

# Three new species of *Nothoscordum* (Amaryllidaceae) from the Campos ecoregion of the Grassland Ecosystems of Río de la Plata, Southeast South America

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## Research Article

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## Abstract

Three new species of *Nothoscordum* are described: *Nothoscordum elongatum* Deble & B.P.Moreira, *Nothoscordum parvum* Deble & B.P.Moreira and *Nothoscordum urutauense* Deble & H.A.Keller. *Nothoscordum elongatum* and *N. parvum* grow in central-eastern Rio Grande do Sul state, while *N. urutauense* is narrowly endemic in southern Misiones Province, northeast Argentina. The three new taxa are characterized by their strong alliaceous smell, pilose leaves and scapes, and one or two-flowered inflorescence. *Nothoscordum elongatum* is segregated from *Nothoscordum marchesii* by its densely pilose leaves and scapes (vs. glabrous leaves and scapes), flowers with longer pedicels and ovaries with fewer ovules per locule. *Nothoscordum parvum* is similar to *N. modestum* and *N. urutauense*, however, can be readily separated from both species by its bulbs with bulbils surrounding the main bulb, by its narrowly infundibuliform flowers, fused towards the base for 1.8–2.2 mm and by its scapes erect at fruit maturity. *Nothoscordum urutauense* differs from *N. inundatum* by its broader leaves, by its flowers with tepals fused at the base for 0.5–1 mm, and by its free filaments at base. These three species of *Nothoscordum* are described, illustrated, compared with morphologically similar taxa, and featured with their geographic distribution.

## Introduction

The *Campos* eco-region of the Grassland Ecosystems of Río de la Plata (RPG sensu Soriano et al. 1992; Bilencia and Miñarro 2004) comprises in approximate lines the Mesopotamic phytogeographic province and the Uruguayense district of the Pampean phytogeographic province of Cabrera (1976), and thereby are distributed in all Uruguayan territory, part of the Argentine provinces of Entre Ríos, Corrientes and southern Misiones, and the southern half of the state of Rio Grande do Sul in Brazil (in the Brazilian portion it corresponds approximately to the Pampa Biome, sensu IBGE 2004). The mentioned region is one of the main centers of diversity and endemism of *Nothoscordum* Kunth, having several endemic species, many of which are known only for one or a few places of occurrence (Deble and Moreira 2022).

The generic and infrageneric status of the one-flowered species of *Nothoscordum* is a matter of controversy among different authors (Kunth 1843; Baker 1870 [1871], 1896; Beauverd 1908; Herter 1943, 1956; Traub 1949, 1963; Traub and Moldenke 1955; Guaglianone 1972; Crosa 1975; Ravenna 1978; Sassone et al. 2014). However, from the second half of the 20th century, the one-flowered species of *Nothoscordum* were mainly linked to *Ipheion* Rafinesque or *Nothoscordum* (see Table 1). More recently, Sassone et al. (2014) reestablished *Beauverdia*, and including taxa previously recognized under *Ipheion* sect. *Hirtellum* Guaglianone and *Nothoscordum* subg. *Monanthoscordum* Ravenna. Later, in the reconstruction of the phylogenetic history of the tribe Leucocoryneae in South America, Sassone and Giusiani (2018) recognized that *Nothoscordum* would be monophyletic if including *Beauverdia*. Recently, Deble (2022) established *Nothoscordum osteni* Beauverd (1908) as segregated from *Beauverdia hirtella* and indicated that *N. ostenii* despite having solitary flowers, should be recognized under *Nothoscordum* because its scapes are erect at fruit maturation. In another contribution, Deble and Moreira (2022) rediscovered *Nothoscordum modestum* and recognized it as intermediate between the genera *Nothoscordum* and *Beauverdia*, reinforcing that it is not possible to separate both genera, a conclusion before reached by Pellicer et al. (2017) and Sassone and Giussani (2018).

Botanical collections carried out in 2018 and 2019 revealed three peculiar species of *Nothoscordum*, which display strong alliaceous smell, dense pilosity on scapes and leaves and one or two-flowered inflorescences. After the analysis of nomenclatural types, examination of exsiccates, studies of populations in their natural environments, and comparison with closely related taxa it was possible to identify that these three taxa are new, and are herein described.

## Material and Methods

The research was part of the revision of the genus *Nothoscordum* in the *Campos* eco-region of the Grassland Ecosystems of Río de la Plata, Southeast South America, which is still in progress, and was carried out by field surveys (central, north and northeastern Argentina, southern Brazil, Paraguay and Uruguay), and analysis of herbarium specimens of the herbaria CTES, FCQ, HDCF, ICN, MVHM, MVM, MVFA, MVJB, P, PACA, PY, SI and SMDB and digital images of the Herbaria B, G, K, MBM, NY, P and US (acronyms according to Thiers 2023). Collected specimens were deposited into CTES and PACA herbaria. The descriptions of the three new taxa are based on morphological characteristics of plants observed in natural habitat and on dry material. Figures 1, 2 and 3 was elaborated using Indian ink, and the illustrations are based on both live specimens and dry material. Figures 4 and 5 were made from photos of specimens in nature or in cultivation and the boards were edited with the Adobe photoshop software, version 24.5. For the elaboration of Figs. 6 and 7, it was utilized the software ArcMap version 10.7, and the features were created from the map base titled Topographic.

## Taxonomic treatment

*Nothoscordum elongatum* Deble and BP Moreira, sp. nov. (Figs. 1, 4 (a–e) and 6). —Type: Brazil, Rio Grande do Sul: Caçapava do Sul, BR 153, 260m, 21 April 2019, LP Deble and BP Moreira 20153 (holotype PACA; isotype CTES).

*Diagnosis* *Nothoscordum elongatum* is morphologically similar to *N. marchesii*, however, can be promptly distinguished by its densely pilose leaves and scapes (vs. glabrous), flowers with 15–32 mm long pedicels, (vs. 3–8 mm long), and 5–6 ovules per locule (vs. 13–16).

