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Source: *Willdenowia*, 49(1) : 35-41

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: <https://doi.org/10.3372/wi.49.49105>

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A new *Viola* (*Violaceae*) from the Argentinian Andes

Version of record first published online on 25 March 2019 ahead of inclusion in April 2019 issue.

Abstract: *Viola beati*, a hitherto unknown species of *V.* sect. *Andinium* (*Violaceae*) is described and illustrated. It is an inconspicuous, diminutive, perennial forb currently known from only one locality in NW Argentina. We draw attention to its morphology, ecology, rarity and endemism. The differences between *V. beati* and its apparently only close relative, *V. singularis* J. M. Watson & A. R. Flores, are defined.

Resumen: Se describe y se ilustra *Viola beati* perteneciente a la *V.* sect. *Andinium* (*Violaceae*), una especie desconocida hasta ahora. Es una planta perenne, discreta, diminuta, conocida actualmente de una sola localidad en el noroeste de Argentina. Llamamos la atención sobre su morfología, ecología, rareza y endemismo. Se definen las diferencias entre *V. beati* y *V. singularis* J. M. Watson & A. R. Flores, que es aparentemente su único pariente cercano.

Key words: Andes, Argentina, endemic, new species, *Viola beati*, *Viola* sect. *Andinium*, *Viola singularis*, *Violaceae*

Article history: Received 4 September 2018; peer-review completed 16 November 2018; received in revised form 23 November 2018; accepted for publication 29 November 2018.

Citation: Watson J. M., Flores A. R. & Arroyo-Leuenberger S. C. 2019: A new *Viola* (*Violaceae*) from the Argentinian Andes. – Willdenowia 49: 35–41. doi: <https://doi.org/10.3372/wi.49.49105>

Introduction

Viola L. is the most species-rich genus in the *Violaceae*, with 610–655 species distributed throughout most temperate regions of the world as well as on mountains and islands in the tropics (Marcussen & al. 2015; Watson & Flores unpubl. data). Marcussen & al. (2015) provisionally recognized 16 sections, but the genus is currently undergoing revision, the first one since the outline by Becker (1925), which may result in changes to the infrageneric classification (T. Marcussen pers. comm.).

Viola sect. *Andinium* W. Becker (Becker 1925) contains the largest number of known species (Marcussen & al. 2015; Watson & Flores unpubl. data), yet remains the least understood of the infrageneric divisions of *Viola*. Currently there are 100 published species accepted by the

present authors (Watson & Flores 2018), excluding the novelty presented here, while 36 more have still to be described.

The longitudinal distribution of *Viola* sect. *Andinium* covers 7500 km when adjusted to follow the Andean chain, and is almost continuous. The equator marks the northernmost limit of its range, which reaches down as far as c. 47°S in Patagonia. Lateral distribution extends from the Pacific coasts of Chile and S Peru inland to the high Andes, reaching its maximum width of c. 700 km at around 25°S. Taxa in this section inhabit elevations from sea level to over 5000 m, but 88% of its species occur at Andean heights exclusively or predominantly (Watson & Flores 2014b; Watson & al. 2015). The centre of diversity of the section stretches from C Chile and Argentina to N Patagonia. Another lesser and more dispersed group cov-

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ers the tropical Andean highlands of Ecuador, Peru and N Bolivia (Watson & Flores unpubl. data), while a third aggregation of 17 species, including the new *Viola beati*, exists in the outlying eastern cordilleras of NW Argentina (Watson & Flores 2014a).

In 2005, two of the present authors (J.M.W. & A.R.F.) visited the Botanischer Garten und Botanisches Museum Berlin (B) to review any remaining material of the heavily bomb-damaged *Viola* collection (Hiepko 1987; Haageman & Zepernick 1993). There we examined a pygmy *Viola* species, which had been collected in NW Argentina in 1994. Notes and sketches were made and a full investigation revealed that the species described below was indeed unknown to science.

