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Cover picture: *Gymnocalycium bruchii* subspec. *pawlovskyi*, MaW 72/90, 10 km north of the crossing of Ruta Provincial 16 and 18, Córdoba, Argentina (photo: M. Wick)

Editorial

Dear Gymnocalycium enthusiast!

An interesting year for Gymno-friends soon passes again. At meetings in Eugendorf, Carmagnola and Radebeul various themes were discussed, the compiled results can already in part be read in this or in a future issue of SCHÜTZIANA.

At the meeting in Carmagnola, the Gymnocalyciums of the subgenus Scabrosemineum from the Sierra de Mazán, Sierra de Velasco and surrounding areas were the theme.

In the first part of his account Wolfgang Papsch deals with the history and ecology of *Gymnocalycium bruchii*.

The articles presented in SCHÜTZIANA are intended to initiate reactions from the readers and friends of Gymnocalyciums. These contributions should lead to an open discussion and the editors would appreciate a lively exchange of ideas.

We would like to express our special thanks to Mr. Graham Charles (United Kingdom), who supports us with the English language, to Mr. Takashi Shimada (Japan), who translates SCHÜTZIANA into Japanese and to Mr. Daniel Schweich (France), who has mirrored our publication under: http://www.cactuspro.com/biblio/.

Gymnocalycium bruchii: History, Ecology, and Systematics Part 1

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ABSTRACT

***Gymnocalycium bruchii* is one of the most discussed taxa in the literature of the genus *Gymnocalycium*.**
The small size of the plant body, it's easy culture and freely appearing flowers have helped to make this species present in almost every collection of cacti.
In many studies about the natural habitats of *G. bruchii* in recent years, new insights into area-geographic data and the ecological conditions there, the variability within the species, as well as the criteria differentiating it from closely related species can be found. Several papers have been published about it recently.
Depending on the personal opinion of the authors about this species with regard to infraspecific ranks, the plants from different localities were either summarized or split extremely.
In this work, an attempt is made to represent the species *Gymnocalycium bruchii* (Spegazzini) Hosseus in its entirety. Here, the relationships between the nomenclatural strongly split and geographically separated populations of the species are clarified and delimited from related species.

Keywords: Gymnocalycium, *Gymnocalycium bruchii*, Systematics, Nomenclature

METHOD:

- Evaluation of more than 100 finding places, documented with pictures and exact locality data (A: W. Albrecht, Vienna, HGR: H. Reitmeier, Nürnberg, MaW: M. Wick, Fichtenwalde, MM: M. Meregalli, Turin, Tom: T. Kulhanek, Brno, LK: L. Kral. Ostrava, LCH: L. Chvastek, Frytek Mistek, VG: V. Gapon, Moscow, WP: W. Papsch, Knittelfeld),
- Additionally, material without exact locality data (GPS) (GN: G. Neuhuber, LF: L. Fischer, STO: H. Amerhauser et al., LB: L. Bercht),
- Personal site studies at 35 localities in the provinces of Córdoba and San Luis,
- Comparison of plants in part after several years of culture,
- Mapping of the documented findings using GPS data and Google Earth,
- Tabular comparison of all protologues,
- Comparison of the offspring.

For geographic analysis and the making of the maps the GIS software ArcView® and Diva-GIS® were used (GIS= Geographical Information System). ArcView® is licensed software from the company ESRI (www.esri.com); Diva-GIS® is freeware (www.diva-gis.org). For the latter, free climate and elevation data are available on the homepage. Google Earth (basic version) is free software of Google Inc. and presents a virtual globe. It can overlay satellite and aerial images with spatial data of different resolution and can display it on a digital elevation model of the earth.

For assessing the variability of populations of *G. bruchii*, in addition to the listed protologue, the ecological, geographical and geological elements in the habitat are evaluated for this study. Furthermore, the dominant type of each of the individual populations is taken into account, as well as their existing variability.

In culture, the reproductive organs of documented material was given particular attention. For seed production, the plants were fertilized and precisely separated by locality. The seeds were only superficially cleaned and then coated in a vacuum with gold. The seed images were acquired with a JSM 6460 microscope of the company JEOL. The seeds are photographed, to enable a direct comparison, with the same scale and at approximately the same position.

The chosen magnification factors were:
The entire seed: X30
Micropylar region: X80
Lateral region of seed surface: X200
Detail of surface cells: X800.

HISTORY:

The description of *G. bruchii* is based on plants which were collected in 1918 by the photographer and entomologist Dr. Carlos Bruch around Alta Gracia in the Sierra de Córdoba (Province Córdoba, Argentina). The plants were forwarded to botanist and mycologist Dr. Carlos Spegazzini in La Plata. In 1923, C. Spegazzini named this discovery in honour of Dr. Bruch as *Frailea bruchii* Spegazzini (Spegazzini 1923).

There is no hint that a type-plant was deposited. The picture with the protologue was used as the lectotype (Metzing et. al. 1995). The error of Spegazzini to allocate this species to the genus Frailea can be understood, when we consider the short time between the publication of the genus Frailea by Britton and Rose (1922) and the publication of the first description of *G. bruchii* (Spegazzini submitted his work for the publication of *Frailea bruchii* on 3rd January 1922. It was published on 23rd January 1923). The diagnosis, extended description and illustration refer this plant as a relative of Gymnocalycium.

One year after the description of *F. bruchii*, Dr. Friedrich Vaupel, Curator at the Botanical Garden in Berlin, described a Gymnocalycium from around La Falda (Prov. Cordoba, Argentina) as *Gymnocalycium lafaldense* (Vaupel 1924). The drawing accompanying the description by Pohl was designated as the lectotype (Metzing et al. 1995).

Important in identifying *G. bruchii* sensu stricto is a 1927 published list of plants in Memoria Anual del Zoológico (Marelli 1927) that must have been created before 1925. It is a compilation of cacti obtained from Professor Carlos Hosseus. In this list, *G. lafaldense* Vaupel is synonymous with *F. bruchii*. This list was checked by Spegazzini. It indicates a confirmation by Spegazzini that his *F. bruchii* belongs to the genus Gymnocalycium. In this context, it is interesting that Spegazzini in his work on cacti after 1923, his *F. bruchii* is mentioned neither among the listed species of Frailea, nor in those of the genus Gymnocalycium (Spegazzini 1925). But he also does not mention *G. lafaldense* in this work.

In 1926 Hosseus transferred *F. bruchii* to the genus Gymnocalycium and consequently places *G. lafaldense* synonymous with it (Hosseus 1926). Together with *G. sigelianum* (Schick) Backeberg, *G. sutterianum* (Schick) Backeberg, *G. capillense* (Schick) Backeberg, *G. multiflorum* (Hooker) Britton & Rose and *Lobivia spiniflora* (Schumann) Britton & Rose the Sierra de Cordoba is specified as the finding place. The localities of *G. bruchii* and *G. lafaldense*, Alta Gracia and La Falda respectively, are about 60 km apart in the Sierra Chica. Both collections thus represent different populations and therefore cannot be simply regarded as synonymous.

In 1935 Curt Backeberg published another plant related to *G. bruchii* under the name *Gymnocalycium albispinum* Backeberg (Backeberg & Knuth 1935) with longer and stronger spines as well as different flowers reported as the differences. The finding place within province Córdoba, Argentina is not specified. In the same publication, Backeberg adds a variety *hossei* to *G. bruchii*. For nomenclatural reasons, this name remained invalid. Later work by Oehme and Backeberg didn't change this (Oehme 1941, Backeberg 1959).

Hanns Oehme, cactus collector and painter in Dresden, believed that Spegazzini should have been able to know a Frailea and in his description characterized features of a different species. Accordingly, in his opinion, the name of Vaupel must be used.

From the same collection, sent from Argentina to Mr. Schwebs in Dresden, and containing about 25-30 specimens including *G. lafaldense*, he described 4 different looking plants as new forms. His new forms: fa. *deviatum* Oehme, fa. *enormous* Oehme, fa. *evolvens* Oehme and fa. *fraternum* Oehme should represent intermediate forms to *G. albispinum*. Correctly, he argues that all are assigned to a form group and agree in all characters and share a common location (Oehme 1941).

William Simon agrees with Oehme, adding to the already known forms he describes another, *G. lafaldense* fa. *spinosissimum* Haage Jr. ex Simon, 15 cm high and 7 cm in diameter a considerably larger plant (Simon 1973). Then Haage Jr. created the still undescribed *Echinocactus (Gymnocalycium) lafaldensis* var. *spinosissimum*, first offered in the plant catalogue of Haage in Erfurt in 1927. Also in the list of the company Richard Graessner Perleberg (Germany), this form can be found offered (Graessner 1931). By Yoshio Ito (1952) it is not put in the correct way as a variety of *G. bruchii* (Ito 1952). A garden variety Simon called *G. lafaldense* fa. *intermedium* (Simon 1973).

For almost 60 years in the literature only the two plant localities Alta Gracia (*G. bruchii*) and La Falda (*G. lafaldense* and its forms) were known. However, in 1965, Walter Rausch with Ernst Markus and Omar Ferrari found a population in the northern part of the Sierra Chica and later named the plants , *G. bruchii* var. *niveum* Rausch because of their dense white spines (Rausch 1989).

In 1980, the first discovery of plants from the relationship of *G. bruchii* became known from the Sierra Grande (Province of Córdoba) by Ferrari (OF 2-80). In 1980, Jörg Piltz found plants on the east side of the Sierra Grande (P 174, P 200) and on the west side near Candelaria, a population of plants with deviating spines. He described it 7 years later as *G. bruchii* var. *brigittae* Piltz (Piltz 1987).

A discovery of Gert Neuhuber in the Sierra de San Luis (province of San Luis) gave rise to controversy. Neuhuber interpreted the discovery as a relation of *G. andreae* (Boedeker) Backeberg and described it as *G. andreae* subspec. *carolinense* Neuhuber (Neuhuber 1994).

In the discussion plants from the eastern side of the Sierra Grande must also be included. Walter Rausch named the population first *G. andreae* var. *leucanthum* n.n. and described it later as *G. andreae* subspec. *matznetteri* Rausch (Rausch 2000).

In 2003, Neuhuber dealt extensively with the issue of *G. bruchii* (Neuhuber 2003). He classified *G. lafaldense* as a subspecies of *G. bruchii* and described two other sub-species and a new variety: *G. bruchii* subspec. *susannae* Neuhuber from the eastern side of the Sierra Grande at Copina and *G. bruchii* subspec. *pawlovskyi* Neuhuber from La Esperanza in the north and *G. bruchii glaucum* Neuhuber from Los Reartes in the southern part of province Córdoba.

2 years later, after further studies by Neuhuber, he comes to the view that *G. andreae* subspec. *carolinense* must be raised to species level and therefore must become *G. carolinense* (Neuhuber) Neuhuber (Neuhuber 2005).

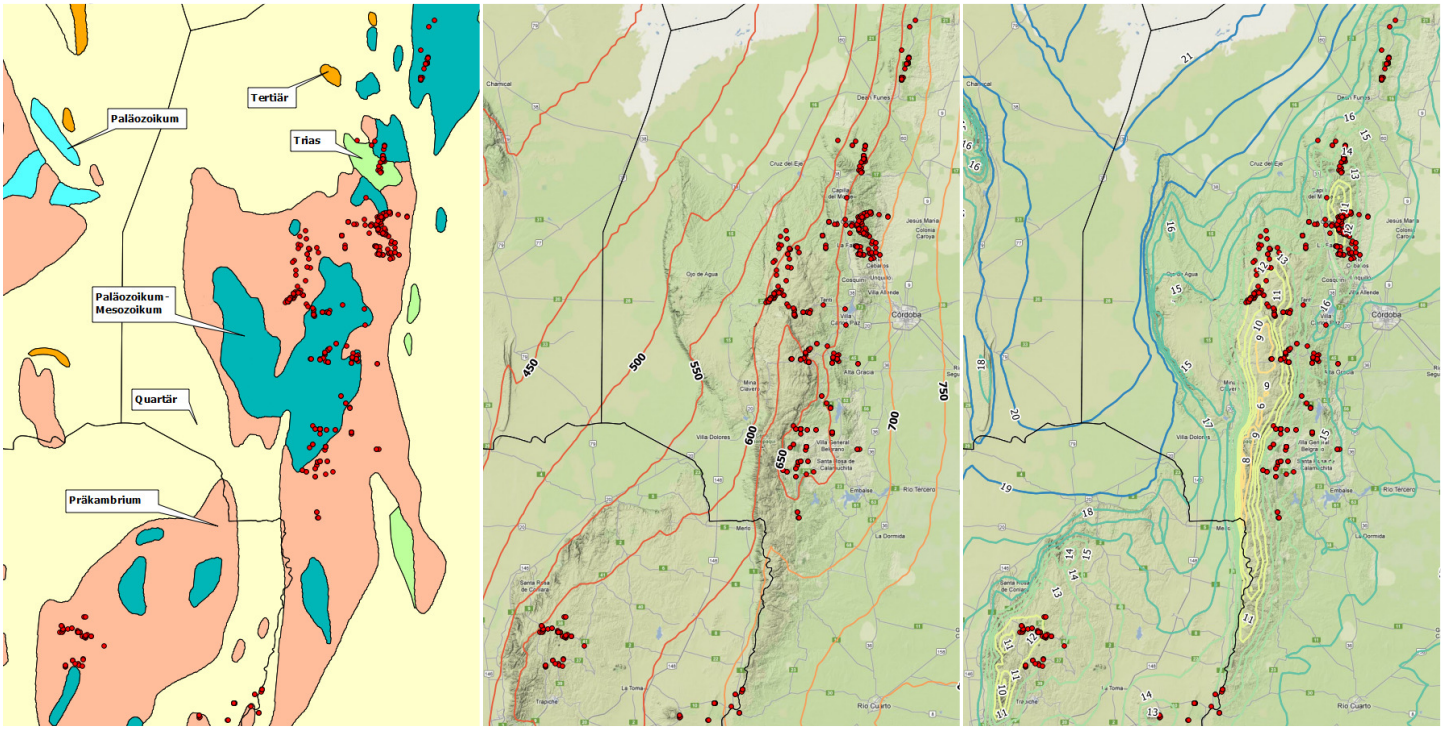
In November 2008, Till et al. advised that it was planned to divide the species *G. bruchii* and *G. carolinense* (Neuhuber) Neuhuber into a number of infraspecific taxa (Till et al. 2008). The descriptions of 9 new sub-species, 2 varieties and the recombination of 2 taxa to *G. bruchii* were introduced in 2009 in 2 parts by Neuhuber. In part one, *G. bruchii* subspec. *lacumbrense* Neuhuber from La Cumbre, *G. bruchii subsp. shimadae* Neuhuber from the Cumbre de Perchel, *G. bruchii* subspec. *cumbrecitense* Neuhuber and *G. bruchii* subspec. *renatae* Neuhuber from the eastern side of the Sierra de Comechingones and south of La Cumbrecita and *G. bruchii* subspec. *melojeri* Neuhuber with the variety *rubroalabastrum* Neuhuber from around Yacanto de Calamuchita are presented (all cities in the Prov. Córdoba). *G. andreae* subspec. *matznetteri* becomes a subspecies of *G. bruchii*, whereby its form *svecianum* Pažout ex H. Till is also transferred (Neuhuber 2009a). In part two, Neuhuber deals with populations of *G. bruchii* which can be found on the Sierra Chica. *G. bruchii* subspec. *elegans* Neuhuber, *G. bruchii* subspec. *implexum* Neuhuber and *G. bruchii* subspec. *multicostatum* Neuhuber were picked up along the way from El Manzano via Candonga to La Cumbre. A population at the pass on the road from La Cumbre to Ascochinga he calls *G. bruchii* subspec. *atroviride* Neuhuber (Neuhuber 2009b).

