



THREE NEW SPECIES OF *NOTHOSCORDUM* (AMARYLLIDACEAE) FROM THE CAMPOS ECO-REGION OF THE GRASSLAND ECOSYSTEMS OF RÍO DE LA PLATA, SOUTHEAST SOUTH AMERICA

Tres nuevas especies de *Nothoscordum* (Amaryllidaceae) de la ecorregión de los Campos de los Ecosistemas de Pastizales del Río de la Plata, Sudeste de Sudamérica

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Summary: Three new Amaryllidaceae species are described: *Nothoscordum elongatum* Deble & B. P. Moreira, *N. parvum* Deble & B. P. Moreira and *N. 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 to southern Misiones Province, northeast Argentina. The three new taxa are characterized by a strong alliaceous odor, pilose leaves and scapes, and 1 or 2-flowered inflorescence. *Nothoscordum elongatum* is segregated from *N. 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, it can be readily separated from both species by the presence of bulbils surrounding the main bulb, the flowers that are narrowly infundibuliform, fused towards the base for 1.8-2.2 mm, and the scapes that are erect at fruit maturity. *Nothoscordum urutauense* differs from *N. inundatum* by its broader leaves, flowers with tepals fused at the base for 0.5-1 mm, and free filaments at base. These three species of *Nothoscordum* are described, illustrated, compared with morphologically similar taxa, and featured with their geographic distribution. In addition, a key to distinguish the 1- or 2-flowered species of *Nothoscordum* is proposed.

Key words: Alliioideae, bioma Pampa, Campos, *Monanthoscordum*, *Uniflorum*.

Resumen: Se describen tres nuevas especies de Amaryllidaceae: *Nothoscordum elongatum* Deble & B. P. Moreira, *N. parvum* Deble & B. P. Moreira y *N. urutauense* Deble & H. A. Keller. *Nothoscordum elongatum* y *N. parvum* crecen en el centro-este del estado de Rio Grande do Sul, mientras que *N. urutauense* es endémico en el sur de la provincia de Misiones, noreste de Argentina. Los tres nuevos taxones se caracterizan por su fuerte olor aliáceo, hojas y escapos pilosos e inflorescencias con 1-2 flores. *Nothoscordum elongatum* se separa de *N. marchesii* por sus hojas y escapos densamente pilosos (frente a hojas y escapos glabros), flores con pedicelos más largos y ovario con menos óvulos por lóculo. *Nothoscordum parvum* es similar a *N. modestum* y *N. urutauense*; sin embargo, puede separarse fácilmente por sus bulbos con bulbillos que rodean el bulbo principal, por sus flores estrechamente infundibuliformes, fusionadas hacia la base entre 1,8 y 2,2 mm y por sus escapos erectos en la madurez del fruto. *Nothoscordum urutauense* se diferencia de *N. inundatum* por sus hojas más anchas, por sus flores con tépalos fusionados en la base entre 0,5 y 1 mm y por sus filamentos libres en la base. Se describen e ilustran las tres especies de *Nothoscordum*, además son comparadas con sus taxones morfológicamente similares y se presentan mapas con la distribución de los taxones. También se incluye una clave para la distinción de los taxones de *Nothoscordum* con 1-2 flores en la inflorescencia.

Palabras clave: Alliioideae, bioma Pampa, Leucocoryneae, *Monanthoscordum*, pastizales, *Uniflorum*.

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Introduction

The Campos eco-region of the Grassland Ecosystems of Río de la Plata (RPG, sensu Soriano *et al.*, 1992; Bilenca & 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). This region is one of the main centers of diversity and endemism of *Nothoscordum* Kunth (1843: 457-458), having several endemic species, many of which are known only from one or a few places of occurrence (Deble & Moreira, 2022).

The generic and infrageneric status of the 1-flowered species of *Nothoscordum* is controversial among different authors (Kunth, 1843; Baker, 1870, 1896; Beauverd, 1908, Herter 1943, 1956; Traub 1949, 1953, 1963; Guaglianone, 1972; Crosa, 1975; Ravenna, 1978, Sassone *et al.* 2014). However, from the second half of the 20th century, the 1-flowered species of *Nothoscordum* were mainly linked to *Ipheion* Rafinesque (1837: 2) or *Nothoscordum* (see Table 1). More recently, Sassone *et al.* (2014) re-established *Beauverdia*, and included taxa previously recognized under *Ipheion* sect. *Hirtellum* Guaglianone (1972: 178) and *Nothoscordum* subg. *Monanthoscordum* Ravenna (1978: 142). Subsequently, in a study of the phylogenetic relationships of the tribe Leucocoryne, Souza *et al.* (2016) established *Beauverdia* as a synonym of *Nothoscordum*, but recognized *Zoellnerallium* Crosa as valid, based on DNA sequences and cytomolecular data. Later, in the reconstruction of the phylogenetic history of the tribe Leucocoryneae in South America, Sassone & Giusiani (2018) recognized that *Nothoscordum* would be monophyletic if *Beauverdia* were included. Recently, García *et al.* (2022) recognized *Beauverdia* as segregated genus, indicating the inflorescence 1-2-flowered (vs. 2- to multiflowered), the

pedicels included in bracts (vs. exerted, not included in bracts) and humifuse fruits (vs. aerocarpic) as morphologic features to distinguish *Beauverdia* from *Nothoscordum*. Deble (2022) established *Nothoscordum ostenii* Beauverd (1908) as segregated from *Beauverdia hirtella* and pointed out that *N. ostenii* despite having solitary flowers, should be recognized under *Nothoscordum* because its scapes are erect at fruit maturity. In another contribution, Deble & Moreira (2022) rediscovered *Nothoscordum modestum* Ravenna 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 & Giussani (2018).