Geophyte 8–14 cm high above the soil. Bulb 6–9 × 6–8 mm, nearly spherical or broadly ovoid, simple, with strong alliaceous smell; outer cataphylls dark-brown, the innermost whitish. Leaves at anthesis 1–6, spirally arranged; leaf sheaths 0.5–1 cm long, subterranean, straw-colored; leaf blades 40–140 × 0.3–0.5 mm, canaliculated in cross-section, grayish-green, erect-ascendant or ascendant reflexes, margin thickened and rigid, apex obtuse or rounded, abundant pilosity composed of 1-celled trichomes with straight or slightly curved cell, trichomes 90–160 µm long. Scapes 1–2, about the same thickness of the leaves, 50–120 × 0.4–0.6 mm long, subcylindrical, green or purplish-green, erect, then humifuse at fruit maturity, with alliaceous smell when breaking, densely covered by 1-celled trichomes with straight terminal cell, trichomes 100–180 µm long. Bracts 2, elliptic-lanceolate, 7–11 × 3–4 mm, shortly fused at base for ca. 1–2 mm. Pedicels 15–32 mm long, purplish-green or yellowish-green, densely covered by 1-celled trichomes shorter than the trichomes of scapes. Inflorescence 1–2-flowered. Flowers 6–7 × 6–7 mm, infundibuliform, light-yellow or white-cream, shiny. Tepals 6 (3 + 3), white become greenish-yellow or

greenish-cream towards the base, shortly fused at base for 0.5–1 mm, the outers ones, elliptic-lanceolate or elliptic, 6–7.5 × 1.8–2.2, apex slight acute, base attenuate; the inners ones elliptic, 6–8 × 1.8–2.3 mm; apex slight acute, base attenuate; tepal middle nerves greenish-yellow, little pronounced, thicker towards the base. Staminal filaments 2.5–4 mm long, awl-shaped, translucent, yellow, free at their bases and attached directly to the tepal; anthers 1.2–1.8 mm long, curved, pollen golden-yellow. Ovary obovate-oblong, slightly 3-humped, 1.8–2 mm long; ovules 5–6 per locule; style yellow or greenish-yellow, 3–3.5 mm long, stigmatic portion capitate, greenish-yellow, shiny. Capsule obovate, 4–5 × 3–3.5 mm. Seeds 1.4–1.8 mm, black, shiny, curved and angled.

*Etymology* The adjective *elongatus* in Latin means elongated, a reference to the delicate and slender habit of the new species.

*Phenology* Flowering time April–May, fruiting time May–June. The flowers open around midday and close in the late afternoon, withering after one or two days. During the flowering period, populations exude a strong alliaceous odor, which becomes the predominant smell in the places and around areas of occurrence of specimens of *Nothoscordum elongatum*.

*Additional material examined* BRAZIL. Rio Grande do Sul: Caçapava do Sul, Guaritas, 320m, 1 May 2020, LP Deble and BP Moreira 20294 (PACA!).

*Distribution and Habitat* *Nothoscordum elongatum* occurs in central-eastern Rio Grande do Sul state, Brazil. The specimens grow between 260–320m, in environments with few drainage capacities, in places of shallow soils and the bulbs develop in crevices of sandstone and conglomerate rocks of the domain of sedimentary and volcanic sedimentary Paleozoic geologic layers (CPRM 2009). The individuals grow associated with mosses, and small subshrubs of *Euphorbia burkartii* Bacigalupo (Euphorbiaceae), *Hysterionica filiformis* (Spreng.) Cabrera (Asteraceae) and *Scoparia ericea* Cham. & Schltdl (Plantaginaceae). Other bulbous plants of the same environments are *Cypella pusilla* (Link and Otto) Benth. and Hook. f. ex B.D. Jacks. (Iridaceae) and *Nothoscordum dyalistemon* (Guagl.) Crosa and *Zephyranthes americana* (Hoffmanns.) Ravenna (Amaryllidaceae).

*Conservation* Based on the analysis of exsiccates and collections in the possible places of occurrence, only two small populations were identified, which indicates the rarity of the species. The extent of occurrence (EOO) is less than 100 km<sup>2</sup> and the Area of Occupancy (AOO) is less than 10 km<sup>2</sup>. This species occurs in specific habitat, in environments with poor drainage capacity in places of shallow soils and the bulbs developed in crevices of sandstone and conglomerate rocks. These environments are being modified by economic activities, as mining and agriculture. In accordance with the criteria of IUCN (2019), *Nothoscordum elongatum* can be considered Critically Endangered (CR), based in direct threat, geographic distribution, occupation area and population size [CR B1 + B2b (i, ii, iii, iv, v) + c (iii, iv)].

*Nothoscordum parvum* Deble and BP Moreira, sp. nov. (Figs. 2, 4 (f–j) and 6).—Type: Brazil, Rio Grande do Sul: São Gabriel, “localidade cerro do Ouro”, 390m, 4 Sep 2019, LP Deble and BP Moreira 20155 (holotype PACA!; isotype CTES).

*Diagnosis* *Nothoscordum parvum* is morphologically related to *N. modestum* and *N. urutauense*; however, it can be readily separated from *N. modestum* by its bulbs surrounded by bulbils (vs. simple), with strong alliaceous smell (vs. mild alliaceous smell when crushing the cataphylls and foliage), leaves and scapes densely pilose (vs. glabrous), flowers infundibuliform, fused towards the base for 1.8–2.2 mm (vs. broadly campanulate, fused towards the base for ca. 0.5 mm long), and scapes erect at fruit maturity (vs. humifuse). *Nothoscordum parvum* differs from *Nothoscordum urutauense* by its bulbs surrounded by bulbils (vs. simple), by its narrowly filiform leaves (0.4–0.5 mm vs. 0.8–1.6 mm), by its erect scapes at fruit maturity (vs. humifuse) and by its nearly obovate and slightly 3-humped fruits (vs. spherical and strongly 3-humped).

Geophyte 5–10 cm high above the soil. Bulb 7–10 × 7–8 mm, ovoid, proliferous, with strong alliaceous smell; outer cataphylls dark-brown, the innermost whitish. Leaves at anthesis 1–3, spirally arranged; leaf sheaths 1–2 cm long, subterranean, straw-colored; leaf blades 30–90 × 0.4–0.5 mm, narrowly linear-filiform broadly elliptic and slightly curved in cross-section, 0.4–0.5 × 0.2–0.3 mm, grayish-green or purplish-green, erect or erect-ascendant, margin thickened and rigid, apex obtuse, abundant pilosity composed of 1-celled trichomes with straight or slightly curved cell, trichomes 70–120 µm long. Scapes 1–2, slightly thicker than the leaves, 40–60 × 0.6–0.7 mm, subcylindrical, green or purplish-green, erect at fruit maturity, with alliaceous smell when breaking, densely covered by 1-celled trichomes with straight terminal cell, trichomes 160–190 µm long. Bracts 2, ovate-elliptic, 6–8 × 3–4 mm, shortly fused at base for ca. 1–2 mm. Pedicels 16–24 mm long, light-green, densely covered by 1-celled trichomes shorter than the trichomes of scapes. Inflorescence 1-flowered. Flowers 10–11 × 6–9 mm, infundibuliform, white, shiny. Tepals 6 (3 + 3), white becoming greenish-white or greenish-cream towards the base, fused at base for 1.8–2.2 mm, the outers ones oblanceolate, 10–11 × 2.1–2.3 mm, apex slight acute, base attenuate; the inners ones elliptic or oblanceolate, 9–10 × 2–2.2 mm; apex slight acute, base attenuate; tepal middle nerves greenish-white, little pronounced, thicker towards the base. Staminal filaments 4.5–5.5 mm long, awl-shaped, translucent, yellowish-white, free at their bases and attached directly to the tepal; anthers 1–1.3 mm long, curved, pollen golden-yellow. Ovary obovate, 3-humped, 2.3–3.3 mm long; ovules 7–9 per locule; style yellowish-white, 5–6 mm long, stigmatic portion capitate, greenish-yellow, shiny. Capsule obovate, slightly 3-humped, 5.5–6.5 × 3–4 mm. Seeds 1.6–1.8 mm, black, shiny, curved and angled.