Recently, he described a subspecies of *G. carolinense*: *G. carolinense* subspec. *ludwigii* Neuhuber and for this a variety: *G. carolinense* subspec. *ludwigii* var. *eltrebolense* Neuhuber (Neuhuber 2012).

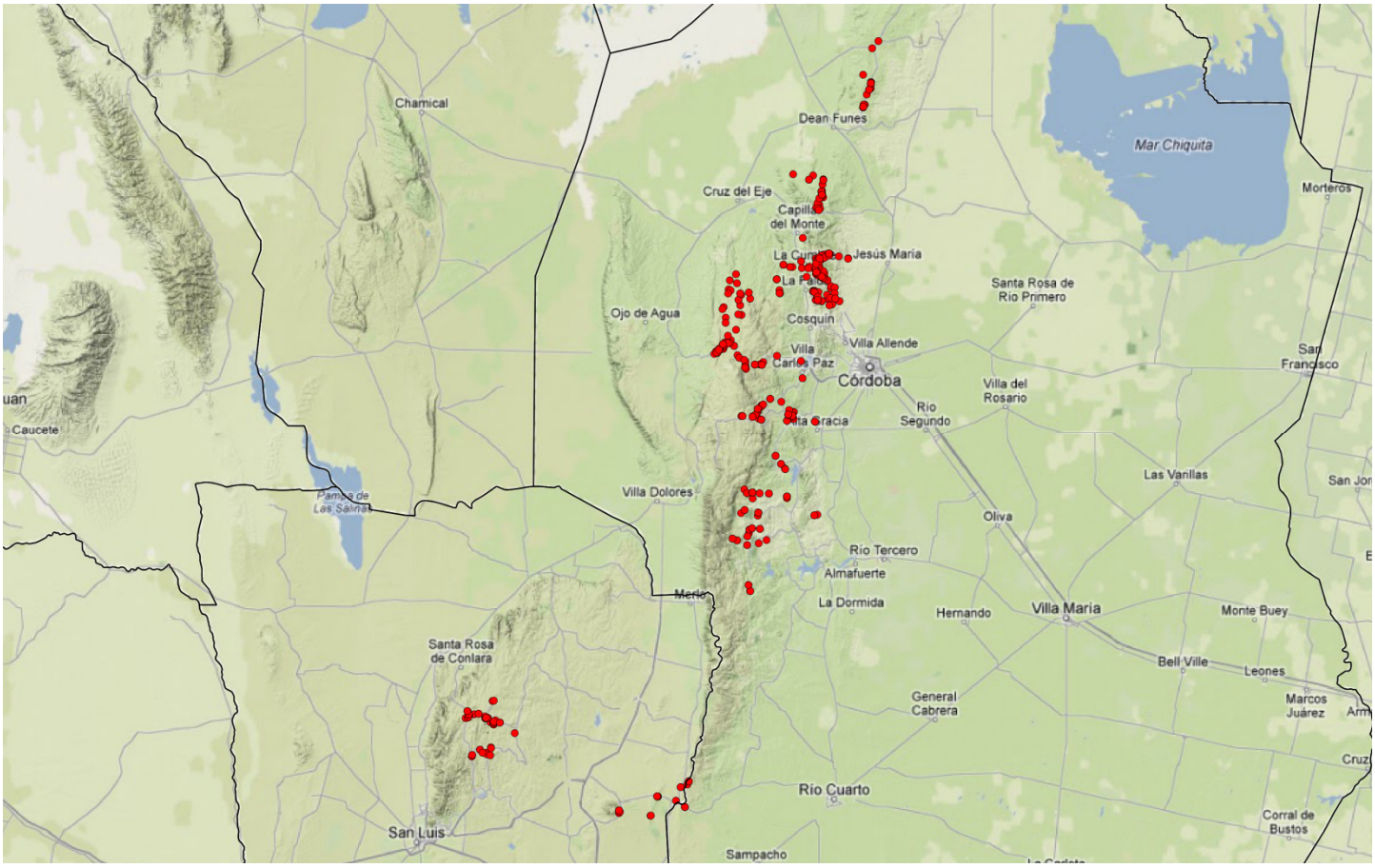
DISTRIBUTION:

The intensive field work in recent years by various people resulted in many new localities being found in which populations of *G. bruchii* forms grow.

Whereas the original localities are at Alta Gracia and La Falda and only about 60 km apart on the west side of the Sierra Chica, the currently known distribution area comprises a narrow, triangular corridor of up to 50 km in width, starting from the Sierra de Ambargasta in the north of Cordoba via the Sierra Grande to the Sierra Chica, to the southern tip of the Sierra de Comechingones. This is a straight line distance of about 340 km. At the southern end, the range extends to the west over a width of about 100 km up to the Sierra de San Luis (province of San Luis). The evaluation of all localities found so far shows that the distribution is divided into different areas. Here, it is easily possible to draw the wrong conclusion that area-geographic boundaries between the local populations do exist. It is highly probable that future access of the mountain ranges between the localities known today will result in further population being discovered. This conclusion can already today be considered as very likely because of the relatively small distances between them. An evaluation of the known collections with exact documentation of localities shows that all findings were made at the extant longitudinal and transverse joints along the mountains mentioned above.



Map 1-3: Geology, average annual precipitation [mm] and mean temperature [°C] in the distribution area of *G. bruchii*



Map 4: Locations of analysed collections

DISCUSSION:

Rausch writes in his publication of the variety niveum that in *G. bruchii* two distinct lines exist. On one hand, the relatively large and white-flowered population on the Sierra Grande and the light pink- and small-flowered forms of the Sierra Chica. This statement cannot be confirmed in this study. All populations studied show a uniform flowering behaviour, where the flower size and flower colour varies within a narrow size range and colour spectrum. A more or less strong variation in flower size and colour is identifiable even within a population to be as great as with all plants in the entire distribution area. There are major differences in the habitual appearance at the borders of its range of distribution. This is especially true for populations in the Sierra de San Luis whose spines already show a strong modification in the arrangement and structure. Also the plants on the Sierra Grande differ from the typical *G. bruchii* of the Sierra Chica with a larger and blue-green body with a less-dense spination. Taking plants from the most northern locality and comparing them to plants from the Sierra de San Luis, which is the opposite south-western locality, one can conclude that we have here two different species.

In order to achieve a comprehensive view of what you have to understand within the species *G. bruchii*, the populations in the areas of connection should especially be observed. In the south, for example, collections link between populations in the Sierra del Morro and Sierra del Portezuelo (Province of San Luis) between those in the Sierra de San Luis and those on the southern tip of the Sierra de Comechingones. The slightly larger gap of about 60 km to the populations in the Sierra de San Luis could be closed by including finds in the Cerros del Rosario.

An even larger gap of about 80 km to the southeast exists between Achiras and Santa Rosa de Calamuchita (Province of Cordoba). By the discovery of MM 2011-014 however, an intermediate population was already found. Again, more finds due to the topography and geology can't be excluded for sure.

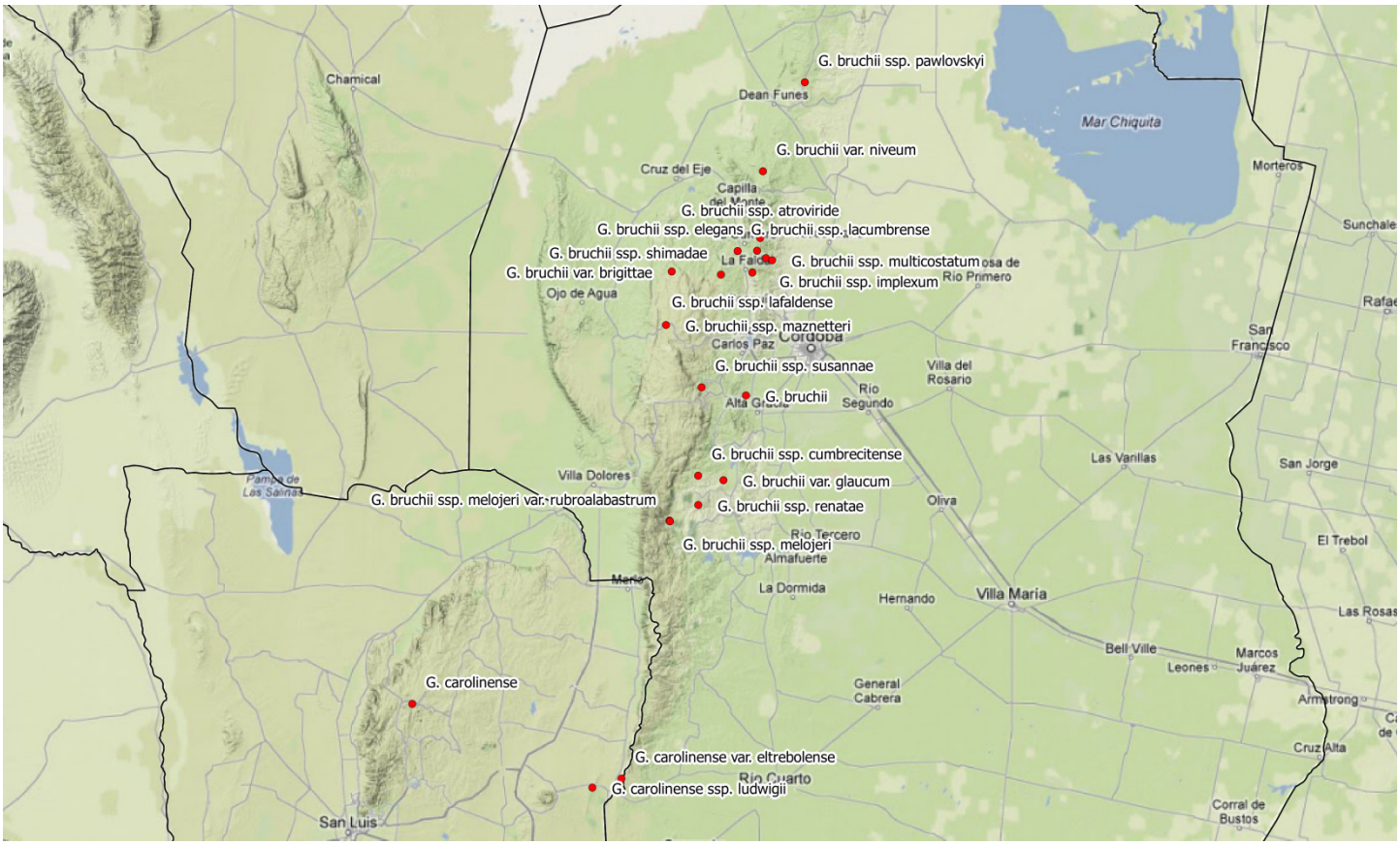
A discussion whether Spegazzini's *Frailea bruchii* is a Gymnocalycium is not necessary with the work of Hosseus (Hosseus 1926), Metzing (Metzing et al. 1995) and Neuhuber (Neuhuber 2003). It is therefore appropriate, based on the type locality of *G. bruchii* at Alta Gracia, to compare the individual local population and subject it a taxonomic review. From this discussion, varieties and forms of *G. bruchii* and *G. lafaldense* described by Haage, Oehme and Simon are excluded. All indications suggest that only forms of one collection have been described, to which a single rank may be assigned.