Botanical collections carried out in 2018 and 2019 revealed three peculiar species of *Nothoscordum*, with strong alliaceous odor, dense pilosity on scapes and leaves and 1-2-flowered inflorescences. After the analysis of nomenclatural types, examination of exsiccates, study of populations in their natural environment, and comparison with closely related taxa it was possible to establish 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 the plants observed in natural habitat and on dry material. Figures 1, 2 and 3 were drawn

Table 1. Brief historic of 1-2-flowered species of *Nothoscordum*.

Author	Beauverd (1908)	Herter (1943, 1956)	Traub (1949, 1953, 1963)	Guaglianone (1972)	Crosa (1975)
Taxa	<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.	<i>Nothoscordum</i>
Species	<i>Nothoscordum canescens</i> Beauv., <i>N. subsessile</i> Beauv., <i>N. ostenii</i> Beauv., <i>N. illoydflorum</i> Beauv. and <i>N. uniflorum</i> Baker	<i>Beauverdia hirtella</i> (Kunth) Herter, <i>B. feilipponei</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, 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>	<i>Nothoscordum dialystemon</i> (Guagl.) Crosa, <i>N. feilipponei</i> Beauv., <i>N. hirtellum</i> (Kunth) Herter and <i>N. vittatum</i> (Griseb.) Ravenna
Comments	Proposed to segregated 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 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> .	Based on morphological, cytological and karyological evidences, the species of <i>Ipheion</i> sect. <i>Hirtellum</i> were transferred to <i>Nothoscordum</i> .
Autor	Ravenna (1978)	Sassone et al. (2014)	Souza et al. (2016)	Garcia et al. (2022)	Deble & Moreira (2022)
Taxa	<i>Nothoscordum</i> subg. <i>Monanthoscordum</i>	<i>Beauverdia</i>	<i>Nothoscordum</i>	<i>Beauverdia</i> / <i>Nothoscordum</i>	<i>Nothoscordum</i>
Species	<i>Nothoscordum dialystemon</i> , <i>N. feilipponei</i> , <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 feilipponei</i> , <i>N. hirtellum</i> , <i>N. marchesii</i> and <i>N. ostenii</i>	<i>Beauverdia dialystemon</i> , <i>B. feilipponei</i> , <i>B. hirtella</i> and <i>B. vittata</i> . <i>Nothoscordum ostenii</i>	<i>Nothoscordum dialystemon</i> , <i>N. feilipponei</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>
Comments	Based on morphological attributes the subgenus was created to accommodate the one-flowered species of <i>Nothoscordum</i> .	Based on morphometrical analysis, the authors reestablish the genus <i>Beauverdia</i>	Based on phylogenetic analysis suggesting that the one-flowered inflorescence is homoplasious in Leucocoryneae or alternatively can be a plesiomorphic condition	Treated under <i>Beauverdia</i> the 1-2-flowered species, names of 1-2- flowered species of <i>Nothoscordum</i> . Based on morphologic attributes they included <i>Beauverdia</i> under <i>Nothoscordum</i>	The authors listed the valid names of 1-2- flowered species of <i>Nothoscordum</i> . Based on morphologic attributes they included <i>Beauverdia</i> under <i>Nothoscordum</i>