Material and methods

The present conclusive outcome is based on the study of herbarium material at B. Detailed measurements and descriptive notes were taken there in 2005 with the aid of a Wild M5A binocular dissecting microscope. Inflorescences and flowers were soaked in tap water and boiled in order to be softened, and close-up photographs showing various aspects and micromorphological details were taken, using an Olympus SZX16 (Fig. 1A–F).

Results

Viola beati J. M. Watson & A. R. Flores, **sp. nov.** – Fig. 1. Holotype: Argentina, Provincia Catamarca, Departamento Belén, hills at summit of first pass on Ruta Nacional 43, 54 km by road travelling north from Ruta Nacional 40 (28 km NNE of Villavil), 26°51'S, 66°45'11"W, 3350–3400 m, 20 Feb 1994, B. E. Leuenberger, S. C. Arroyo-Leuenberger & U. Eggl 4263 (B 10 0630577! <http://herbarium.bgbm.org/object/B100630577>).

Diagnosis — The new species belongs in *Viola* sect. *Andinium* W. Becker, where it is apparently closely allied only to *V. singularis* J. M. Watson & A. R. Flores. It differs from that species by stipules being absent, lamina with abaxial surface eglandular and margin with fewer (3 vs 5 or 6) crenations, and inferior petal conduplicate and deeply naviculate. Uniquely for the section, *V. beati* also possesses a ligneous aerial structure and porrect, paddle-shaped style crest lobes.

Description — *Herb*, perennial, ligneous-cauline, cushion-forming chamaephyte, c. 2 cm high × 3.5 cm in diam.; *indumentum* where present always long, pale silky-silvery, villous, flattened trichomes. *Lower subterranean rootstock* unknown; *caudex* remnant (as present on holotype specimen) vertical, undivided, c. 7 mm long × c. 2 mm in diam., ligneous, containing sparse leaf scars of previous growth, radiating at ground level into regular

branching; *stem* 14–20 mm long × c. 0.35 mm thick, simple or few-branched, bare basally for 7–12 mm, terminating apically in dense subrosettes 5–8 mm high × 10–14 mm in diam. *Leaves* somewhat thick-textured but not rigid, cryptic; *main lower mature leaves* petiolate, 5–8 mm long, occasional leaves subtending rosettes sessile, c. 1.5 mm long; *upper juvenile leaves* shorter and with pre-developed petiole; *stipules* absent; *petiole* 3.5–5.8 mm long × c. 0.2 mm wide in mature leaves, somewhat channelled beneath, glabrous; *mature lamina* 1.5–2.2 × 1–1.5 mm, obovate to oblanceolate, tapering to petiole, apex subacute to subobtusate; *adaxial surface* reticulate-alveolate, greyish to pale grey-brown; *abaxial surface* subrugose, with dense indumentum when juvenile, less so at maturity, eglandular; *margin* thickened, crenate, on both sides with 2 large, rounded main lobes and 1 smaller, somewhat forward-curved basal lobe, crenation less pronounced in lowermost mature leaves; *marginal indumentum* irregularly directed, denser in basal part and sparse along subglabrous apex of mature leaves. *Flowers* solitary from leaf axil, produced level with leaves or slightly recessed; *peduncle* somewhat shorter than mature leaves, indumentum present in distal $\frac{2}{3}$, dense apically, becoming glabrous toward base; *bracteoles* c. 5.25 mm long, inserted in basal $\frac{1}{2}$ of peduncle, narrowly linear, tapering to point, hyaline, subglabrous basally, indumentum present on distal $\frac{1}{4}$. *Calyx* 5–6 mm long; *sepals* c. 0.8 mm wide at base, linear-triangular, hyaline margin curved and terminating below thickened, acuminate apex; margin and abaxial surface densely covered with irregularly directed indumentum. *Corolla* c. 4.5 mm long, white or pale violet, with violet staining distally on superior and lateral petals, where terminating below in longitudinal central vein; lowermost petal with extensive fine violet veining, at least at apex; *superior petals* c. 4.5 × 0.8 mm, linear, glabrous, apex rounded; *lateral petals* c. 4 × 1.8 mm, proximal $\frac{2}{3}$ oval, distal $\frac{1}{3}$ a slightly narrower triangular extension, indumentum present on face, forming dense, central patch, apex rounded; *inferior petal* somewhat porrect, notably larger in area than superior four, c. 4 × 6 mm (when flattened), broadly obcordate, conduplicate, deeply navicular and distinctly carinate, glabrous; *spur* not visible on holotype specimen, but evidently either much reduced and contained within apical curve of peduncle or absent. *Style* surrounded and covered basally to 1.6 mm in diam. by conjoined anthers and dull, dark yellow connectives; style head globose, directed downward and somewhat outward, terminated by anterior stigmatic aperture; *stigma* wide, blunt; *style crests* 2, lateral, porrect, curved, concave, paddle-shaped lobes c. 0.8 mm long on both sides of style head and exceeding stigmatic aperture. *Fruit* (as seen in immature stage) a capsule containing c. 4 seeds; *submature seeds* c. 1.7 × 1.2 mm, pyriform, chestnut-brown.

