]. The main characteristics are presented in Table 1, comparing the two new species with three related species: *G. oligocephala*, *G. bicolor*, and *G. stellata*.

Table 1. Comparative table of morphological characteristics distinguishing *Gomphrena vallegrandensis*, *G. palmariensis*, and closely related species *G. oligocephala*, *G. bicolor* and *G. stellata*.

Species	<i>G. vallegrandensis</i>	<i>G. oligocephala</i> Remy	<i>G. bicolor</i> Mart.	<i>G. palmariensis</i>	<i>G. stellata</i> T. Ortuño & Borsch
Type collection	J.R.I Wood & M. Mendoza 21467	Borsch, T. & T. Ortuño 3760	Borsch, T. & T. Ortuño 3558	Julia Gutiérrez, a. Copa, & D. Soux. 2034	J.R.I Wood & A. Carretero 19600
Herbarium	LPB, USZ, K	LPB, B	LPB, B	HSB, LPB	LPB, B
Plant size (cm)	27–40	10–22	5–15	20–30	30–40
Altitude (m.a.s.l.)	2745	2600–3200	2400–3800	3100	1100–1300
Ecoregion	Bolivian Tucuman Forest	Inter-Andean dry forest, Bolivian–Tucuman forest, puna	Inter-Andean dry forest, prepuna, humed puna	Inter-Andean dry forest	Chaco Serrano
Habit	Erect	Erect	Ascending	Decumbent	Erect to ascendent
Vegetative branching systems	Unbranched or Secondary and tertiary branches	Unbranched, rarely with secondary branches	Unbranched	Stems are arranged in secondary and tertiary branches	With secondary stem
Stem trichome ornamentation	Spiny	Salicose and spiny	Salicose to granulose	Spiny	Granulate to spiny
Basal leaf petiole (cm)	0.5–1.3	Sessile	Sessile	Sessile	Sessile
Leaf form	Elliptic	Lanceolate or linear	Ovate–lanceolate	Widely cordate	Obovate–lanceolate

Table 1. Cont.

Species	<i>G. vallegrandensis</i>	<i>G. oligocephala</i> Remy	<i>G. bicolor</i> Mart.	<i>G. palmariensis</i>	<i>G. stellata</i> T. Ortuño & Borsch
Leaf plant size (cm)	3–4 × 0.5–1.5	1.5–2.1 × 0.8	0.3–2 × 0.4–0.9	1.3–1.5 × 1–1.5	0.8–4 × 0.9–1
Leaf vein prominence	Middle nerve	Middle nerve and two nerve secondaries	Middle nerve	Actinodromus	Middle nerve
Involucral leaf form	Oblanceolate	Orbicular	Cordate	Ovoblancheolate	Ovoblancheolate
Involucral leaf size (cm)	1.3–2.3 × 0.7–1.3	0.8–1.3 × 0.4–1.5	0.5–2 × 0.4–1	0.4–1.6 × 0.4–1.6	1.2–1.5 × 0.6–0.8
Involucral leaf apex	Cuspidate or mucronate	Acuminate	Acute	Mucronate	Acute to mucronate
Indumentum of adaxial surface of involucral leaves	Strigose	Hirsute	Hirsute	Appressed	Glabrous
Ornamentation cuticle trichomes of abaxial surface involucral leaves	Spiny	Granulose	Granulate	Spiny	Spiny
Characteristics of peduncle	Thin and twining (scapiform), covered with dark brown trichomes, scapiform	Firm, covered with uniseriate white trichomes	Firm, covered with uniseriate white, dark brown, and black trichomes	Firm, covered with white to light to dark brown trichomes	Firm, covered with white trichomes
Synflorescence diameter (cm)	1.3–1.8	1.5–2	0.5–1.7	0.8–1.6	0.7–1.1
Flower size of synflorescence (cm)	0.42–0.5.1	0.55–0.6	0.22–0.3	0.48–0.52	0.35–0.45
Color of bract	White to light brown	White, translucent	Brown–light brown	Light to dark brown at the apex	White
Trichomes of Bract	In the basal part	In the basal part	In the basal part	In the basal and in the all-margin	Few on the basal part
Crest bracteoles located along middle nerve of dorsal part	Widely crested 2/3	Tiny crested 1/4	Tiny crested 1/4	Widely crested 1/3	Small crested 1/2 extending along the entire dorsal nerve
Form of two lobes on filament appendix	Two lobes lanceolate, apex acute	Two lobes lanceolate, apex acuminate	Two lobes lanceolate, apex rounded	Two lobes broadly ovate, cuspidate apex	Two lobes elliptic

Additionally, trichomes of the stems, leaves, involucral leaves, and sepals were analyzed under a Leica ICC50 optical microscope and an RoHS digital microscope to study the type of cells, tissue ornamentations, and type of indumentum, following the terminology proposed in Ortuño and Borsch [11,19,20]. Specific morphological features, such as hair structures, were examined in detail by measuring and documenting their size, shape, and distribution on the leaves and flowers. A detailed description of the trichomes is provided, as their characterization is valuable for future taxonomic studies.

2.3. Distribution

Localities were recorded during fieldwork and the study of herbarium specimens. A distribution map was created using ArcGis version 10.8. Ecological regions followed the classification by [31]. Localities were identified through fieldwork and the study of herbarium specimens (Table 1), and the map includes voucher data from LPB, HSB, and USZ and types of *G. oligocephala*, *G. stellata*, and *G. fuscipellita* to support the identified localities. Further details about the specific vouchers are provided in the figure legends. The distribution data for *G. vallegrandensis* and *G. palmariensis* are also supported by the voucher specimens.

To enable a comparison between the new species and their closest relatives, we have included a table summarizing key the morphological characteristics of *G. vallegrandensis*, *G. palmariensis*, and closely related species from Bolivia.

3. Results

3.1. *Gomphrena vallegrandensis* T. Ortuño & Lozada-Gobilard, sp. nov.

The first new species described is *G. vallegrandensis* (Figure 1). Full diagnosis, description and specific features are presented in the following sections.

