South America 2011/2013
Giovanna Anceschi & Alberto Magli

Giovanna Anceschi & Alberto Magli

cactusinhabitat booklet
South America 2011/2013

Contents

00. Introduction

About two and a half years have passed since the first publication of cactusinhabitat.org (in 2010) and our first booklet, which Gordon Rowley described as: "... stimulating reading and some revolutionary ideas to arouse controversy" (letter, 27 October 2010). Since then cactusinhabitat has been the activity of our lives, and after another year spent in the habitats of South America, we return to devote ourselves exclusively to the elaboration of the data collected. With the 2013 output we present more than 100 new taxa, bringing the total number of species recognized in cactusinhabitat.org to 252 (from the 292 taxa studied in habitat), many of which are accompanied by related comments. The new surveys are documented by more than 4500 photos, in addition to the existing 2000. Although we documented some new genera, the total number we are presenting is still 40, as in the first publication. We have in fact chosen to assimilate some genera in *Echinopsis* Zuccarini as a consequence of the phylogenetic hypothesis adopted on the basis of the evidence of the latest molecular analyses (Nyffeler & Eggli 2010, 6: 109-149; Schlumpberger & Renner, 2012, 99 (8) 1335-1349). In this regard, we think that the new theories, the new methods and the new techniques are not of use unless the results can be evaluated with an open mind, without which it old ideas that are always lurking are likely to encroach on the space. The subject of the text on taxonomy is time, the master of the lives of every living being. Only the recognition of the importance of an exact chronology of historical events allows us to identify, as the only truth, a phylogenetic system of classification, as an alternative to other methods based on artificial parameters (morphological, typological etc.) Following time's arrow, we analyzed methods and techniques currently in use for the definition of natural (monophyletic) groups in higher taxa, the system based on Hennig simplesiomorphies / synapomorphies, and the choice of specific evolutionary models in the reprocessing of molecular data, e.g. ML, Bayesian analysis, etc. We want to emphasize the importance of the system proposed by Hennig for the definition of the lower taxa (species), the semaphoront figure, and that of accessory science to recognize genetic relationships within a taxonomic system, called "comparative holomorphy between semaphoronts"

(Hennig, 1966, 66-67). In conclusion, our work in habitat led us to prefer the relationships between species rather than separations; relationships also evident in the results of molecular analysis. If there aren't many taxa or there are, it is a problem of interpretation: If you think of things as being linked together, there are a few; on the other hand, if you think of them as separate, there are many more.

Giovanna Anceschi & Alberto Magli

01. Taxonomy (part II)

In view of a more traditional approach to the classification of the Cactaceae, both genera and species

Time, reality, individuality

In the conclusions of the previous text, dedicated to the taxonomic aspect of our studies (Anceschi & Magli 2010, 19), we stressed that the results obtained using phylogenetic criteria to achieve a genealogical classification according to Darwin, or a natural classification according to Hennig, expressed through the Linnaean hierarchical system, make up one of the possible interpretations (the one used by current science) to classify living things. The reason why a phylogenetic classification is preferable to others (morphological, typological, etc..), is that living things are transformed over time, they have a beginning and an end, and in this sense are manifested as real processes, provided with individuality. A classification which does not consider this aspect, does not set as object of study real phenomena, but rather artificial projections. The idea is expressed by N. Hartmann: "The true characteristics of reality are not dependent on the categories of space and matter, but of those of time and individuality. And temporality is inseparably connected with individuality. It consists in nothing else but the onceness and the singleness" (Hartmann 1942, quoted from Hennig 1966, 81). For reality Hartmann means "the mode of existence of everything that has a place or a duration in time, its origins and its cessation" (ibid.). So the entities (individuals, populations, species) measured by phylogenetic criteria, are concrete and real entities, with a beginning, contrasting with those that are abstract and timeless, whose distinction is based on other parameters. In the last pages of *Philogenetic Systematics*, Hennig (1966, 238-239) stresses the importance of an exact chronology of the real historical events in phylogeny, to distinguish the monophyletic groups from those that are paraphyletic, and that terms like reality, individuality, origin, differentiation and extinction have a different significance for the different groups. The correct interpretation of the direction of time's arrow is therefore an essential element

in establishing the reality and proper assessment of the links between all members of an evolutionary line, coming from the same ancestor or monophyletic group.