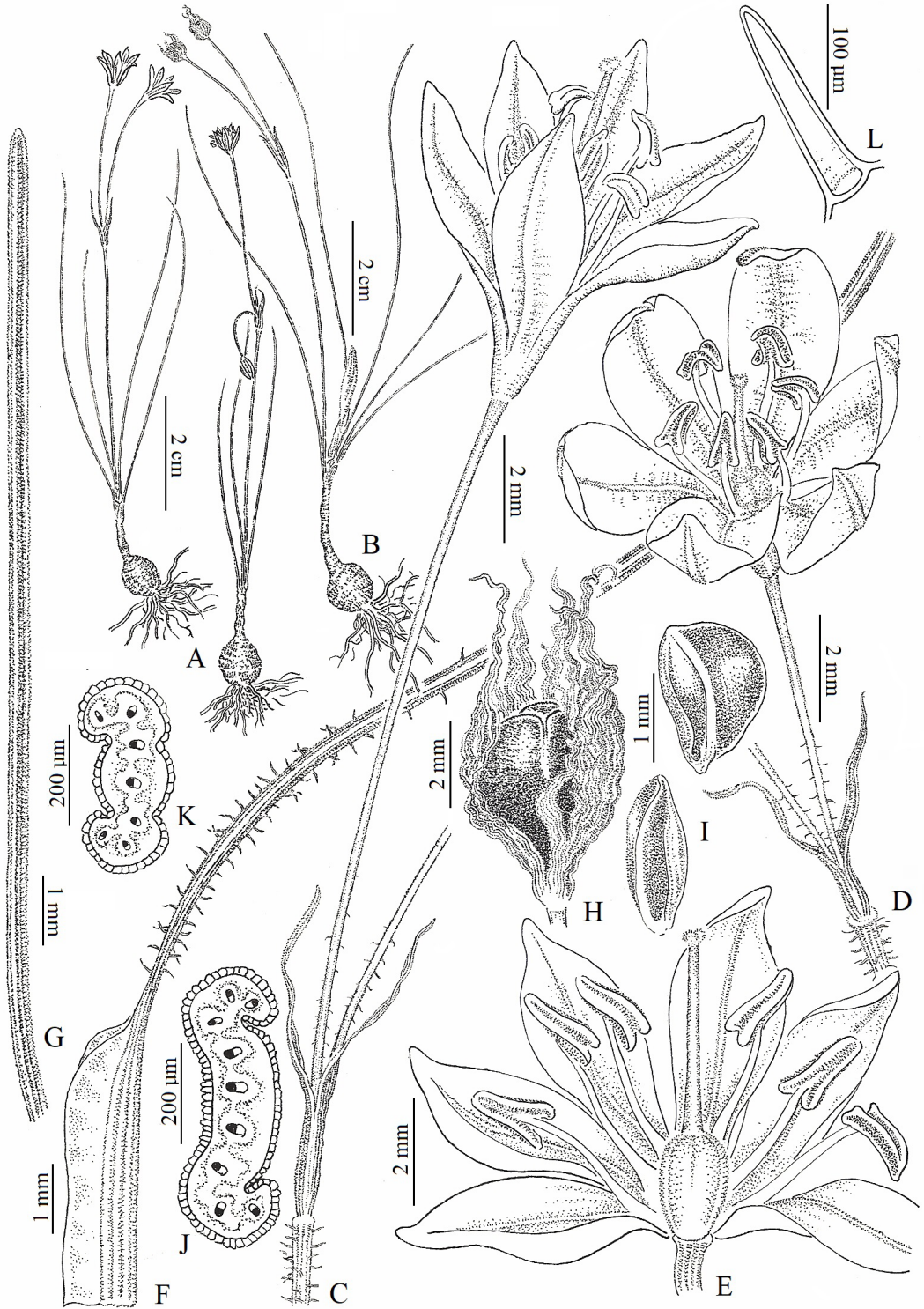


Fig. 1. *Nothoscordum elongatum*. A: Flowering specimens. B: Fruiting specimen. C: Flower, lateral view, showing pedicels, bracts and apex of scape. D: Flower, upper view. E: Flower open, showing pistil and stamens. F: Proximal part of the leaf blade and leaf sheaths. G: Distal part of leaf blade. H: Capsule. I: Seeds. J-K: Cross section of leaf blade. L: Trichome of the scape [A, C-G, J-L from Deble & Moreira 20153 (PACA); B, H-I from Deble & Moreira 20294 (PACA)].