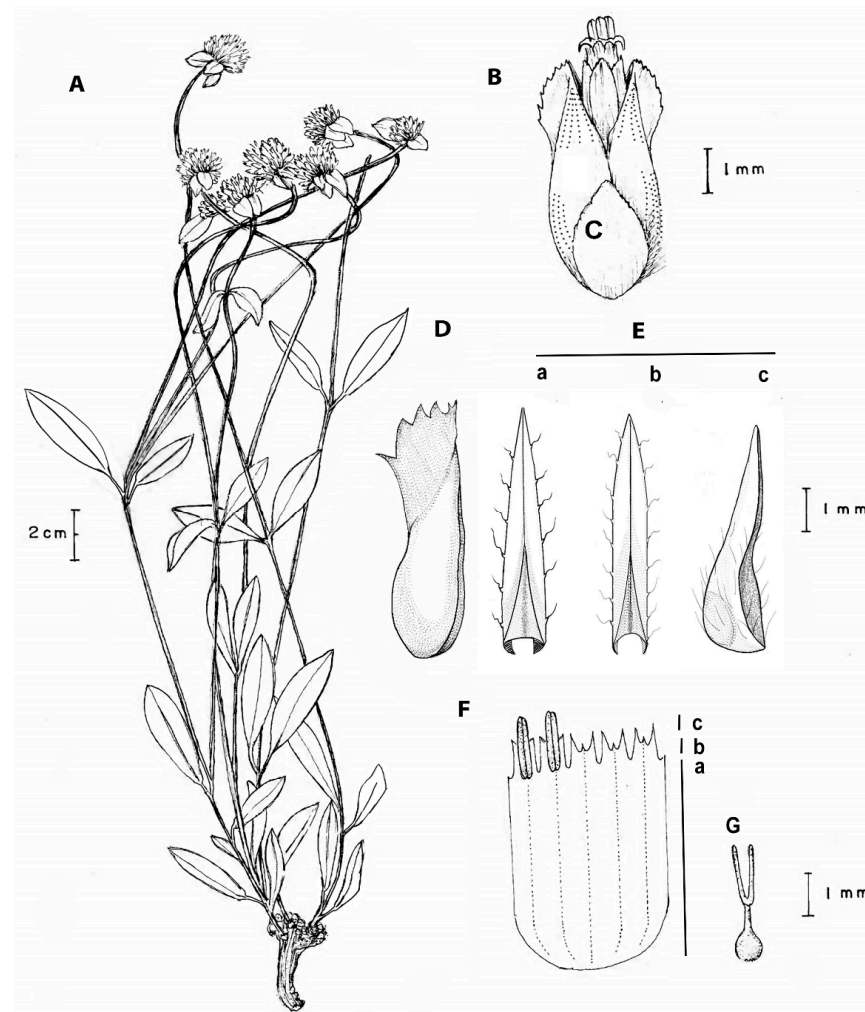


Figure 1. *Gomphrena vallegrandensis* T. Ortuño & Lozada-Gobilard sp. nov. (A) Habit. (B) Flower. (C) Bract. (D) Bracteoles. (E) Sepals: (a) outer sepal, (b) middle sepal, (c) inner sepal. (F) Androecium: (a) androecial tube, (b) fused part of appendix on androecial tube, (c) free part or lobes of appendix on androecial tube. (G) Gynoecium: of the two-branched, filiform stigmas and globose ovary. Images drawn by Carlos Maldonado, Teresa Ortuño Limarino, and Pedro Huayllas Espinosa from Wood & Mendoza 21467.

Type. BOLIVIA: Santa Cruz. Prov, Vallegrande, Pucara, Camino entre Guadalupe y Pucara, camino entre Guadalupe y Pucara, cerca de la cima del cerro más alto; 18°36'35" S 64°07'45" W, 2732 m.a.s.l., 25 de enero 2005, J.R.I. Wood & Mendoza 21467 (holotype: LPB 000 3521; isotype: USZ 64230).

Diagnosis. *Gomphrena vallegrandensis* differs from *Gomphrena oligocephala* J. Rémy (1846: 350) by a combination of morphological characteristics. In *G. vallegrandensis*, the leaves are elliptic and pedicellate, measuring 0.5–1.3 cm long. In contrast, *G. oligocephala* exhibits ovate–lanceolate, sessile leaves measuring 1.5–2 × 0.9 cm. In *G. vallegrandensis*

there are three–five involucreal oblanceolate, involucreal leaves measuring $1.3\text{--}2.3 \times 0.7\text{--}1.3$ cm, variable in size. In *G. oligocephala*, the involucreal leaves are lanceolate, measuring $0.8\text{--}1.3 \times 0.4\text{--}1.5$ cm. The synflorescence of *G. vallegrandensis* is long–pedunculate, measuring 12–20 cm in length, becoming thinner and twining, and is covered with dark brown trichomes. In *G. oligocephala*, the synflorescence is shorter (2–6 cm), relatively stout, and covered with uniseriate white trichomes. Additionally, the bracteoles in *G. vallegrandensis* possess a broadly winged, dentate crest that covers approximately one-half (1:2) of the dorsal part of the midvein. In contrast, in *G. oligocephala*, the crests are less extensive, covering only one-fifth (1:5) of the midveins dorsally.