From about 1990, a discussion began on how narrowly or widely *G. bruchii* and *G. andreae* Boedecker are related to each other. *G. andreae* can also be found on the Sierra Grande, the Sierra Chica and the Sierra de Comechingones, but usually at locations which are above the localities of *G. bruchii* and almost always above 2000 m elevation. However, there are only a few overlapping areas such as north of Los Gigantes on the Sierra Grande or in the southern part of the Sierra de Comechingones. In these habitats natural hybrids could also be observed. Here it seems that time-shifted flowering times of both taxa aggravate mutual pollination but do not prevent it. Flower, body morphology and the behaviour of seedlings of *G. andreae* are so far different from those of *G. bruchii* that there is no problem to regard them as separate species. This assumption is supported by the fact that both taxa, albeit rarely, occur sympatrically. Here, the taxon *G. andreae* fa. *svecianum* is to be considered critical. It cannot be decided with certainty whether a white-flowering *G. andreae* is meant with this form or the sometimes sympatrically occurring *G. bruchii*. Considering the different plants in collections, the lack of a precise location, including those of the type made by Till, as well as the lack of a descriptive figure, this name should be eliminated.

Was there after the description of *G. bruchii* var. *brigittae* from the west side of the Sierra Grande no discussion about whether a relationship with *G. bruchii* is here present? Plants from the east side

were regarded as relatives of *G. andreae* and accordingly described as *G. andreae* subspec. *matznetteri*. Neuhuber put this taxon with *G. bruchii* (Neuhuber 2009a).

Also, the discoveries in the Sierra de San Luis were, as mentioned, discussed very controversially, but finally regarded as relatives of *G. andreae* and thus placed as a subspecies called *carolinense*. Neuhuber later revised his opinion and raises this subspecies to an independent species: as *G. carolinense* (Neuhuber 2005).

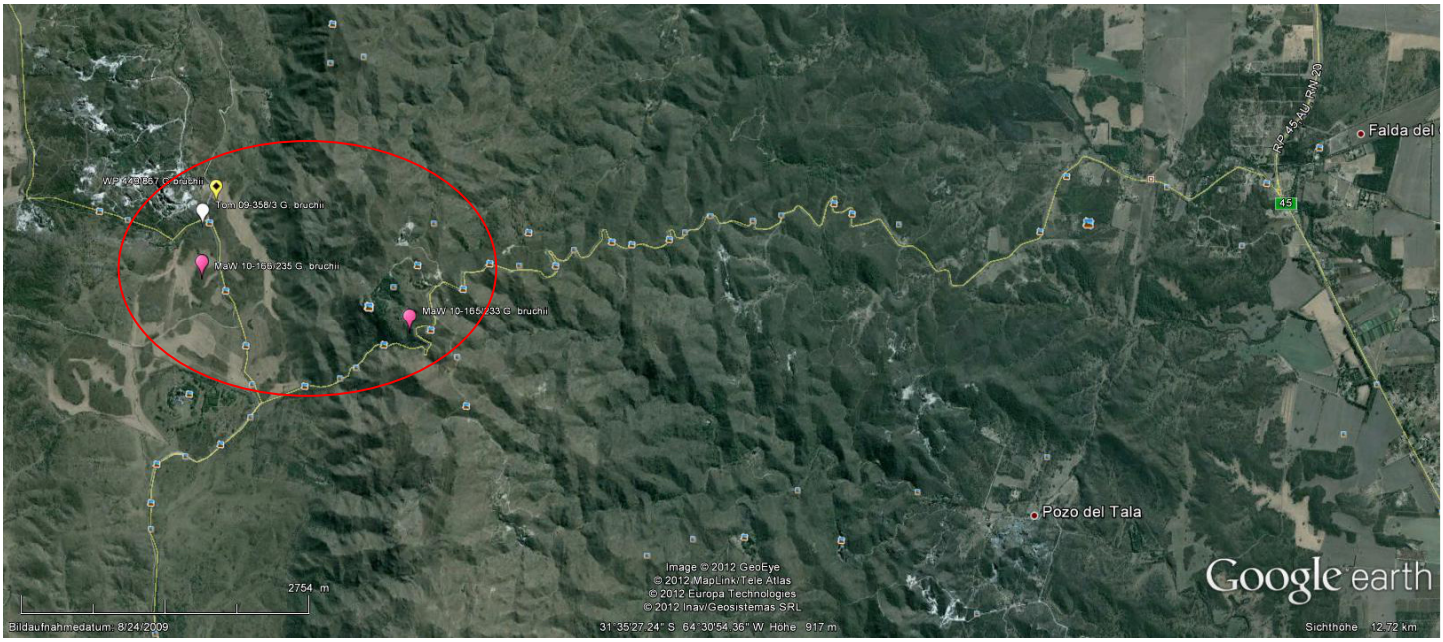


Map 5: Geographical locations of the described taxa

Neuhuber bases his work on a very narrow systematic approach. Some of his descriptions of subspecies can be compared with descriptions of the first half of the last century, where each different form or plant has been regarded as a new species. In a modern species concept, some subspecies described would not meet even the level of a variety. This extreme splitting led to the situation that even adjacent populations have been considered to be subspecies. In the work of Neuhuber it is suggested repeatedly that these subspecies colonize isolated locations and thus no gene exchange between them is possible. This is possibly true to some extent for populations at the edge of the distribution. There are also usually the largest uniformity within populations observed. A genetic separation can certainly be assumed because of the large distance between the northern-most, southern and south-eastern populations. As noted above, all finding places, except those on the Sierra de San Luis (*G. carolinense*), are close together. The few gaps, however, still contain a wealth of potential finding places, where accessibility is at present hardly possible.

Fig. 1: *G. bruchii* overview

If one considers that east of the Sierra Chica and the Sierra de Comechingones the terrain falls to the plane of the Pampa and with this a limit to the spread of *G. bruchii* is set, you can consider the type location of *G. bruchii*, Alta Gracia, as the centre of the entire distribution area of this species. The Sierra Chica here reaches its southern end and goes over the Sierra Morena and the Cumbre de Chica in the Sierra de Cóndores.



Map 6: Distribution of *G. bruchii* sensu stricto

The populations of *G. bruchii* occurring here correlate with the description and illustration of Spegazzini. On one (or more) usually strong and long taproot are often formed by sprouting multi-headed plant groups from cylindrical single heads. The heads reach 4-5 cm in diameter. The 11 ribs are clearly divided into small hemispherical tubercles. The fine, white to brownish spines do not quite spread across and reveals the green body. In some plants, particularly noticeable in the population occurring closer to Carmen del Falda, the juvenile spines can be intensely coloured reddish-brown on the new shoots. With increasing age, the spines lose this colour except for a small residue at the base. (6)-8-(12) spines of 4-5 mm length are bent sideways to the body in pairs. In addition, at the lower margin of the areole up to 3 shorter edge spines can be formed.

Fig. 2: *G. bruchii* MaW 165/233 south of Bosque Alegre

Fig. 3: *G. bruchii* MaW 166/235 west of Observatory Bosque Alegre

The central location of these plants is also reflected in the appearance of the above-ground plant parts. The spines have characteristics which plants from the northern and southern adjacent populations also exhibit. The documented findings are relatively concentrated west of Falda del Carmen on open, gently sloping meadows, which are strongly permeated with boulders and large rocks. A higher growth with shrubs or trees is not present. The soil consists of highly organic, black earth.

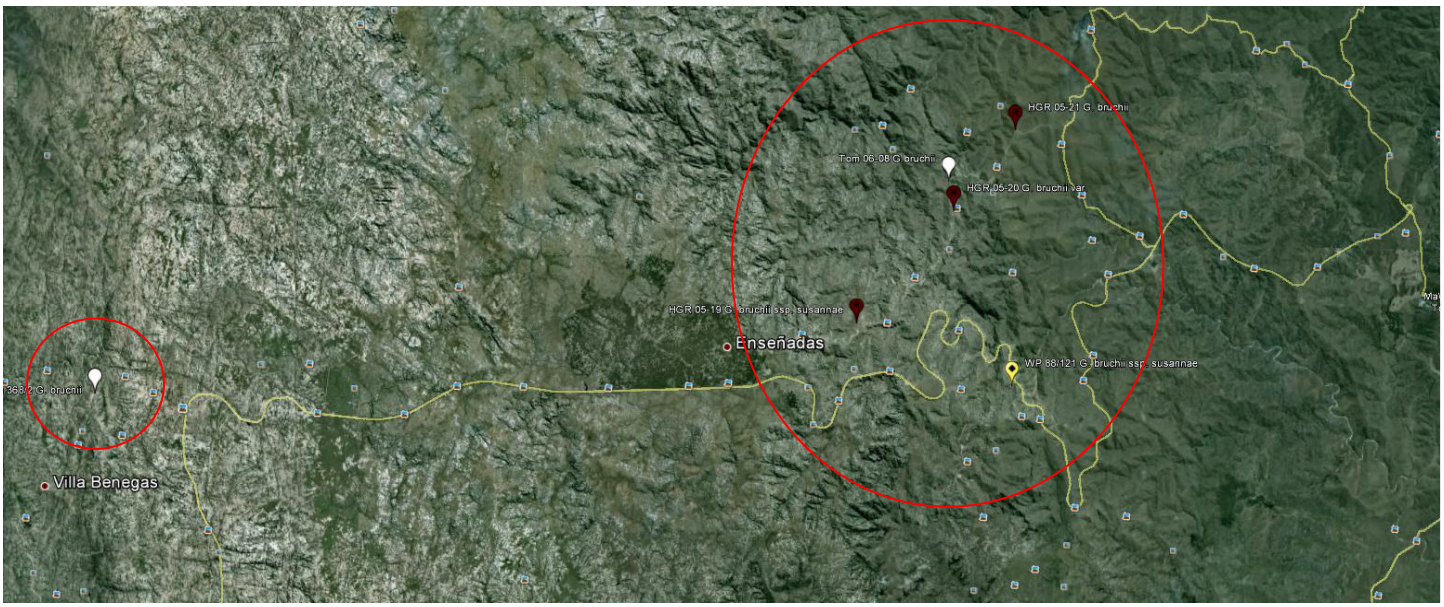
Fig. 4: *G. bruchii* MaW 166/235 west of Observatory Bosque Alegre

Fig. 5: *G. bruchii* MM 1445 south of Bosque Alegre

Investigated material:

MaW 165/233 Prov. Córdoba, Dept. Santa Maria, south of observatory Bosque Alegre
MaW 166/ 235 Prov. Córdoba, Dept. Santa Maria, west of observatory Bosque Alegre
MM 1445 Prov. Córdoba, Dept. Santa Maria, south of Bosque Alegre, 960 m
Tom 09-358/3 Prov. Córdoba, Dept. Santa Maria, west of observatory Bosque Alegre
WP 449/867 Prov. Córdoba, Dept. Santa Maria, west of observatory Bosque Alegre

About 10 km east of the localities of *G. bruchii* sensu stricto is the area where the populations of *G. bruchii* can be found which have been described as the subspecies *susannae*. The locations of the subspecies *bruchii* can be found at altitudes of 1000 m. In contrast, the previously documented findings of the subspecies *susannae* are located 500 to 1000 m higher. The hitherto highest locality is situated at slightly above 1900 m.



Map 7: Geographic location of the analysed findings from *G. bruchii susannae*

Fig. 6-7: *G. bruchii susannae* GN 216-617, flower and flower section, west of Copina

Noticeable in some plants is only the shorter flower, particularly in female-determined plants. A speciality of the stigma base position as indicated in the protologue cannot be found.

