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Cover picture: *Gymnocalycium saglionis* VoS 109, 10 km north of Calalao del Valle, Province Tucuman, Argentina, 1699 m (photo: V. Schädlich)

Editorial

Dear *Gymnocalycium* enthusiasts

Mario Wick



In the last few years a lot of new insights into distribution and relationships between the species of the genus *Gymnocalycium* have been gained. A number of people from different countries visit the localities of this genus regularly, especially in Argentina. Bolivia, Brazil and Uruguay are visited less and only few *Gymnocalycium* friends go to the trouble of travelling to Paraguay. It is hot there; roads and paths to the distant unexplored and potentially interesting *Gymnocalycium* localities are bad and not accessible every year. Rain and nature simply taking over the paths again prevent getting ahead. In addition, the species diversity of *Gymnocalycium* and thus the results cannot be compared to those of Argentina.

The main author of this *Schütziana* issue's article has already travelled to Paraguay five times and has brought along with him a lot of new insights as well as the confirmation of previous knowledge. Thus he could, for instance, together with Ludwig Bercht (Eck en Wiel, Netherlands), his travel companion at that time, retrace *G. matoense* in Mato Grosso do Sul in 2006. This species had been described by Buining & Brederoo in 1975 and up to then had been found again only once by Braun and Horst in 1983. Among other things, he was able to confirm the type locality of *G. anisitsii* by the River Tagatiya-mi in Paraguay together with Christian Hefti (Grindel, Switzerland) in 2012 and in 2016 he verified *G. mihanovichii*, described as *Echinocactus* by Frič & Gürke in 1905, near Puerto Casado on Rio Paraguay, again together with Ludwig Bercht.

In the course of all these investigations a lot of material accumulates in the form of locality photographs, travel records and knowledge gained from evaluating material at home. This material also includes seed photographs of superior quality, which are to be presented here, together with pictures of locality, habitat and the respective locality maps.

Have fun leafing through and gazing!

We would like to express our warmest thanks to Mrs Iris Blanz (Fernitz, Austria), to Mr Brian Bates (Bolivia) and to Mr Graham Charles (United Kingdom), who support us with the translation into English, to Mrs Larisa Zaitseva for the translation into Russian (Tscheljabinsk, Russia), to Mr Takashi Shimada (Japan) for the translation into Japanese and to Mr Daniel Schweich (France), who has mirrored our publications under <http://www.cactuspro.com/biblio/>.

The Seeds of the Genus *Gymnocalycium* Pfeiffer ex Mittler Part 1: The Subgenera *Microsemineum*, *Muscosemineum*, *Piriseineum* and *Trichomosemineum*

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ABSTRACT

The authors present a paper about those *Gymnocalycium* species which they accept. The species are introduced with one photograph of their habitat, one of their environment and one of their seed respectively. A map of each plant's locality completes the presentation. Part 1 deals with the subgenera *Microsemineum*, *Muscosemineum*, *Piriseineum* and *Trichomosemineum*.

KEYWORDS: Cactaceae, *Gymnocalycium*, UG *Microsemineum*, UG *Muscosemineum*, UG *Piriseineum*, UG *Trichomosemineum*, *Gymnocalycium anisitsii*, *Gymnocalycium basiatrum*, *Gymnocalycium bodenbenderianum*, *Gymnocalycium chacoense*, *Gymnocalycium chiquitanum*, *Gymnocalycium delaetii*, *Gymnocalycium euryleurum*, *Gymnocalycium friedrichii*, *Gymnocalycium hamatum*, *Gymnocalycium marsoneri*, *Gymnocalycium matoense*, *Gymnocalycium megatae*, *Gymnocalycium mendozaense*, *Gymnocalycium mihanovichii*, *Gymnocalycium ochoteranae*, *Gymnocalycium paediophilum*, *Gymnocalycium pflanzii*, *Gymnocalycium quehlianum*, *Gymnocalycium ragonesei*, *Gymnocalycium saglionis* subsp. *tilcareense*, *Gymnocalycium saglionis*, *Gymnocalycium schickendantzii*, *Gymnocalycium zegarrae*

INTRODUCTION

Cactus seeds differ substantially with respect to size, shape, colour and number per fruit. This fact can well be applied to the genus *Gymnocalycium*. Here we find a variety of seeds which could not be more diverse. Alberto V. Frič was the first to use this feature for subdividing the genus according to shape of seeds (Kreuzinger 1935). Bohumil Schütz (1962, 1969a, 1969b) developed the subdivision further. In 1985 it was Hans Till and Michael Hesse who supplemented the classification by creating the new subgenus *Piriseineum*. First amendments were made by Detlev Metzger in 1992. The changing of the type for the genus *Gymnocalycium* from *G. denudatum* to *G. gibbosum* inevitably caused further modifications and innovations.

For the species with large seeds, up to then listed in the subgenus *Gymnocalycium*, the subgenus *Macrosemineum* was introduced. This classification with 6, later with 7 subgenera has since then been widely recognized.

Molecular genetic research (Demaio & al. 2010, Meregalli & al. 2010) yields the same results, confirming the classification by Schütz (1969) with its adaptations by Till & Hesse and Metzing. The results indicate that *G. saglionis* with its subspecies *tilcarensis* is the oldest species in the way of evolution and thus sister to all other species of the genus *Gymnocalycium*. Therefore the assignment of only one species (*G. saglionis*) to the subgenus *Microsemineum* is logical. Consequently, the description of a new subgenus *Scabrosemineum* instead of the former subgenus *Microsemineum* was necessary (Demaio & al. 2011).

Within the subgenus *Piriseimineum* there are some uncertainties as far as assignment is concerned. Surprisingly, molecular genetic research (Demaio & al. 2010, Meregalli & al. 2010) revealed that there are probably closer relationships between *G. pflanzii*, *G. chacoense* and *G. chiquitanum*. So far *G. paediophilum*, *G. chiquitanum* and *G. chacoense* have mostly been assigned to the subgenus *Microsemineum* (now *Scabrosemineum*). Here we assign them to the subgenus *Piriseimineum*. Only further investigation which includes *G. paediophilum* can give fresh insight into the final position.

With this contribution we want to corroborate that the seed of the genus *Gymnocalycium* is an important feature for classifying the species taxonomically into the seven subgenera. With some practice and a good magnifying glass there should be no problem comprehending this by yourself.

We have rounded off this paper with maps of geographic distribution, which are based on 21,000 locality data about the species *Gymnocalycium* established by 134 collectors. Thus we provide very detailed and, above all, current maps (as of 2016) on the distribution of the *Gymnocalycium* subgenera. For compiling the maps we used the free GIS software QGIS (<http://www.qgis.org/de/site/forusers/download.html>). The background of the maps is formed by Google Inc. data, which can be combined in QGIS with the QGIS extension Quick Map Services (<http://nextgis.com/blog/quickmapservices/>) by Nextgis company (<http://nextgis.com/>).

Maybe this contribution can be an incentive for dealing with the genus *Gymnocalycium* in more detail.

Type species of the subgenera presented here are:

- | | |
|-------------------|--|
| Microsemineum: | <i>Gymnocalycium saglionis</i> (Cels) Britton & Rose (1922) |
| Muscosemineum: | <i>Gymnocalycium mihanovichii</i> (Frič ex Gürke) Britton & Rose (1922) |
| Piriseimineum: | <i>Gymnocalycium pflanzii</i> (Vaupel) Werdermann (1935) |
| Trichomosemineum: | <i>Gymnocalycium quehlianum</i> (F. Haage ex Quehl) Vaupel ex Hosseus (1926) |

Subgenus *Gymnocalycium* Pfeiffer ex Mittler

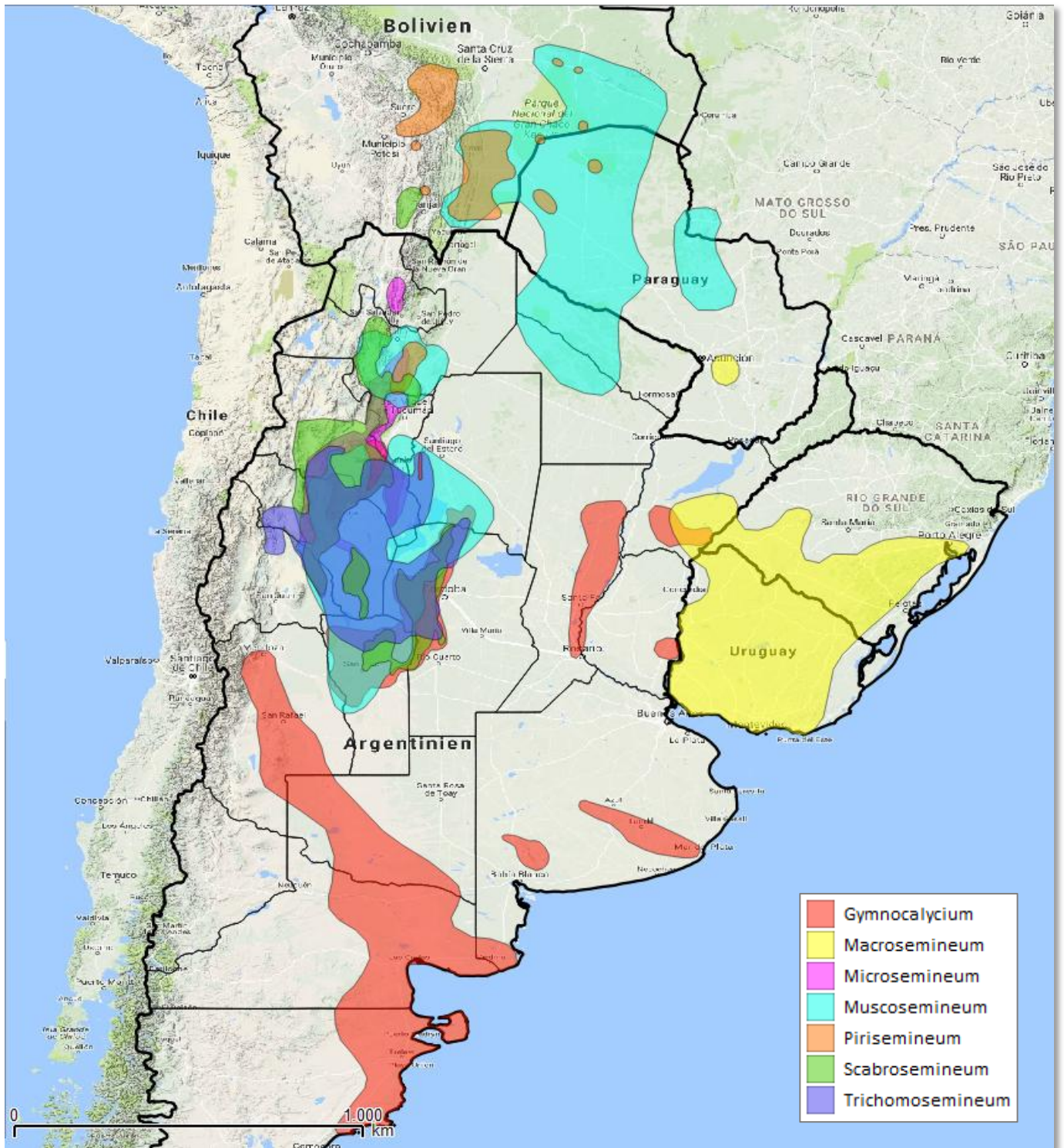


Fig. 1: Overview map of the distribution areas of the subgenera of the genus *Gymnocalycium*

Subgenus *Microsemineum* Schütz

Body: large, spherical to short columnar, fibrous roots,

Spines: ± bent,

Flowers: short, forming a ring around the apex, urn-shaped,

Fruits: spherical, red, dehiscing vertically,

Seeds: 0.6-0.8 mm in size, **Testa:** with protuberances, matt, brownish to blackish,

Locality: northwestern Argentina.

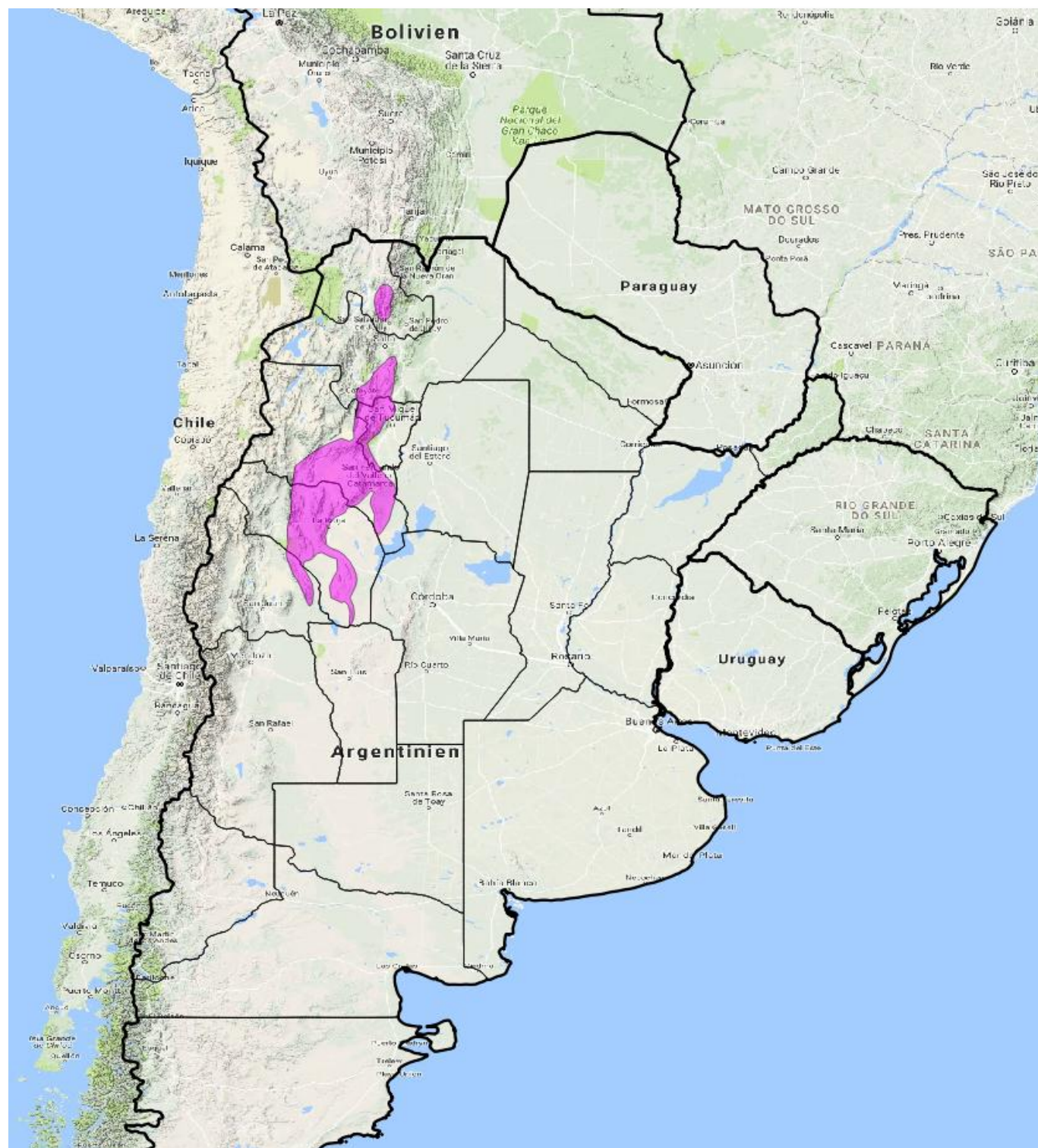


Fig. 2: Overview map of the distribution area of subgenus *Microsemineum*, type species: *G. saglionis*

***Gymnocalycium saglionis* (Cels) Britton & Rose (1922)**



Fig. 3: *Gymnocalycium saglionis* VoS 109, 10 km north of Calalao del Valle, Province Tucuman, Argentina, 1699 m



Fig. 4: Habitat of *Gymnocalycium saglionis* VoS 109



Fig. 5: Seeds of *Gymnocalycium saglionis* VoS 109 (20 x)