Description. Perennial herb, 40 cm tall. The *root* is a fleshy taproot longer than 20 cm in adult plants. The *stems* are erect, 27 to 40 cm long, usually with secondary and tertiary branches, and strigose, and trichomes are uniseriate and white to dark brown. *Basal leaves* are not always arranged in a single elliptical rosette, measuring $3.5\text{--}5.2 \times 0.8\text{--}1.3$ cm, with uniseriate white trichomes, and the petioles are 0.5–1.3 cm. *Cauline leaves* are elliptical, $3\text{--}4 \times 0.5\text{--}1.5$ cm long, and 0.7–1.2 mm; have an acute apex; and are abaxially strigose with appressed white trichomes, which are 0.05–0.07 cm long, and adaxial trichomes are bicolored, white and light brown. There are three–five *involucreal leaves*, arranged symmetrically, that are exerted from the synflorescence, unequal, oblanceolate, $1.3\text{--}2.3 \times 0.7\text{--}1.8$ cm long, apex mucronate or cuspidate, and abaxially villous, with trichomes 0.08–0.12 cm long that are adaxial and strigose, and trichomes 0.05–0.07 cm long that are bicolored; margins are ciliate with dark brown trichomes. The *peduncle* grows 12–20 cm upwards and is thinner and twining, covered densely in dark brown uniseriate trichomes. The *synflorescence* is globose, terminal, 1.3–1.8 cm in diameter, and arranged in three to five groups forming a partial florescence, and each group contains 9 to 12 flower units in a single spike with short axes (Figure 2D). The *flowers* are bisexual, measuring $4.2\text{--}5.1 \times 0.13\text{--}0.15$ cm. The *bracts* are ovate, cymbiform, and $0.28\text{--}0.33 \times 0.15\text{--}0.18$ cm; have a prominent midvein; are excurrent at the apex, hyaline in texture, and white to yellow; and have a margin and base with white trichomes (Figure 3A). The *bracteoles* are ovate to lanceolate, cymbiform, $0.5\text{--}0.52 \times 0.12\text{--}0.15$ mm, membranous, and broadly winged, with a toothed, dorsal crest, covering two thirds of the middle dorsal vein, and are white (Figure 3B). *Sepals* are lanceolate, membranous, thickened basally at maturity, and sparsely lanate on the abaxial surface margin; the dentate apex is obtuse, white, and unequal; the two outer sepals are $0.5\text{--}0.52 \times 0.08\text{--}0.09$ cm, the middle sepal is $0.49\text{--}0.5 \times 0.08\text{--}0.09$ cm, and the two inner sepals are $4.6\text{--}4.9 \times 0.5\text{--}0.6$ mm, strongly appressed to the utricle (Figure 3G). The *androecium* is 0.45–0.55 cm long, and the androecial tube is 0.35–0.45 cm long. Appendages measuring 0.1 cm long can be seen on the androecial tube, which is conspicuous and 0.06 cm long and fused basally for 0.04 cm; the anthers are oblong, 1.6 cm long, inserted between two lobes the appendages on the androecial tube. The *gynoecium* of the two-branched, filiform stigmas are 0.14 cm long, with a style of 0.06 cm and a globose ovary of 0.06 cm.

Micromorphology of trichomes. The *stem* trichomes (Figure 2C) are multicellular and uniseriate, and 0.03–0.8 cm long. Basal one–two cells are conical and bulbous, and the next two–four cells are straight and elongated, ranging in color from light to dark brown. Trichomes on the abaxial surface of the cauline leaves have one–two conical, wide, rounded basal cells. The second cell is elongated and straight, followed by three–five upper cells with spinous ornamentations and a striated texture, appearing white. On the adaxial surface, the basal one–two cells are dark brown in color, while the next one–three cells are elongated and thin, and exhibit spiny ornamentation, appearing white. Trichomes on the abaxial surface of involucreal leaves resemble those found on the cauline leaves. The adaxial surface exhibits two types of trichomes. The predominant type has two rounded, white or yellow basal cells (Figure 2A,B). The next one–two cells are thin, dark brown, and

with spiny ornamentations. The second type of trichome has three cells, two basal and one upper cell, which are cylindrical and yellow. The marginal trichomes resemble those on the stems in both form and color. All interlocking junctions are conspicuous, appearing as linear scars arranged either parallel to the trichome axis or at a 45-degree angle (Figure 2).