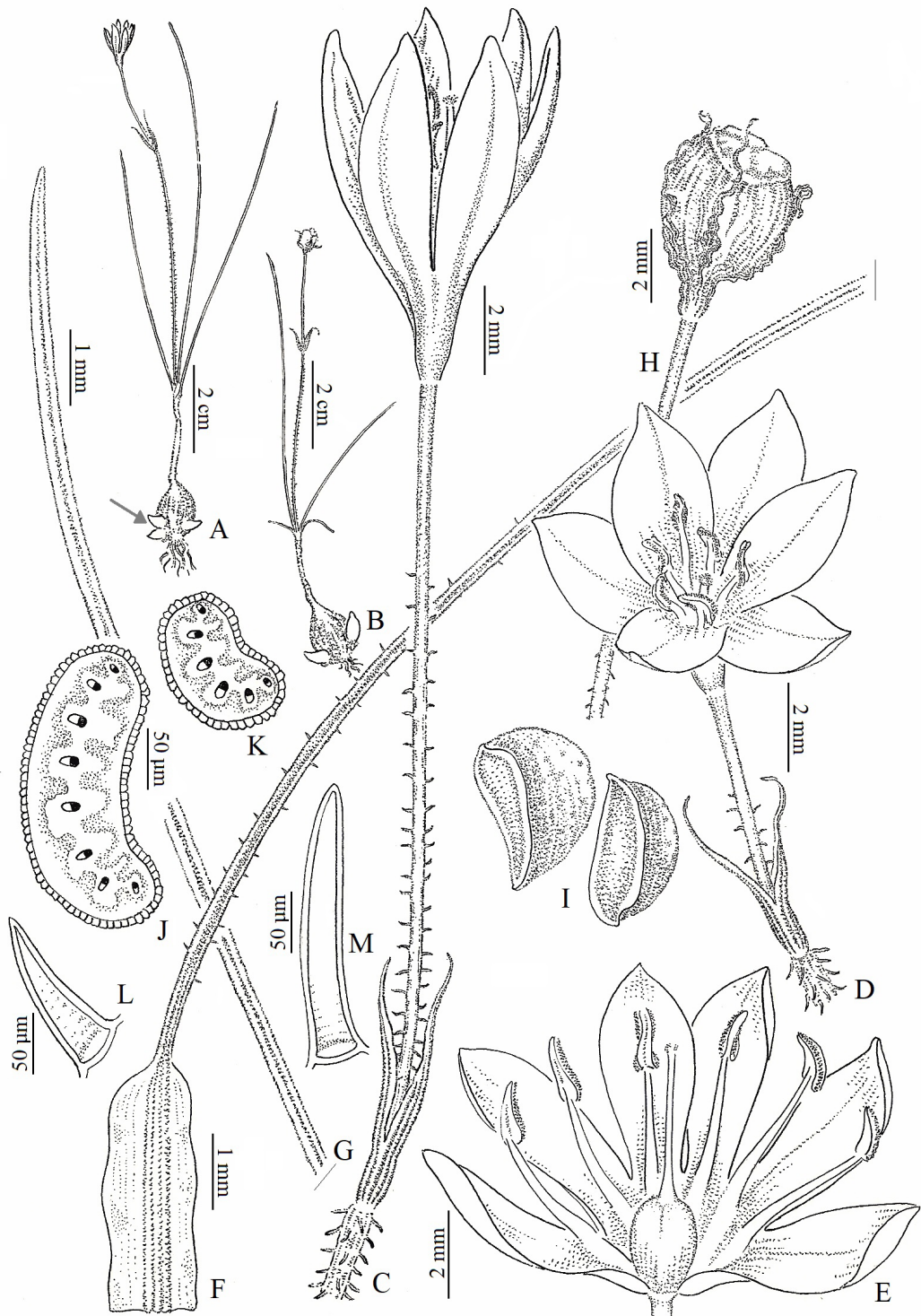


Fig. 2. *Nothoscordum parvum*. A: Flowering specimen. B: Fruiting specimen. C: Flower, lateral view, showing pedicels, bracts and apex of scape. D: Flower, upper view. E: Flower open, showing pistil and stamens. F: Proximal part of the leaf blade and leaf sheaths. G: Distal part of leaf blade. H: Capsule. 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 & Moreira 20155 (PACA); B, H-I from Deble & Moreira 20234 (PACA)].



Fig. 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 (CTES)].

in Indian ink and the illustrations are based on both living specimens and dry material. Figures 4 and 5 were made from photographs of specimens in nature or in cultivation, and the plates were edited with the Adobe Photoshop software, version 24.5. Figures 6 and 7 were produced using ArcMap version 10.7 and the features were created from the map base titled Topographic.

To create Table 2, the following specimens of the related species included in it were consulted:

- N. gaudichaudianum* Kunth. **ARGENTINA. Corrientes:** Monte Caseros, 7-IX-1952, *Nicora 6267* (SI044977). **BRAZIL. Rio Grande do Sul:** 16 km N of Rio Camaquã on Passo dos Marinheiros, 10-X-1972, *Lindeman et al.* (ICN20606). **URUGUAY. Maldonado:** Sierra de las Ánimas, *Crosa 2733* (SI044987). **Montevideo:** Sur la Bonite, IV-1836-37, *Gaudichaud s.n.* (*holotypus* P00852537 photo!).
- N. inundatum* Ravenna. **ARGENTINA. Corrientes:** Mburucuyá, Estancia Sta. María, 8-V-1956, *Pedersen 3912* (*holotypus* CTES0000187; *isotypus* C10005325 photo).
- N. marchesii*. **URUGUAY. Rocha:** Parque Nacional de San Miguel, coleccionado em el borde de afloramientos rochosos, entre el Fuerte San Miguel y el cerro Picudo, 6-VI-2001, *Crosa* (*holotypus* MVFA32139; *isotypus* SI000430).
- N. modestum* Ravenna. **BRAZIL. Rio Grande do Sul:** Dom Pedrito, estrada da Pedreira, 18-V-2021, *Deble et al. 18852* (PACA). **PARAGUAY.** Without additional data, *Jorgensen 4757* (*holotypus* SI000433).
- N. vittatum*. **ARGENTINA. Entre Ríos:** Concepción del Uruguay, Coloni Elía, 24-V-1967, *Ragonese & Guaglianone* (SI26103!). **BRAZIL. Rio Grande do Sul,** Dom Pedrito estrada da Barragem do Tacuarembó, 18-V-2021, *Deble & Moreira 18854* (PACA). **URUGUAY. Montevideo:** Cerro, V-1920, *Felippone 3447a* (SI044788!).

Taxonomic Treatment

Nothoscordum elongatum Deble & B. P. Moreira, *sp. nov.* [Figs. 1, 4 (A-E) and 6].

Typus: Brazil. Rio Grande do Sul: Caçapava do Sul, BR 153, 260 m, 21-IV-2019, *L. P. Deble & B. P. Moreira 20153* (*holotypus* PACA; *isotypi* CTES, ICN).

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 tall above the soil. Bulb 6-9 × 6-8 mm, nearly spherical or broadly ovoid, simple, with strong alliaceous odor; 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 reflexed, margin thickened and rigid, apex obtuse or rounded, abundant pilosity composed of straight or slightly curved 1-celled 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, humifuse at fruit maturity, with alliaceous odor when crushed, densely covered by straight 1-celled 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 smaller than the ones of the 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 abaxially greenish-yellow, discreet, thicker towards the base. Staminal filaments 2.5-4 mm long, subulate, translucent, yellow, free at their bases and attached directly to the tepal; anthers 1.2-1.8 mm long, curved, pollen golden-yellow. Ovary trilocular,



Fig. 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.