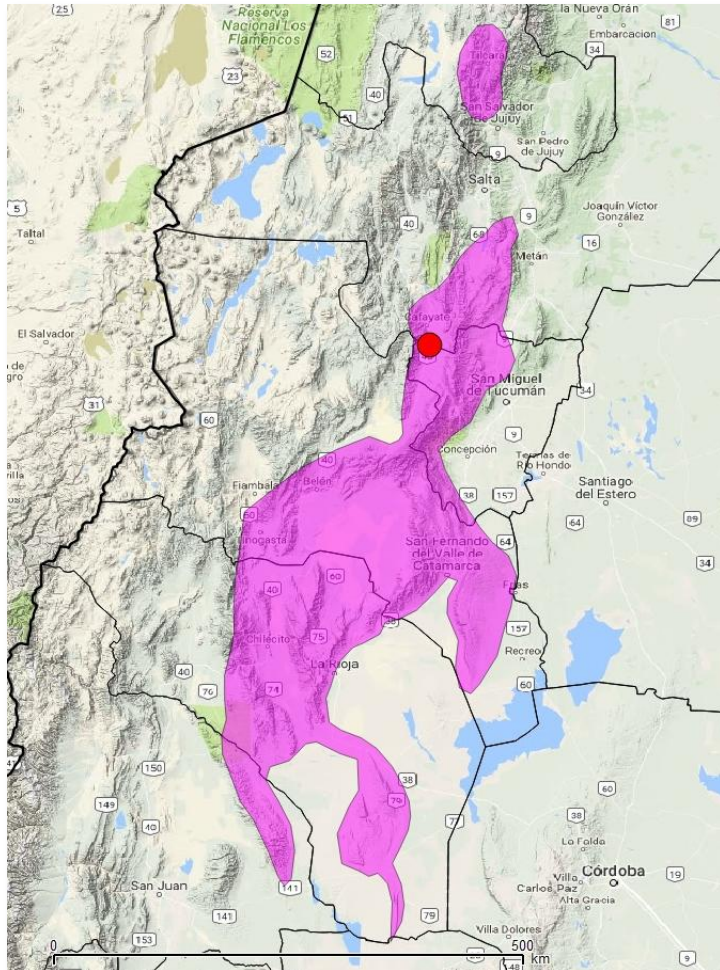


Fig. 6: Locality of *Gymnocalycium saglionis* VoS 109

***Gymnocalycium saglionis* subsp. *tilcarensis* (Backeberg) H. Till & W. Till (1985)**



Fig. 7: *Gymnocalycium saglionis* subsp. *tilcarensis* VoS 1588, south of Posta de Hornillos, Province Jujuy, Argentina, 2416 m



Fig. 8: Habitat of *Gymnocalycium saglionis* subsp. *tilcarensis* VoS 1588



Fig. 9: Seeds of *Gymnocalycium saglionis* subsp. *tilcarensis* VoS 1588 (20 x)

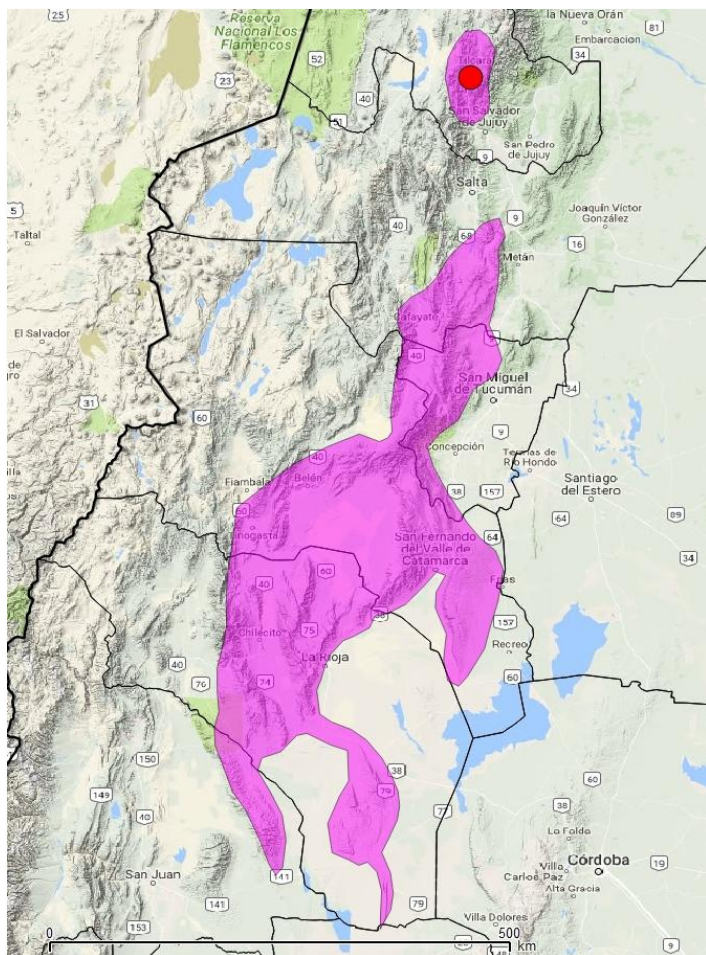


Fig. 10: Locality of *Gymnocalycium saglionis* subsp. *tilcarensis* VoS 1588

Subgenus *Muscosemineum* Schütz

Body: sub-spherical, also short columnar at older age, fibrous roots,

Spines: ± straight or bent,

Flowers: emerging from the apex or from older areoles, lateral, funnel- to bell-shaped,

Fruits: spherical, cylindrical or spindle-shaped, red or bluish when mature, pulp transparent to red, dehiscing vertically,

Seeds: 0.6-1.0 mm in size, spherical to helmet-shaped. **Testa:** light brown to brown, with protuberances, testa cells hollow, outer walls fragile,

Locality: southern and eastern Bolivia, northwestern Paraguay, northern Argentina.

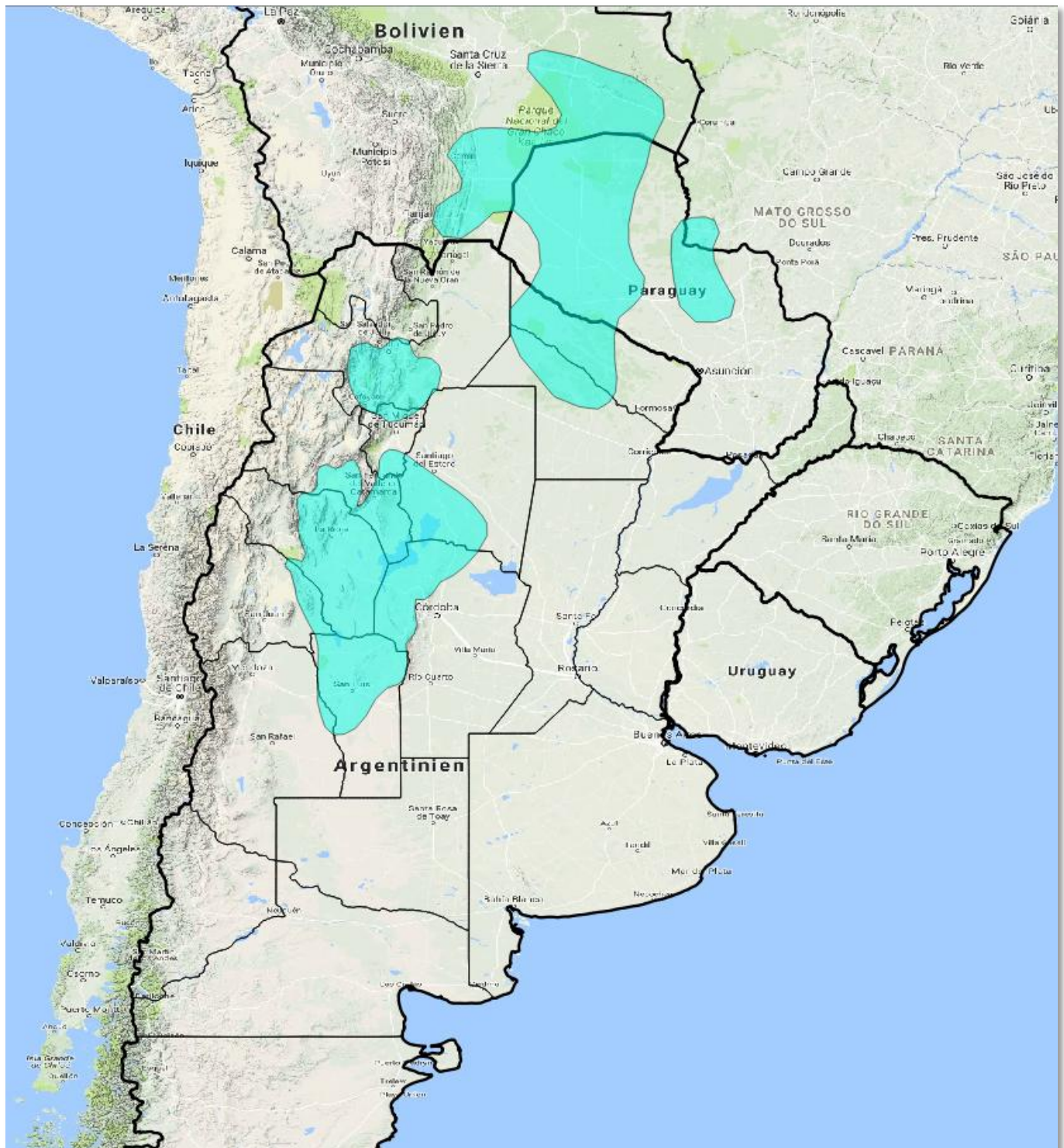


Fig. 11: Overview map of the distribution area of subgenus *Muscosemineum*, type species: *G. mihanovichii*

***Gymnocalycium anisitsii* (K. Schumann) Britton & Rose (1922)**



Fig. 12: *Gymnocalycium anisitsii* VoS 523, 18 km east of Puerto Valle-mi, Province Concepcion, Paraguay, 87 m



Fig. 13: Habitat of *Gymnocalycium anisitsii* VoS 523



Fig. 14: Seeds of *Gymnocalcium anisitsii* VoS 523 (20 x)

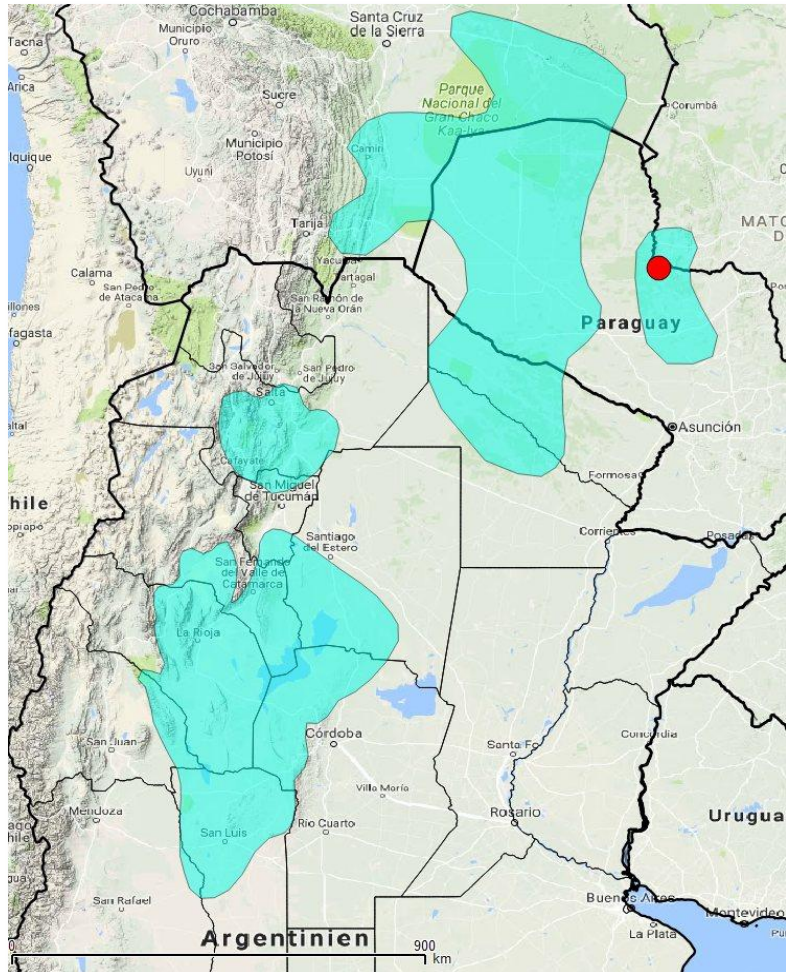


Fig. 15: Locality of *Gymnocalcium anisitsii* VoS 523

***Gymnocalycium delaetii* (K. Schumann) Hosseus (1926)**



Fig. 16: *Gymnocalycium delaetii* VoS 1573, Palomitas, Province Salta, Argentina, 903 m



Fig. 17: Habitat of *Gymnocalycium delaetii* VoS 1573

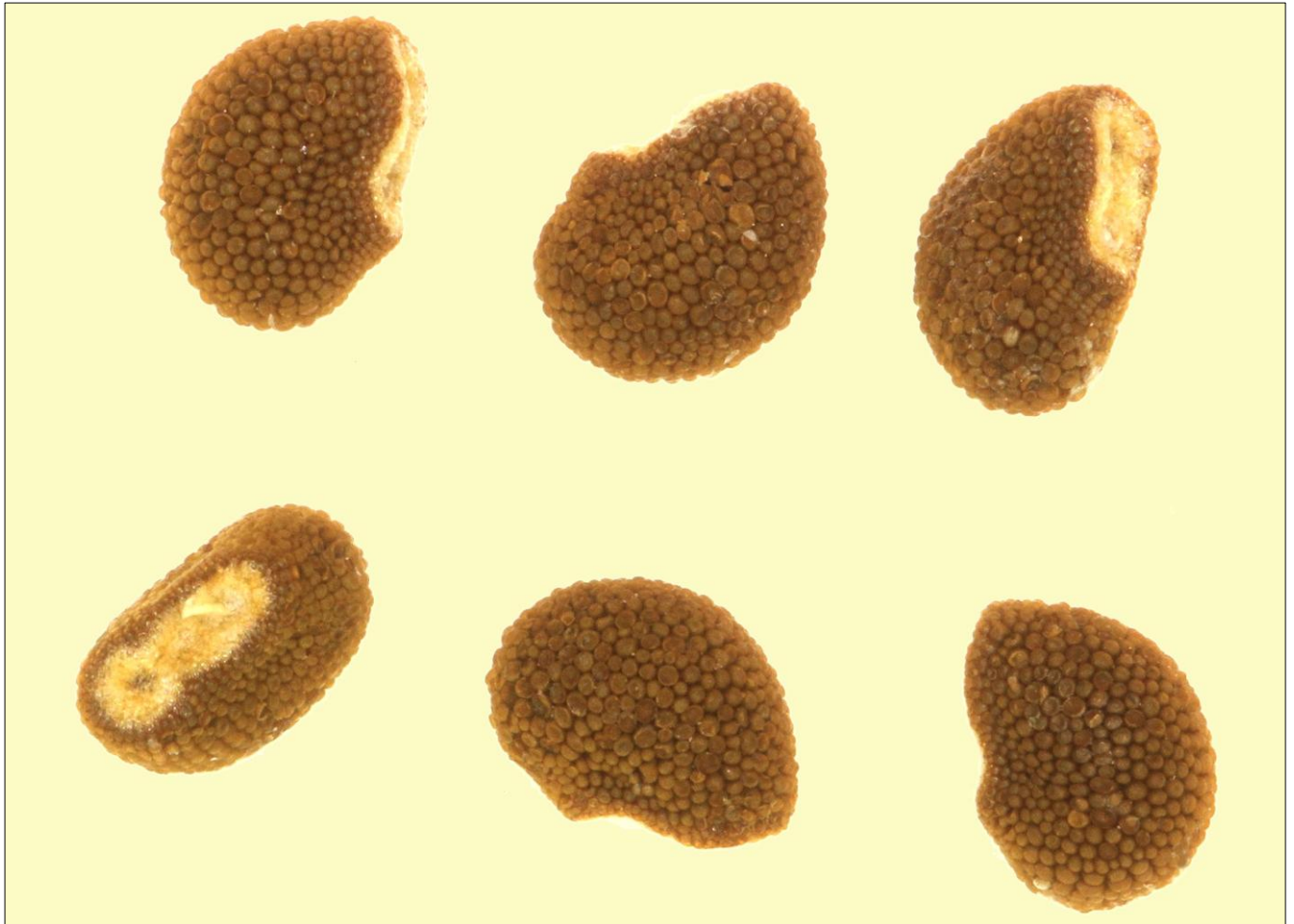


Fig. 18: Seeds of *Gymnocalcium delaetii* VoS 1573 (20 x)