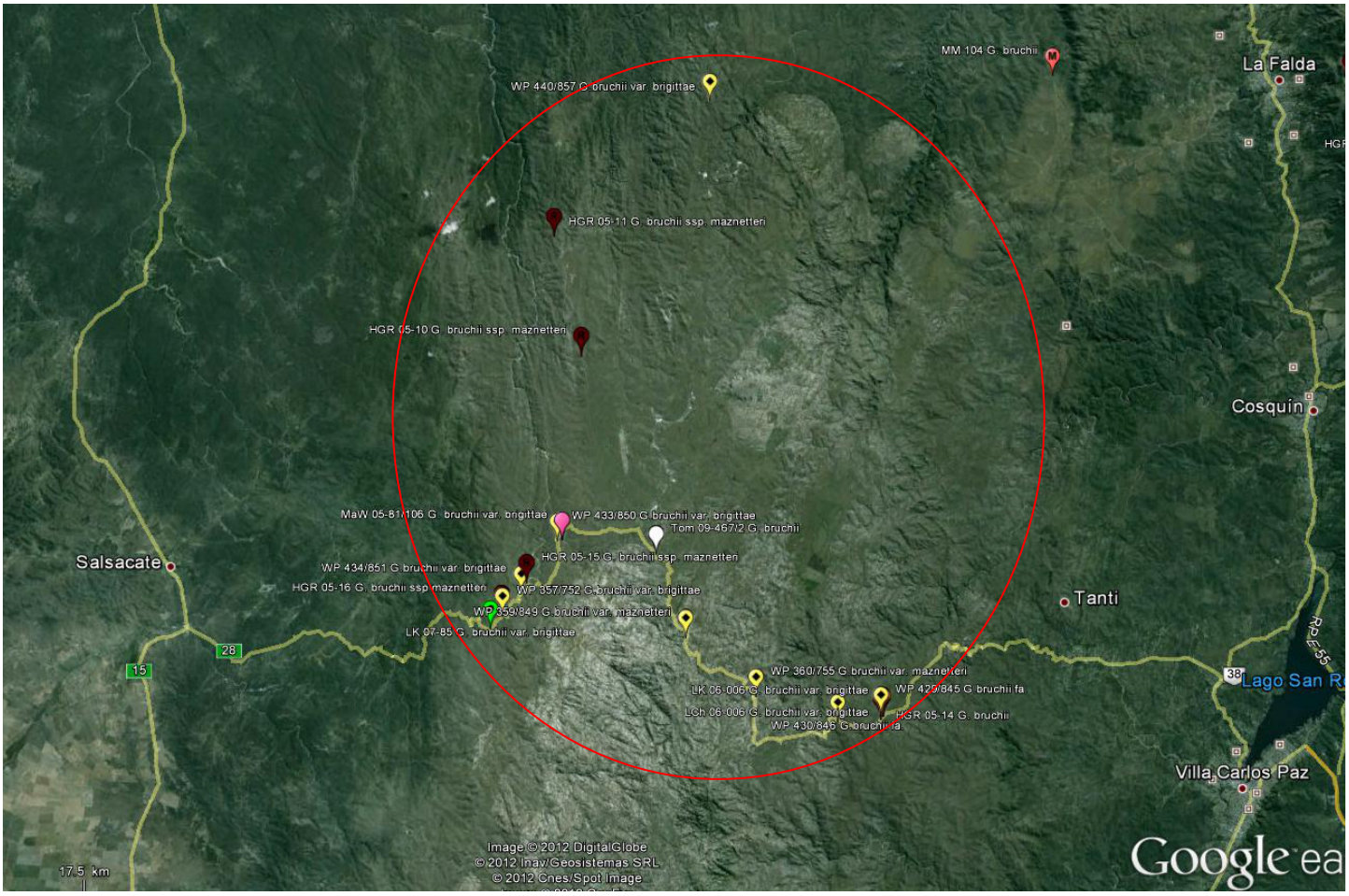
Growth locations are small, slightly sloping meadow areas in rocky terrain. The soil is black earth with boulders interspersed.

Fig. 8-9: *G. bruchii susannae* STO 415-2, flower and flower section, east of Copina

Investigated material:

GN 216/617 Prov. Córdoba, Dept. Punilla, west of Copina, 1250 m
HGR 05-19 Prov. Córdoba, Dept. Punilla, east of Las Ensenadas, 1900 m
HGR 05-20 Prov. Córdoba, Dept. Punilla, southwest of Copina, 1650 m
HGR 05-21 Prov. Córdoba, Dept. Punilla, northeast of Copina, 1420 m
Tom 06-08 Prov. Córdoba, Dept. Punilla, west of Copina, 1590 m
WP 88/121 Prov. Córdoba, Dept. Punilla, Ruta 20, south of Copina, 1680 m

Between Tanti and Salsacate, about 25 km north of Ruta 20, the Ruta 28 crosses the Sierra Grande. This road has along it a number of localities of other *G. bruchii* forms.



Map 8: Geographic location of the analysed findings from *G. bruchii brigittae*

Walter Rausch and Omar Ferrari (1980) found plants about 50 km west of La Falda and gave this discovery the field number OF 2-80. They placed these plants in association with *G. bruchii* var. *hossei*. In the same year, Jörg Piltz also made findings on the east side of the Sierra Grande. The locations of his field numbers P 174 and P 200 are located at a height of 1200 to 1300 m on the rise to Los Gigantes. On the same trip, he found further to the north also plants close to Candelaria, which he described seven years later as *G. bruchii* var. *brigittae*. As significant differences in characteristics for *G. bruchii* var. *bruchii*, he indicated a smaller number of ribs, a larger spacing of areoles and a lower number of spines. Thus, the plants appear more nude compared to the type variety. Other differences he observes were a compressed, wider than high pericarpel and larger, blue-green fruits.

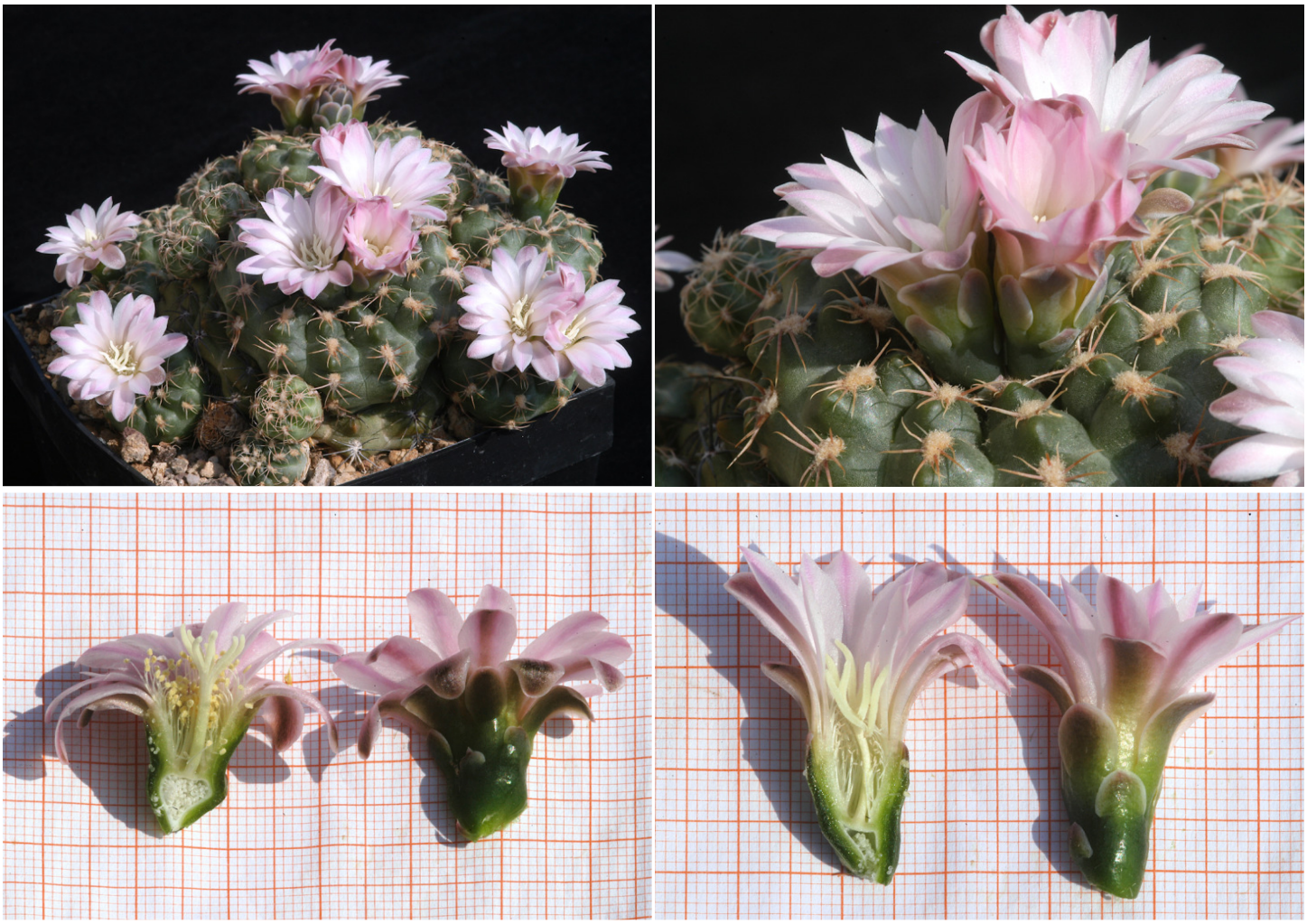


Fig. 10-13: *G. bruchii brigittae* P 214, Candelaria, flower and flower section

In 1990, *G. rauschii* Till, H. & Till, W. was described. It is a collection of Rausch that he is said have made allegedly in Uruguay. Rausch gathered all Uruguayan Gymnocalyciums under one field number: R 350. So far, at the specified type locality Ansina, no plants have been found that match the description. The morphology of the body, flowers, fruits and seeds of *G. rauschii* match in all respects those of *G. bruchii* var. *brigittae*. All evidence suggests that *G. rauschii* can be a younger synonym of *G. bruchii* var. *brigittae*.

Fig. 14-15: *G. rauschii* HT 408, flower and flower section

There has been a long history of discussion about what the plants growing at the eastern access road to Los Gigantes can considered to belong to. Piltz called the plants occurring at lower altitudes *G. bruchii*-forms (P 174, P 200) and those from high altitudes *G. andreae* (P 199, P 213). Omar Ferrari calls his find OF 2-80, which must also be, in accordance with the information provided, in the vicinity of Los Gigantes, as a form of *G. bruchii*.

The *G. bruchii*-forms can be found in this area of the Sierra Grande generally at altitudes between 1400 and 1700 m s.m. Approximately 100 m above and beyond are the growing places of *G. andreae*. As mentioned above, at higher elevations around 1800 to 2000 m, although rarely, in some places *G. andreae* and *G. bruchii* var. *brigittae* occur together. This even results in intermediate hybrids. Without knowledge of these flowers mixed forms are barely discernible. Even the white-flowered *G. andreae* var. *svecianum* Pažout ex H. Till could, if it was a plant from that area, also have been a hybrid. As the type of this taxon a plant with the field number the R 108 is reported. R 108 however by Rausch, is on one side reported to be *G. andreae* var. *longispinum* nom. nud. (GÖK 1976, Rausch & Zecher 1987), and on the other side only as *G. andreae* (Rausch & Zecher 1994).

Fig. 16-17: *G. bruchii brigittae* WP 359/754-1 Chuchilla Nevada, flower and flower section

Fig. 18-19: *G. bruchii* X *andreae fechseri* WP 359/754-2 Chuchilla Nevada, flower and flower section

Fig. 20: *G. andreae fechseri* WP 359/754-1 Chuchilla Nevada

Fig. 21: *G. andreae fechseri* and hybrid form WP 359/754 Chuchilla Nevada

Rausch could possibly have found this hybrid form also. Under the field number R 567a white flowering plants and under R 567b *G. andreae* are listed. In the field number lists of Rausch there is also plenty of confusing statements. As the locality of R 567a El Condor is specified in the field list of the 1994, his number R 108a should have been found at Los Gigantes on the other hand, both field numbers however are reported to be *G. andreae* var. *leucanthum*. A field number R 567b is not found in these lists. R 567a is described as *G. andreae* subspec. *matznetteri* by Rausch (Rausch 2000). In the Protologue he mentions only the general locality Sierra Grande, without exact location and elevation data. Also in the accompanying text only the northern Sierra Grande is published. According to the given characters and the presented pictures a plant from the environment of *G. bruchii* was described. R 567 is a *G. moserianum* Schütz nom. inval. from Salsacate. It therefore could be concluded that Rausch on the way from Los Gigantes to Salsacate also collected a *G. andreae* (R 567 b) and *G. bruchii*-form (R 567a). Sowings of R 567a from the collection Rausch yielded only *G. andreae*.

Possibly, *G. andreae* subspec. *matznetteri* is therefore a younger synonym of *G. bruchii* var. *brigittae*.

Neuhuber now groups the taxa *svecianum* and *matznetteri* under *G. bruchii* (Neuhuber 2009a). The already precarious details from Rausch for his field numbers are complemented by equally confusing information. R 108a shall now also have been collected at El Condor. For nomenclatural reasons, *G. bruchii* subspec. *matznetteri* would now have priority and Neuhuber argues that the morphological differences from *G. bruchii* var. *brigittae* justify only the rank of a form, although he uses in his work the rank of a variety. It would have been reasonable, to raise *G. bruchii* var. *brigittae* to the rank of a subspecies and better to eliminate the unsafe taxa *matznetteri* and *svecianum*.

The distance to the growing places of HGR 05-21 (*G. bruchii* subspec. *susannae*) and WP 430/846 (*G. bruchii* var. *brigittae*) is less than 20 km. In between lies a currently hardly accessible area of the

same geological nature and thus with further potential growing locations. Even the distance from the northern-most locality of the taxon *brigittae* near Candelaria (type locality of *G. bruchii* var. *brigittae*) to those at Los Gigantes is significantly larger (<30 km).

G. bruchii var. *brigittae* occupies the north-eastern part of the entire growing area and shows, compared to the typical subspecies, some morphological changes. The body size is increasing, the epidermis colour darkens, the spines become shorter and hardly interlace. In the flower morphology no specific deviations can be detected. The flowers and plants vary in size compared with the preceding populations, but are on average, slightly larger.