Fig. 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.

obovate-oblong, slightly trilobed, 1.8-2 mm long; ovules 5-6 per locule; style yellow or greenish-yellow, 3-3.5 mm long, stigma capitate, greenish-yellow, shiny. Capsule obovate, 4-5 × 3-3.5 mm. Seeds 1.4-1.8 mm long, black, shiny, curved and angled.

Etymology: The specific epithet *elongatus* in Latin means elongated, a reference to the scapes and pedicels, which are long and quite thin, especially when compared to their morphologically closest taxon (*N. marchesii*).

Phenology: Flowering time April-May, fruiting time May-June. The flowers open around midday and close in the late afternoon, withering after a day or two. During the flowering period, plants exude a strong alliaceous odor, which becomes the predominant odor around areas of occurrence of specimens of *N. elongatum*.

Additional material examined: **BRAZIL. Rio Grande do Sul:** Caçapava do Sul, Guaritas, 320 m, 1-V-2020, Deble & Moreira 20294 (PACA).

Distribution and habitat: *Nothoscordum elongatum* occurs in central-eastern Rio Grande do Sul state, Brazil. The specimens grow between 260-320 m, in environments with low drainage capacity, in places with 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 ericacea* Cham. & Schldl. (Plantaginaceae). Other bulbous plants of the same environment are *Cypella pusilla* (Link & Otto) Benth. & Hook. f. ex B. D. Jacks. (Iridaceae) and *Nothoscordum dialystemon* and *Zephyranthes americana* (Hoffmanns.) Ravenna (Amaryllidaceae).

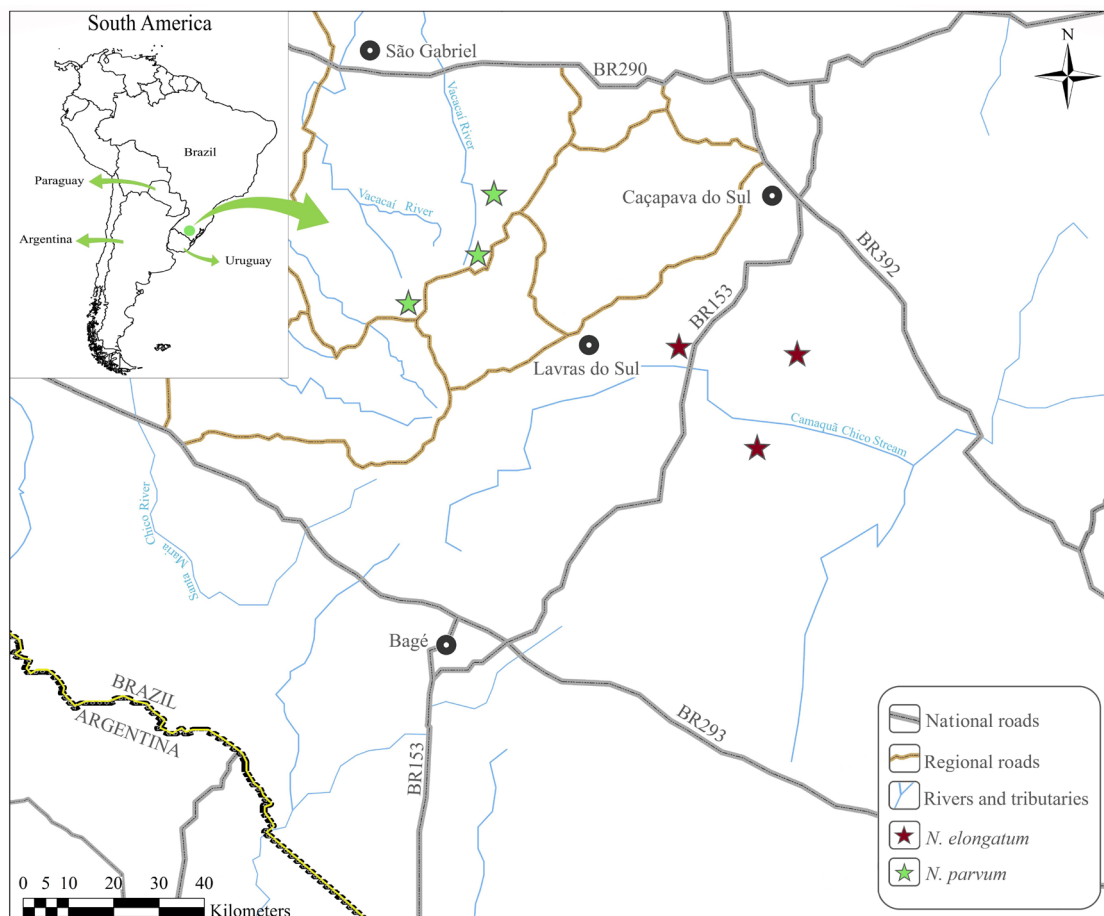


Fig. 6. Geographic distribution of *Nothoscordum elongatum* and *Nothoscordum parvum*.