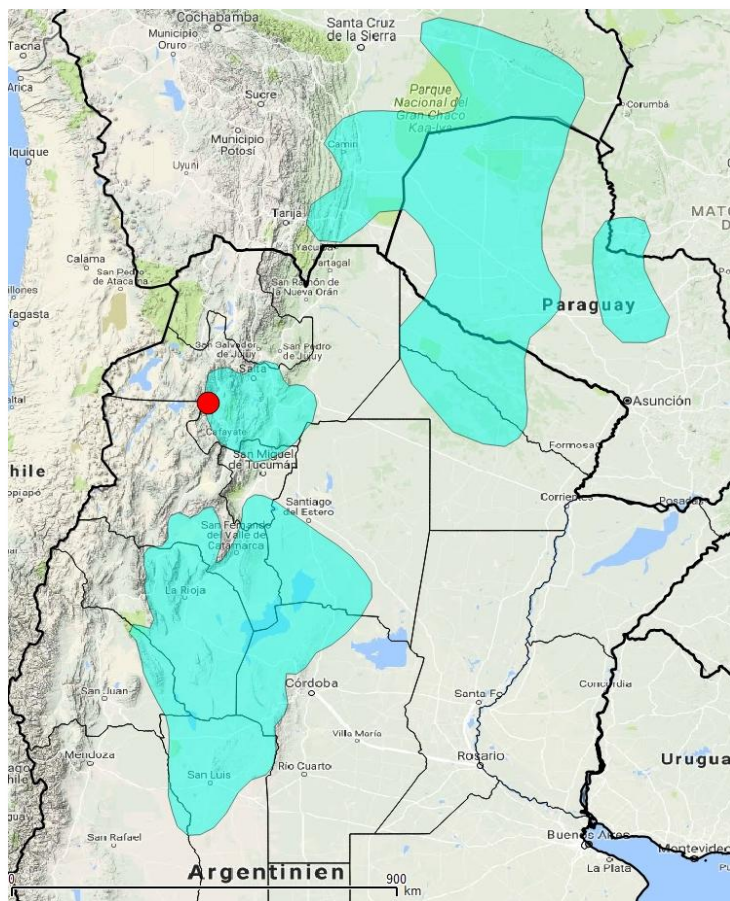


Fig. 19: Locality of *Gymnocalcium delaetii* VoS 1573

***Gymnocalycium eurypleurum* Plesnik ex Ritter (1979)**



Fig. 20: *Gymnocalycium eurypleurum* VoS 2142, northwest of the Cerro Leon, Province Alto Paraguay, Paraguay, 170 m



Fig. 21: Habitat of *Gymnocalycium eurypleurum* VoS 2142



Fig. 22: Seeds of *Gymnocalcium euryleurum* VoS 2142 (20 x)

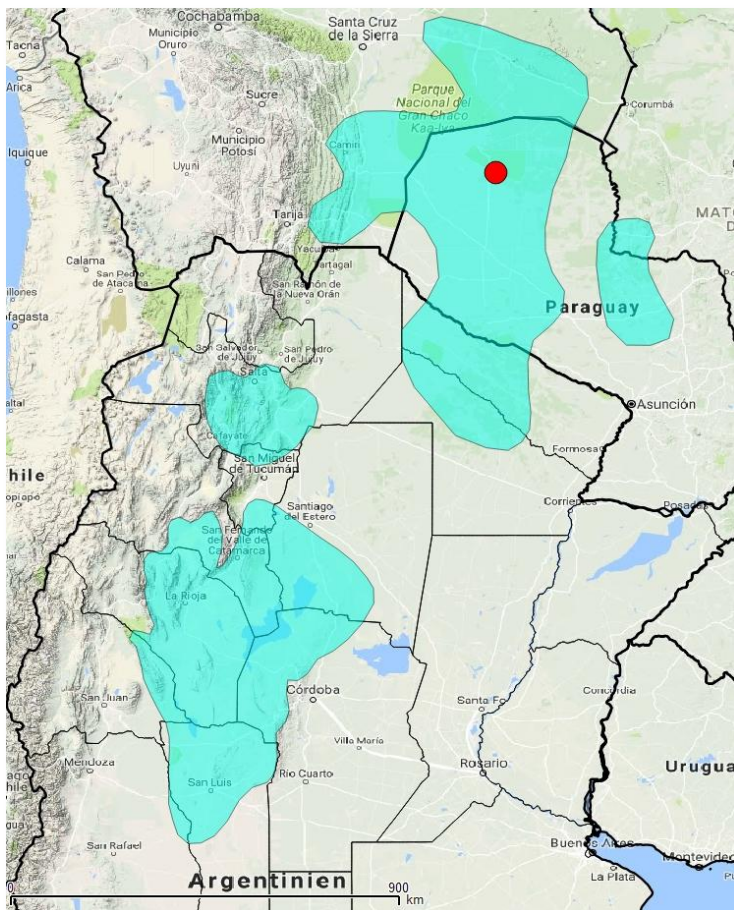


Fig. 23: Locality of *Gymnocalcium euryleurum* VoS 2142

***Gymnocalycium friedrichii* (Werdermann) Pazout ex Schütz (1980)**



Fig. 24: *Gymnocalycium friedrichii* VoS 2116, 80 kilometer north of Mariscal, Province Boqueron, Paraguay, 150 m



Fig. 25: Habitat of *Gymnocalycium friedrichii* VoS 2116



Fig. 26: Seeds of *Gymnocalycium friedrichii* VoS 2116 (20 x)

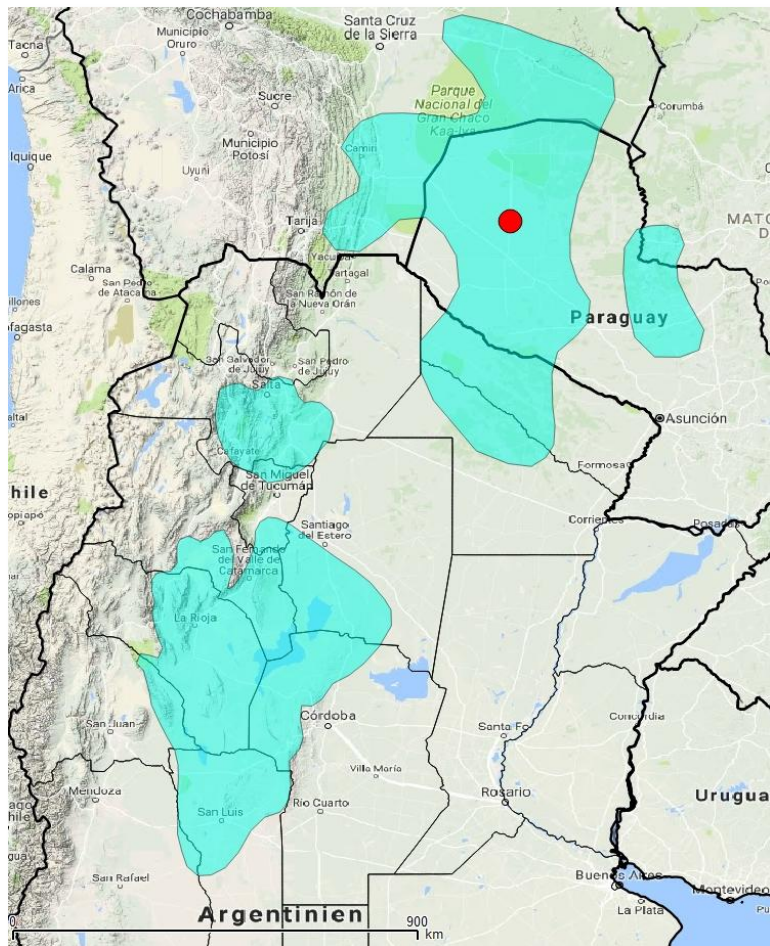


Fig. 27: Locality of *Gymnocalycium friedrichii* VoS 2116

Gymnocalycium hamatum Ritter (1980)



Fig. 28: *Gymnocalycium hamatum* VoS 966, west of Palos Blancos, Province Tarija, Bolivia, 733 m



Fig. 29: Habitat of *Gymnocalycium hamatum* VoS 966

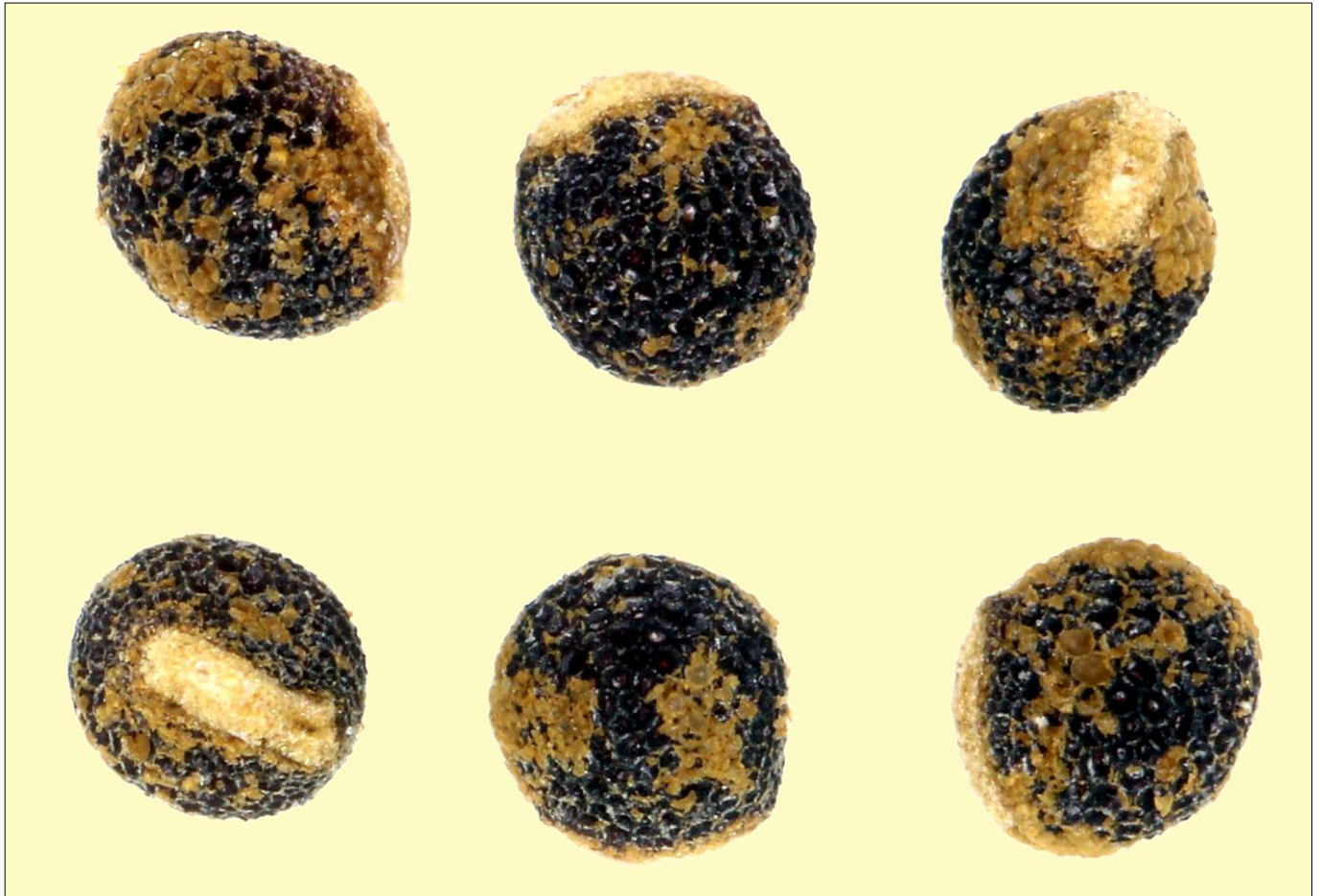


Fig. 30: Seeds of *Gymnocalcium hamatum* VoS 966 (20 x)

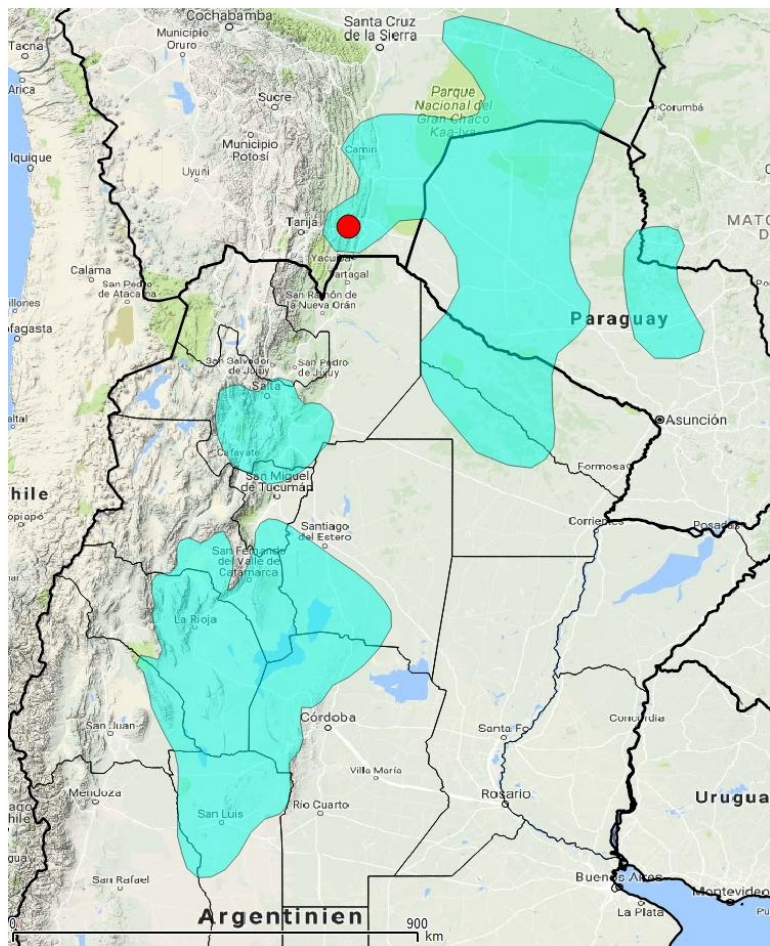


Fig. 31: Locality of *Gymnocalcium hamatum* VoS 966

***Gymnocalycium marsoneri* Frič ex Y. Ito (1957)**



Fig. 32: *Gymnocalycium marsoneri* VoS 1392, Choya, Province Santiago del Estero, Argentina, 386 m