Fig. 22-23: *G. bruchii brigittae* LB 988 Chuchilla Nevada, flower and flower section

Fig. 24-25: *G. bruchii brigittae* STO 502 Cerro Negro, flower and flower section

Investigated material:

HGR 05-10 Prov. Córdoba, Dept. Punilla, street from Candelaria to R 28, 1690 m
HGR 05-11 Prov. Córdoba, Dept. Punilla, street from Candelaria to R 28, 1500 m
HGR 05-14 Prov. Córdoba, Dept. Punilla, Los Gigantes, 1530 m
HGR 05-15 Prov. Córdoba, Dept. Pocho, Dos Rios, 1650 m
HGR 05-16 Prov. Córdoba, Dept. Pocho, San Geronimo, 1750 m
MaW 05-81/116 Prov. Córdoba, Dept. Pocho, Dos Rios, 1660 m

MM 1420 Prov. Córdoba, Dept. Pocho, Dos Rios, 1650 m

MM 1009 Prov. Córdoba, Dept. Pocho, Dos Rios, 1685 m

MM 1415 Prov. Córdoba, Dept. Cruz del Eje, east of Candelaria, 1540 m

MM 1416 Prov. Córdoba, Dept. Cruz del Eje, south of Candelaria, 1620 m

P 214 Prov. Córdoba, Dept. Cruz del Eje, near Candelaria, 1800 m

Tom 09-467/2 Prov. Córdoba, Dept. Punilla, El Infernillo, 1850 m

WP 360/755 Prov. Córdoba, Dept. Punilla, Rio Yuspe, 1700 m

WP 357/752 Prov. Córdoba, Dept. Pocho, San Geronimo, 1760 m

WP 359/849 Prov. Córdoba, Dept. Punilla, El Infernillo, 1930 m

WP 429/845 Prov. Córdoba, Dept. Punilla, east of Los Gigantes, 1515 m

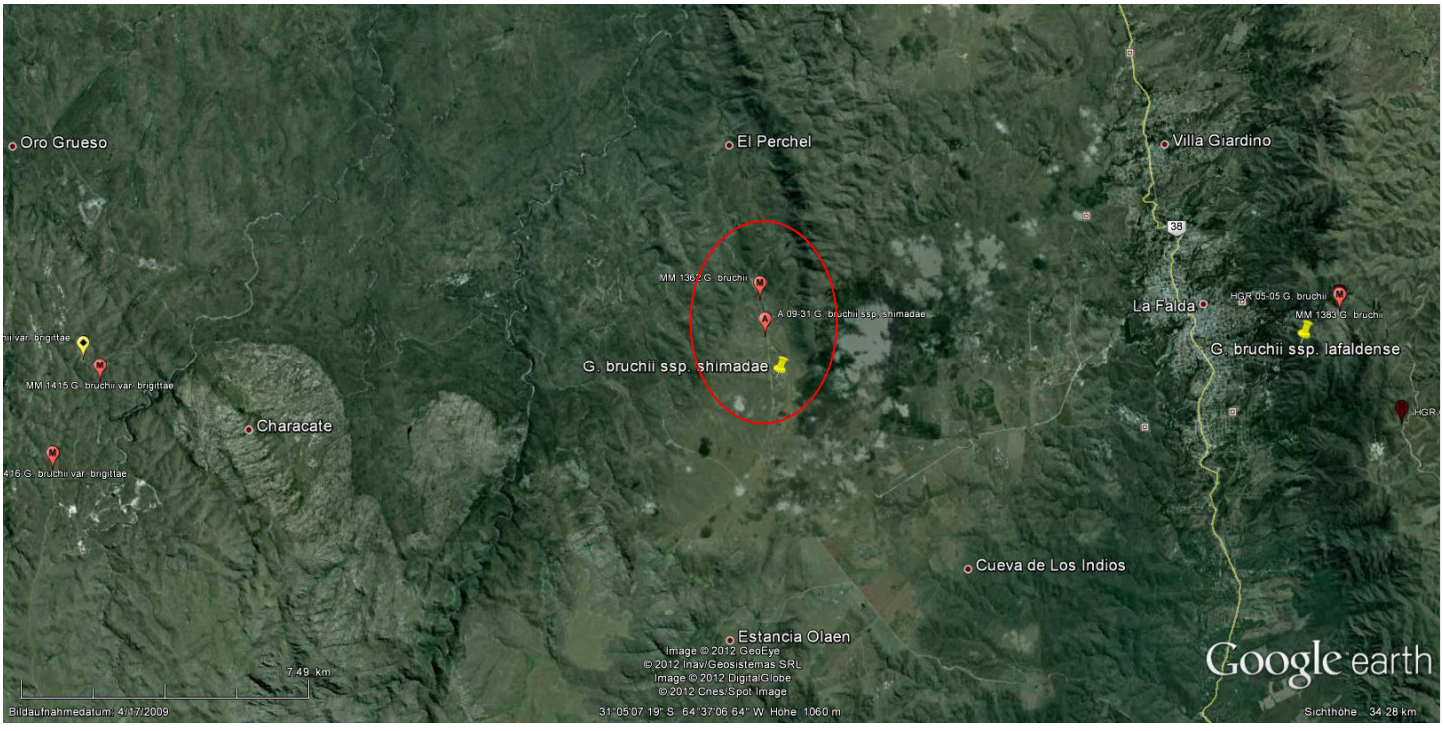
WP 430/846 Prov. Córdoba, Dept. Punilla, east of Los Gigantes, 1590 m

WP 433/850 Prov. Córdoba, Dept. Pocho, Dos Rios, 1650 m

WP 434/851 Prov. Córdoba, Dept. Pocho, Dos Rios, 1670 m

WP 440/857 Prov. Córdoba, Dept. Cruz del Eje, east of Candelaria, 1510 m

With the discovery of MM 1362 south of El Perchel, another gap between the findings on the Sierra Grande and those in the Sierra Chica was closed. Neuhuber described his GN 93-531 from the Cumbre de Perchel as *G. bruchii* subspec. *shimadae*.



Map 9: Geographic location of the analysed findings from *G. bruchii* subspec. *shimadae*

Fig. 26-27: MM 1362 *G. bruchii shimadae*, south of El Perchel

As differences from the typical subspecies, Neuhuber mentioned a dull dark green epidermis, less offsets, a stronger taproot, projecting needle-like spikes and the formation of a central spine in older plants. The flower is amongst the largest of this species. The seed is also reported to be larger. In contrast to the cited differences in characteristics, the figures show strongly sprouting plants. All plants of *G. bruchii* do have a strong taproot. The size of the seeds from the previously studied taxa varies between 1.2 and 1.5 mm. Also the colour of the body varies within all taxa and is usually dependent on the condition of the plant.

Investigated material:

A 09-31 Prov. Córdoba, Dept. Punilla, south of El Perchel, 900 m
MM 1362 Prov. Córdoba, Dept. Punilla, south of El Perchel, 860 m

The subspecies *shimadae* leads on to the plant which was described by Vaupel as *G. lafaldense*. Neuhuber presented this as another subspecies of *G. bruchii*. Along the road from La Falda to Salsipuedes over the Sierra Chica some localities were documented. On the plateau east of the steep slope of La Falda the plants colonize gently sloping, grassy and rocky slopes.

Map 10: Geographic location of the analysed findings from *G. bruchii lafaldense*

Fig. 28: *G. bruchii lafaldense* MM 1383 east of La Falda

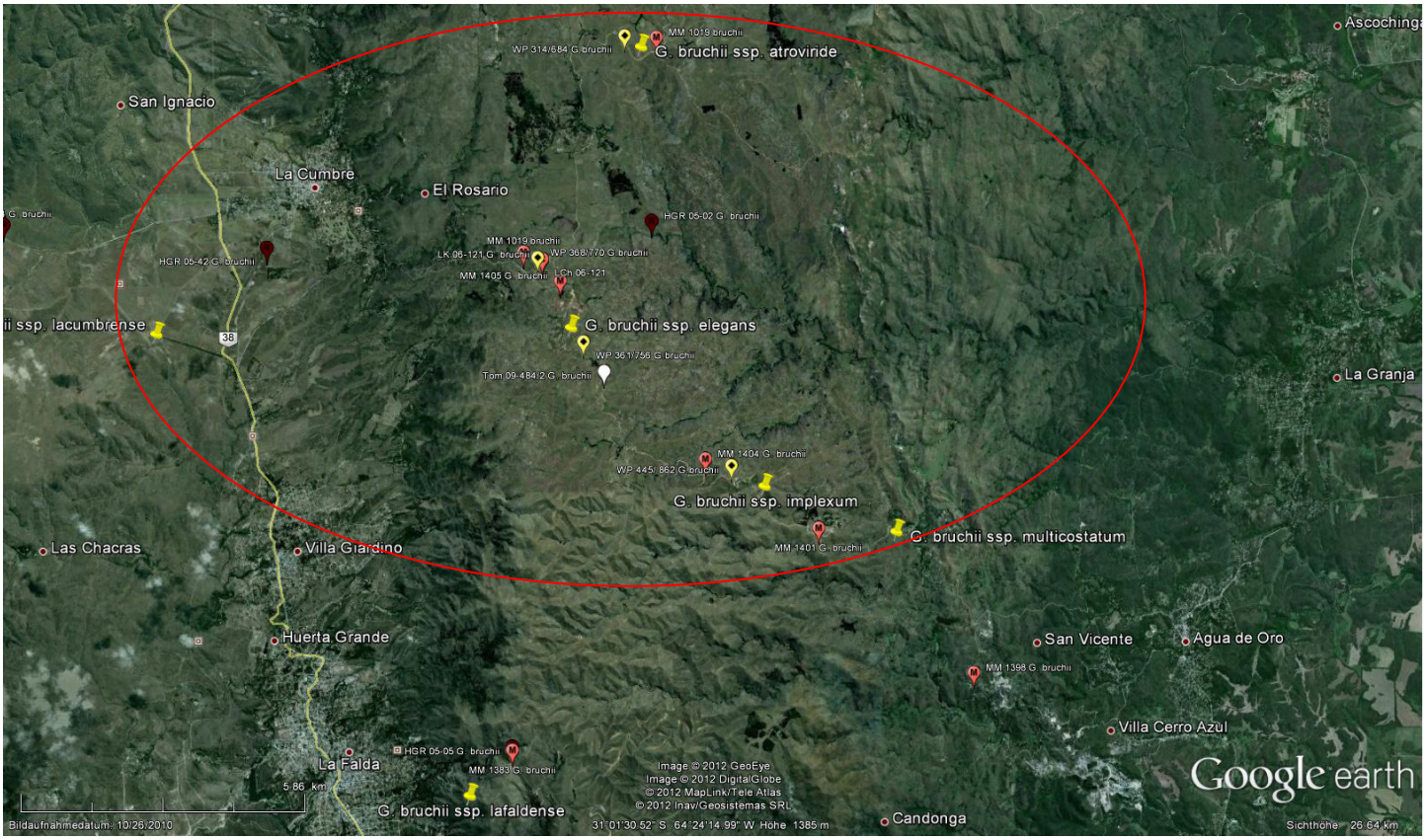
Fig. 29: *G. bruchii lafaldense* MM 1380 between La Falda and Salsipuedes

They are partly heavily offsetting and thus form larger cushion plants. There are no major differences in body and flower anatomy from the plants of Alta Gracia. Neuhuber speaks of significant differences between young and adult plants. That argument cannot be followed. For all taxa of *G. bruchii* sensu lato there are these differences. The distance of the locations of Alta Gracia and those east of La Falda of about 50 km does not justify the separation as a subspecies. Again, it is possible that after closer fieldwork on the eastern slopes of the Sierra Chica, other localities of *G. bruchii* can be found. Altitude and terrain are surely no reason for exclusion.

Investigated material:

HGR 5-05 Prov. Córdoba, Dept. Punilla, Sierra Chica, east of La Falda, 1340 m
HGR 5-06 Prov. Córdoba, Dept. Punilla, Sierra Chica, east of La Falda, 1270 m
HGR 5-07 Prov. Córdoba, Dept. Punilla, Sierra Chica, east of La Falda, 1060 m
MM 1379 Prov. Córdoba, Dept. Punilla, Sierra Chica, east of La Falda, 1000 m
MM 1380 Prov. Córdoba, Dept. Punilla, Sierra Chica, east of La Falda, 1180 m
MM 1383 Prov. Córdoba, Dept. Punilla, Sierra Chica, east of La Falda, 1330 m
WP 446/863 Prov. Córdoba, Dept. Punilla, Sierra Chica, east of La Falda, 1200 m

From locations to the north and northeast of La Falda, an area of about 15 x 15 km of the Sierra Chica Neuhuber has described 5 subspecies of *G. bruchii*. Including the subspecies *lafaldense* from the southern edge of this area, six subspecies can be found on these few square kilometres according to Neuhuber. Here the interpretation of the concept of species and its subordinate ranks takes an extreme approach, its systematic value is more than questionable.



Map 11: Geographic location of the analysed findings from various forms of *G. bruchii lafaldense*

Only 8 km north of the locations of *G. bruchii* subspec. *lafaldense* Neuhuber describes a *G. bruchii* subspec. *multicostatum*. It is a relative said to be characterized by a larger body (32 mm diameter), more numerous ribs (-17) and a different fruit colour.

Fig. 30-31: *G. bruchii multicostatum* MM 1398 west of San Vicente

Only 9 km west of the locality of the subspecies *multicostatum* according to Neuhuber grows the subspecies *implexum*. This has an even bigger body (35 mm diameter) with fewer ribs (-12) and has interwoven spines. This taxon is said to have a wider distribution.

Fig. 32-33: *G. bruchii implexum* MM 1401 west of San Vicente

The next subspecies grows again just 10 km to the west. Neuhuber names these *G. bruchii* subspec. *elegans*. The body reaches 40 mm in diameter, consisting of 13 ribs and the spines are short and fine.

Fig. 34-35: *G. bruchii elegans* WP 361/756 road to Candonga, flower and flower section

Only about 5 km north of the subspecies elegans, at the pass connecting La Cumbre to Asconchinga, according to Neuhuber grows another subspecies that he names *G. bruchii* subspec. *atroviride*. The additional information of the author about this subspecies is interesting. He indicates that it grows together with a different subspecies that he puts to the subspecies *lafaldense*. He also indicates that at all occurrences of *G. andreae* var. *grandiflorum* Krainz et Andreae on the Sierra Chica, *G. bruchii* always grows as well. All previously observed plants on the section between El Rosario and Tres Cascadas must be assigned to *G. bruchii*. It seems that here, at higher elevation, hybridization between *G. bruchii* and *G. andreae* also occurs and that with the subspecies atroviride a hybrid of both species was described. In the attached plant photos, it is not difficult to recognize a *G. andreae*, the enclosed flower section supports this notion.