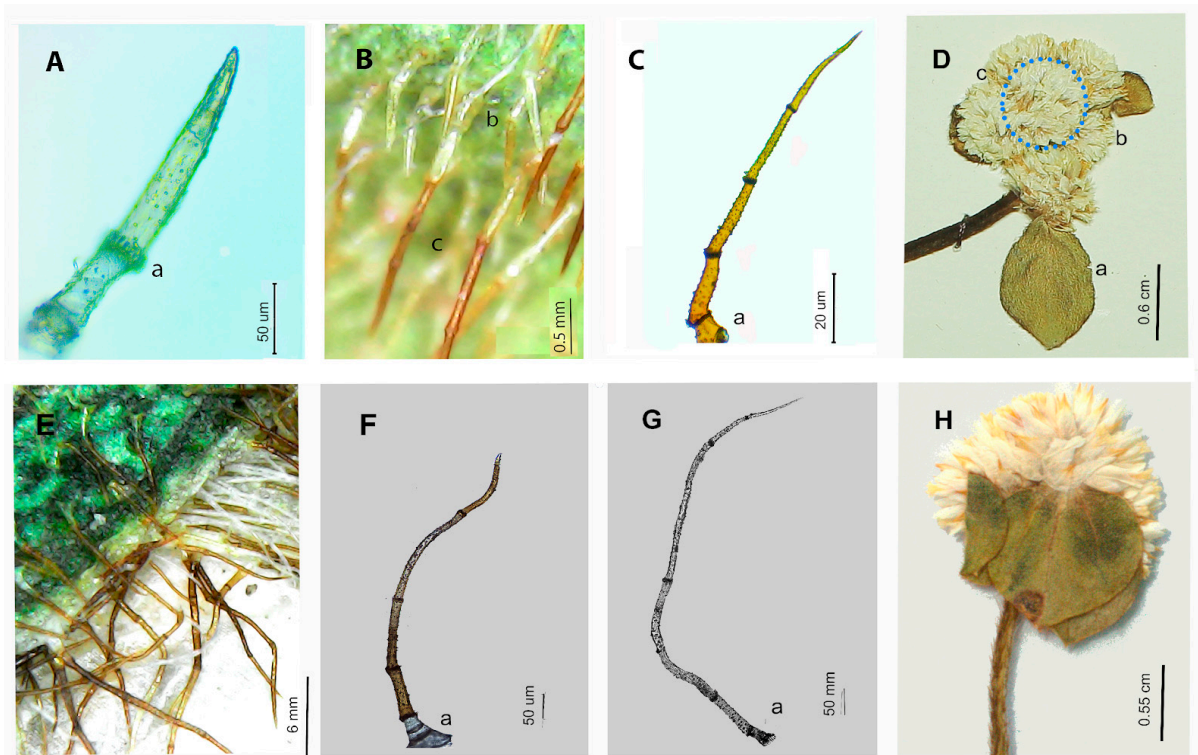


Figure 2. *Gomphrena vallegrandensis*, involucre leaves: (A,B) Trichome of the adaxial surface: (a) interlocking junctions are conspicuous, with white linear scars, parallel to the trichome axis or at a 45° angle; (b) basal cells are white to yellow; (c) upper cells are dark brown, exhibiting a spiny ornamentation. (C) Stem trichomes: (a) trichomes with cylindrical basal cells. (D) Synflorescence: (a) involucre leaves; (b) globose, terminal synflorescence; (c) 9–12 flowers grouped in a spike with very short axes forming a single partial florescence—one synflorescence can be arranged with 3–5 partial florescences. *Gomphrena palmariensis*, involucre leaves: (E) indumentum margin ciliate. (F) Trichome adaxial surface: (a) basal conical, rounded cells. (G) Trichome abaxial leaves: (a) cylindrical basal cells. (H) Globose synflorescence with 3 partial florescences and 3 cordate involucre leaves. Photos taken by Teresa Ortuño Limarino.

3.1.1. Etymology

This specific epithet honors the Bolivian province of Vallegrande, located within the department of Santa Cruz, where the type specimen was collected. This region, known for its rich biodiversity and unique ecological conditions, serves as the exclusive habitat for the new species, highlighting its endemic status. The collection site is situated along the road between Guadalupe and Pucara.

3.1.2. Phenology

The species was observed to flower from January to March, coinciding with the wet season in the Bolivian region where it was discovered. This period of abundant rainfall is likely to play a critical role in its reproductive cycle and ecological dynamics.

3.1.3. Habitat and Ecology

Gomphrena vallegrandensis thrives in open spaces in shallow soil overlying rocks or close to patches of the Tucuman–Bolivian Forest (Figure 4). This species has been found

at elevations around 2700 m.a.s.l. The region of the type locality is botanically significant, harboring several endemic species, including *Dyschoriste boliviana* Wassh. & J. R. I. Wood (Acanthaceae) [32], *Eryngium beckii* M. Mendoza (Apiaceae) [33], *Philibertia urceolata* Goyder (Asclepiadaceae) [34], and *Salvia sophrona* Briq. (Lamiaceae) [35]. However, none of these species are exclusive to this area. *G. vallegrandensis* has also been collected from the Tucuman–Bolivian Forest in the transition to the cloud forest.

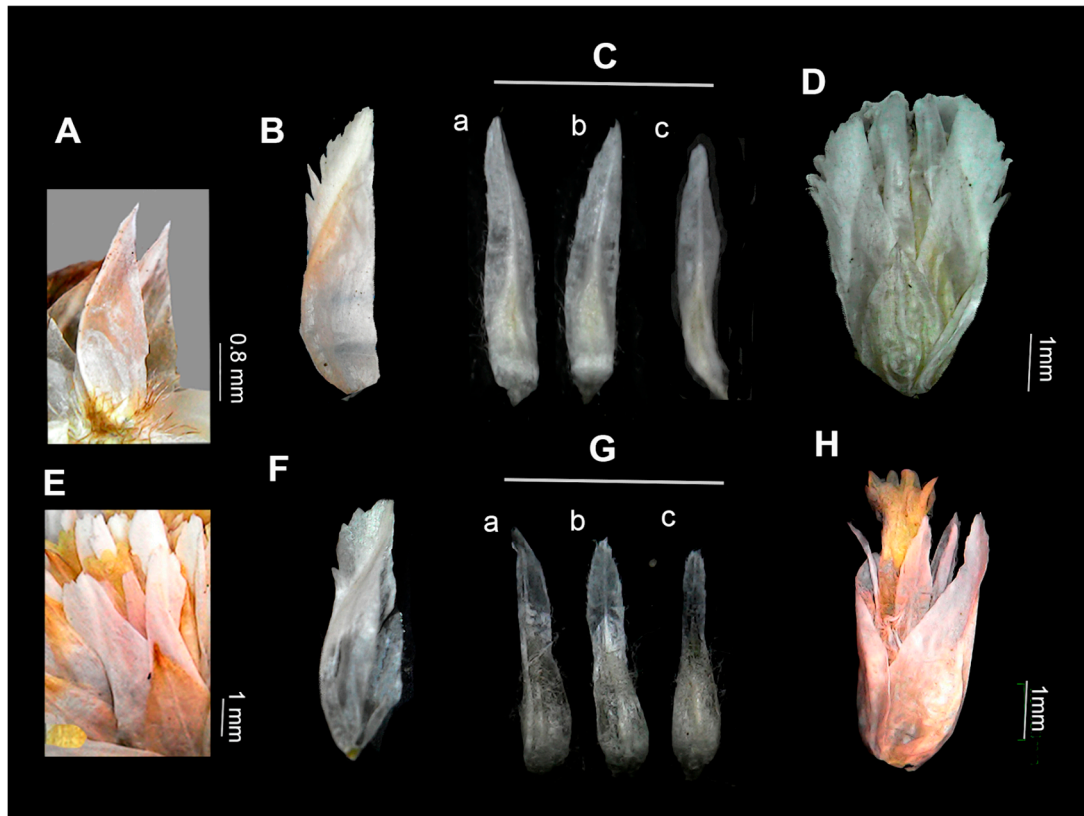


Figure 3. *Gomphrena vallegrandensis*. (A) Bract, ovate with midvein excurrent, white to yellow. (B) Bracteole with dorsal crest covering two-thirds of middle dorsal vein. (C) Sepal thickening basally with maturity: (a) outer sepal, (b) middle sepal, (c) inner sepal. (D) Flower with yellow bract and toothed bracteole, with equal size to sepals. *Gomphrena palmariensis*. (E) Flower with bract ovate, acuminate apex, and color brown. (F) Bracteole with dorsal crest one-third of way along middle veins. (G) Sepal: (a) outer sepal, (b) middle sepal, (c) inner sepal. (H) Flower bracteoles same sizes as sepal. Photos taken by Teresa Ortuño Limarino.