Fig. 33: Habitat of *Gymnocalycium marsoneri* VoS 1392

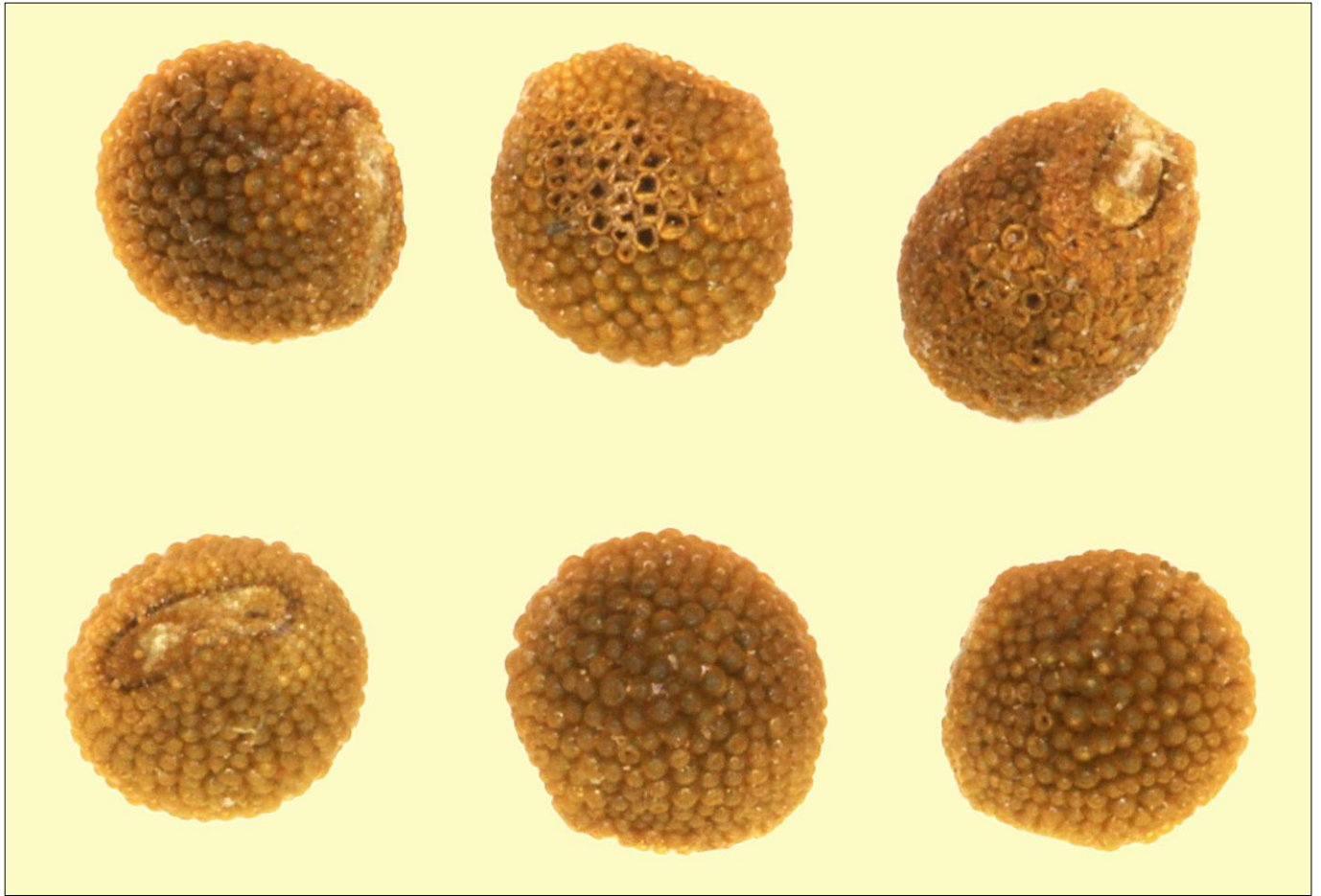


Fig. 34: Seeds of *Gymnocalycium marsoneri* VoS 1392 (20 x)

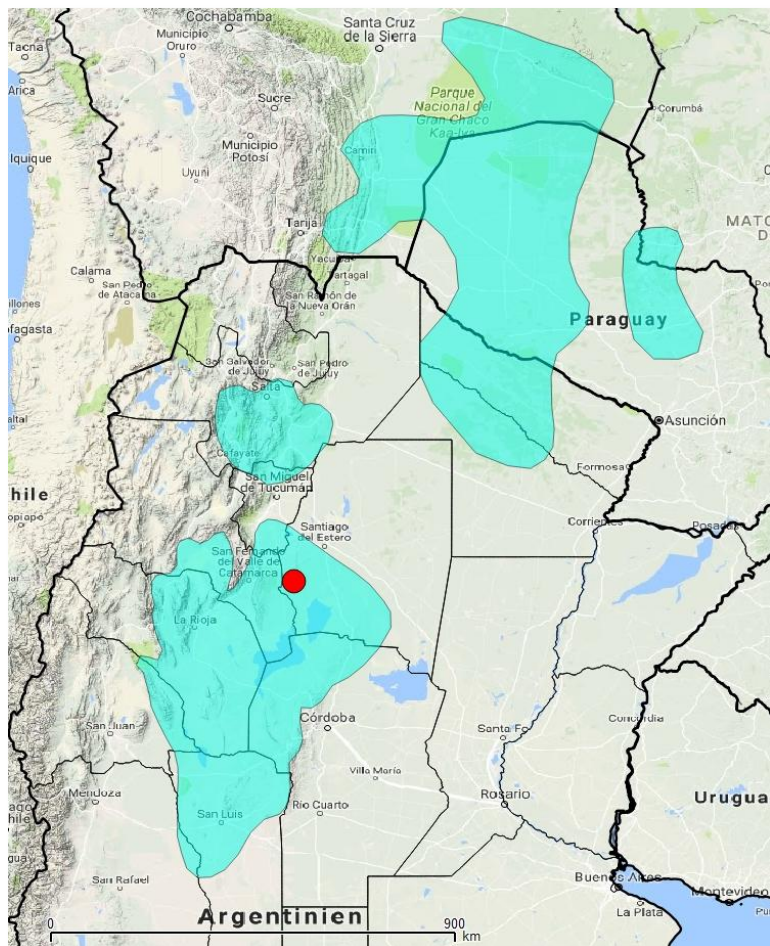


Fig. 35: Locality of *Gymnocalycium marsoneri* VoS 1392

Gymnocalycium matoense Buining & Brederoo (1975)



Fig. 36: *Gymnocalycium matoense* VoS 288, Province Mato Grosso do Sul, Brazil, 293 m



Fig. 37: Habitat of *Gymnocalycium matoense* VoS 288

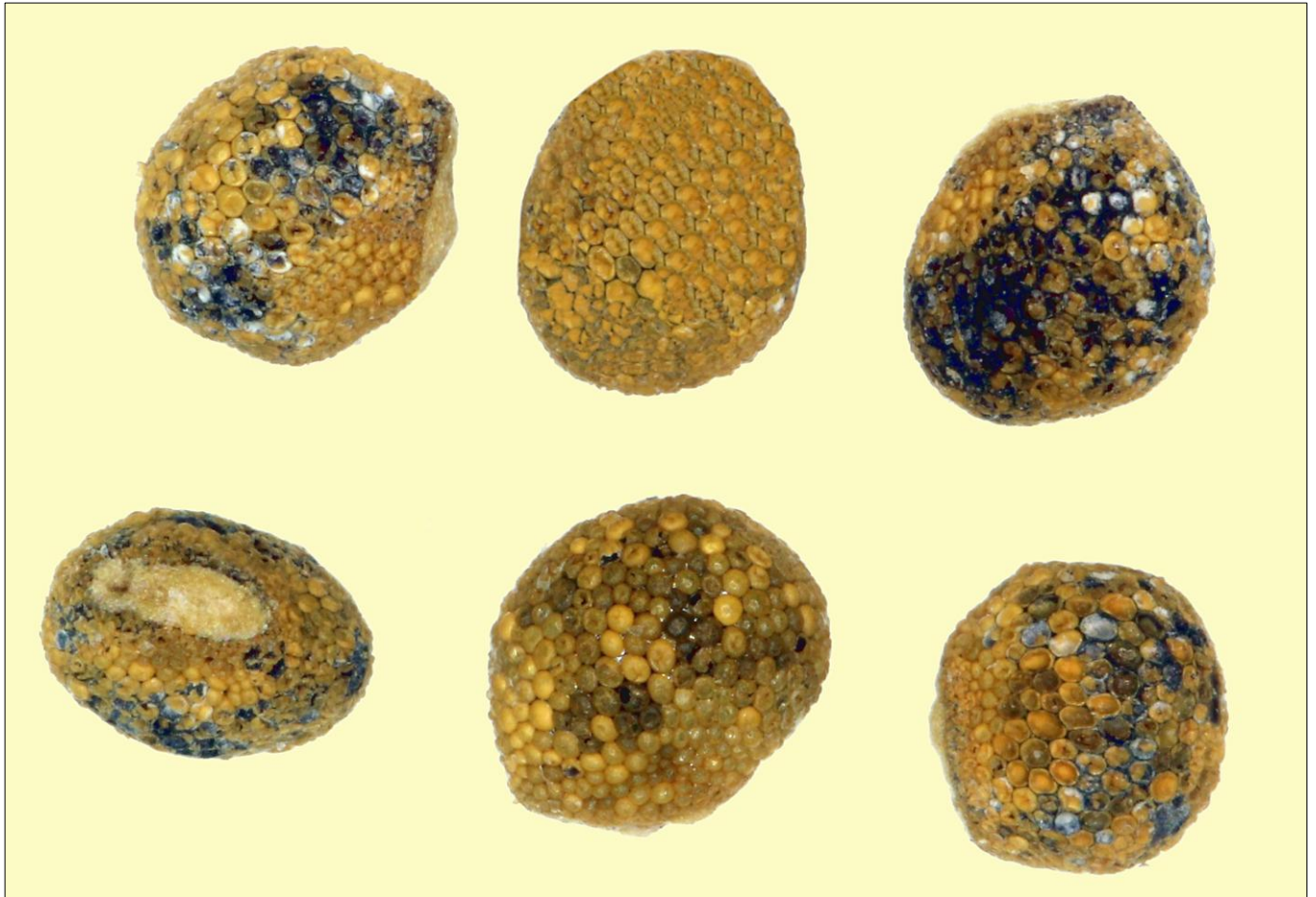


Fig. 38: Seeds of *Gymnocalycium matoense* VoS 288 (20 x)

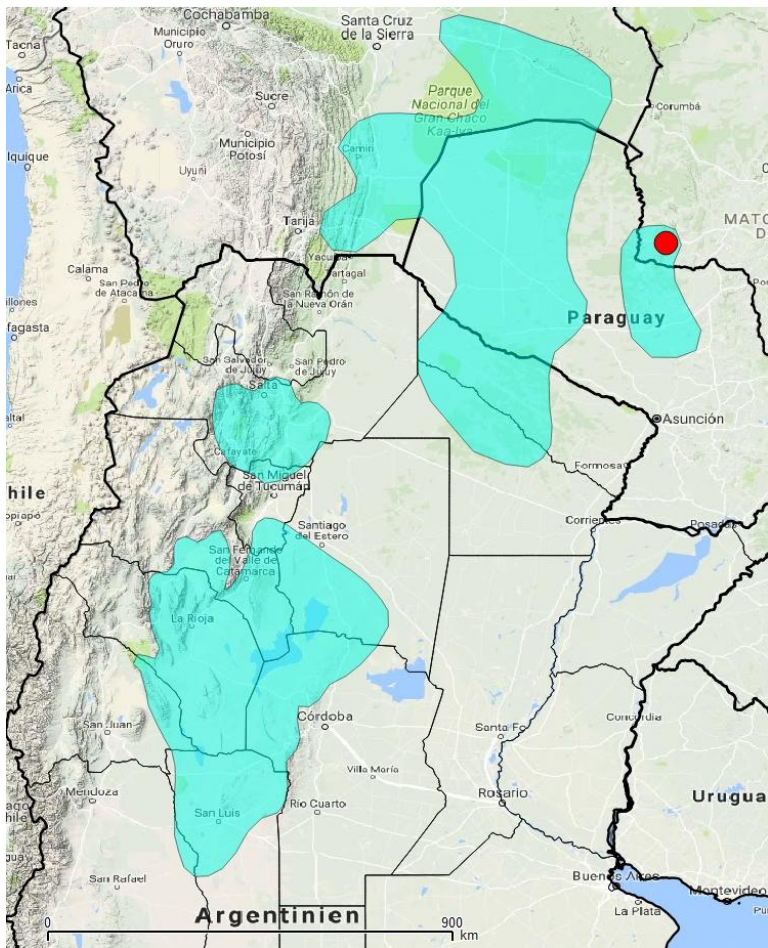


Fig. 39: Locality of *Gymnocalycium matoense* VoS 288

***Gymnocalycium megatae* Y. Ito (1957)**



Fig. 40: *Gymnocalycium megatae* VoS 2144, south of Mariscal, Province Boqueron, Paraguay, 172 m



Fig. 41: Habitat of *Gymnocalycium megatae* VoS 2144

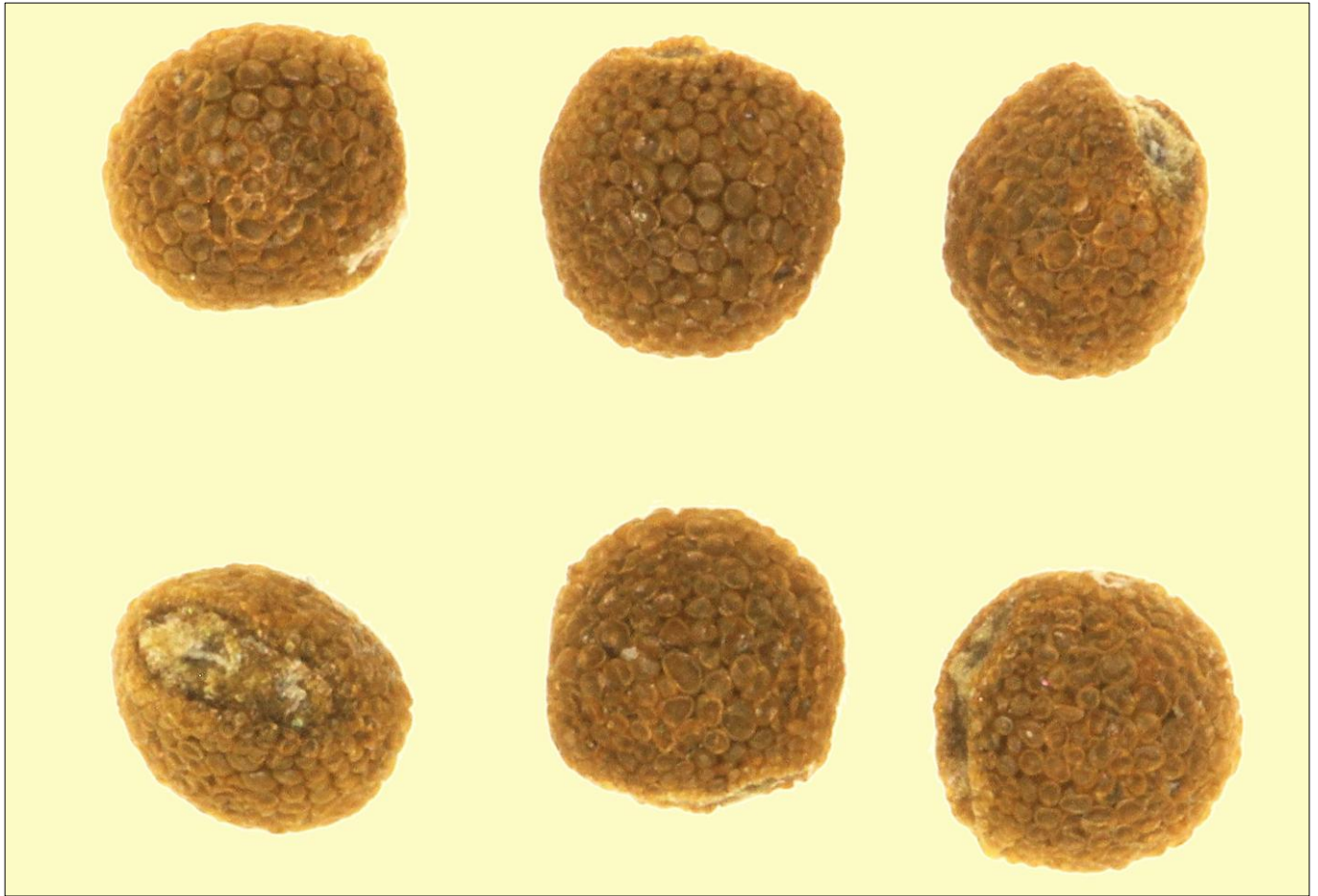


Fig. 42: Seeds of *Gymnocalycium megatae* VoS 2144 (20 x)