*Etymology* The adjective *parvus* in Latin means small, a reference to the thin and small size of the new species.

*Phenology* Flowering and fruiting time September. The flowers open in the middle afternoon during one or two days. During the flowering period, populations exude a strong alliaceous odor, which becomes the predominant smell in the places and around areas of occurrence of specimens of *Nothoscordum parvum*.

*Additional material examined* BRAZIL. Rio Grande do Sul: São Gabriel, Três Cerros, 410m, 18 Sep 2021, LP Deble and BP Moreira 20233 (PACA!); trajeto a vila de Palma, 280m, 18 Sep 2021, L.P. Deble and BP Moreira 20234 (PACA!).

*Distribution and Habitat* *Nothoscordum parvum* occurs in central-southern Rio Grande do Sul state, Brazil in the border between São Gabriel and Lavras do Sul municipalities. The specimens grow between 280–410m, in environments with poor drainage capacity, in places of wet shallow soils, with abundant organic matter and rich in clay minerals, developed over concavities of granitic rocks from the domain of undeformed granitic rocks (CPRM 2009). The individuals grow associated with mosses, *Drosera brevifolia* Pursh (Droseraceae), *Nothoscordum dyalistemon* (Guagl.) Crosa (Amaryllidaceae) and small and delicate

Cyperaceae and Poaceae species. *Nothoscorum collinum* Ravenna is another endemic in the same area, but this species occurs in more dry places and often the bulbs developed in crevices of rocks.

**Conservation** Based on the analysis of exsiccates and collections in the possible places of occurrence, only three small populations were identified, which indicates the rarity of the species. The extent of occurrence (EEO) is less than 100 km<sup>2</sup> and the Area of Occupancy (AOO) is less than 10 km<sup>2</sup>. This species occurs in specific habitat, grows in environments with poor drainage capacity in places of wet shallow soils, with abundant organic matter and rich in clay minerals, developed over concavity of granitic rocks. These environments are being modified by economic activities, as mining and agriculture. In accordance with the criteria of IUCN (2019), *Nothoscordum parvum* can be considered Critically Endangered (CR), based in direct threat, geographic distribution, occupation area and population size [CR B1 + B2b (i, ii, iii, iv, v) + c (iii, iv)].

*Nothoscordum urutauense* Deble and HA Keller, sp. nov. (Figs. 3, 5 and 7). —Type: Argentina, Misiones, Candelaria, Reserva Urutaú, 27° 28' 47,6" S and 55° 43' 57,6"W, 98m, 6 Jun 2019, fl and fr, HA Keller 13867 (holotype CTES!).

**Diagnosis** *Nothoscordum urutauense* is similar to *N. inundatum* and *N. parvum*; however, it can be readily distinguished from *N. inundatum* by its broader leaves (0.8–1.6 mm vs. 0.2–0.4 mm), by its flowers with tepals fused at the base for 0.5–1 mm (vs. 1–1.5 mm), and free filaments at base (vs. shortly fused for 0.3–0.5 mm). From *Nothoscordum parvum*, the new species differs by its simple bulbs (vs. bulbs surrounded by bulbils), by its broader leaves (0.8–1.6 mm vs. 0.4–0.5 mm), by its humifuse scapes at fruit maturity (vs. erect) and by its spherical and strongly 3-humped fruits.

Geophyte 8–14 cm high above the soil. Bulb 6–8 × 6–8 mm, nearly spherical or ovoid, simple, with strong alliaceous smell; outer cataphylls dark-brown, the innermost whitish. Leaves at anthesis 3–10, spirally arranged; leaf sheaths 2–6 cm long, subterranean, straw-colored; leaf blades 60–130 × 0.8–1.6 mm, canaliculate in cross-section, dark-green, erect-ascendant or ascendant reflexes, margin thickened and rigid, apex slight acute or obtuse, abundant pilosity composed of 1-celled trichomes with straight or slightly curved cell, trichomes 150–200 µm long. Scapes 1–5, thicker than the leaves, 4–8 cm long, subcylindrical, green or purplish-green, erect, then humifuse at fruit maturity, with alliaceous smell when breaking, densely covered by 1-celled trichomes with straight terminal cell, trichomes 200–240 µm long. Bracts 2, ovate-elliptic, 6–10 × 3–4.5 mm, shortly fused at base for ca. 1 mm. Pedicels 15–25 mm long, light-green, densely covered by 1-celled trichomes shorter than the trichomes of scapes. Inflorescence 2-flowered. Flowers 8–10 × 7–8 mm, campanulate, white, shiny. Tepals 6 (3 + 3), white become greenish-white or greenish-cream towards the base, shortly fused at base for 0.5–1 mm, the outer ones elliptic-lanceolate or elliptic, 6.5–9 × 1.8–2.3, apex slight acute, base attenuate; the inner ones elliptic-lanceolate, blades 6–8 × 1.8–2 mm; apex slight acute, base attenuate; tepal middle nerves greenish-brown, conspicuous, thicker towards the base. Staminal filaments 3.5–4.5 mm long, awl-shaped, translucent, yellowish-white, free at their bases and attached directly to the tepal; anthers 0.9–1.3 mm long, curved, pollen golden-yellow. Ovary obovate-oblong, 3-humped, 1.3–1.8 mm long; ovules 3–4 per locule; style yellowish-white, 1.8–3.5 mm long, stigmatic portion capitate, greenish-yellow, shiny. Capsule broadly obovate, markedly 3-humped, 3.5–4.5 × 3–4 mm. Seeds 1.8–2 mm, black, shiny, curved and angled.

**Etymology** A reference to the only known location for the new species, Urutaú Natural Reserve, Candelaria department, Misiones province, Argentina.