Conservation: Based on the analysis of exsiccates and observations in the possible occurrences, only two small populations were identified, indicating the rarity of the species. The Extent of Occurrence (EOO) is less than 100 km² and the Area of Occupancy (AOO) is less than 10 km². This species occurs in a specific rocky habitat, with shallow soils and poor drainage and the bulbs develop in crevices of sandstone and conglomerate rocks. These areas are being modified by economic activities, such as mining and agriculture around, with use of herbicides and loss of habitat quality. According to the criteria of IUCN (2019), *N. elongatum* can be considered Critically Endangered (CR), based on direct threats, geographical distribution, occupied area and population size [CR B1+B2b (i, ii, iii, iv, v) + c (iii, iv)].

Nothoscordum parvum Deble & B. P. Moreira, *sp. nov.* (Figs. 2, 4 (F-J) and 6). *Typus:* Brazil. Rio Grande do Sul: São Gabriel, cerro do Ouro, 390 m, 4-IX-2019, L. P. Deble & B. P. Moreira 20155 (*holotypus* PACA; *isotypi* CTES, ICN).

Nothoscordum parvum is morphologically related to *N. modestum* and *N. urutauense*; however, it can be easily distinguished from *N. modestum* by its bulbs surrounded by bulbils (vs. simple), with strong alliaceous odor (vs. mild alliaceous odor when the cataphylls and foliage are crushed), densely pilose leaves and scapes (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 erect scapes at fruit maturity (vs. humifuse). *Nothoscordum parvum* differs

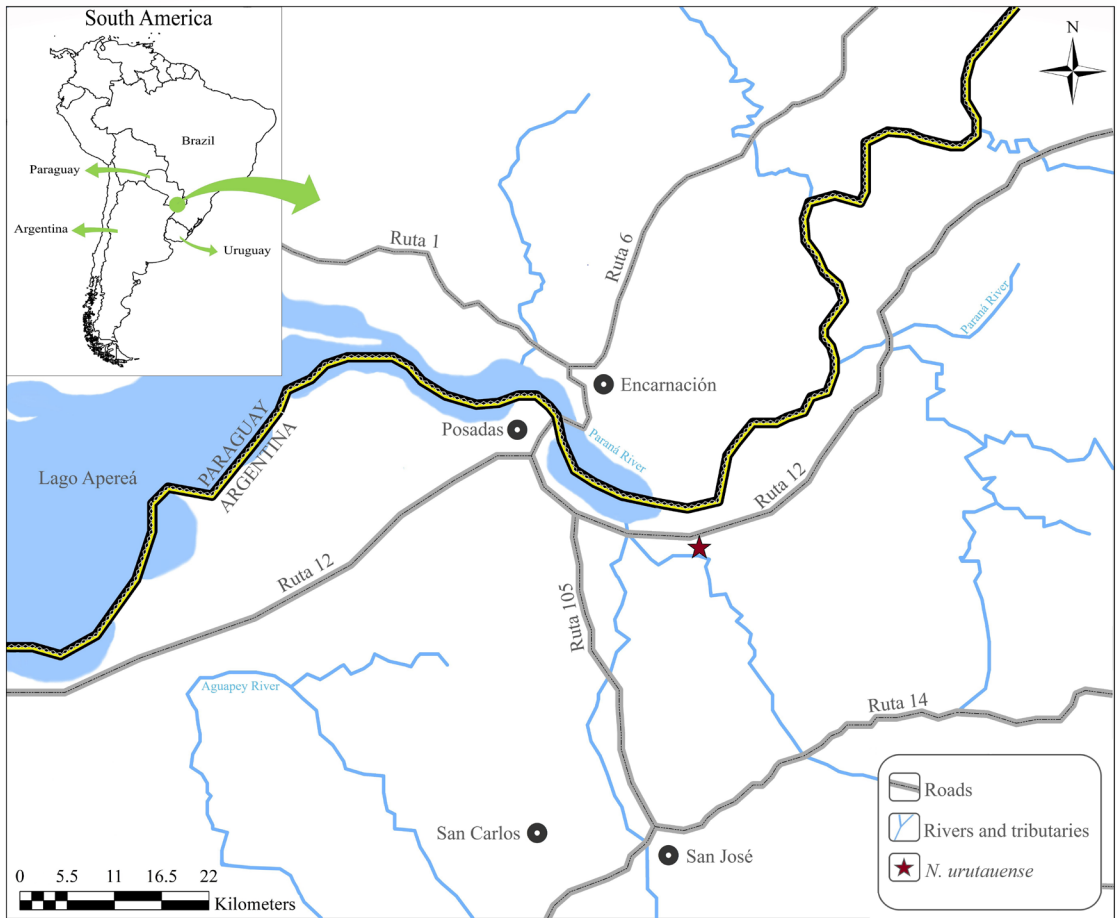


Fig. 7. Geographic distribution of *Nothoscordum urutauense*.

from *Nothoscordum urutauense* by its bulbs surrounded by bulbils (vs. simple), narrower filiform leaves (0.4-0.5 mm vs. 0.8-1.6 mm), erect scapes at fruit maturity (vs. humifuse) and nearly obovate and slightly 3-lobed fruits (vs. spherical and strongly 3-lobed).