Fig. 36-37: *G. bruchii atroviride* MM 1019 Tio Mayo

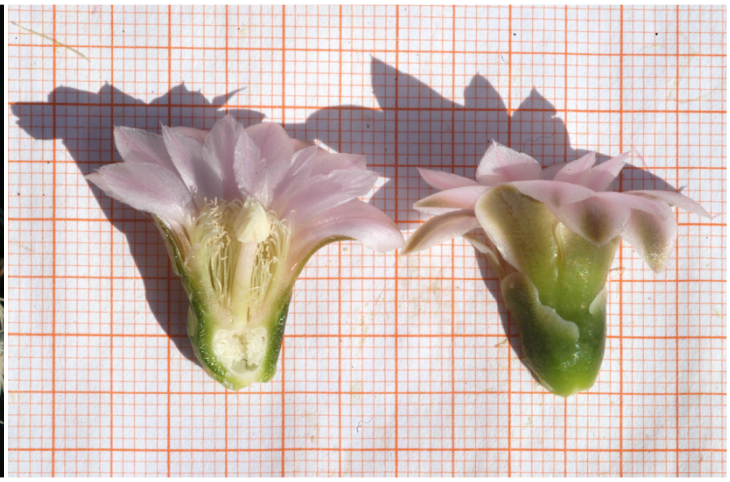



Fig. 38-39: *G. bruchii atroviride* SNE 04-114, flower and flower section

At lower elevations in the vicinity of La Cumbre, according to Neuhuber, grows another subspecies. This he described as *G. bruchii* subspec. *lacumbrense*. In the diagnosis no differences can be detected from the typical subspecies.

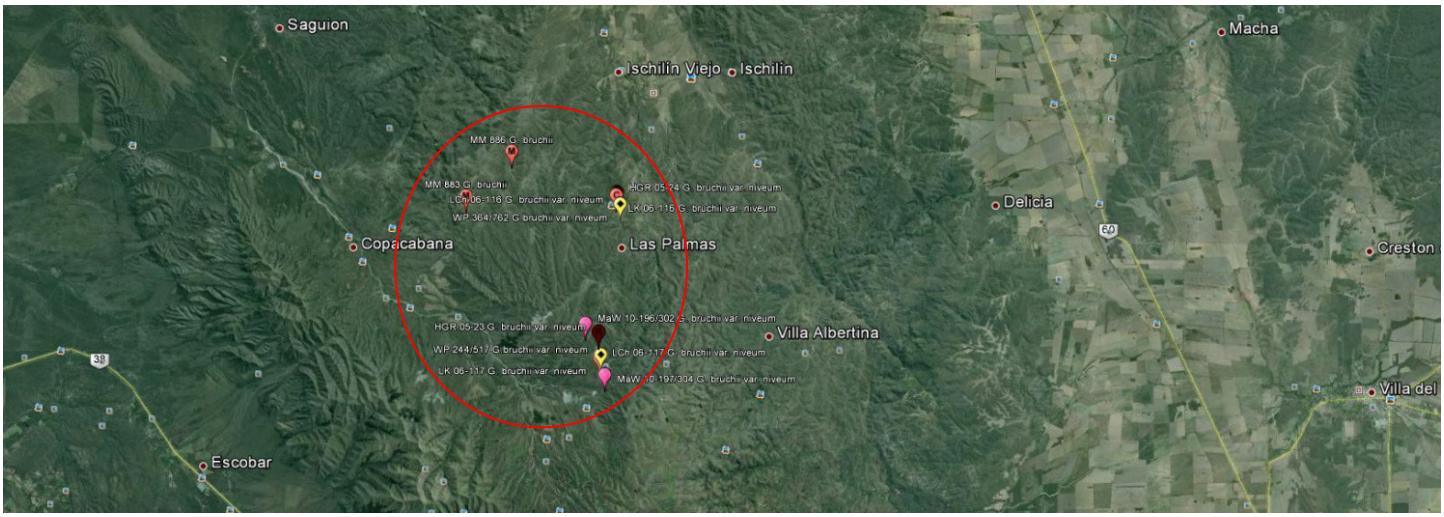
Fig. 40: *G. bruchii lacumbrense* HGR 05-43 west of La Cumbre

Fig. 41: *G. bruchii lacumbrense* HGR 05-44 west of La Cumbre

Investigated material:

HGR 05-02 Prov. Córdoba, Dept. Punilla, Tio Mayo, 1350 m
HGR 05-42 Prov. Córdoba, Dept. Punilla, La Cumbre, 1100 m (*lacumbrense*)
HGR 05-43 Prov. Córdoba, Dept. Punilla, west of La Cumbre, 1140 m (*lacumbrense*)
HGR 05-44 Prov. Córdoba, Dept. Punilla, west of La Cumbre, 1160 m (*lacumbrense*)
MaW 05-76/96 Prov. Córdoba, Dept. Punilla, La Cumbre-Asconchinga, top of the pass, 1460 m
MM 1019 Prov. Córdoba, Dept. Punilla, east of La Cumbre, 1380 m (*elegans*?)
MM 1022 Prov. Córdoba, Dept. Punilla, La Cumbre-Asconchinga, top of the pass, 1500 m
MM 1398 Prov. Córdoba, Dept. Punilla, west of San Vicente, street to Candonga, 1040 m (*multicostatum*)
MM 1401 Prov. Córdoba, Dept. Punilla, west of San Vicente, street to Candonga, 1240 m (*implexum*)
MM 1404 Prov. Córdoba, Dept. Punilla, west of San Vicente, street to Candonga, 1440 m (*implexum*)
MM 1405 Prov. Córdoba, Dept. Punilla, east of La Cumbre, street to Candonga, 1420 m (*elegans*)
Tom 09-484/2 Prov. Córdoba, Dept. Punilla, east of La Cumbre, street to Candonga, 1470 m (*elegans*)
WP 314/685 Prov. Córdoba, Dept. Punilla, La Cumbre-Asconchinga, top of the pass, 1590 m
WP 316/687 Prov. Córdoba, Dept. Punilla, west of Tres Cascadas, 1320 m
WP 361/756 Prov. Córdoba, Dept. Punilla, east of La Cumbre, street to Candonga, 1470 m (*elegans*)
WP 368/770 Prov. Córdoba, Dept. Punilla, east of La Cumbre, 1410 m (*elegans*?)
WP 445/862 Prov. Córdoba, Dept. Punilla, west of San Vicente, street to Candonga, 1440 m (*implexum*)

With a discovery site "near Capilla del Monte" Walter Rausch (1989) described another population of *G. bruchii*. The fine, partially interwoven and hair-like spines led to the name *G. bruchii* var. *niveum*. Today we know that the habitats of this variety are north of Ongamira. The characteristics of the plants, the author has described well. Noticeable is the mostly cylindrical elongated body shape of the sprouts.



Map 12: Geographic location of the analysed findings from *G. bruchii niveum*

Fig. 42: *G. bruchii niveum* MM 883 Sierra Higuerita, between Napa and S. Colomba

Fig. 43: *G. bruchii niveum* MM 886 Sierra Higuerita, between Napa and S. Colomba

Investigated material:

HGR 05-23 Prov. Córdoba, Dept. Ischilin, between Ongamira und Las Palmas, 1160 m
HGR 05-24 Prov. Córdoba, Dept. Ischilin, Museo Fader, 1020 m
MaW 10-196/302 Prov. Córdoba, Dept. Ischilin, Museo Fader, 1180 m
MaW 10-197/305 Prov. Córdoba, Dept. Ischilin, between Ongamira und Las Palmas, 1150 m
MM 883 Prov. Córdoba, Dept. Ischilin, Sierra Higuerita, Napa-S. Colomba, 1060 m
MM 886 Prov. Córdoba, Dept. Ischilin, Sierra Higuerita, Napa-S. Colomba, 1040 m
WP 244/517 Prov. Córdoba, Dept. Ischilin, between Ongamira und Las Palmas, 1160 m
WP 364/762 Prov. Córdoba, Dept. Ischilin, Museo Fader, 1030 m

The northern-most locations of *G. bruchii* are located in the department Tulumba, between Inti Huasi and San Pedro Norte. The habitats are very different from those in the Sierra Chica. There are gently inclined gravelly hills with relatively thick grass cover. Notable are the occasional palms [*Trithrinax campestris* (Burmeister) Drude & Grisebach], which one encounters at no other habitat of *G. bruchii*.

Map 13: Geographic location of the analysed findings from *G. bruchii pawlovskyi*

These plants were described by Neuhuber as *G. bruchii* subspec. *pawlovskyi*. They have great morphological similarities with the variety niveum. The body is slightly more cylindrical and the spines are more or less pectinate and more colourful.


Fig. 44-45: *G. bruchii pawlovskyi* MaW 72/90 10 km north of the crossing of Ruta Provincial 16 and 18, Córdoba

Fig. 46: *G. bruchii pawlovskyi* MM 833 north of La Esperanza

Fig. 47: *G. bruchii pawlovskyi* WP 385-793 Agua del Rodeo, flower

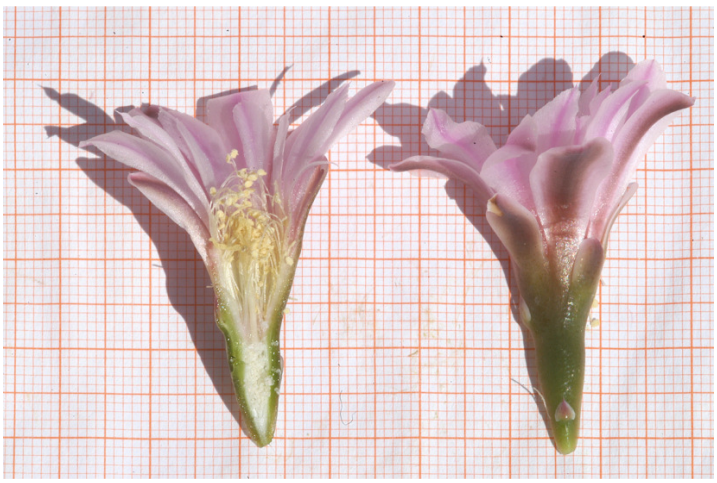
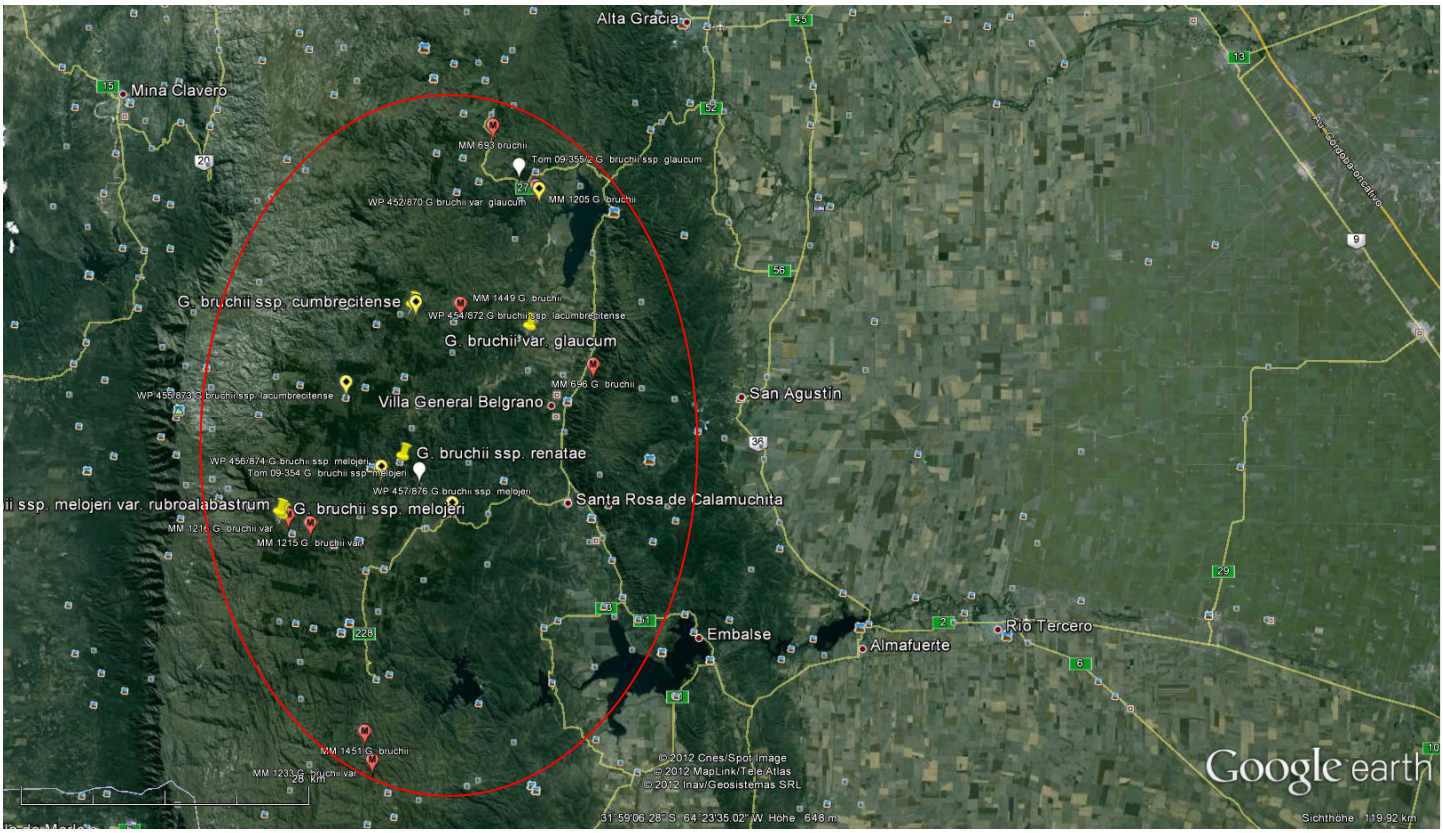