**Phenology** Flowering time May–June, fruiting time June–July. The flowers open around midday and close in the late afternoon, withering after one or two days.

**Additional material examined** Argentina, Misiones, Candelaria. Reserva Urutaú, 27° 28' 47,6" S – 55° 43' 57,6"W. 29 May 2019, fl, HA Keller and G Ruiz-Díaz 13830 (CTES).

**Distribution and Habitat** *Nothoscordum urutauense* inhabits a grassland with shallow soils developed on basalt outcrops from the domain of Mesozoic Vulcanism, between 90–100m. It shares the habitat with small subshrub and herbs such as *Ayenia mansfeldiana* (Herter) Herter ex Cristóbal (Malvaceae), *Evolvulus sericeus* Sw. (Convolvulaceae), *Oxypetalum microphyllum* Hook. and Arn. (Apocynaceae), *Tripogon spicatus* (Nees) Ekman (Poaceae), among others small and delicate herbs.

**Conservation** The species occurs in the Urutaú Reserve site closest to a human population (next to the suburbs of the city of Candelaria and a short distance from an improvised garbage disposal site). The only known population has about 50 individuals distributed in about 200 m<sup>2</sup>. Other similar environments present in the Urutaú Reserve, in the Candelaria Department and in several localities in the south of Misiones Province and north of Corrientes Province have been exhaustively explored, but no other populations have been found. All this suggests that according to criteria B1ab(iii) + D (IUCN 2019), the species is critically endangered (CR).

With this finding, two species of the genus are known as endemic to Misiones; the other is *Nothoscordum moconense* Ravenna, which occurs in the center-east of the province, on the banks of the Uruguay River.

## Discussion

The study of new species and field analysis of other previously described taxa, which were known only from herbarium material, have helped to reveal the limits of the genus *Nothoscordum* (Deble 2022; Deble and Moreira 2022). Important morphological characteristics, such as the position of the scapes at fruit maturation (humifuse vs. erect), the number of flowers in the inflorescence (solitary vs. numerous) and the union or not of the filaments is more diversified within the genus than previously recognized.

From a morphological point of view, the description of these three new species corroborates the inclusion of *Beauverdia* in *Nothoscordum*, as previously suggested by other authors (for example, Crosa 2006; Pellicier et al. 2017; Sassone and Giussani 2018; Deble and Moreira 2022). Distinctive morphological characteristics for the recognition of *Beauverdia*, such as solitary flowers and humifuse scapes during fruit maturation are found in *Nothoscordum elongatum*

and *N. urutauense*. On the other hand, these species have long pedicellate flowers, a morphological characteristic commonly found in *Nothoscordum*. *Nothoscordum parvum*, in turn, although morphologically related to the other species described here, has erect scapes during fruit maturation, as in most *Nothoscordum* species.

The three new species proposed here are morphologically related with *Nothoscordum gaudichaudianum* Kunth, *N. inundatum* Ravenna, *N. marchesii* Crosa, *N. modestum* Ravenna and *N. vittatum* (Griseb.) Ravenna. *Nothoscordum elongatum* is morphologically similar to *N. marchesii*, due its linear-filiform leaves, small flowers, tepals light-yellow or white-cream, and bulbs and leaves with strong alliaceous smell. Nevertheless, *N. elongatum* has densely pilose leaves and scapes (vs. glabrous), flowers with long pedicels 15–32 mm long (vs. 3–8 mm long), and ovary with 5–6 ovules per locule (vs. 13–16). *Nothoscordum elongatum* differs from *N. inundatum* by its tepals light yellow or white-cream (vs. white), and staminal filaments free at base (vs. adnate). *Nothoscordum elongatum* can be distinguished from *N. parvum* by its simple bulb (vs. with bulbils surrounded the main bulb), two-flowered inflorescence (vs. one-flowered), smaller flowers (6–7 × 6–7 mm vs. 10–11 × 6–9), tepals light-yellow or white-cream (vs. white), adnate at the base for 0.5–1 mm (vs. 1.8–2.2 mm). *Nothoscordum parvum* is morphologically related to *N. modestum*; nevertheless, it is distinguished by its bulbs surrounded by bulbils (vs. bulbs without bulbils), strong alliaceous smell (vs. mild alliaceous smell when breaking), densely pilose leaves and scapes (vs. glabrous), flowers narrowly campanulate, fused towards the base for 1.8–2.2 mm (vs. broadly campanulate, fused towards the base for ca. 0.5 mm long), and scapes erect at fruit maturity (vs. humifuse). *Nothoscordum parvum* can be distinguished from *N. urutauense* by its bulbs surrounded by bulbils (vs. bulbs without bulbils), narrower leaves (0.4–0.5 mm vs. 0.8–1.6 mm) and tepals fused at the base for 1.8–2.2 mm (vs. 0.5–1 mm). *Nothoscordum parvum* can be separated from *N. vittatum* by its bulbs surrounded by bulbils (vs. bulbs without bulbils), narrower leaves (0.4–0.5 mm vs. 1–3 mm), and longer pedicels of flowers (16–24 mm vs. 4–10 mm). *Nothoscordum urutauense* is morphologically associated to *N. inundatum*; nevertheless, can be distinguished by its broader leaves (0.8–1.6 mm vs. 0.2–0.4 mm), by its flowers with tepals fused at the base for 0.5–1 mm (vs. 1–1.5 mm), and free filaments at base (vs. shortly fused for 0.3–0.5 mm). *Nothoscordum elongatum*, *N. parvum* and *N. urutauense* promptly differ from *N. gaudichaudianum* by their delicate habit, by their scapes, bulbs and leaves with strong alliaceous smell (vs. mild), and by their fewer numbers of flowers in the inflorescence (1–2 vs. 3–10). Additional features to distinguish *Nothoscordum elongatum*, *N. parvum* and *N. urutauense* from their morphologically related species can be assessed in the Table 2.