Phenology — Flowering in February.

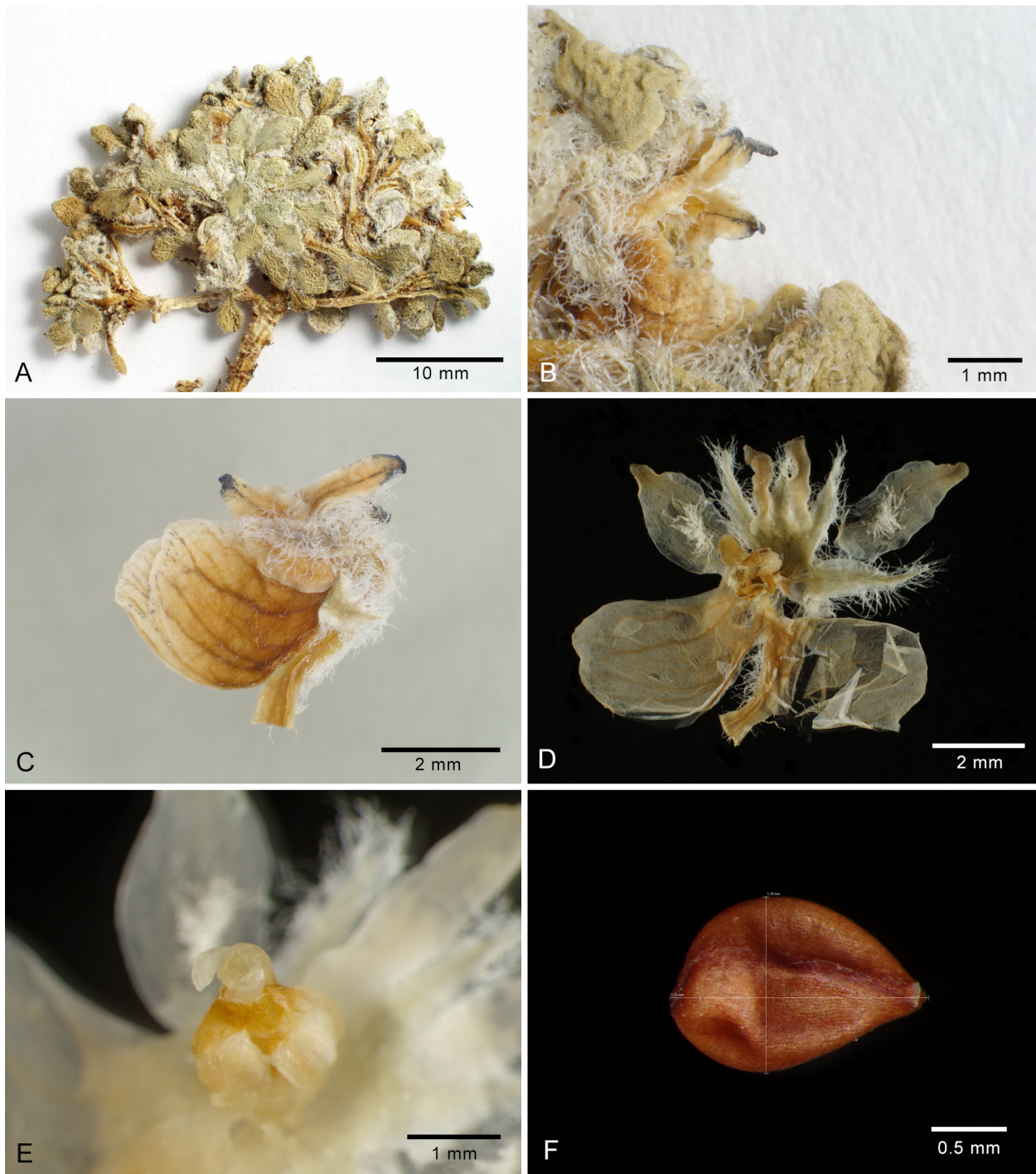


Fig. 1. *Viola beati*, holotype specimen – A: lateral view of whole aerial formation of plant; B: flower in natural position among foliage; C: lateral view of flower showing strong navicular conduplication of lowermost petal; note also atypical size imbalance between that and higher four petals; D: frontal view of flower opened and flattened, resulting in splitting and separation of lowermost petal sides; E: basal stamens, connectives (yellow), apex of style, and lateral lobes of style crest directed forward and covering stigma; F: lateral view of immature seed. – All photographs by Monika Lüchow.

Distribution and ecology — Apparently endemic to high ridges to the north of Belén, Catamarca Province, Argentina (Fig. 3 & 4) as one small population of a few individuals in exposed sandy to loose, gravelly ground at the foot of a hillslope (Fig. 2). Dominant vegetation consists of a mixed bunch grass and low to cushion shrub community with intermittent clearings and more extensive open

stretches. Other immediate Andean taxa include *Airam-poa soehrensii* (Britton & Rose) Lodé [syn. *A. ayrampo* (Haenke) Doweld] (*Cactaceae*), *Caiophora coronata* Gillies ex Hook. & Arn. (*Loasaceae*), *Glandularia* cf. *microphylla* (Kunth) Cabrera (*Verbenaceae*), *Phacelia pinnatifida* Griseb. ex Wedd. (*Boraginaceae*) and *Trichocline excapata* Griseb. (*Asteraceae*). As noted in situ by the col-

lectors, the rosettes of *V. beati* were at soil level, with their leaves tightly arranged and greyish tomentose.

Conservation status — Known only from the type collection, made in 1994; it was not found by the present authors in Argentinian herbaria or at any other institution visited. Although under no apparent immediate threat, as a small population confined to an extremely restricted area, it classifies as a very rare, potentially endangered, single-site microendemic.