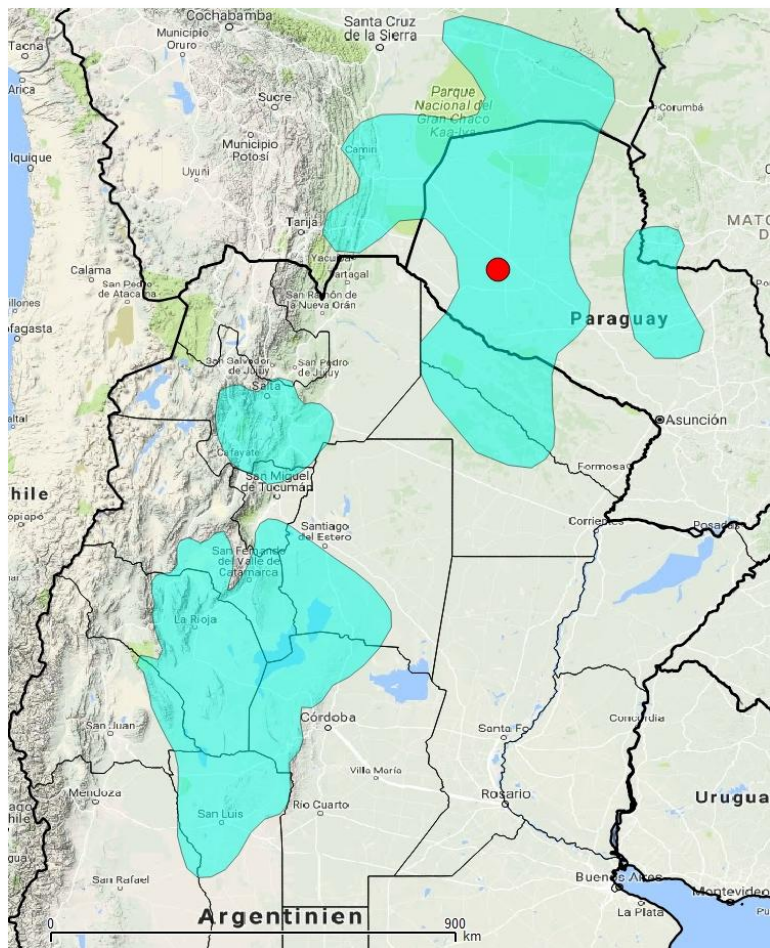


Fig. 43: Locality of *Gymnocalycium megatae* VoS 2144

Gymnocalycium mendozaense Bercht & Schädlich (2015)



Fig. 44: *Gymnocalycium mendozaense* VoS 1906, northwest of Amboro, Province Santa Cruz, Bolivia, 463 m



Fig. 45: Habitat of *Gymnocalycium mendozaense* VoS 1906

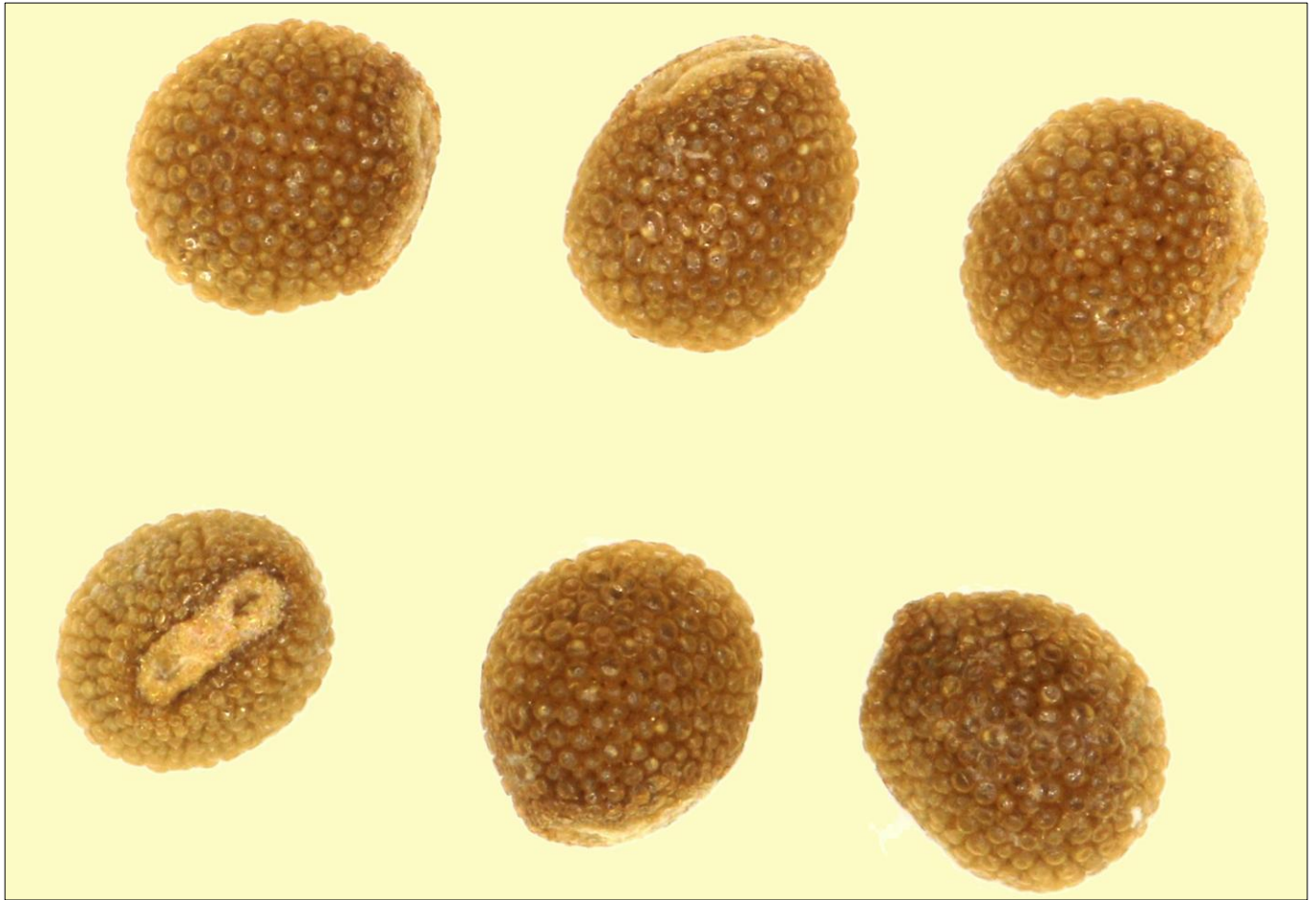


Fig. 46: Seeds of *Gymnocalycium mendozaense* VoS 1906 (20 x)

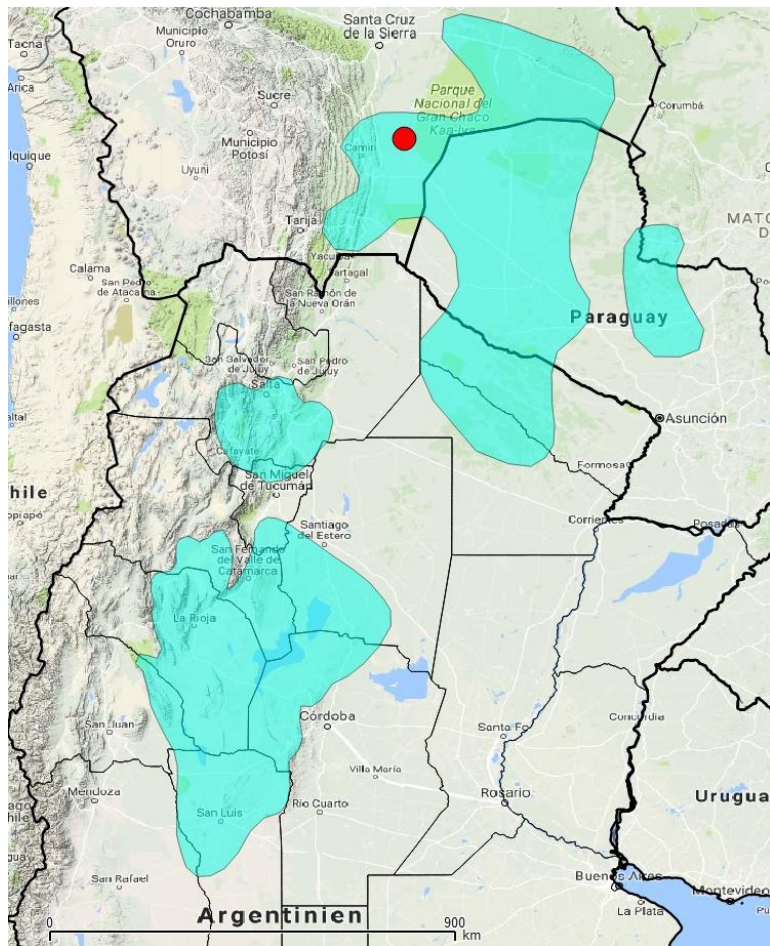


Fig. 47: Locality of *Gymnocalycium mendozaense* VoS 1906

***Gymnocalycium mihanovichii* (Frič ex Gürke) Britton & Rose (1922)**



Fig. 48: *Gymnocalycium mihanovichii* VoS 2129, woods from Puerto Casado west of the Rio Paraguay, Province Alto Paraguay, Paraguay, 89 m



Fig. 49: Habitat of *Gymnocalycium mihanovichii* VoS 2129



Fig. 50: Seeds of *Gymnocalcium mihanovichii* VoS 2129 (20 x)

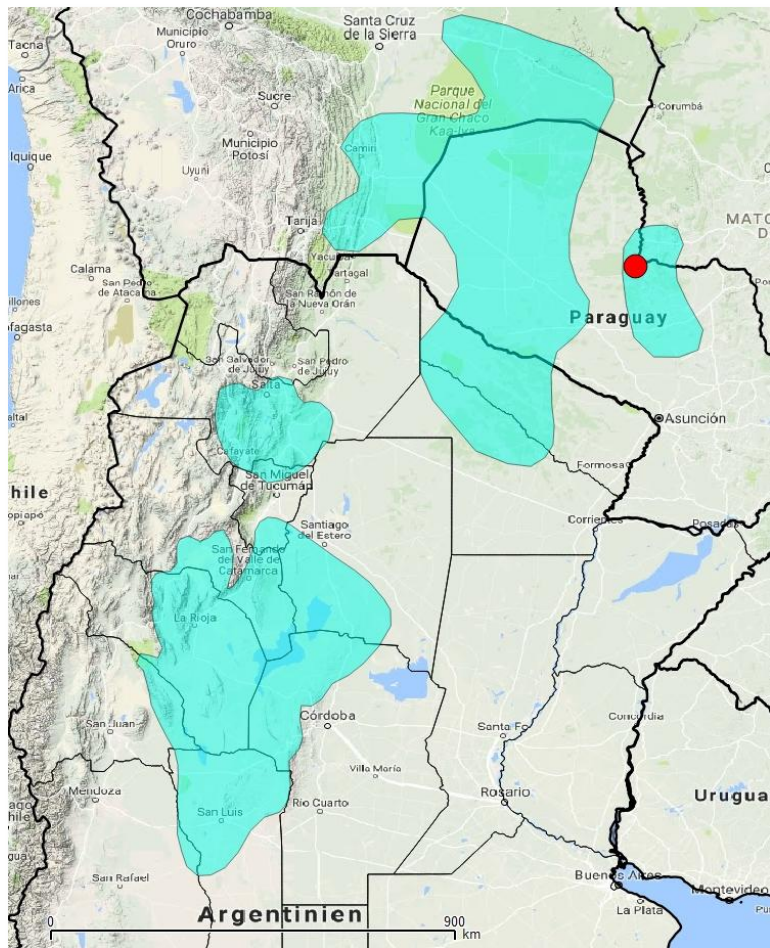


Fig. 51: Locality of *Gymnocalcium mihanovichii* VoS 2129

***Gymnocalycium schickendantzii* (F. A. C. Weber) Britton & Rose (1922)**



Fig. 52: *Gymnocalycium schickendantzii* VoS 1298, northeast of Cruz del Eje, Province Córdoba, Argentina, 529 m



Fig. 53: Habitat of *Gymnocalycium schickendantzii* VoS 1298

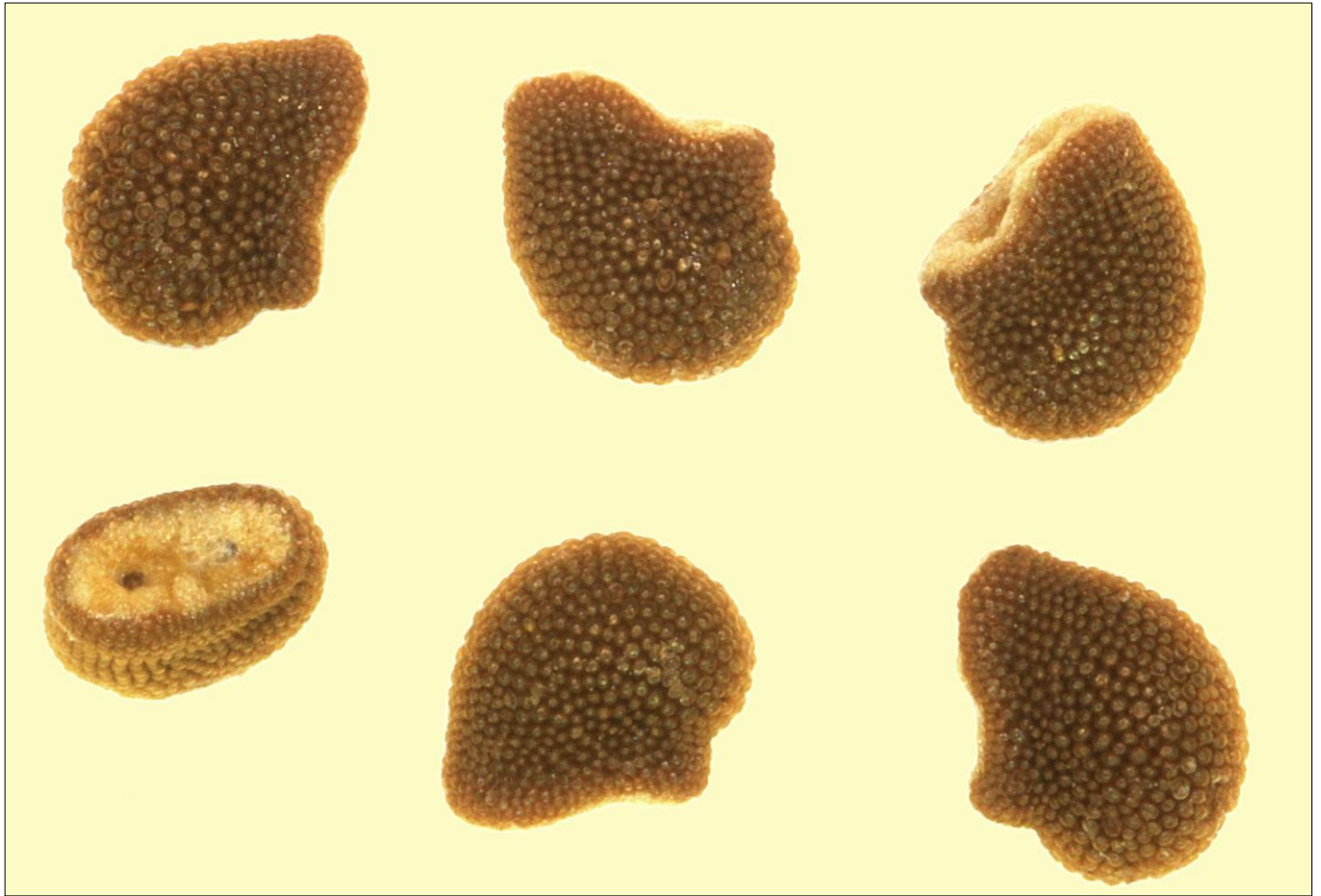


Fig. 54: Seeds of *Gymnocalycium schickendantzii* VoS 1732 (20 x)

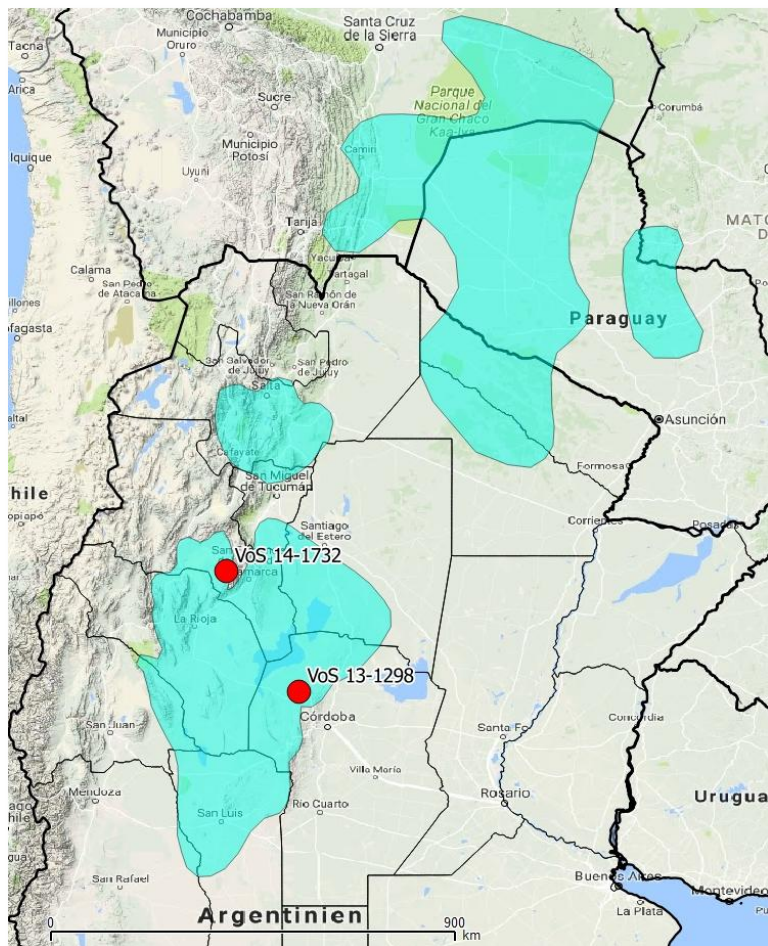


Fig. 55: Localities of *Gymnocalycium schickendantzii* VoS 1298 und VoS 1732

Subgenus *Pirisemineum*

Body: body sub-spherical to spherical, also short columnar at older age, fibrous roots,

Spines: ± straight or bent,

Flowers: emerging from the apex,

Fruits: spherical to elliptical, red, yellow to bluish when mature, dehiscing vertically or horizontally,

Seeds: 0.6-1.0 mm in size, **Testa:** smooth or with protuberances, ± shining, light brown to black,

Locality: southern and eastern Bolivia, northwestern Paraguay, northern Argentina, frequently relict localities.