Table 1

Brief history of the generic and infrageneric interpretation of 1-2-flowered species of *Nothoscordum* and some morphologically related taxa

Autor	Beauverd (1908)	Herter (1943, 1956)	Traub (1949, 1963), Traub and Moldenke (1955)	Guaglianone (1972)
<b>Genus</b>	<i>Nothoscordum</i> Kunth sect. <i>Uniflorum</i> Beauv.	<i>Beauverdia</i> Herter	<i>Ipheion</i> Raf. and <i>Tristagma</i> Poepp.	<i>Ipheion</i> sect. <i>Hirtellum</i> Guagl.
<b>Listed species</b>	<i>Nothoscordum canescens</i> Beauv., <i>N. subsessile</i> Beauv., <i>N. ostenii</i> Beauv., <i>N. lloydiflorum</i> Beauv. and <i>N. uniflorum</i> Baker.	<i>Beauverdia hirtella</i> (Kunth) Herter, <i>B. felipponei</i> (Beauv.) Herter, <i>B. lloydiflora</i> (Beauv.) Herter, <i>B. lorentzii</i> Herter, <i>B. recurvifolia</i> (Wright) Herter [= <i>Tristagma sessile</i> (Phil.) Traub], <i>B. sellowiana</i> (Kunth) Herter, <i>B. subsessilis</i> (Beauv.) Herter, <i>B. tweediana</i> (Griseb.) Herter [= <i>T. tweediana</i> (Griseb.) Traub], <i>B. uniflora</i> (Lindl.) Herter [= <i>T. uniflora</i> (Lindl.) Traub], and <i>B. vittata</i> (Griseb.) Herter.	Traub (1949) and Traub and Moldenke (1953) transferred all species recognized in <i>Beauverdia</i> by Herter to <i>Ipheion</i> and also included two species not mentioned by Herter: <i>I. setaceum</i> (Baker) Traub and <i>I. vittatum</i> (Griseb.) Traub. Later Traub (1963) replaced all these taxa under <i>Tristagma</i> .	<i>Ipheion dialystemon</i> Guagl., <i>I. hirtellum</i> (Kunth) Traub, <i>I. sellowianum</i> (Kunth) Traub., <i>I. setaceum</i> and <i>I. vittatum</i> .
<b>Comments</b>	Proposed to segregate the one-flowered species of <i>Nothoscordum</i> from the several-flowered species belonging to section <i>Umbelliflorum</i> Beauv.	The genus was erected to place the one-flowered species of <i>Nothoscordum</i> , and some species of <i>Brodiaea</i> Sm., <i>Ipheion</i> Raf. and <i>Milla</i> Cav.	<i>Beauverdia</i> is firstly treated as a synonym of <i>Ipheion</i> and later placed under <i>Tristagma</i>	It was proposed as distinguished from <i>Ipheion</i> sect. <i>Ipheion</i> by its morphological attributes. The author also treated <i>Nothoscordum</i> sect. <i>Uniflorum</i> as a synonym of her sect. <i>Hirtellum</i> .
<b>Autor</b>	Crosa (1975)	Ravenna (1978)	Sassone et al. (2014)	Deble and Moreira (2022)
<b>Genus</b>	<i>Nothoscordum</i>	<i>Nothoscordum</i> subg. <i>Monanthoscordum</i>	<i>Beauverdia</i>	<i>Nothoscordum</i>
<b>Listed species</b>	<i>Nothoscordum dialystemon</i> (Guagl.) Crosa, <i>N. felipponei</i> Beauv., <i>N. hirtellum</i> (Kunth) Herter and <i>N. vittatum</i> (Griseb.) Ravenna.	<i>Nothoscordum dialystemon</i> (Guagl.) Crosa, <i>N. felipponei</i> Beauv., <i>N. hirtellum</i> (Kunth) Herter, <i>N. setaceum</i> (Baker) Ravenna and <i>N. vittatum</i> (Griseb.) Ravenna	<i>Beauverdia dialystemon</i> (Guagl.) Sassone & Guagl., <i>B. hirtella</i> , <i>B. sellowiana</i> and <i>B. vittata</i> . Four species also are listed as doubtful to <i>Beauverdia</i> : <i>Nothoscordum izaguirrae</i> Crosa, <i>N. marchesii</i> Crosa, <i>N. ostenii</i> Beauv. and <i>Ipheion setaceum</i> .	<i>Nothoscordum dialystemon</i> , <i>N. felipponei</i> , <i>N. hirtellum</i> , <i>N. inundatum</i> Ravenna, <i>N. marchesii</i> , <i>N. modestum</i> Ravenna, <i>N. ostenii</i> , <i>N. setaceum</i> , <i>N. subsessile</i> , <i>N. subtile</i> Ravenna and <i>N. vittatum</i> .
<b>Comments</b>	Based on morphological, cytological and karyological evidences, the species of <i>Ipheion</i> sect. <i>Hirtellum</i> were transferred to <i>Nothoscordum</i> .	Based on morphological attributes the subgenus was created to accommodate the one-flowered species of <i>Nothoscordum</i> .	Based on morphometrical analyses, the authors reestablish the genus <i>Beauverdia</i> .	The authors listed the valid names of 1-2-flowered species of <i>Nothoscordum</i> . Based on morphologic attributes they proposed <i>Beauverdia</i> under <i>Nothoscordum</i>

Table 2

A comparison of selected characters differing among *Nothoscordum elongatum*, *N. parvum* and *N. urutauense* and their related species