Fig. 48-49: *G. bruchii pawlovskyi* SNE 04-29 Agua del Rodeo, flower and flower section

Investigated material:

HGR 05-25 Prov. Córdoba, Dept. Tulumba, R 18, north of La Esperanza, 920 m
HGR 05-28 Prov. Córdoba, Dept. Tulumba, R 18, northeast of Agua del Rodeo, 920 m
HGR 05-29 Prov. Córdoba, Dept. Tulumba, R 18, Aqua del Rodeo, 920 m
MaW 10-212/338 Prov. Córdoba, Dept. Tulumba, R 18, north of La Esperanza, 940 m
MaW 10-213/340 Prov. Córdoba, Dept. Tulumba, R 18, Aqua del Rodeo, 920 m
MM 830 Prov. Córdoba, Dept. Tulumba, R 18, Aqua del Rodeo, 920 m
MM 833 Prov. Córdoba, Dept. Tulumba, R 18, north of La Esperanza, 960 m
WP 386/793 Prov. Córdoba, Dept. Tulumba, R 18, Aqua del Rodeo, 920 m
WP 387/795 Prov. Córdoba, Dept. Tulumba, R 18, north of La Esperanza, 960 m

South of Alta Gracia, there is another inflationary massing of subspecies. At about 30 km distance between Los Reartes and Santa Rosa de Calamuchita three further subspecies and two varieties were described, all by Neuhuber. Again, the assigned ranks and demarcation criteria are questionable. *G. bruchii* var. *glaucum* has been described from the vicinity of Los Reartes. Meanwhile, it was shown that *G. bruchii* populations also between Alta Gracia and Los Reartes can be found. South of Alta Gracia, currently there is only a small gap of about 15 km to the nearest adjoining populations of *G. bruchii* sensu stricto at San Pedro. Also, the distance to the subspecies *susannae* is not greater.



Map 14: Geographic location of the analysed findings from *G. bruchii glaucum* and related forms

G. bruchii var. *glaucum* is said to vary from the typical *G. bruchii* by bigger flowers and the darker body colouring . The explicitly mentioned stigma position is not confirmed by the attached image of a flowering plant.

Fig. 50: *G. bruchii glaucum* MM 693 San Pedro

Fig. 51: *G. bruchii glaucum* WP 452/870 south of Potrero de Garay

Fig. 52: *G. bruchii glaucum* WP 452/870 south of Potrero de Garay

Fig. 53: *G. bruchii glaucum* MM 1449 east of Villa Berna

Fig. 54-55: *G. bruchii glaucum* MM 1449 east of Villa Berna

About 15 km west of Los Reartes there is the small village La Cumbrecita. From here, Neuhuber describes his *G. bruchii* subspec. *cumbrecitense*. He indicates that this is an archaic population. In support of this theory he cites the simple flower structure, the strong pistil with just such stigmata, and the very small ovary.

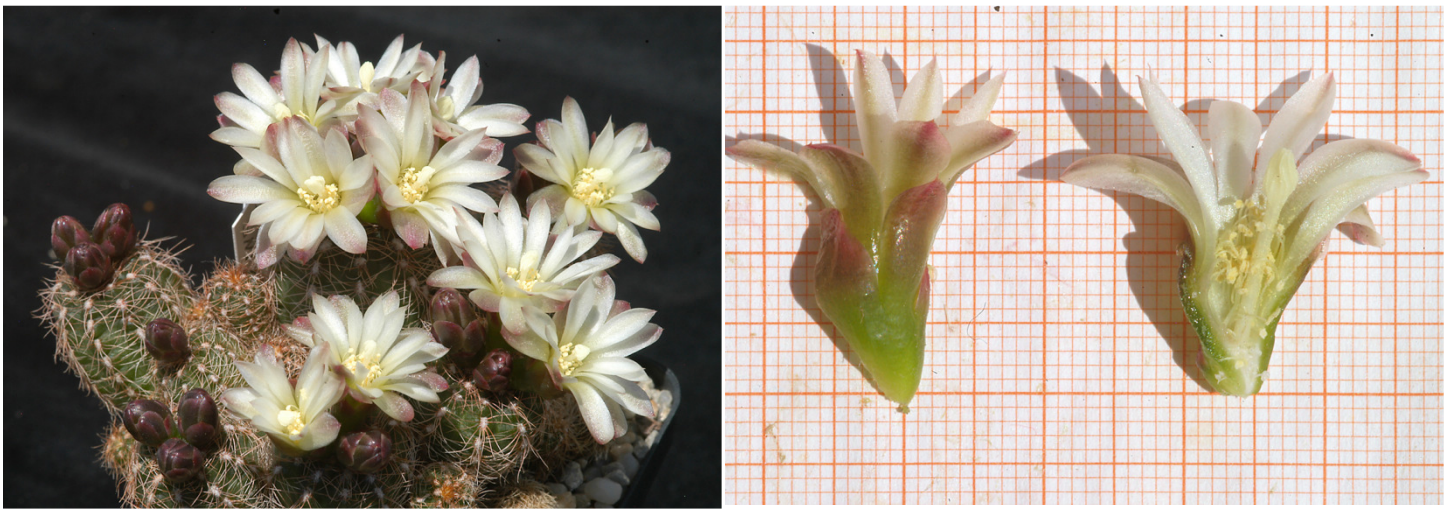


Fig. 56-57: *G. bruchii cumbrecitense* WP 455/873 east of Villa Alpina, flower and flower section

Fig. 58-59: *G. bruchii cumbrecitense* GN 232-718, flower and flower section

About 8 km southeast of La Cumbresita and 4 km south of Atos Pampa Neuhuber names the population occurring there *G. bruchii* subspec. *renatae*. Differing characteristics are small, silky-shiny, dark green body, spines twice as long and a much smaller ovary so thus to be completely different from the other described taxa.

Fig. 60-61: *G. bruchii renatae* WP 456/874 south of Atos Pampa

On a few square kilometres west of Yacanto de Calamuchita, according to the description, *G. bruchii* subspec. *melojeri* is distributed. This subspecies is said to be less offsetting with long and thick spines. From the same site still another variety is described. It was named as *G. bruchii* subspec. *melojeri* var. *rubroalabastrum* because of the intense colour of the scales.

Today, we know in the near and far of Yacanto de Calamuchita several localities of *G. bruchii*, and isolation – there can be no question of it. The dense spination mentioned in the description of the subspecies *melojeri* is found in all populations south of Alta Gracia. It is understandable that these remarkably spiny plants produce interest. They are here certainly more often found between normal sometimes strongly spined examples. That the plants are offsetting less at these localities may also not be confirmed. Groups with up to 30 heads are not rare.

Fig. 62-63: *G. bruchii melojeri* MM 1215 west of Yacanto de Calamuchita


Fig. 64-65: *G. bruchii melojeri* WP 457/876 La Orillada

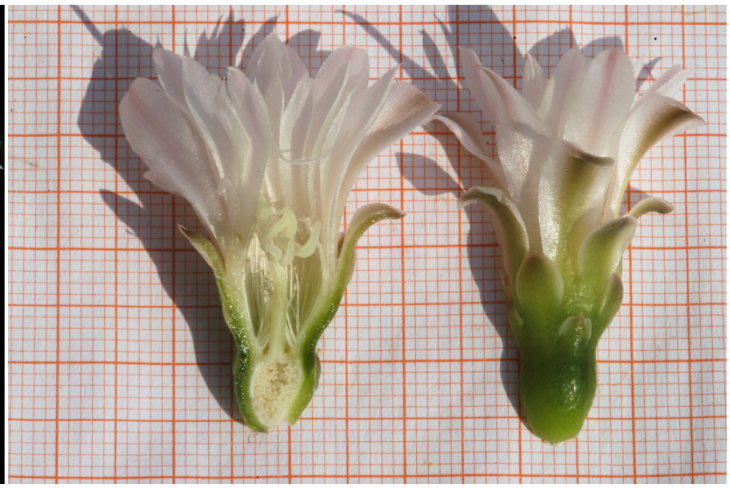



Fig. 66-67: *G. bruchii melojeri* SNE 04/125, flower and flower section

Other new locations of *G. bruchii* were also discovered in the south of Yacanto de Calamuchita; for example, north of and west of Tala Cruz. There are no major differences from the northern-growing populations.


Fig. 68-69: *G. bruchii melojeri* MM 1233 north of Lutti

Fig. 70-71: *G. bruchii melojeri* MM 1451 north of Lutti

Fig. 72-73: *G. meregallii* ? MM 1205 west of Tala Cruz

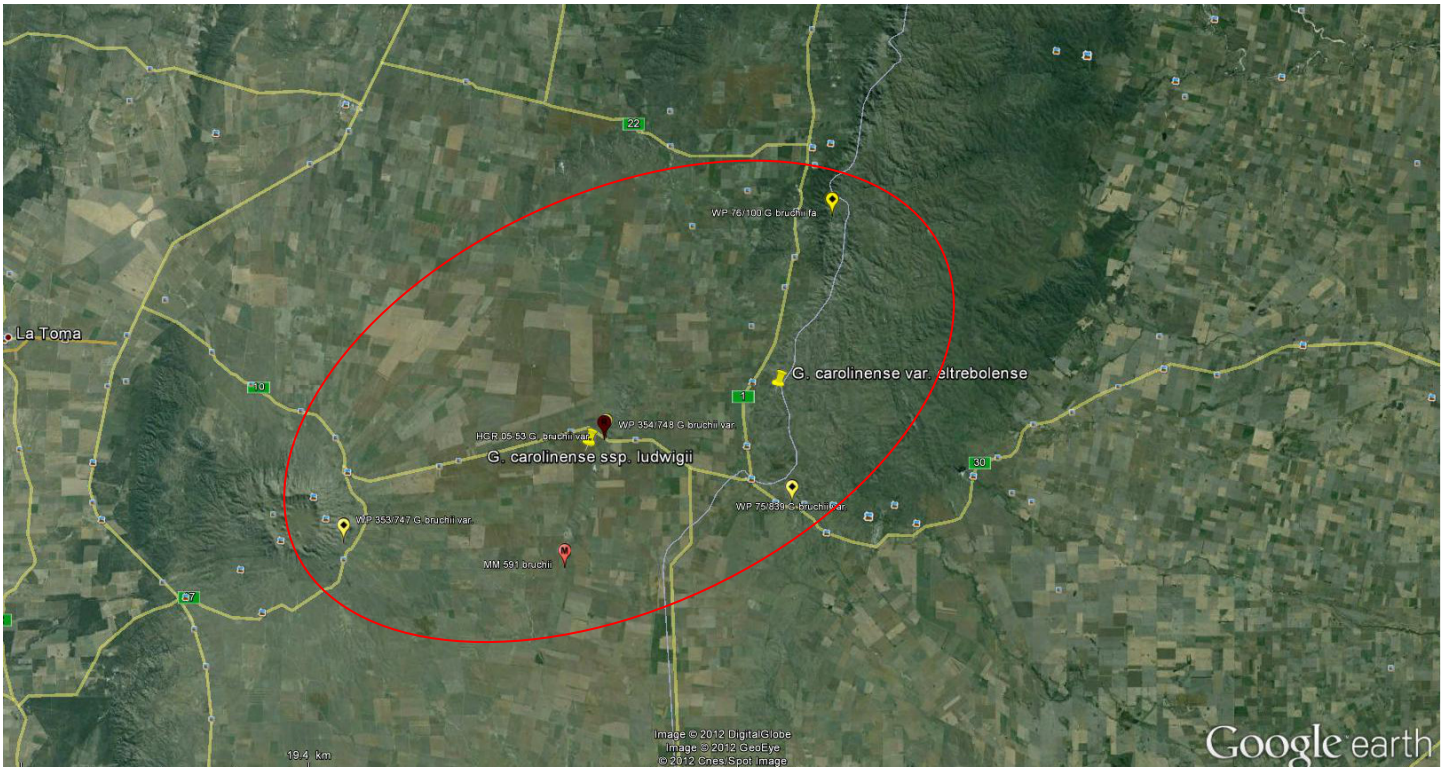
Investigated material:

MM 693 Prov. Córdoba, Dept. Santa Maria, San Pedro, 1010 m
MM 696 Prov. Córdoba, Dept. Calamuchita, north of Va. G. Belgrano, 1050 m (*glaucum*)
MM 1205 Prov. Córdoba, Dept. Calamuchita, west of Tala Cruz, 1430 m
MM 1207 Prov. Córdoba, Dept. Santa Maria, west Dique los Molinos, 880 m
MM 1215 Prov. Córdoba, Dept. Calamuchita, west of Yacanto de Calamuchita, 1230 m (*melojeri*)
MM 1233 Prov. Córdoba, Dept. Calamuchita, north of Lutti, 1080 m
MM 1449 Prov. Córdoba, Dept. Calamuchita, between Los Reartes and Villa Berna, 1130 m
MM 1451 Prov. Córdoba, Dept. Calamuchita, north of Lutti, 1010 m
Tom 09-354 Prov. Córdoba, Dept. Calamuchita, Rio Tabaquillo, 960 m (*renatae*)
Tom 09-355/2 Prov. Córdoba, Dept. Santa Maria, west of Potrero de Garay, 970 m
WP 452/870 Prov. Córdoba, Dept. Santa Maria, south of Potrero de Garay, 850 m
WP 454/872 Prov. Córdoba, Dept. Calamuchita, Villa Berna, 1200 m (*cumbrecitense*)
WP 455/873 Prov. Córdoba, Dept. Calamuchita, east of Villa Alpina, 1200 m

WP 456/874 Prov. Córdoba, Dept. Calamuchita, near Rio Tabaquillo, 1030 m (renatae)
WP 457/876 Prov. Córdoba, Dept. Calamuchita, La Orillada, 940 m (melojeri)

The west side of the Sierra de Comechingones with its steep slopes offers few options for the establishment of *G. bruchii*. Only at the southern end of the mountain range near La Punilla do the side flanks flatten and here again can be found other populations of *G. bruchii*. The east side between Yacanto de Calamuchita and La Punilla is fairly flat rising and there are certainly further optimal growing areas between Tala Cruz and Achiras for *G. bruchii*. The discoveries by Massimo Meregalli at Tala Cruz already support this assumption and could be considered as links to the populations of *G. bruchii* domiciled further to the south.