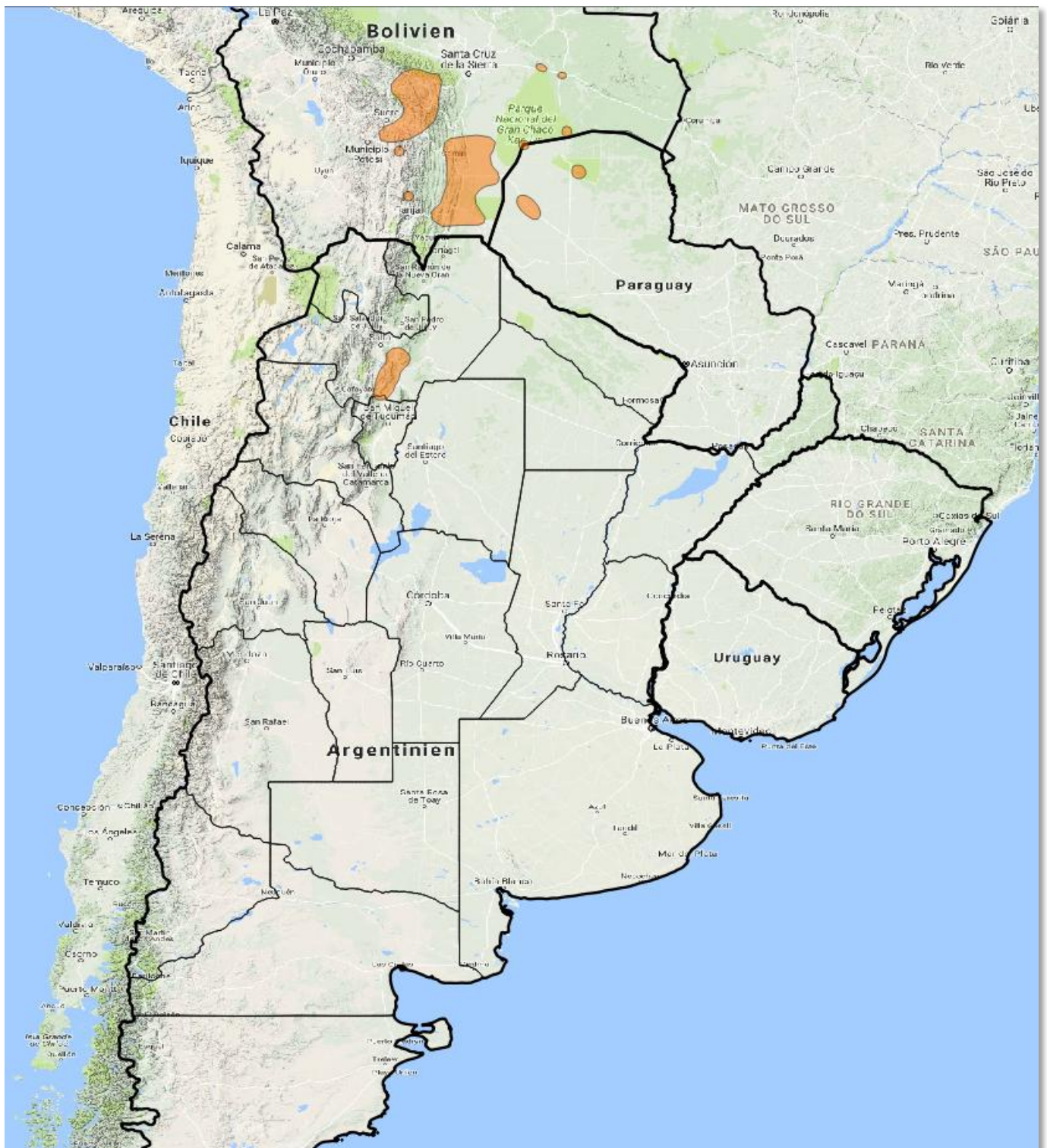


Fig. 56: Overview map of the distribution area of subgenus *Pirisemineum*, type species: *G. pflanzii*

Gymnocalycium chacoense Amerhauser (1999)



Fig. 57: *Gymnocalycium chacoense* VoS 260, Cerro San Miguel, Province Santa Cruz, Bolivia, 564 m



Fig. 58: Habitat of *Gymnocalycium chacoense* is the Cerro San Miguel (background) VoS 260

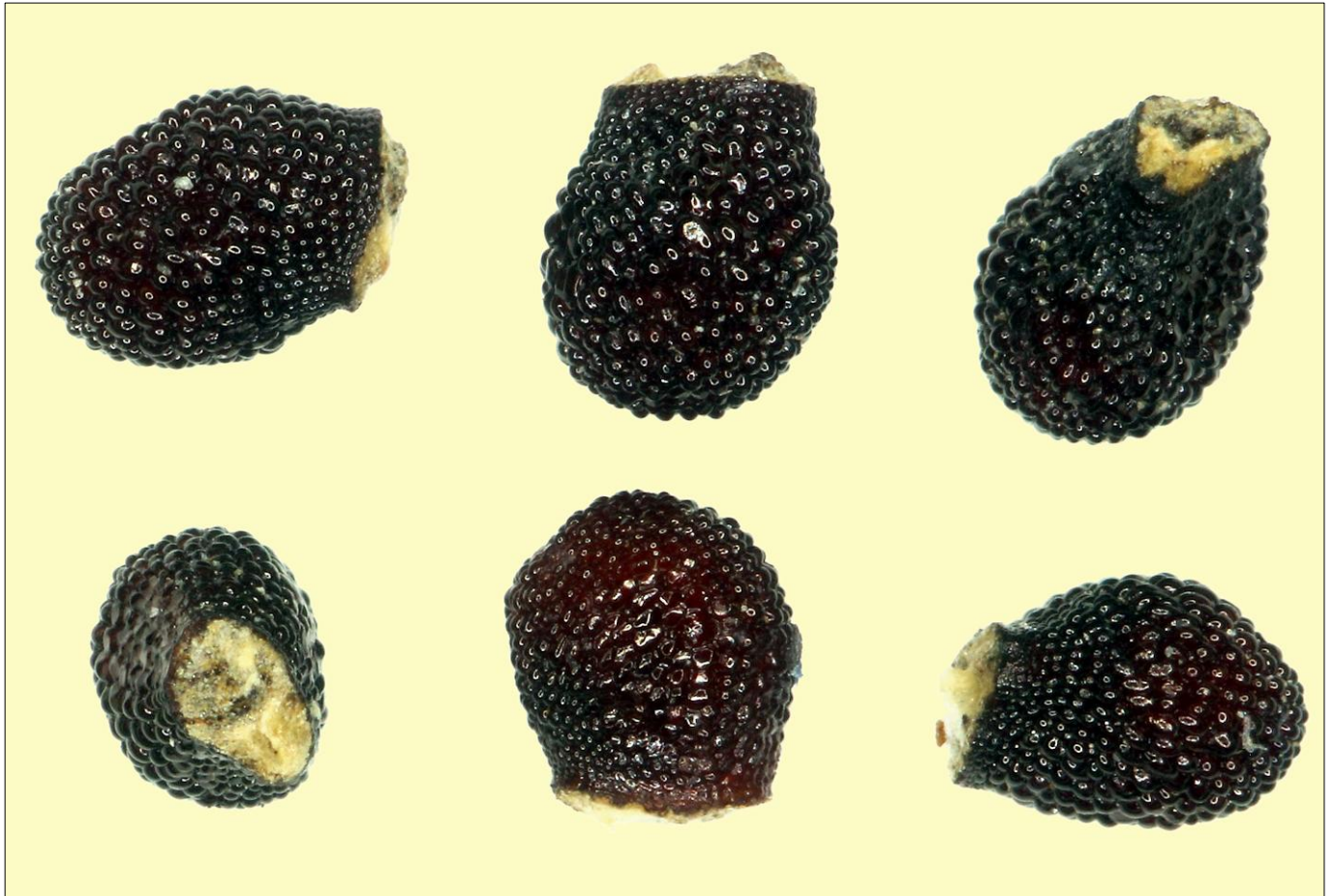


Fig. 59: Seeds of *Gymnocalycium chacoense* VoS 260 (20 x)

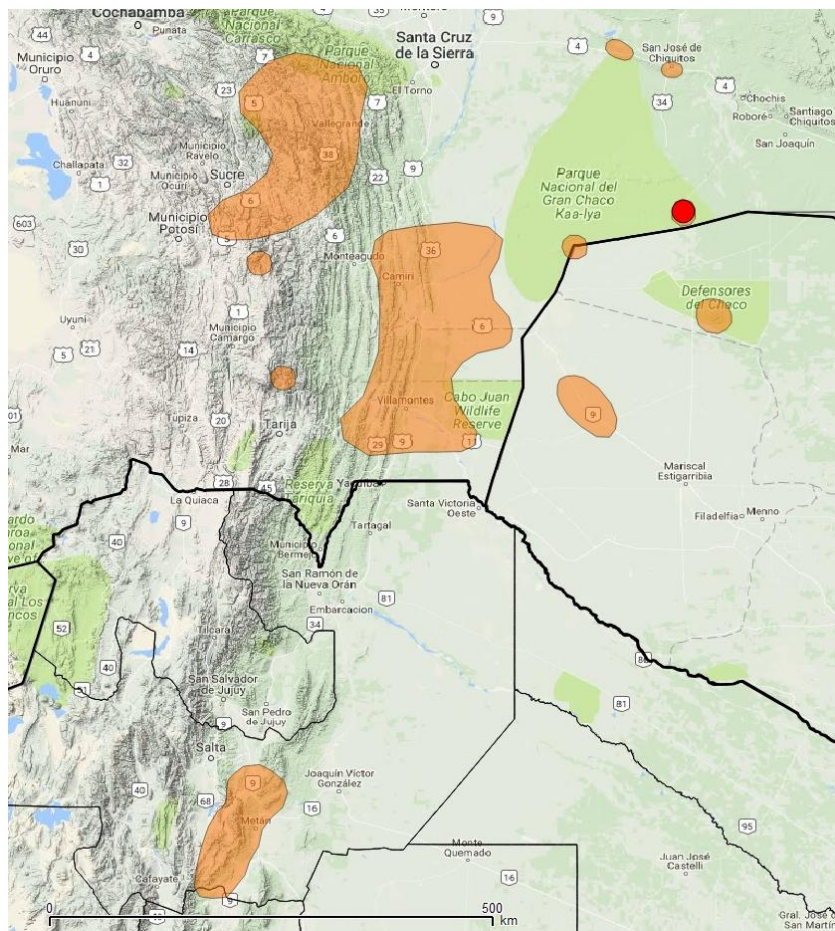


Fig. 60: Locality of *Gymnocalycium chacoense* VoS 260

***Gymnocalycium chiquitanum* Cardenas (1963)**



Fig. 61: *Gymnocalycium chiquitanum* VoS 36, west of La Cantera, Province Santa Cruz, Bolivia, 279 m



Fig. 62: Habitat of *Gymnocalycium chiquitanum* VoS 36



Fig. 63: Seeds of *Gymnocalycium chiquitanum* VoS 36 (20 x)

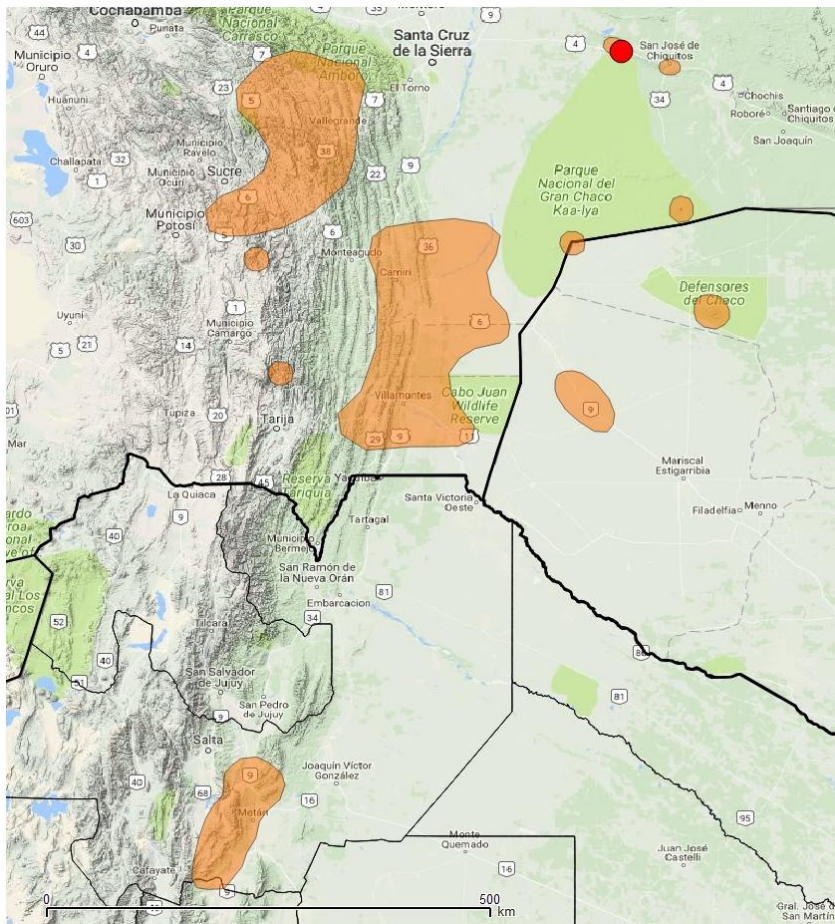


Fig. 64: Locality of *Gymnocalycium chiquitanum* VoS 36

***Gymnocalycium paediophilum* Ritter ex Schütz (1977)**



Fig. 65: *Gymnocalycium paediophilum* VoS 2139, Cerro Leon, Province Alto Paraguay, Paraguay, 260 m



Fig. 66: Habitat of *Gymnocalycium paediophilum* VoS 2139



Fig. 67: Seeds of *Gymnocalycium paediophilum* VoS 2139 (20 x)