Geophyte 5-10 cm tall above the soil. Bulb 7-10 × 7-8 mm, ovoid, proliferous, with strong alliaceous odor; 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

straight or slightly curved 1-celled 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 odor when breaking, densely covered by straight 1-celled 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 trilobular, obovate, 3-lobed, 2.3-3.3 mm long; ovules 7-9 per locule; style yellowish-white, 5-6 mm long, stigma capitate, greenish-yellow, shiny. Capsule obovate, slightly 3-lobed, 5.5-6.5 × 3-4 mm. Seeds 1.6-1.8 mm long, black, shiny, curved and angled.

Etymology: The specific epithet *parvum* in Latin means small, a reference to the thin and small size of the new species.

Phenology: Flowering and fruiting time September. Flowers open in midafternoon during one or two days. During the flowering period, the plants exude a strong alliaceous odor, which becomes the predominant odor around areas where *N. parvum* occurs.

Additional material examined: **BRAZIL. Rio Grande do Sul**: São Gabriel, Três Cerros, 410 m, 18-IX-2021, *Deble & Moreira 20233* (PACA); trajeto a vila de Palma, 280m, 18-IX-2021, *Deble & Moreira 20234* (PACA!).

Distribution and habitat: *Nothoscordum parvum* occurs in central-southern Rio Grande do Sul state, Brazil, on the border between the municipalities of São Gabriel and Lavras do Sul. The specimens grow between 280-410 m, in environments with poor drainage capacity, in places of wet shallow soils, with abundant organic matter and rich in clay minerals, in concavities of the granitic rocks from the domain of undeformed granitic rocks (CPRM, 2009). The individuals grow in association with mosses, *Drosera brevifolia* Pursh (Droseraceae), *Nothoscordum dialystemon* (Guagl.) Crosa (Amaryllidaceae) and small and delicate Cyperaceae and Poaceae species. *Nothoscordum collinum* Ravenna is another endemic in the same area, occurring in dryer places and in rocky crevices.

Conservation: Based on the analysis of exsiccates and observations in the possible places of occurrence, only three small populations were identified, indicating the rarity of the species.

The Extent of Occurrence (EOO) is less than 100 km² and the Area of Occupancy (AOO) is less than 10 km². This species occurs in a specific habitat, in environments with poor drainage in places with wet shallow soils, rich in organic matter and clay minerals, developed in cavities on granitic rocks. These environments are being modified by economic activities, such as mining, agriculture, and silviculture. According to the criteria of IUCN (2019), *N. parvum* can be considered Critically Endangered (CR), based on the direct threat, geographical distribution, area of occupation and population size [CR B1+B2b (i, ii, iii, iv, v) + c (iii, iv)].

Nothoscordum urutauense Deble & H. A. Keller, *sp. nov.* (Figs. 3, 5 and 7). *Typus*: Argentina. Misiones: Candelaria, Reserva Urutaú, 27°28'47,6''S and 55°43'57,6''W, 98 m, 6-VI-2019, fl and fr, *H. A. Keller 13867* (*holotypus* CTES).

Nothoscordum urutauense is similar to *N. inundatum* Ravenna and *N. parvum*; however, it can be easily distinguished from *N. inundatum* by its broader leaves (0.8-1.6 mm vs. 0.2-0.4 mm), 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 *N. parvum*, the new species differs by its simple bulbs (vs. bulbs surrounded by bulbils), broader leaves (0.8-1.6 mm vs. 0.4-0.5 mm), humifuse scapes at fruit maturity (vs. erect) and spherical and strongly 3-lobed fruits.

Geophyte 8-14 cm tall above the soil. Bulb 6-8 × 6-8 mm, nearly spherical or ovoid, simple, with strong alliaceous odor; 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 reflexed, margin thickened and rigid, apex slightly acute or obtuse, abundant pilosity 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 odor when crushed, densely covered by 1-celled trichomes of straight cells, 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 smaller than the trichomes on scapes. Inflorescence 2-flowered. Flowers 8-10 × 7-8 mm, campanulate, white, shiny. Tepals 6 (3+3), white turning 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 mm, apex slightly acute, base attenuate; the inner ones elliptic-lanceolate, blades 6-8 × 1.8-2 mm; apex slightly acute, base attenuate; tepal middle nerves greenish-brown abaxially, 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-lobed, trilocular, 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-lobed, 3.5-4.5 × 3-4 mm. Seeds 1.8-2 mm long, black, shiny, curved and angled.

Etymology: The specific epithet refers to the only known location of 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 a day or two.

Additional material examined: **ARGENTINA. Misiones:** Candelaria, Reserva Urutaú, 27°28'47,6"S, 55°43'57,6"W, 29-V-2019, fl, Keller & 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 90-100 m. It shares the habitat with small subshrubs and herbs such as *Ayenia mansfeldiana* (Herter) Herter ex Cristóbal (Malvaceae), *Evolvulus sericeus* Sw. (Convolvulaceae), *Oxypetalum microphyllum* Hook. & Arn. (Apocynaceae), *Tripogon spicatus* (Nees) Ekman (Poaceae), among others small and delicate herbs.

Conservation: The species occurs in the Urutaú Reserve site close 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 m². 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 the species is critically endangered (CR) according to criteria B1ab(iii) + D (IUCN, 2019).

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 the field analysis of other previously described taxa, which were known only from herbarium material, have helped to clarify the limits of the genus *Nothoscordum* (Deble, 2022; Deble & Moreira 2022). Important morphological characters, such as the position of the scapes at fruit maturity (humifuse vs. erect), the number of flowers in the inflorescence (1-2 vs. numerous) and the union or not of the filaments, are more diverse within the genus than previously recognized.