At La Punilla the Sierra de Comechingones runs down to the lowlands. In the hills east and north of La Punilla there are some localities of *G. bruchii*.



Map 15: Geographic location of the analysed findings from *G. bruchii ludwigii*

From El Trebol, a village about 5 km north of La Punilla, Neuhuber describes a *G. bruchii* population as the variety *eltrebolense* and puts it in the relationship of *G. carolinense*. *G. carolinense* was originally regarded to be a subspecies of *G. andreae* and was raised later to species level. The author indicates here that the populations at the southern end of the Sierra de Comechingones and the Sierra de Portezuelo represent forms of *G. bruchii* of which *G. carolinense* is separate. Now he revised this opinion and summarizes the plants west of La Punilla to the Sierra de San Luis together under *G. carolinense*. Comparing the plants of La Punilla with those which grow northeast on the east side of the Sierra de Comechingones, one can see no noticeable differences. Differences such as the

extent of the spines, the formation of central spines and larger plant bodies will only become visible in culture.

The dissemination of these plants is not limited to El Trebol. There are other localities between Villa del Carmen and Achiras.

Fig. 74-75: *G. bruchii eltrebolense* WP 75/839 east of La Punilla

Fig. 76-77: *G. bruchii eltrebolense* WP 76/100 Villa Carmen, flower

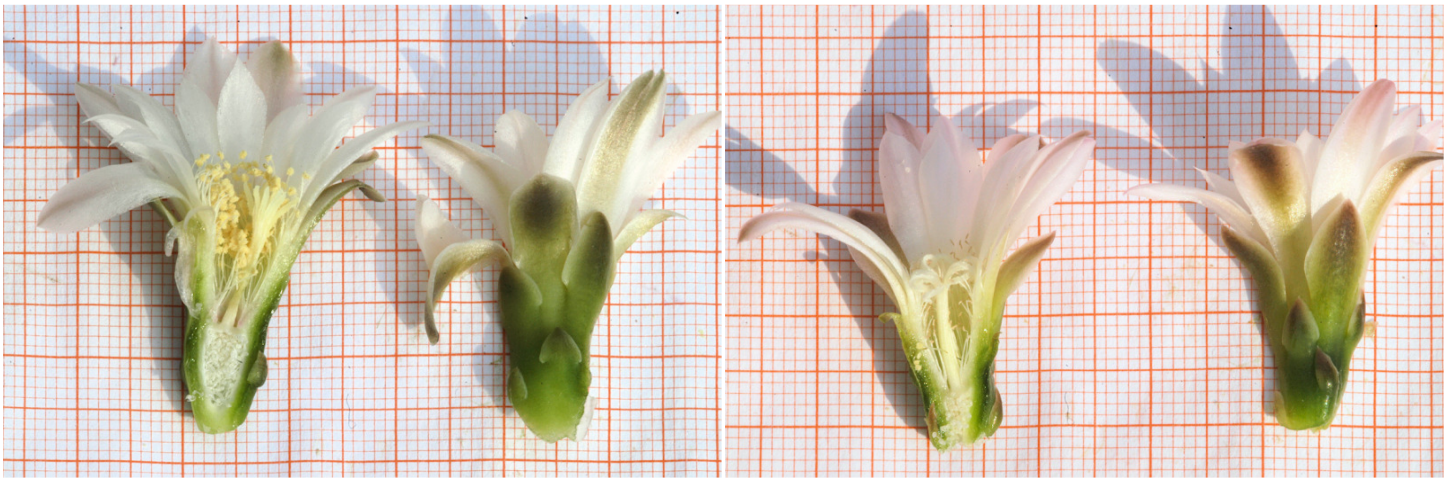


Fig. 78-79: *G. bruchii eltrebolense* WP 76/100 Villa Carmen, flower section

About 10 km west of La Punilla the Sierra de Portezuelo ends in a push through the otherwise flat terrain to the east of the province of San Luis. Along this incision one finds more plants from the

affinity discussed. Neuhuber has also described this population and puts it as a subspecies of *G. ludwigii* also to *carolinense*. The reason for the installation of this group as a subspecies is mainly justified with the formation of an extremely strong tap root which, in his opinion, does not match *G. bruchii*. Plants found in narrow rock crevices in habitat often form this root type. The plant searches in lower layers for water and for this reason extends its root. Typical is the compressed form of the root because of a lack of space, as is clearly visible in the illustration in the protologue. The remaining described plant characters are not very meaningful. In culture, this population also changes its appearance very much regarding its size and spines.

Fig. 80: *G. bruchii ludwigii* WP 354/748 Sierra de Portezuelo

The Sierra del Morro is again only a few miles west of the site of the subspecies *ludwigii*. On the eastern flank of this volcano-influenced massif small alluvial gravel plains along drainage channels are incorporated where *G. bruchii* populations are also found. Neuhuber also places these plants in his subspecies *ludwigii*.

There are only a few documented findings from this region. South of La Esquina, the find WP 353/747 was recorded. Franz Strigl and Helmut Amerhauser found it, according to the travel records of Strigl, a bit further south toward San Jose del Morro (STO 533).

Fig. 81-84: *G. bruchii* fa. WP 353/747 Sierra del Morro

Fig. 85-86: *G. bruchii ludwigii* GN 162-442, flower and flower section

Investigated material:

HGR 05-53 Prov. San Luis, Sierra de Portezuelo, 1020 m (*ludwigii*)

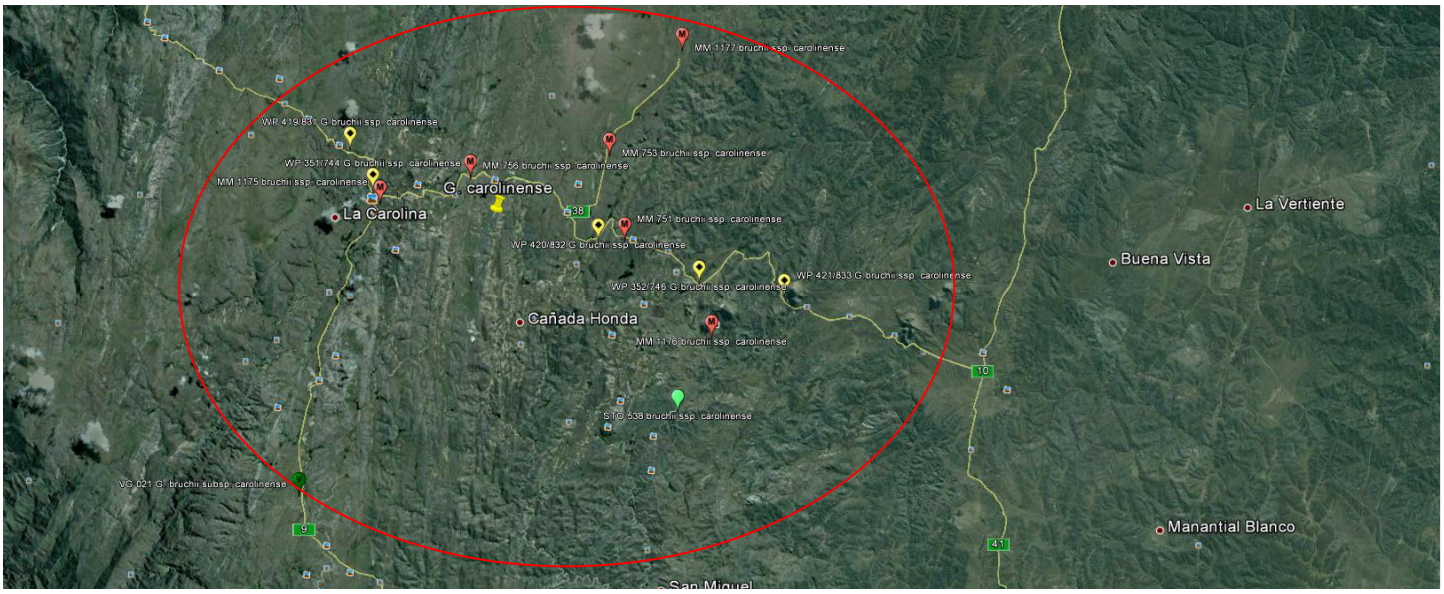
MM 591 Prov. San Luis, southern end on the Sierra de Portezuelo, 940 m (*ludwigii*)

WP 75/839 Prov. San Luis, Sierra de Comechingones, between La Punilla und Achiras, 1000 m (*eltrebolense*)

WP 76/100 Prov. San Luis, Sierra de Comechingones, Villa Carmen, 1470 m (*eltrebolense*)

WP 353/747 Prov. San Luis, Sierra del Morro, south of La Esquina, 1160 m (*ludwigii*?)

WP 357/748 Prov. San Luis, Sierra de Portezuelo, 1020 m (ludwigii)



Map 16: Geographic location of the analysed findings of *G. bruchii carolinense*

For the plants from the Sierra de San Luis, the situation is similar to that of *G. bruchii* subspec. *matznetteri*. Neuhuber first regarded these plants as relatives of *G. andreae* and described it in 1994 as *G. andreae* subspec. *carolinense*. The name refers to the locality near the little town Carolina on the plateau of the Sierra. As reasons for a distinction from *G. andreae* it is argued that the new subspecies offsets less, has white to light pink, fragrant flowers, and the filaments are not arranged in two series. The dark-green body colour should also indicate a relationship with *G. andreae*, because that colour is not found within *G. bruchii* according to the author. It is also said to have a greater variability in appearance which can be a phenotypic effect.

Fig. 87-88: *G. bruchii carolinense* MaW 118/160, north of Carolina

Fig. 89: *G. bruchii carolinense* WR s. n., near Carolina

More than 10 years later, Neuhuber comes to the realization that his placement in the relationship of *G. andreae* was a mistake and changes the rank to species level. With the extended description of the current *G. carolinense*, the author delimits this taxon of plants to the Sierra de Portezuelo and those near La Punilla. These represent *G. bruchii* and have nothing in common with *G. carolinense*. With the descriptions of the subspecies *ludwigii* and variety *eltrebolense*, he changes his mind again about the scope of the species *carolinense*.

In the meantime, *G. carolinense* was found in many places in the Sierra de San Luis. With the findings STO 538 and VG 021, the range in the direction of Paso del Rey was extended.

Between the Sierra de San Luis and the Sierra del Morro, the Cerros del Rosario are located where possibly other localities can also be discovered. Thus, the relatively large gap between the taxa *carolinense* and *ludwigii* could be closed.

Investigated material:

MaW 05-118/160 Prov. San Luis, Sierra San Luis, north of Carolina, 1710 m
MM 751 Prov. San Luis, Sierra San Luis, west of Intihuasi, 1490 m
MM 753 Prov. San Luis, Sierra San Luis, R 38, 1640 m

MM 756 Prov. San Luis, Sierra San Luis, east of Carolina, 1730 m

MM 1175 Prov. San Luis, Sierra San Luis, north of Carolina, 1430 m

MM 1176 Prov. San Luis, Sierra San Luis, Intihuasi, 1480 m

MM 1177 Prov. San Luis, Sierra San Luis, R 38, 1630 m

MM 1178 Prov. San Luis, Sierra San Luis, R 38, 1540 m

WP 351/744 Prov. San Luis, Sierra San Luis, north of Carolina, 1430 m

WP 352/746 Prov. San Luis, Sierra San Luis, north of Intihuasi, 1530 m

WP 419/831 Prov. San Luis, Sierra San Luis, Rio Turbo, 1730 m

WP 420/832 Prov. San Luis, Sierra San Luis, Canada Honda, 1620 m

WP 421/833 Prov. San Luis, Sierra San Luis, R 10, east of Intihuasi, 1510 m

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ILLUSTRATIONS

Mario Wick: Fig. 2, 3, 4, 44, 45, 87, 88; map 1-16

Massimo Meregalli: Fig. 5, 25, 26, 27, 28, 29, 30, 31, 32, 35, 36, 41, 45, 49, 52, 53, 54, 61, 62, 67, 68, 70, 71, 72

Wolfgang Papsch: all other illustrations