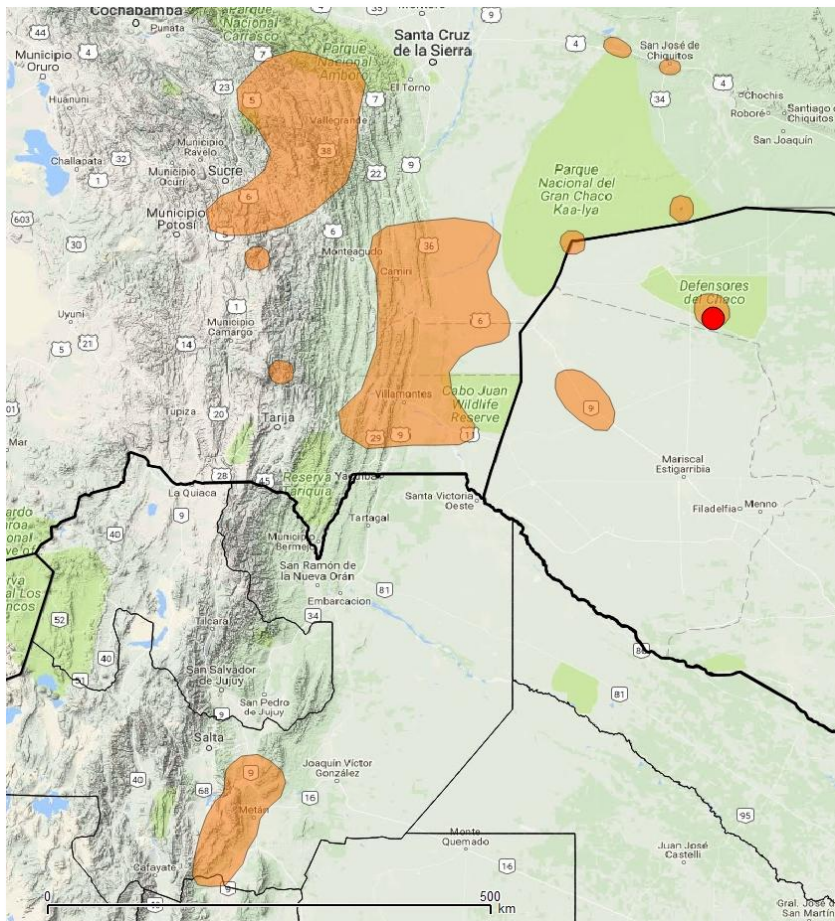


Fig. 68: Locality of *Gymnocalycium paediophilum* VoS 2139

***Gymnocalycium pflanzii* (Vaupel) Werdermann (1935)**



Fig. 69: *Gymnocalycium pflanzii* VoS 355, 35 km west of Palos Blancos, Province Tarija, Bolivia 1033 m



Fig. 70: Habitat of *Gymnocalycium pflanzii* VoS 355



Fig. 71: Seeds of *Gymnocalycium pflanzii* VoS 8, 1 km southwestern of La Patria, Province Chaco Boreal, Paraguay, 195 m (30 x)

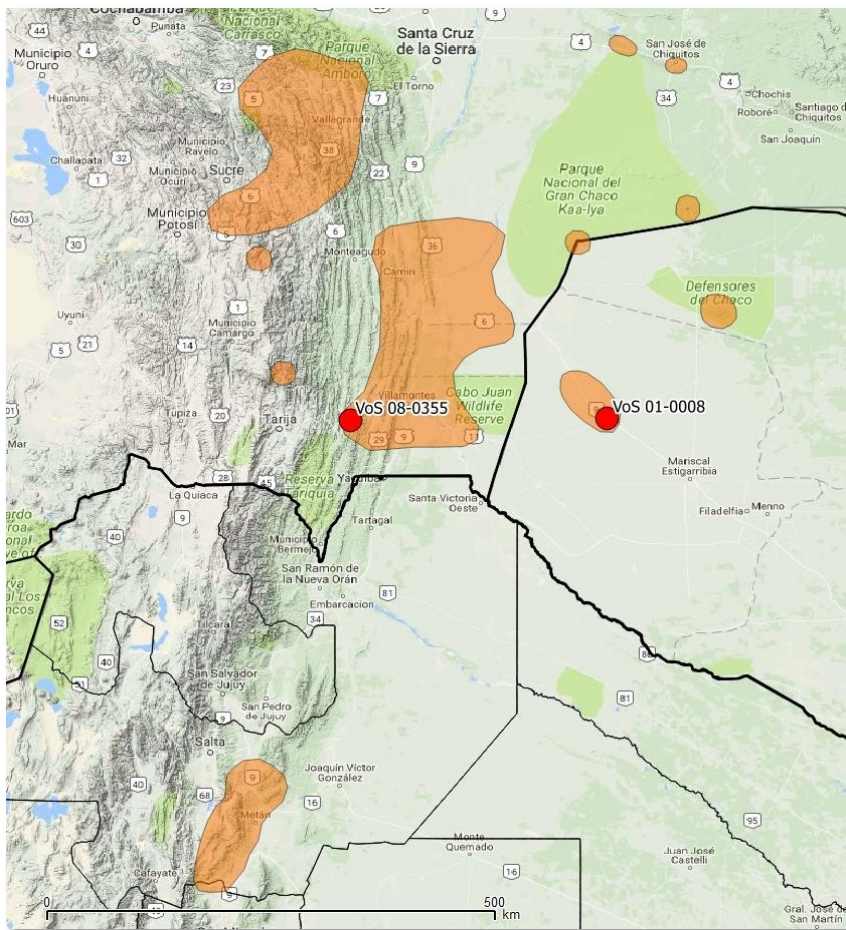


Fig. 72: Localities of *Gymnocalycium pflanzii* VoS 8 und VoS 355

***Gymnocalycium zegarrae* Cardenas (1958)**



Fig. 73: *Gymnocalycium zegarrae* VoS 2064, west of Sotomayor, Province Chuquisaca, Bolivia, 2193 m



Fig. 74: Habitat of *Gymnocalycium zegarrae* VoS 2064



Fig. 75: Seeds of *Gymnocalycium zegarrae* VoS 2098, west of Materal, Province Santa Cruz, Bolivia, 1628 m (30 x)

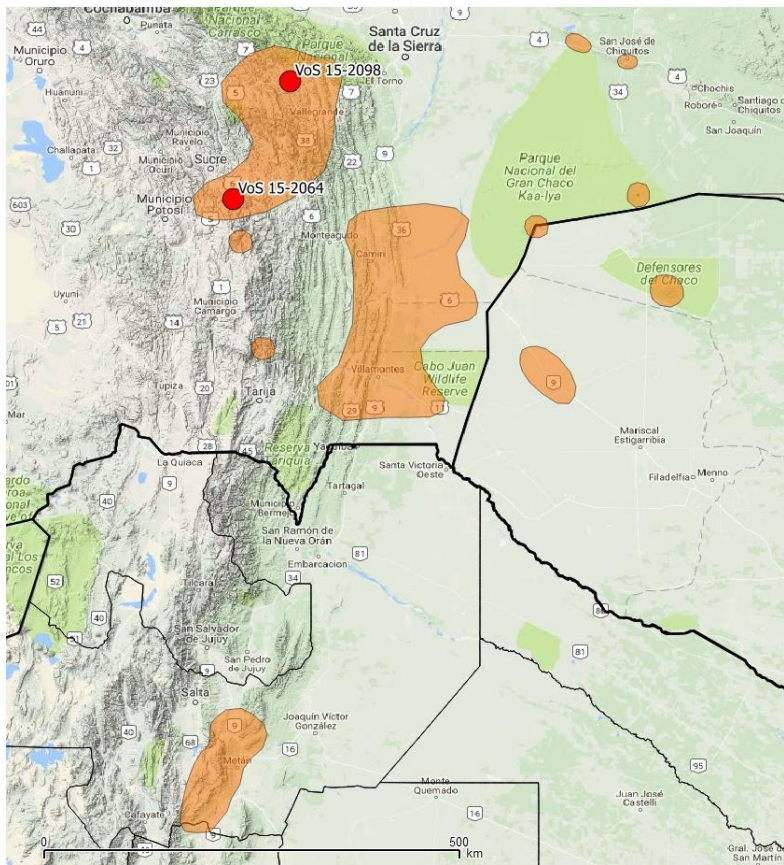


Fig. 76: Localities of *Gymnocalycium zegarrae* VoS 2064 und VoS 2098

Subgenus *Trichomosemineum* Schütz

Body: body sub-spherical to spherical, tap root,

Spines: ± straight or bent,

Flowers: emerging from the apex, funnel- or bell-shaped,

Fruits: spindle-shaped, greenish or bluish when mature, dehiscing vertically,

Seeds: 1.0-1.3 mm in size, helmet-shaped, **Testa:** light brown to brown, shining, smooth with small papillae, hilum-micopylar area large, spongy margin,

Locality: Argentina.



Fig. 77: Overview map of the distribution area of subgenus *Trichomosemineum*, type species: *G. quehlianum*

***Gymnocalycium basiatrum* F. Berger, Amerhauser & Sedlmeier (2015)**



Fig. 78: *Gymnocalycium basiatrum* VoS 1783, south of El Totoral, Province La Rioja, Argentina, 525 m



Fig. 79: Habitat of *Gymnocalycium basiatrum* VoS 1783



Fig. 80: Seeds of *Gymnocalycium basiatrum* VoS 1783 (20 x)

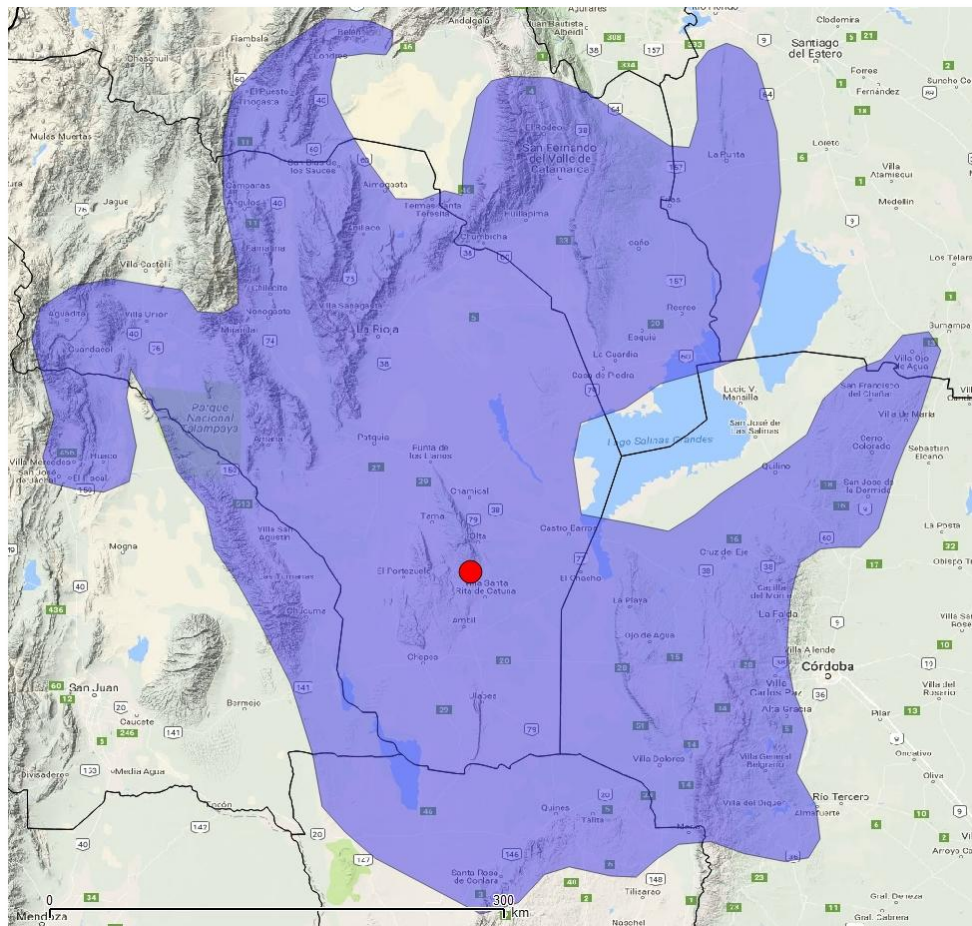


Fig. 81: Locality of *Gymnocalycium basiatrum* VoS 1783

***Gymnocalycium bodenbenderianum* (Hoss.) Berger (1928)**



Fig. 82: *Gymnocalycium bodenbenderianum* VoS 1750, east of Chuquis, Province La Rioja, Argentina, 1364 m



Fig. 83: Habitat of *Gymnocalycium bodenbenderianum* VoS 1750



Fig. 84: Seeds of *Gymnocalycium bodenbenderianum* VoS 1750 (20 x)

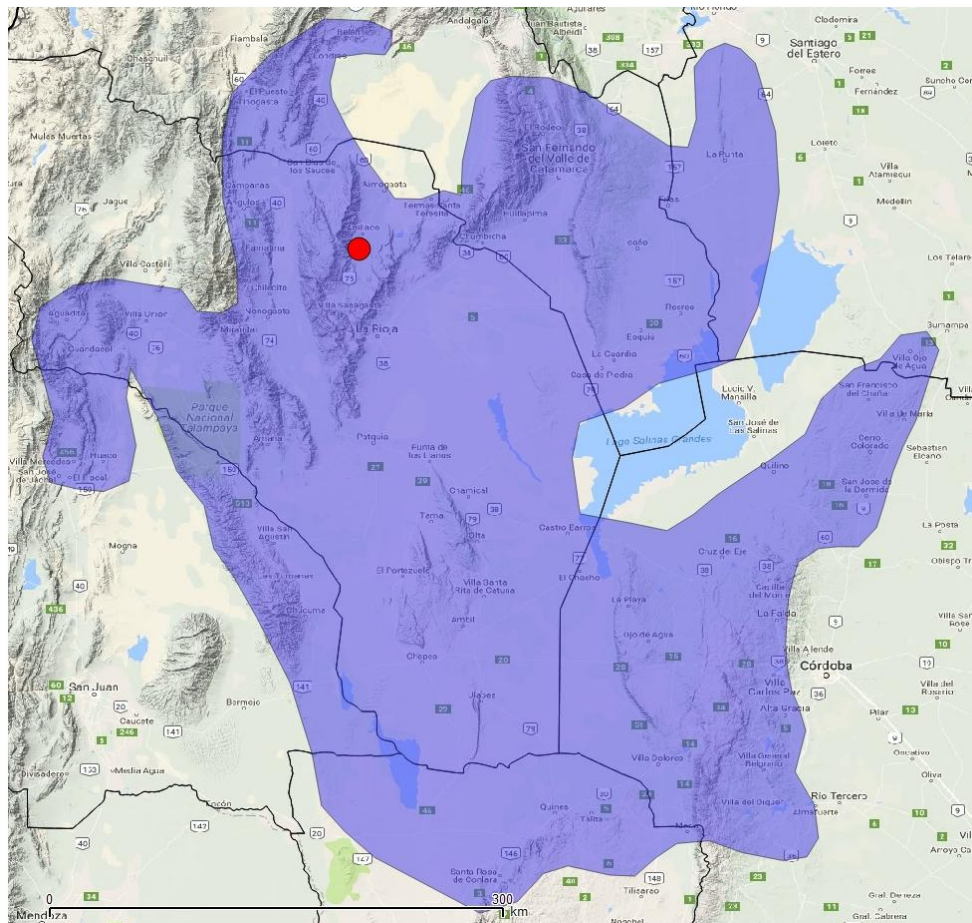


Fig. 85: Locality of *Gymnocalycium bodenbenderianum* VoS 1750

***Gymnocalycium ochoterena* Backeberg (1936)**



Fig. 86: *Gymnocalycium ochoterena* VoS 168, 40 km east of Quines, Ruta 5, Province San Luis, Argentina, 526 m