3.1.4. Specimens Examined for Distribution Assessment

Bolivia, Department: Santa Cruz, Vallegrande Province, Community Pucara, between Guadalupe and Pucara, near the top of the mountain (18°36'35" S, 64°07'45" W, 2732 m.a.s.l.), 25 January 2005. John R.I. Wood & Moises Mendoza 21467 (USZ, LPB, K). Caballero Province ca. 4 km from Siberia village alongside road descending to the south (17°50' S, 64°44' W), 6 March 2007, Wood, J.R.I., Hind, D.J.N., Gutierrez, J. 22979 (USZ), Lajas a 4 km de Moromoro vegetación rupestre (LPB, K). (18°21'47" S, 64°17'50" W, 2745 m.a.s.l.), 1 February 2009, Luzmila Arroyo P. Carreño y Inturias, C. Roth & Julio Davalos 4374 (USZ).

3.2. *Gomphrena palmariensis* T. Ortuño, J. Gutiérrez. & Montesinos sp. nov.

The second new species described is *G. palmariensis* (Figure 5). Full diagnosis, description and specific features are presented in the following sections.

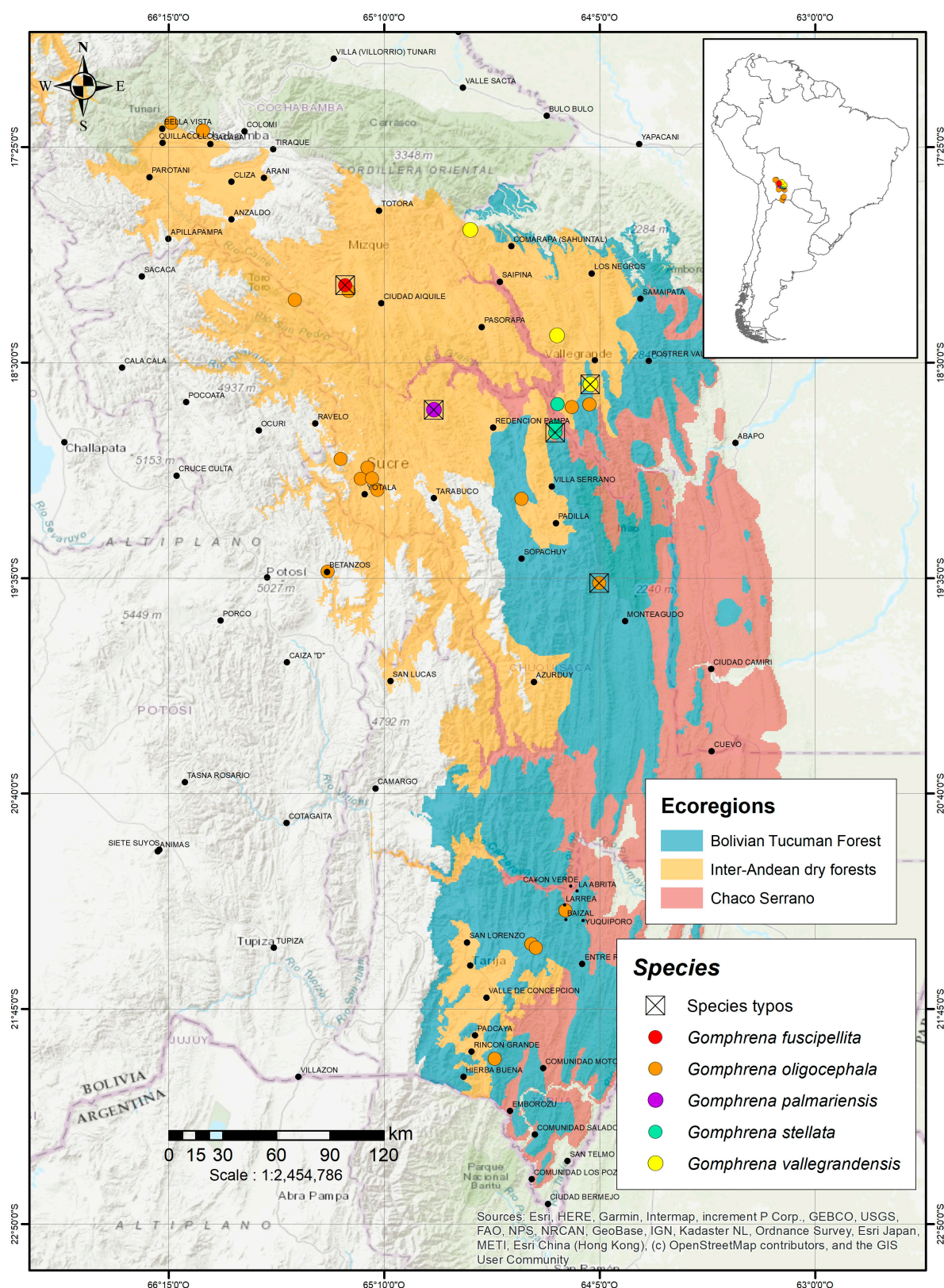


Figure 4. The locations of *G. vallegrandensis* and *G. palmariensis*, and the distributions of the selected closely related perennial Andean species of the genus *Gomphrena*. *G. oligocephala* exhibit a wide distribution in the inter-Andean dry forests of Bolivia. In contrast, at the moment, *G. stellata*, *G. vallegrandensis*, and *G. palmariensis* show more localized ranges.