From a morphological point of view, the description of these three new species supports the inclusion of *Beauverdia* in *Nothoscordum*, as previously suggested by other authors (for example, Crosa, 2006, Souza *et al.*, 2016, Pellicier *et al.*, 2017, Sassone & Giussani, 2018, Deble & Moreira, 2022). Distinctive morphological features for the recognition of *Beauverdia*, such as solitary flowers and humifuse scapes during fruit maturity are found in *N. elongatum* and *N. urutauense*. On the other hand, these species have long pedicellate flowers, a morphological characteristic commonly found in the genus. *Nothoscordum parvum*, in turn, although morphologically related to the other species here described, has erect scapes during fruit maturity, as in most *Nothoscordum* species.

Table 2. A comparison of selected characters differing among *Nothoscordum elongatum*, *N. parvum* and *N. urutaense* 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. urutaense</i>
Alliaceae smell	Present	Absent or mild on bulbs	Present	Absent or mild on bulbs	Present	Present	Absent	Present
Indument	Abundant on leaves, scapes and pedicels	Glabrous	Abundant on scapes and pedicels	Glabrous	Glabrous	Abundant on leaves, scapes and 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
Leaf 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-October	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)

The three new species proposed here are morphologically related to *N. gaudichaudianum*, *N. inundatum*, *N. marchesii*, *N. modestum*, and *N. vittatum*. *Nothoscordum elongatum* is morphologically similar to *N. marchesii*, because of its linear-filiform leaves, small flowers, light-yellow or white-cream tepals, and bulbs and leaves with strong alliaceous odor. 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), 2-flowered inflorescence (vs. 1-flowered), smaller flowers (6-7 × 6-7 mm vs. 10-11 × 6-9 mm), 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 odor (vs. mild alliaceous odor 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), 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, scapes, bulbs and leaves with strong alliaceous odor (vs. mild), and fewer numbers of flowers in the inflorescence (1-2 vs. 3-10). Additional features to distinguish *N. elongatum*, *N. parvum* and *N. urutauense* from their morphologically related species can be assessed in the Table 2.

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

1. Stamens with adnate filaments. 2
- 1'. Stamens with free filaments. 6
2. Flowers golden-yellow or yellow. 3
- 2'. Flowers white or pinkish white. 5
3. Leaves reflexes, narrowly lanceolate. *N. felipponei* Beauverd
- 3'. Leaves erect-ascendant, linear-filiform. 4
4. Plants with strong alliaceous odor. Bulbs simple, without rhizomes. Roots slender.
..... *N. hirtellum* (Kunth) Herter
- 4'. Plants without or with mild alliaceous odor. Bulbs with long horizontal rhizomes. Roots thickened.
..... *N. subsessile* Beauverd
5. Leaves at anthesis absent. Scapes glabrous. Pedicels 10-15 mm long. *N. subtile* Ravenna
- 5'. Leaves at anthesis present. Scapes densely pilose. Pedicels 12-24 mm long. *N. inundatum* Ravenna
6. Scapes humifuse at fruit maturity. 7
- 6'. Scapes erect at fruit maturity. 13
7. Flowers shortly pedicellate (pedicels up to 10 mm, shorter than the length of the tepals). 8
- 7'. Flowers pedicellate (pedicels 11-25 mm long, longer than the length of the tepals). 11

8. Flowers yellow, with 8-13 tepals. *N. dialystemon* (Guagl.) Crosa
 8'. Flowers white, cream or light-yellow, with 6 tepals. 9
 9. Leaves with papillose margin, ascendant-reflexed or reflexed, linear, 1-3 mm wide. Scapes papillose.
 *N. vittatum* (Griseb.) Ravenna
 9'. Leaves glabrous, erect-ascendent, narrowly linear-filiform, 0.4-0.8 mm wide. Scapes glabrous. 10
 10. Plants with strong alliaceous odor. Flowers white-cream or light yellow. *N. marchesii* Crosa
 10'. Plants without alliaceous odor. Flowers white. *N. setaceum* (Baker) Ravenna
 11. Leaves 0.3-0.5 mm wide. Flowers white-cream or light yellow. *N. elongatum* Deble & B. P. Moreira
 11'. Leaves 0.6-2 mm wide. Flowers white. 12
 12. Plants glabrous. Leaves broadly elliptic in cross-section. Capsule obovate-oblong, slightly 3-lobed.
 *N. modestum* Ravenna
 12'. Plants pubescent. Leaves sulcate in cross-section. Capsule broadly obovate, markedly 3-lobed.
 *N. urutauense* Deble & H. A. Keller
 13. Plants pubescent, with strong alliaceous odor. Flowers white. *N. parvum* Deble & Moreira
 13'. Plants glabrous, without alliaceous odor. Flowers yellow. *N. ostenii* Beauverd

Nothoscordum pachyrhizum Ravenna and *N. muscorum* Ravenna were described as having humifuse scapes and 2-flowered inflorescence (Ravenna, 1991a, b). Nevertheless, type analysis and examination of plants from the original populations revealed that both species present 3-4-flowered inflorescence, and therefore not included in the key.

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