Fig. 87: Habitat of *Gymnocalycium ochoterena* VoS 168

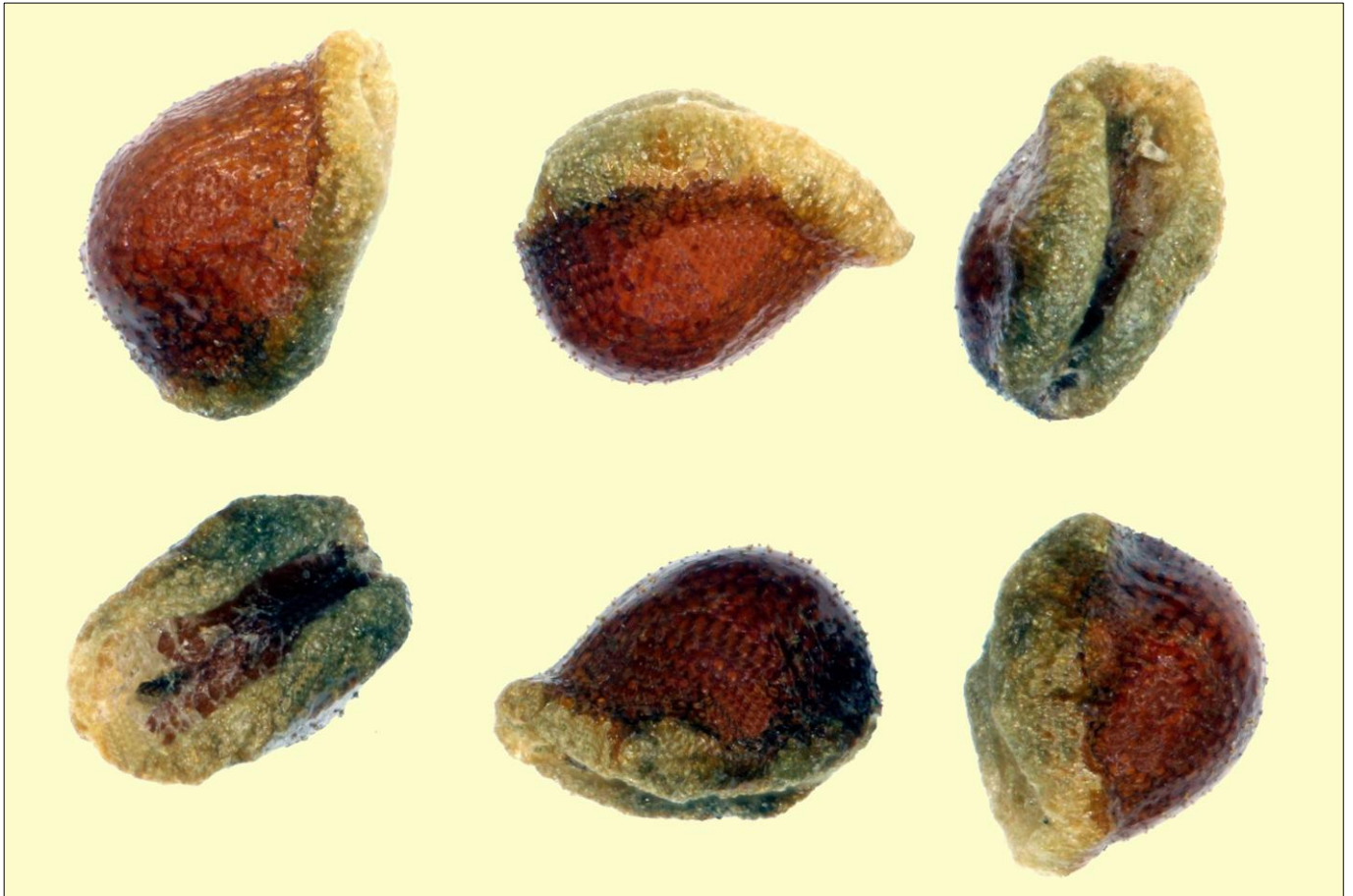


Fig. 88: Seeds of *Gymnocalycium ochoterenae* VoS 167, 36 km east of Quines, Ruta 5, Province San Luis, Argentina, 501 m (20 x)

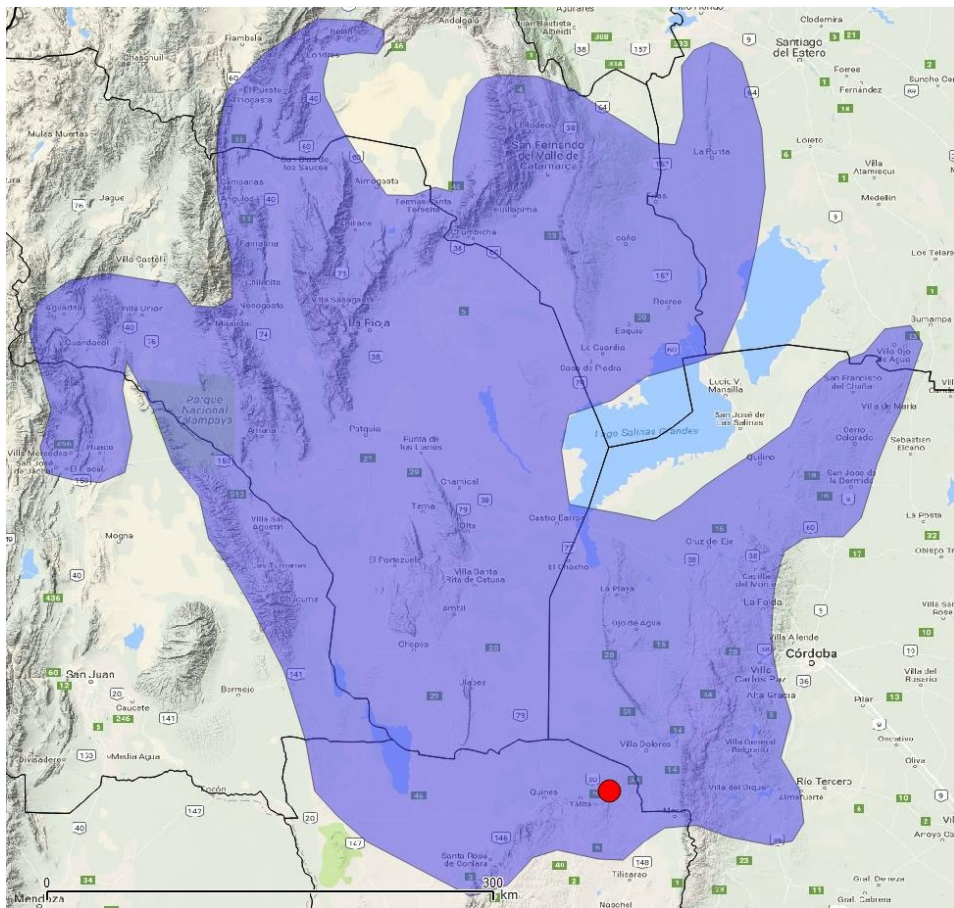


Fig. 89: Locality of *Gymnocalycium ochoterenae* VoS 167 und VoS 168

***Gymnocalycium quehlianum* (F. Haage ex Quehl) Vaupel ex Hosseus (1926)**



Fig. 90: *Gymnocalycium quehlianum* VoS 673, 3 km south of Tanti, Province Córdoba, Argentina, 903 m



Fig. 91: Habitat of *Gymnocalycium quehlianum* VoS 673



Fig. 92: Seeds of *Gymnocalycium quehlianum* VoS 673 (20 x)

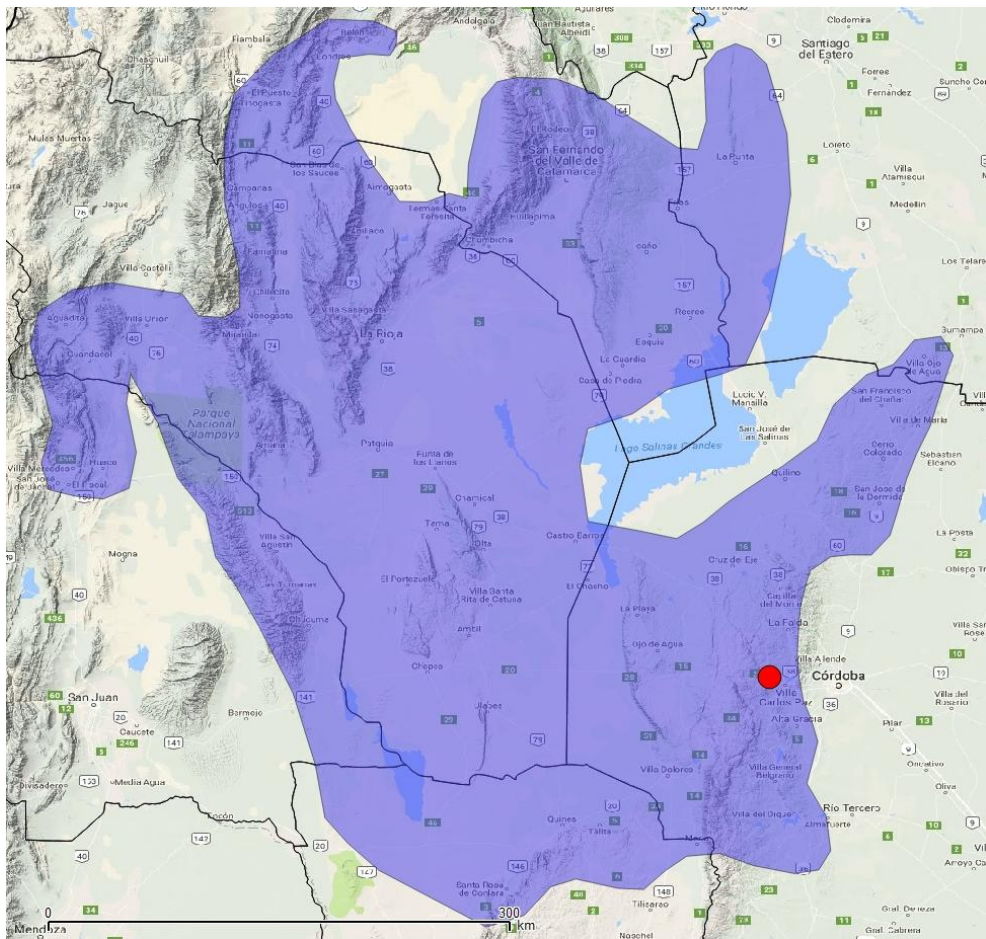


Fig. 93: Locality of *Gymnocalycium quehlianum* VoS 673

***Gymnocalycium ragonesei* Castellanos (1950)**



Fig. 94: *Gymnocalycium ragonesei* TS 948, 20 km southeast of Recreo, Province Catamarca, Argentina, 189 m (photo: Thomas Strub)



Fig. 95: Habitat of *Gymnocalycium ragonesei* TS 948 (photo: Thomas Strub)

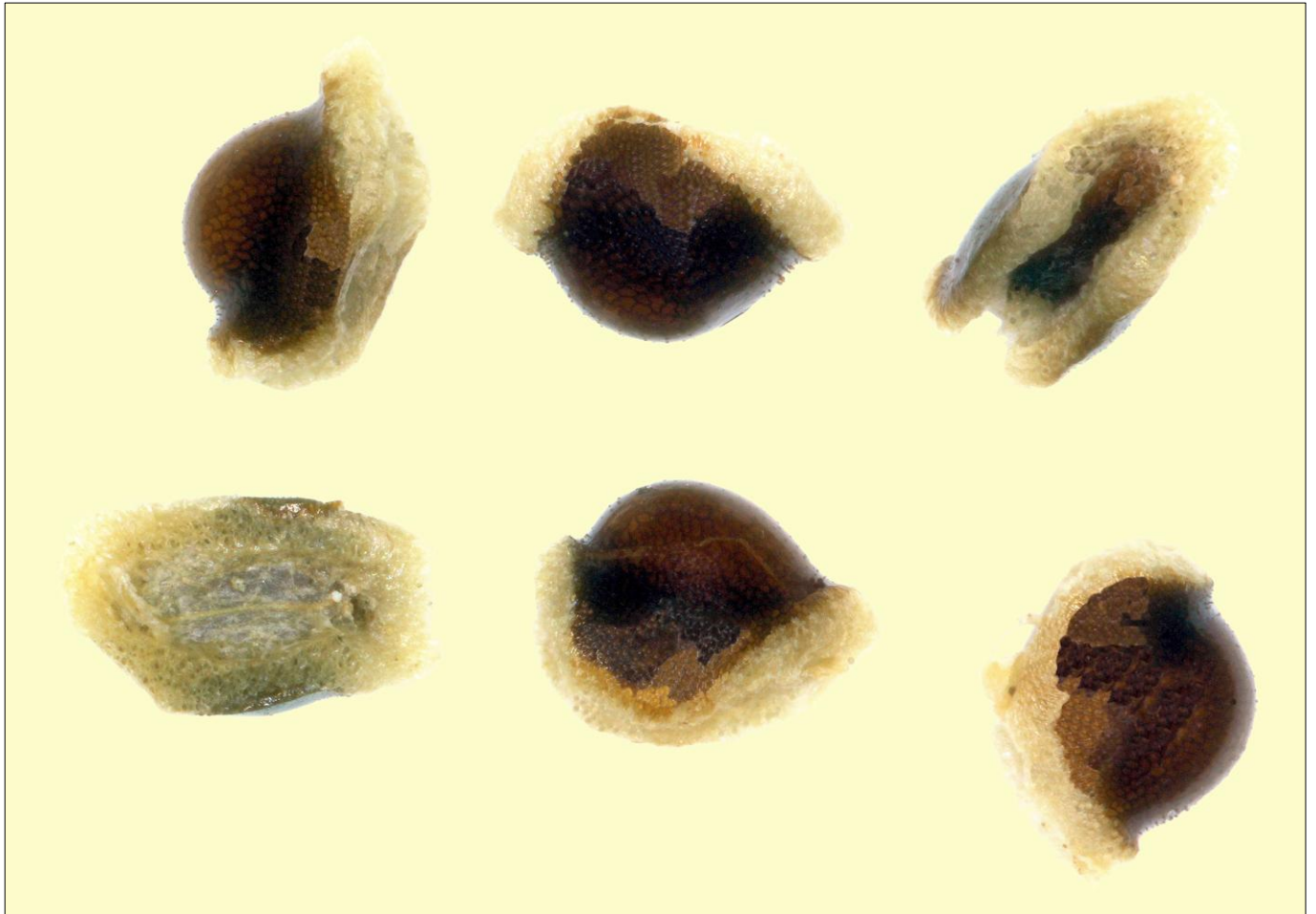


Fig. 96: Seeds of *Gymnocalycium ragonesei* HV 883 (20 x)

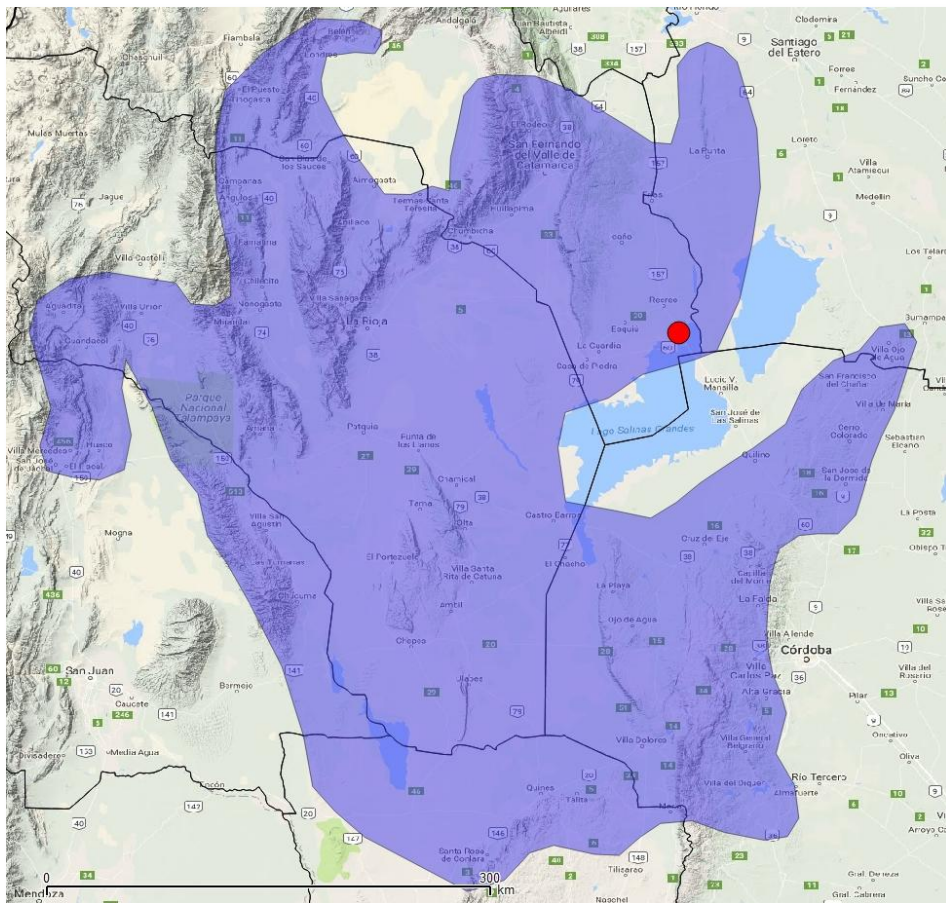


Fig. 97: Locality of *Gymnocalycium ragonesei* TS 948 and HV 883

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Unless otherwise stated all photos by the authors.

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