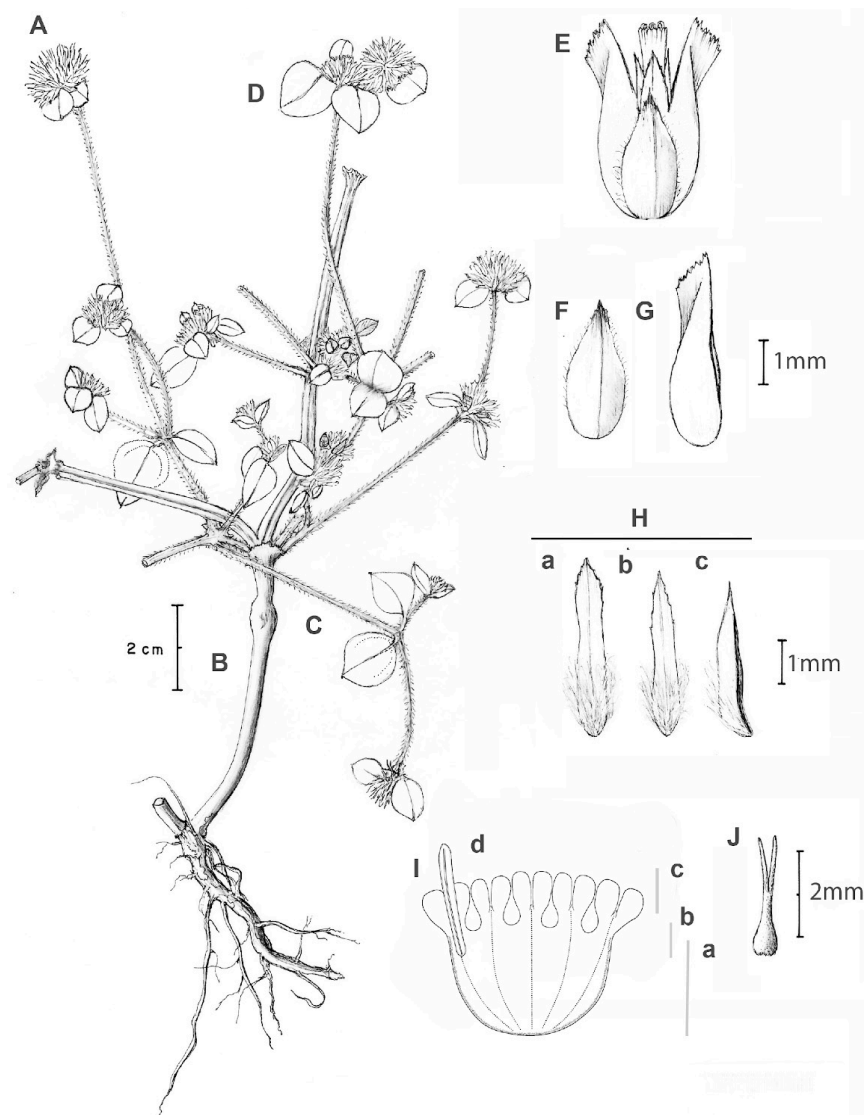


Figure 5. *Gomphrena palmariensis* T. Ortuño, J. Gutiérrez. & Montesinos [ined]. (A) Habit. (B) Main woody stems. (C) Leaves cordate. (D) Involucral leaves. (E) Monoecious flower with bracts. (F) Bract. (G) Bracteoles. (H) Sepal: (a) outer sepal, (b) middle sepal, (c) inner sepal. (I) Androecium: (a) androecial tube, (b) unit part appendix on androecial tube, (c) free part or lobes on appendices on androecial tube (widely ovate, rounded apex), (d) anther oblong. (J) Gynoecium: with two-branched filiform stigmas, style and a globose uniovulate ovary measuring [voucher: Julia Gutiérrez, A. Copa, & D. Soux. 2034, HSB 0005013] (drawn by Carlos Maldonado, Teresa Ortuño Limarino, and Pedro Huayllas Espinosa from Gutierrez, Copa, and Soux. 2034).

Type. BOLIVIA: Chuquisaca, Prov. Zudañez, ANMI El Palmar. Aproximadamente 8 km de la tranca de ingreso al Palmar Área de Manejo Integrado Natural (ANMI) en dirección a la comunidad de El Palmar; 18°44′15.8″ S, 64°54′57″ W, 3102 m.a.s.l., 7 de mayo 2014, E. Julia Gutiérrez, A. Copa, & D. Soux. 2034 (holotype: HSB 00015013; isotype: HSB 00013438).

Diagnosis. *Gomphrena palmariensis* is distinguished from *G. stellata* T. Ortuño & Borsch (2007:566) by the adaxial side of its broadly cordate involucral leaves, which bears short, light brown, uniseriate trichomes, and spinous spiny ornamentation. In contrast, the adaxial side of the involucral leaves of *G. stellata* are ovate-lanceolate, glabrous, or with a few uniseriate, white trichomes, and exhibit granulate to spiny ornamentation. The flower of *G. palmariensis* varies from 0.48 to 0.52 cm in length, with ovate-lanceolate acuminate bracts that are brown in color, and with trichomes along both surfaces of the margins.

Conversely, in *G. stellata*, the flowers are smaller, 0.35–0.45 cm in length, with bracts that are white, ovate (0.16×0.12 cm in size), and acute and bear simple trichomes (ca. 0.1 cm long) on the upper surface near the margin. The bracteoles of *G. palmariensis* measure 0.51×0.12 cm in size, with a crest located one third of the way along the dorsal vein that is highly toothed along the margin (Figure 3F), while in *G. stellata*, the bracteoles measure 0.35×0.15 cm in size, with the crest located halfway along the dorsal part.