Eponymy — The epithet commemorates and honours the late Dr Beat Leuenberger, who was a botanist at the Botanischer Garten und Botanisches Museum Berlin and husband of the present author Silvia Arroyo-Leuenberger. He is the first and so far only person to have found this species. The personal name Beat possesses a well-established latinized form, *Beatus*, meaning “blessed”. Therefore, and in accordance with Rec. 60C.1 of the *International Code of Nomenclature for algae, fungi, and plants* (Turland & al. 2018), the correct orthography of the epithet is the genitive of *Beatus*, i.e. *beati*, with a single “i”. Art. 60.8 does not apply in this case.

Remarks — Heavy pressing of specimens can lead to some or all of the diagnostic adaxial lamina reticulation being partially or completely reduced to a flat, smooth surface, as has occurred with the type of *Viola beati*. This may give rise to inaccurate descriptions and lead to subsequent taxonomic confusion (e.g. Rossow 1988).

The existence or not of a lower petal nectar spur remains unresolved due to the undesirability of risking damage to the delicate floral structure of this unique specimen by dissection. It may either be concealed and very short, as in other species of the section (pers. obs.), or absent. One allied species only, *Viola granulosa* Wedd., does lack this feature (Weddell 1864; Baehni & Weibel 1941).



Fig. 2. Locality and environment of *Viola beati* – A: general situation on pass to north-northeast of Villavil, Catamarca, Argentina at 3400 m, 20 Feb 1994; B: same area as A, showing vegetation with sandy clearings as habitat of *V. beati*, 20 Feb 1994. – Both photographs by Urs Eggli.