Characteristic/species	<i>N. elongatum</i>	<i>N. gaudichaudianum</i>	<i>N. inundatum</i>	<i>N. marchesii</i>	<i>N. modestum</i>	<i>N. parvum</i>	<i>N. vittatum</i>	<i>N. urutauense</i>
Alliaceous smell	present	absent or mild on bulbs	present	present	absent or mild on bulbs	present	absent	present
Pilosity	abundant on leaves, scapes and scarce on pedicels	glabrous	abundant on scapes and scarce on leaves and pedicels	glabrous	glabrous	abundant on leaves, scapes and scarce on pedicels	scarce on leaves, scapes and pedicels	abundant on leaves, scapes and pedicels
Leaf width (mm)	0.3–0.5	1–3	0.2–0.5	0.4–0.5	0.6–2	0.4–0.5	1–3	0.8–1.6
Shape in cross section	canaliculate	canaliculate	canaliculate	broadly elliptic, curved	broadly elliptic	broadly elliptic and slightly curved	canaliculate	canaliculate
Scapes at fruit maturity	humifuse	erect	humifuse	humifuse	humifuse	erect	humifuse	humifuse
Flowers per inflorescence	1–2	3–10	2	1	1–2	1	1	2
Color of flowers	light-yellow or cream, tepals with a light-yellow or greenish-yellow longitudinal stripe outside	white, tepals with a dark purplish-brown longitudinal stripe outside	white, tepals with a purplish-brown longitudinal stripe outside	light-yellow or cream, tepals with a light-yellow or greenish-yellow longitudinal stripe outside	white, tepals with a dark purplish-brown longitudinal stripe outside	white, tepals with a greenish-white longitudinal stripe outside	white, tepals with a purplish-brown longitudinal stripe outside	white, tepals with a purplish-green longitudinal stripe outside
Pedicels length (mm)	15–32	11–35	12–24	up to 8	11–25	16–24	up to 10	15–25
Staminal filaments	free	free	slightly adnate at their bases	free	free	free	free	free
Flowering and fruiting period	April–June	May–June, September–October	May–July	May–June	May–June	September	April–June	May–June
Geographic distribution	central-eastern Rio Grande do Sul state (Brazil)	eastern and northeastern Argentina, Uruguay and Rio Grande do Sul state (Brazil)	northeastern Argentina, Corrientes province	northeastern Uruguay	southern Paraguay and southern Rio Grande do Sul state (Brazil)	central-southern Rio Grande do Sul state (Brazil)	eastern and northeastern Argentina, Uruguay and Rio Grande do Sul state (Brazil)	southern Misiones province (Argentina)
Examined specimens of <i>Nothoscordum gaudichaudianum</i> . ARGENTINA. Corrientes: Monte Caseros, 7 Sep 1952, <i>E Nicora</i> 6267 (SI044977).								
BRAZIL. Rio Grande do Sul: 16km N of Rio Camaquã on Passo dos Marinheiros, 10 Oct 1972, <i>JC Lindeman</i> et al. (ICN 20606).								
URUGUAY. Maldonado: Sierra de las Animas, <i>O Crosa</i> 2733 (SI044987). Montevideo: Sur la Bonite, Apr 1836-37, <i>M Gaudichaud</i> (holotype: P00852537, P00852537).								
<i>Nothoscordum inundatum</i> . ARGENTINA. Corrientes: Mburucuyá, Estancia Sta María, 8 May 1956, <i>TM Pedersen</i> 3912 (holotype CTES0000187!, isotype C10005325 photo!).								
<i>Nothoscordum marchesii</i> . URUGUAY. Rocha: Parque Nacional de San Miguel, "coleccionado em el borde de afloramientos rochosos, entre el Fuerte San Miguel y el cerro Picudo" 6 June 2001, <i>O Crosa</i> (holotype: MVFA 32139! Isotype: SI000430!).								
<i>Nothoscordum modestum</i> . BRAZIL. Rio Grande do Sul: Dom Pedrito, estrada da Pedreira, 18 May 2021, <i>LP Deble</i> et al. 18852 (PACA!).								
PARAGUAY. Without additional data, <i>P Joergensen</i> 4757 (holotype: SI000433!).								
<i>Nothoscordum vittatum</i> . ARGENTINA. Entre Rios: Concepción del Uruguay, Coloni Eliá, 24 May 1967, <i>AM Ragonese</i> and <i>R Guaglianone</i> (SI26103!). BRAZIL. Rio Grande do Sul, Dom Pedrito: estrada da Barragen do Tacuarembó, 18 May 2021, <i>LP Deble</i> and <i>BP Moreira</i> 18854 (PACA!).								
URUGUAY. Montevideo: Cerro, May 1920, <i>F Felippone</i> 3447a (SI044788!).								

**Key to distinguish the single or two-flowered species of *Nothoscordum***

1. Stamens with adnate filaments.
2. Flowers golden-yellow or yellow.
3. Leaves reflexes, narrowly lanceolate ..... *Nothoscordum felipponei* (Herter) Ravenna

3. Leaves erect-ascendant, linear-filiform.
4. Plants with strong alliaceous smell. Bulbs simple, without rhizomes. Roots slender ..... *Nothoscordum hirtellum* (Kunth) Herter
4. Plants without or with mild alliaceous smell. Bulbs with long horizontal rhizomes. Roots thickened .....  
*Nothoscordum subsessile* Beauverd
2. Flowers white or pinkish white.
5. Leaves at anthesis absent. Scapes glabrous. Pedicels 10–15 mm long ..... *Nothoscordum subtile* Ravenna
5. Leaves at anthesis present. Scapes densely pilose. Pedicels 12–24 mm long ..... *Nothoscordum inundatum* Ravenna
1. Stamens with free filaments.
6. Scapes humifuse at fruit maturity.
7. Flowers shortly pedicellate (pedicels up to 10 mm, shorter than the length of the tepals).
8. Flowers yellow, with 8–13 tepals..... *Nothoscordum dyalistemon* (Guagl.) Crosa
8. Flowers white, cream or light-yellow, with 6 tepals.
9. Leaves with papillose margin, ascendant-reflexes or reflexes, linear, 1–3 mm wide. Scapes papillose .....  
*Nothoscordum vittatum*
9. Leaves glabrous, erect-ascendent, narrowly linear-filiform, 0.4–0.8 mm wide. Scapes glabrous.
10. Plants with strong alliaceous smell. Flowers white-cream or light yellow..... *Nothoscordum marchesii*
10. Plants without alliaceous smell. Flowers white.....*Nothoscordum setaceum* (Baker) Ravenna
7. Flowers pedicellate (pedicels 11–25 mm long, longer than the length of the tepals).
11. Leaves 0.3–0.5 mm wide. Flowers white-cream or light yellow ..... *Nothoscordum elongatum*
11. Leaves 0.6–2 mm wide. Flowers white.
12. Plants glabrous. Leaves broadly elliptic in cross-section. Capsule obovate-oblong, slightly 3-humped .....  
*Nothoscordum modestum*
12. Plants pubescent. Leaves sulcate in cross-section. Capsule broadly obovate, markedly 3-humped .....  
*Nothoscordum urutauense*
6. Scapes erect at fruit maturity.
13. Plants pubescent, with strong alliaceous smell. Flowers white.....*Nothoscordum parvum*
13. Plants glabrous, without alliaceous smell. Flowers yellow..... *Nothoscordum ostenii* Beauverd

*Nothoscordum pachyrhizum* Ravenna and *Nothoscordum muscorum* Ravenna were described as having humifuse scapes and two-flowered inflorescence (Ravenna 1991a, Ravenna 1991b). Nevertheless, the type analysis and the topotypical population observations, revealed that both species present 3-4-flowered inflorescence, and thus are not included in the key.

## Declarations

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### Declaration of competing of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to undermine the objectivity or integrity of the work reported in this paper.