Description. The root is thin and sub-woody. The subshrub stems are 20–30 cm in length, decumbent, and branched; the main stem is woody with swollen nodes and glabrescent, and younger branches have a white-villous indumentum. The cauline leaves are cordate, $1.3\text{--}1.5 \times 1\text{--}1.5$ cm, and sessile, with a 0.03 cm apex that is apiculate and mucronate; the midrib and parallel veins are prominent, and both sides are villous with white trichomes measuring 0.07–0.23 cm long. The involuclral leaves are arranged symmetrically, with 2–3 equal leaves subtending the synflorescence, and cordate (Figure 3H), measuring $0.4\text{--}1.6 \times 0.4\text{--}1.6$ cm, and the apex is mucronate. They are abaxially villous and adaxially appressed with white to light brown trichomes, measuring 0.2–0.5 mm long, and the margins are ciliate (Figure 2E). The peduncle is 3–11 cm, firm, red, and villous with white to light to brown appressed trichomes. Synflorescences are terminal and axillary, globose, 0.8–1.6 cm in diameter, and arranged in one to five groups forming partial florescence, and each group contains with 3 to 10 flowers units in a single spike with short axes. The flowers are bisexual and $0.48\text{--}0.52 \times 0.12\text{--}0.15$ mm in length. The bracts are cymbiform and ovate; the apex is acuminate, light to dark brown apically (Figure 3E), and $0.45\text{--}0.48 \times 0.13\text{--}0.15$ cm; the margin dentate, membranous, and translucent, with trichomes present at the base and margins. The bracteoles are lanceolate–ovate; 0.51×0.15 cm; cymbiform; membranous, with a crest covering one-third of the middle dorsal vein (Figure 3F); dentate; and white. The sepals are lanceolate and membranous, thickening basally with maturity, abaxially sparsely lanate, and unequal; the two outer sepals are $0.47\text{--}0.52 \times 0.04\text{--}0.06$ cm, the middle sepal is $0.46\text{--}0.51 \times 0.03\text{--}0.04$ cm, and the two inner sepals are $0.45\text{--}0.50 \times 0.03\text{--}0.04$ cm, and they are strongly compressed against the utricle. The androecium is 0.33–0.48 cm long and membranous; the androecial tube is 0.21–0.36 cm long, bearing two appendages that are conspicuous, ovate, and rounded, and basally fused appendages that are 0.06×0.05 cm and widely ovate; the anthers are oblong, 0.16 cm long, inserted between the lobes of the appendages of the androecial tube, unilocular, and five-lobed. The gynoecium of the two-branched filiform stigmas are 0.16 cm long, with a 0.02 cm style and a globose uniovulate ovary measuring 0.06 cm wide.

Micromorphology of trichomes. The stem and cauline leaves (abaxial and adaxial surface) exhibit multicellular and uniseriate trichomes, measuring 0.04–0.14 cm in length. The basal one–two cells are elongated, and the next three–six cells are both straight and elongated; the tissue ornamentation is spiny, ranging in color from white to dark brown (Figure 2G). The trichomes on the abaxial surface of involuclral leaves resemble those found on the stems and cauline leaves; those of the adaxial surface have two basal cells, the first conical and rounded, and the second more cylindrical. The next three–four cells are thin and white to light brown with spiny ornamentation (Figure 2F). The interlocking junctions in all the trichomes are conspicuous and linear, with scars arranged in parallel to the trichome axis or at an angle of 45 degrees [voucher: Julia Gutierrez, A. Copa, & D. Soux. 2034].

3.2.1. Etymology

This specific epithet refers to the Bolivian community of El Palmar where the type specimen was collected. This species is found exclusively in the Department of Chuquisaca, Bolivia, specifically within the “El Palmar” Natural Integrated Management Area (ANMI

El Palmar). This collection site is located approximately 8 km from the entrance checkpoint to the “Palmar” protected area, along the route leading to the community of El Palmar (Figure 4).

3.2.2. Phenology

Gomphrena palmariensis is currently known only from the type specimen, which was collected in full bloom in May at the end of the wet season, specifically in the first week of May. This suggests that the species may exhibit a seasonal flowering pattern, likely influenced by the region’s climatic conditions.

Notes. *Gomphrena palmariensis* is a subshrub and, due to its growth form, may be related to *G. stellata* and *G. cardenasii* Standl. ex E. Holz. However, it differs notably from *G. cardenasii*, particularly in its flowers, which have a denser indumentum on the sepals. Additionally, the bracts and bracteoles of *G. palmariensis* are significantly smaller than its sepals. Both *G. palmariensis* and *G. stellata* are subshrubs, but *G. palmariensis* has decumbent stems with secondary and tertiary branches with dense villous indumentum. In contrast, *G. stellata* has more ascending, usually simple branches that are glabrous. Another distinguishing feature is the shape of the cauline and apical leaves subtending the paracladia. In *G. palmariensis*, the leaves are cordate with prominent secondary venation, whereas in *G. stellata*, the leaves are obovate–lanceolate with prominent central veins, a trait shared by most species of the core *Gomphrena*.

3.2.3. Habitat and Ecology

Gomphrena palmariensis has only been collected near El Palmar, Area Natural de Manejo Integrado (ANMI) (Figure 5), which has unusual flora and fauna. The specimens were collected in the highest parts of the inter-Andean dry forest region in an open place with sparse vegetation, on a rocky slope with an 80% gradient and the presence of Poaceae and Asteraceae (Figure 6).

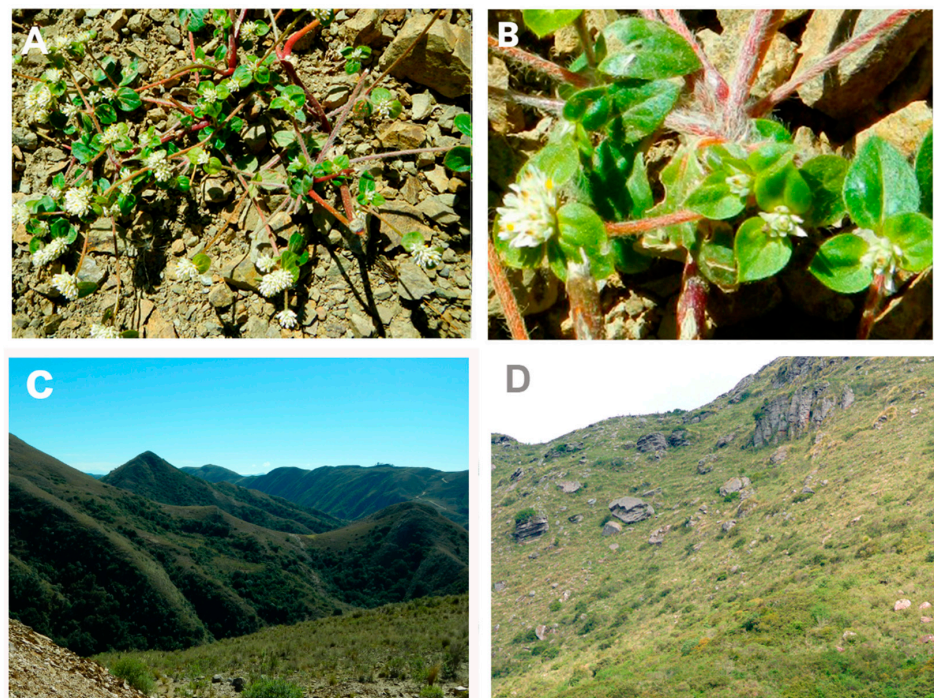


Figure 6. *Gomphrena palmariensis*. (A,B) Details of synflorescence and leaves. (C) Habitat: rocky slope in El Palmar community [voucher: Julia Gutiérrez, A. Copa, & D. Soux. 2034]. Photos: Julia Gutiérrez. (D) *Gomphrena vallegrandensis* habitat: open spaces in shallow soil overlying rocks or close to patches of Tucuman–Bolivian Forest. Photos: Julia Gutiérrez (A–C) and Alexander Parada (D).