Viola singularis is noted here as the only species bearing any significantly close morphological resemblance to *V. beati*, as well as being nearest to it geographically. Nicola (2017) treated the former species as doubtfully present in the flora of Argentina. This judgement was based on the grounds that the holotype is the only known individual of the species, its overall morphology had been impossible to assess, and its authors had noted its similarity to other taxa of *V. sect. Andinium* (Watson & Flores 2009). This assessment, which could also be largely applied to *V. beati*, lacks foundation because critical characters that distinguish *V. singularis* from all others in the section, including *V. beati*, are clearly defined both in the type description (Watson & Flores 2009) and the present work. Furthermore, the known existence of

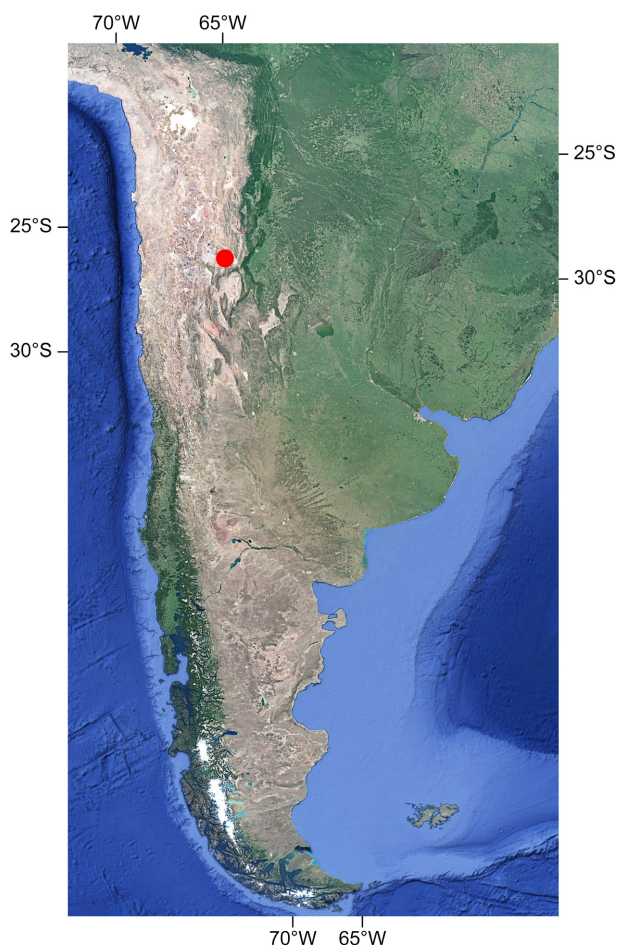


Fig. 3. Known distribution of *Viola beati* (red circle) in southern cone of South America. Coordinates are distorted by projection curvature and angle of alignment of map. – Google Earth (<https://www.google.com/earth/>), modified by John Watson and BGBM Berlin.

only one representative of a taxon is not by itself a scientifically valid reason to dispute its acceptance as a distinct entity.

Discussion

Infra-sectional affiliation

The most recognizable common feature of the new species is the network of raised veins on the adaxial lamina surface, which unites an otherwise fairly disparate and very widely distributed complex of *Viola* sect. *Andinium* species under the provisional grouping of the *Viola volcanica* Gillies ex Hook. & Arn. alliance (Watson & Flores unpubl. data). Beyond that, its precise systematic relationships are unclear, but morphologically it is significantly different from all taxa presumed to be closely related to it except the even smaller *V. singularis* (Fig. 3 & 4). Originally, the latter species was presumed on available evidence to be situated 500 km to the south of *V. beati* (Watson & Flores 2009). Subsequently, it was accurately located at a mere 10–15 km distant from *V. beati* across a valley in the same mountain ridge (Watson & Flores

2014b) (Fig. 4). Despite this geographical proximity, shared morphology is limited to their perennial, dwarf, cryptic life-forms; long “true” petioles; and laminas with crenate margins and reticulate-alveolate venation. Other diagnostic features, such as style crest, leaf outline, corolla configuration and presence or not of glands, are either only broadly comparable or differ entirely.