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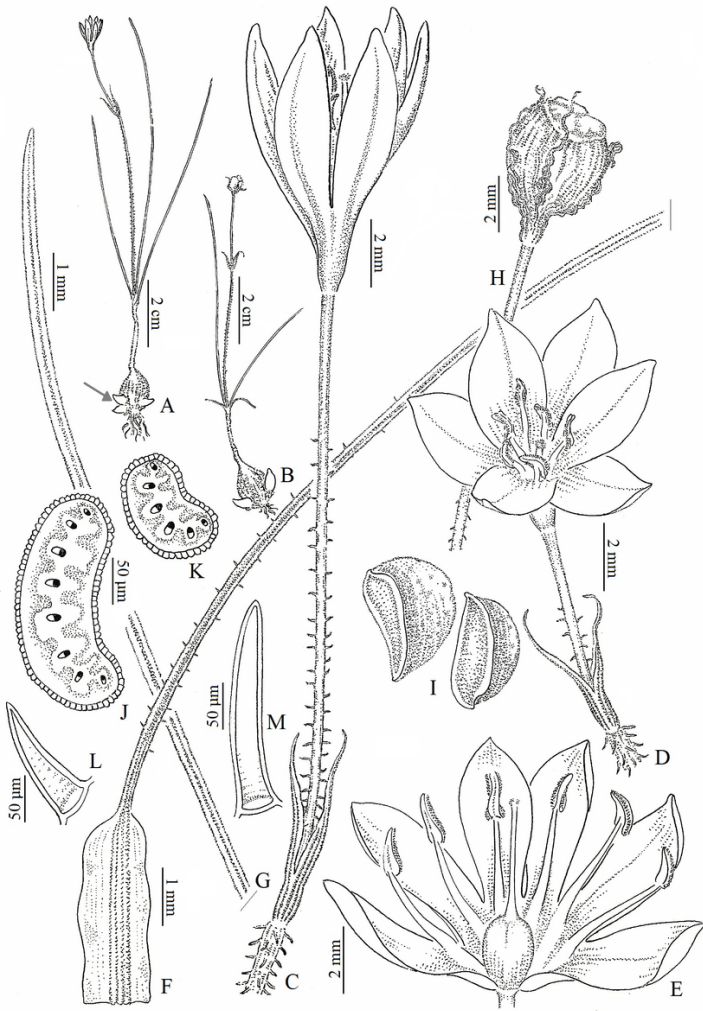


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## Figures



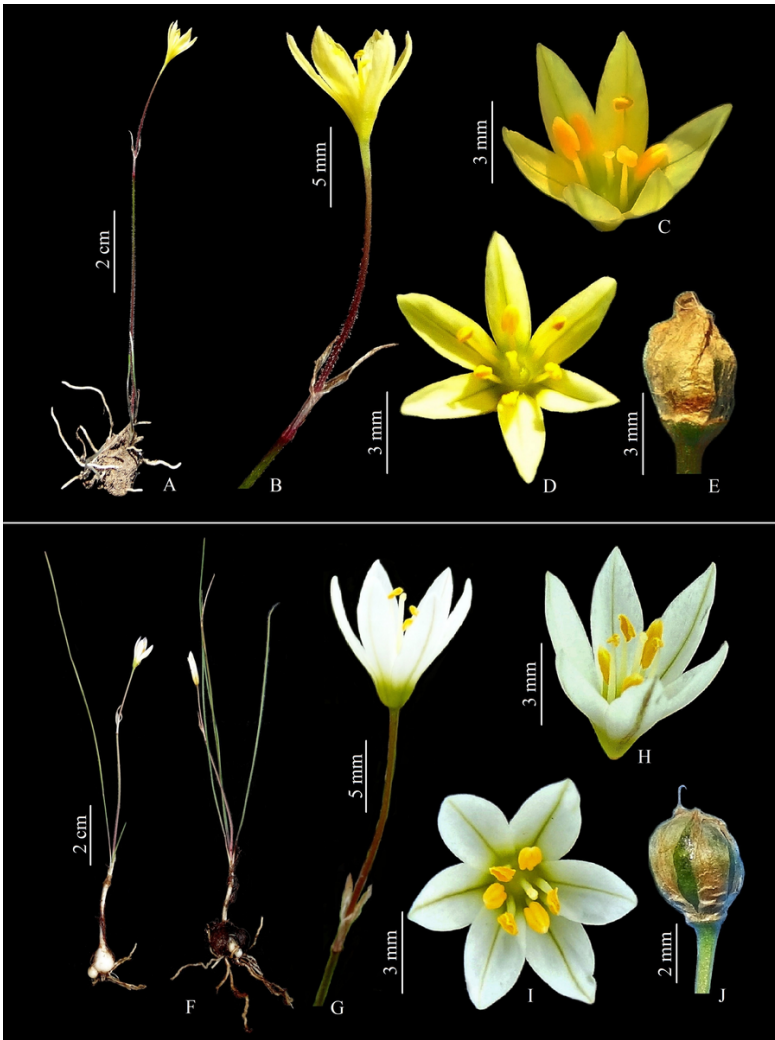
**Figure 1**  
*Nothoscordum elongatum* **a** Flowering specimens **b** Fruiting specimen. **c** Flower, lateral view, showing pedicels, bracts and apex of scape **d** Flower, upper view **e** Flower open, showing pistil and stamens **f** Proximal part of the leaf blade and leaf sheaths **g** Distal part of leaf blade **h** Capsule **i** Seeds **j-k** Cross section of leaf blade **l** Trichome of the scape (a, c-g, j-l from *Deble and Moreira 20153*; b, h-i from *Deble and Moreira 20294*)



**Figure 2**  
*Nothoscordum parvum* **a** Flowering specimen **b** Fruiting specimen **c** Flower, lateral view, showing pedicels, bracts and apex of scape **d** Flower, upper view **e** Flower open, showing pistil and stamens **f** Proximal part of the leaf blade and leaf sheaths **g** Distal part of leaf blade **h** Capsule. **i** Seeds **j-k** Cross section of leaf blade **l** Trichome of the pedicel **m** Trichome of the scape (a, c–g, j–m from *Deble and Moreira 20155*; b, h–i from *Deble and Moreira 20234*)



**Figure 3**  
*Nothoscordum urutauense* **a** Flowering and fruiting specimen **b** Flower, lateral view, showing pedicels, bracts and apex of scape **c** Flower, upper view **d** Flower open, showing pistil and stamens **e** Proximal part of the leaf blade and leaf sheaths **f** Distal part of leaf blade **g** Capsule **h** Seeds **i** Trichome of the leaf blade **j** Trichome of the scape. (All from Keller 13867)



**Figure 4**  
*Nothoscordum elongatum* (a–e) and *Nothoscordum parvum* (f–j) **a** Flowering specimen **b** Flower, lateral view, showing bracts and pedicels **c** Flower, inclined view **d** Flower, upper view **e** Capsule **f** Flowering specimens **g** Flower, lateral view, showing bracts and pedicels **h** Flower, inclined view **i** Flower, upper view **j** Capsule



**Figure 5**  
*Nothoscordum urutauense* **a** Flowering specimen **b** Flower, lateral view, showing bracts and pedicels **c** Open flower, evidencing Stamens and pistil **d** Flower upper view **e** Capsule, partially opened and showing the seeds