3.2.4. Specimens Examined for Distribution Assessment

Bolivia, Department: Chuquisaca, Zudañez Province, aproximadamente 8 km de la tranca de ingreso a ANMI El Palmar (18°44'15.8" S, 64°54'57" W) 3102 m.a.s.l., 7 May 2014, E. Julia Gutiérrez, A. Copa, & D. Soux 2034.

Key to *Gomphrena* perennial species of the Bolivian Andes, similar to the new species

- 1a. Bracteoles smaller than sepals.2
 - 2a. Involucral leaves ovate–lanceolate. Sepals finely membranous, white. Stems ≥ 45 to 100 cm long. Leaves ovate–lanceolate. Sepals white, membranous in texture. Bracteoles with crest one quarter of dorsal part. Bract ovate–lanceolate, cymbiform, $0.16\text{--}0.2 \times 0.7\text{--}0.1$ cm, chartaceo texture, white opaque.*G. perennis* L.
 - 2b. Involucral leaves linear to lanceolate. Sepal chartaceous, strongly pink or purple.3
 - 3a. Stems ≥ 30 (–80) cm long. Leaves linear or narrowly oblong. Sepals chartaceous strongly pink. Three outer sepals dentate at apex, and inner ones entire. Bracteoles half or less than length of tepals. Acute, crest often rudimentary or absent. Root is thickened below neck, succulent.*G. pulchella* Mart.
 - 3b. Stems ca. 35 cm long. Leaves linear–lanceolate. Sepals deep purple, chartaceous in texture, acute at apex. Bracteoles without crests, only prominent middle nerve broadened. Root woody taproot, with nodes.*G. trollii* Suess.
- 1b. Bracteoles equal to or larger than sepals.4
 - 4a. Perennial herbs. Stems 5 to ≤ 45 cm long, synflorescence terminal.5
 - 5a. Stems 10 to 30 cm long. Bracteoles with crest extending one-quarter to half length on dorsal midveins. Synflorescence has straight peduncle. Habit erect or prostrate6
 - 6a. Habit erect. Bracteoles with crest extending to quarter of midvein length. Bracts white or light to dark brown. Stem trichomes appressed, white or brown to black.7
 - 7a. Stems 5 to 15 cm long. Bracts light to dark brown. Stem trichomes brown.*G. bicolor*.
 - 7b. Stems 10 to 25 cm long. Bracts white.*G. oligocephala*.
 - 6b. Habit prostrate. Bracteoles with crest extending to half of midvein length. Bracts white, stem trichomes hirsute, light brown or yellow.*G. fuscipellita*.
 - 5b. Stems 20 to 40 cm long. Bracteoles with broad, winged crest extending to half length of midveins. Leaves elliptic, petiolate (0.5 to 2 cm long). Synflorescence with peduncle twining. Habit erect.*G. vallegrandensis* (Figure 1).
 - 4b. Subshrubs, stems 20 to ≤ 45 cm long, synflorescence terminal and axillary or terminal only....8
 - 8a. Erect plants 20 to 45 cm high. Cauline leaves ovate with base tapering, amplexicaul, and apex acute and mucronate. Involucral leaves subglabrous adaxially. Synflorescence terminal. Androecium with lobes rounded on free parts of filament appendix.*G. stellata*.
 - 8b. Decumbent plants 20 to 30 cm length. Cauline leaves cordate, with cordate base and mucronate apex. Involucral leaves appressed and adaxially pubescent, with margin ciliate. Synflorescence axillary and terminal. Androecium with ovate, rounded lobes on free parts of filament appendix (Figure 6).*G. palmariensis* (Figure 2).

4. Discussion

Based on their morphological characteristics, *G. vallegrandensis* and *G. palmariensis* are classified within *Gomphrena* s. str., which is characterized by a distinct sepal arrangement consisting of two outer sepals and one middle sepal, and the inner sepals are smaller than the outer sepals, being strongly compressed and carinate in fruit—this characteristic is proposed to be a synapomorphy by Ortuño and Borsch [11], according to the result of their assessment of morphological characteristic and ancestral characteristic state reconstruction. Another distinguishing trait shared by these two new species is the presence of involucreal leaves. This feature has previously been identified and utilized to differentiate the genus in America [27], Brazil [2], Argentina [36] and Paraguay [37]. The specialized leaves are closely associated with the evolutionary development of synflorescence in *Gomphrena*, which is believed to have originated from the inflorescences of the genera. The perennial *Gomphrena* species in southern Bolivia can be morphologically categorized based on the relative size of the bracts and sepals. Two groups are distinguishable: (1) *G. perennis*, *G. haenkeana*, and *G. trollii*, characterized by longer, chartaceous sepals [11], some with intense colors, and (2) *G. oligocephala*, *G. bicolor*, *G. potosiana*, and *G. fuscipellita*, where bracteoles and sepals are nearly equal in size; thus, the two new species should be within this group.

The species described here can be distinguished morphologically. However, future studies should aim to complement this information with molecular data to provide a comprehensive understanding of the relationship between these new species and their close relatives.

The description of these two new species highlights the need to extend our knowledge and continue exploration within the Amaranthaceae family—a group that includes species adapted to the conditions of the inter-Andean dry valleys [11], and exhibits diverse distribution ranges [38]. The discovery of such species reinforces the urgent need for integrated strategies that balance conservation and sustainable development in the Andes.

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