Key to distinguish *Viola beati* from all other taxa of *Viola* sect. *Andinium*

1. Plants glabrous or with indumentum; ericaceous, open-structured, or rosette-forming; adaxial lamina surface plane or with scarcely raised veins
 61 published species of *Viola* sect. *Andinium*
- Plants always with indumentum, rosette-forming; superior lamina surface with notably raised alveolate-reticulate veins **2**
2. Leaves pseudopetiolate; style crest apical or absent
 38 published species of *Viola volcanica* alliance
- Leaves petiolate; style crest lateral **3**
3. Leaves stipulate; marginal crenations of lamina 5 or 6 per side, abaxial surface of lamina glandular; inferior petal plane, 6–7 mm long; style crest appendages flat, subtriangular, directed downward . . . *Viola singularis*
- Leaves estipulate; marginal crenations of lamina 3 per side, abaxial surface of lamina eglandular; inferior petal conduplicate, c. 4 mm long; style crest appendages concave, paddle-shaped, porrect . . . *Viola beati*

Evolution, ecology and phylogeography

Viola sect. *Andinium* has evolved over a calculated period of c. 30 million years (Marcussen & al. 2015) in a context of continuous Andean orogeny involving violent volcanic activity (Luebert & Weigend 2014). Due to ceaseless and at times rapid resultant geological and climatic transformations throughout their range, an abundance new habitats has continually been available for these opportunist, short- and long- distance *Viola* colonizers. But without doubt, wide-scale extinctions, both instantaneous and gradual, have also occurred (Watson & Flores 2013).

Although the date of origin of *Viola beati* is not known, that of another species of the proposed *V. volcanica* alliance within *V. sect. Andinium* has been revealed by molecular analysis. As noted above, the section itself is calculated to have appeared c. 30 million years ago (mya), while *V. congesta* Gillies ex Hook. & Arn., considered on morphological evidence to be a relatively evolutionarily advanced member of the *V. volcanica* alliance (Watson & Flores unpubl. data), dates back to c. 10 mya (Marcussen & al. 2015; T. Marcussen in litt.). This extensive timescale, taken in conjunction with the 4000 km range of the *V. volcanica* alliance and the unstable geological setting of its development, provides a background explanation for both the unique morphology and lack of apparent close allies of *V. beati* apart from *V. singularis* as

assumed here. The possibility that shared morphology of the latter two species has arisen through reticulation should be taken seriously (Marcussen & al. 2015).

Acknowledgements

Special thanks are due from Silvia Arroyo-Leuenberger to Dr. Urs Egli (ZSS) for his company during the fieldwork in Argentina and for providing collections of specimens, photographs and notes additional to those of Beat Leuenberger. Furthermore, we all appreciate Urs Egli's valuable direct contribution to the present work. Monika Lühchow (B) generously spared time to take high-quality photographs in the laboratory for us, several of which are reproduced here (Fig. 1). John Watson and Ana Flores are particularly indebted to Prof. Harvey E. Ballard Jr. of Ohio University (BHO). He kindly arranged funding for our journey to the 2005 International Botanical Congress at Vienna, which enabled us to include the subsequent visit to Berlin. We also wish to express our gratitude for the generosity of several colleague-friends who have provided funds to assist us in realizing this and other investigations. Helpful guidance by the Editor, and the exhaustive and thoughtful overall evaluation of the manuscript by Harvey Ballard and two anonymous reviewers, with many consequent valuable suggestions, criticisms and corrections incorporated, are much appreciated.



Fig. 4. *Viola beati* type locality (red circle) in Catamarca Province, Argentina, with area containing type locality of *V. singularis* (cyan ellipse). – Google Earth (<https://www.google.com/earth/>), modified by John Watson and BGBM Berlin.

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Willdenowia

Open-access online edition bioone.org/journals/willdenowia



Online ISSN 1868-6397 · Print ISSN 0511-9618 · Impact factor 1.500

Published by the Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin

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