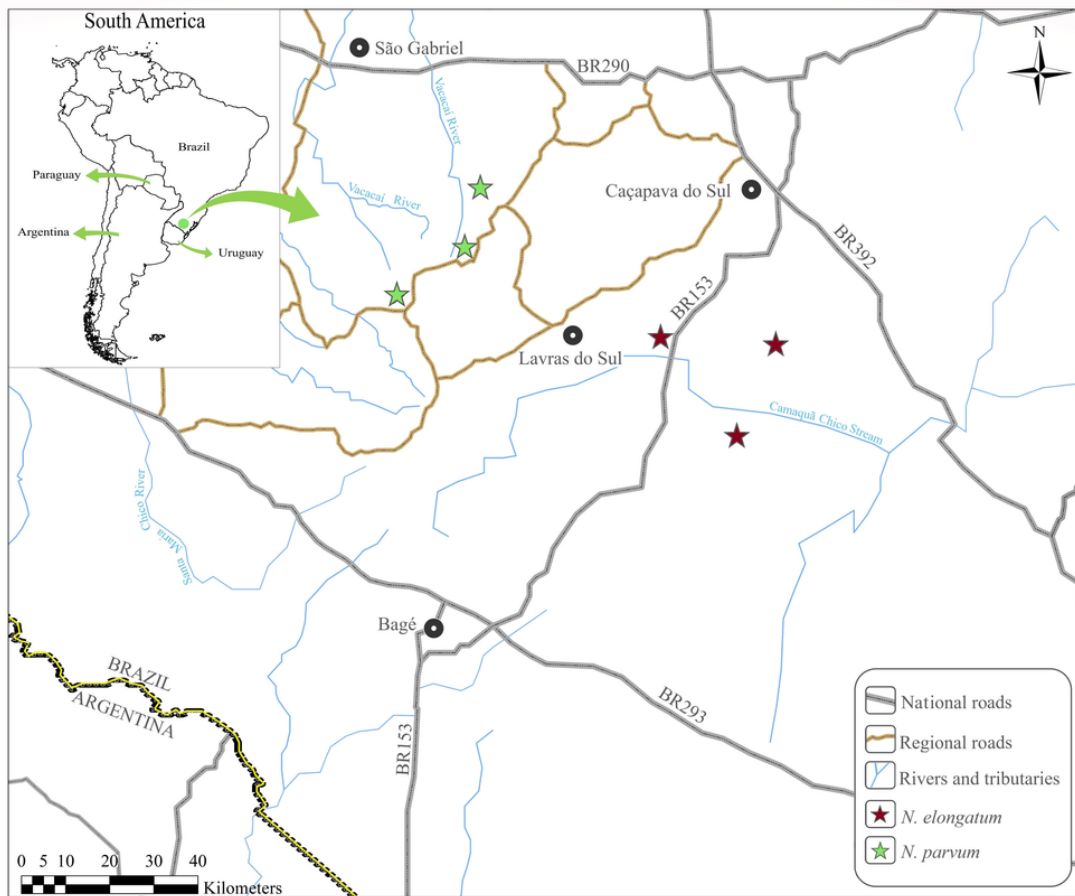


Figure 6

Geographic distribution of *Nothoscordum elongatum* and *Nothoscordum parvum*

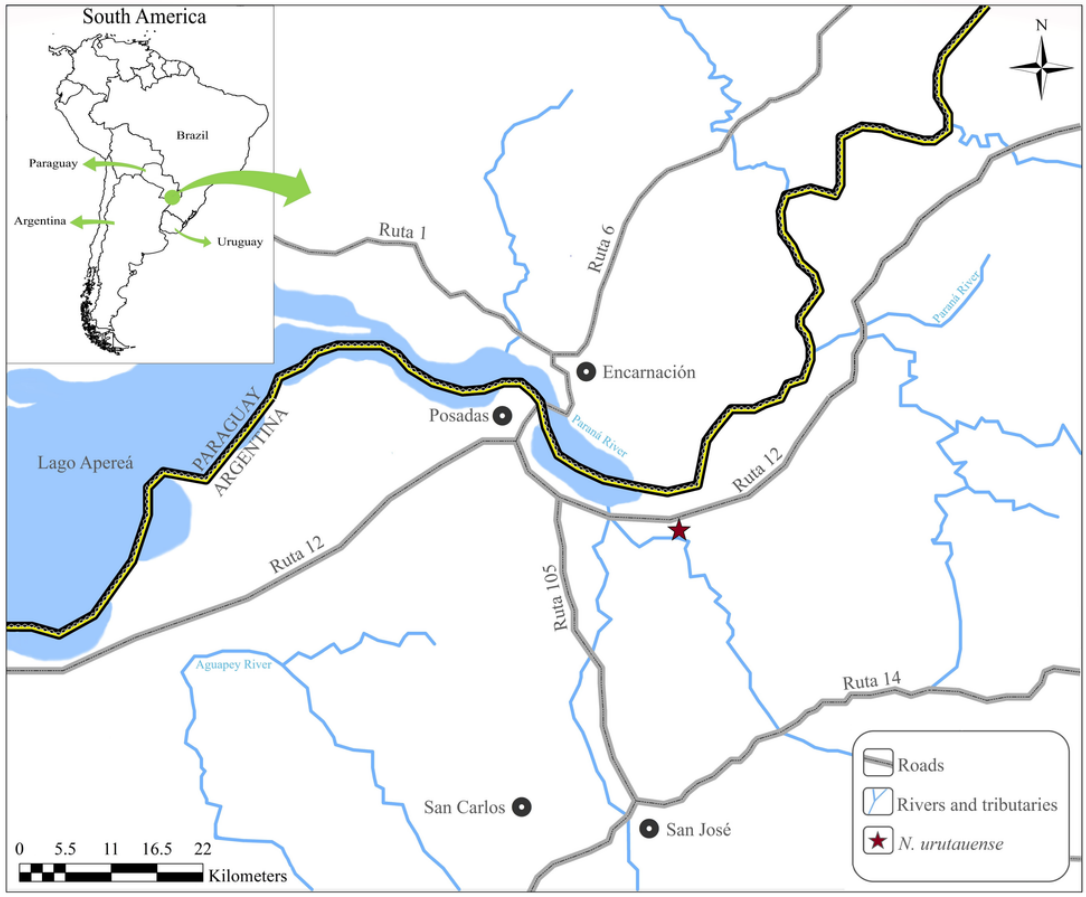


Figure 7

Geographic distribution of *Nothoscordum urutauense*