Higher taxa: methods and definition techniques

Many authors consider that only the individuals and the species are real entities, whereas the other taxonomic categories (from the genus up) are mere abstractions. For Plate, for example, the species occupies "a position distinct from the genus, family, etc. in that it exists in nature as an actual 'complex of individuals' independent of human analysis, and therefore as an objective entity. The members of a species recognize each other and reproduce together, whereas the higher groups of individuals (genus, family, etc.), are not formed through themselves, but by the comparing and reflecting mind of man. In this sense the species is real, whereas the genus, family, and other higher groups are abstractions". (Plate 1914, in Uhlmann 1923, quoted from Hennig 1966, 78). As already highlighted in Taxonomy (Anceschi & Magli 2010, 9), the only higher taxon which we deal with, in our classification system of the *Cactaceae* (in addition to the family), is the genus, making the infrageneric ranks unnecessary (sub-genera and groups) (ibid., 13, 18) as well as the suprageneric (subtribes, tribes and subfamilies). For the definition of higher taxa, and the relationships between them, the current biological systematics uses:

a) Hennig's phylogenetic systematics theories (1966) and of his successors Wiley (1981); Wiley & Liebermann (2011).

b) The large amount of comparative information from molecular investigations (ie the DNA sequence data from different genomes).

c) Software able to handle large amounts of information in complex numerical analyses.

d) Likelihood models of DNA sequence evolution and statistical tests to explore and evaluate the probabilities of competing phylogenetic hypotheses.

Currently the most important work on the classification of the higher taxa in the Cactaceae is by Nyffeler and Eggli (2010, 6: 109-149).

The interpretation of the arrow of time in the methods for the definition of the higher taxa. The recognition of monophyletic groups through the system based on symplesiomorphy / synapomorphy

As already mentioned, an exact chronology of the real historical events is what distinguishes the monophyletic groups from other non-natural groups. In the theory of the cladistical phylogenetic systematics (Hennig 1950, 1966; Wiley 1981; Wiley & Liebermann 2011), in the time which gave rise to the transformation process, which led to the current species (and genera), the first ancestor of the analysed group was born with the stem species. The time dimension during the process is marked by the moments of splitting, which during the series of transformations leads from the stem species to the current taxa. The ancestors of the current species are extinct, not only the first, but also those representing the successive points of splitting in the transformation process. The only possible connection based on a real time (even in the past), would be the reconstruction of the steps, through the instruments of paleontology, but for the family *Cactaceae* A. L. de Jussieu, there are no relevant fossils. The instruments provided by the cladistics school to recognize monophyletic groups, ie those that "... are subordinated to one another according to the temporal distance between their origins and the present; the sequence of subordination corresponds to the 'recency of common ancesty' of the species making up each of the monophyletic groups "(Hennig 1966, 83), are the characters that Hennig identified as synapomorphy. He considers the characters carried by the first ancestor (stem species) plesiomorphous, those derived during the process of transformation, and fixed on subsequent ancestors (later becoming extinct themselves) apomorphous. In the current species, the characters directly inherited from the first ancestor (plesiomorphous) are defined symplesiomorphous, while the characters derived from more recent ancestors (apomorphous), although not necessarily the most recent, are defined synapomorphous (ibid., 89). So let's call synapomorphies a particular category of characters, i.e. those that distinguish a monophyletic group, which are inherited by all members of the group, or clade, from a recent common ancestor. In the identification of these characters, it is essential to have the distinction of those who are genuinely sinapomorphous from:

a) Those that are simplesiomorphous, which like the first, represent types of homologous characters, i.e. inherited from a common stem species.

b) Those resulting from evolutionary convergence or parallelism (analogous characters), either morphologically similar in different species, but not derived from a common ancestor

(due to convergence), or similar characters, absent in the stem species of a monophyletic group, occurred independently in the subsequent species (parallelism) (ibid., 117). Phylogenetic systematics start rather from the conviction that all correspondences and differences between species and groups of species, in the course of phylogeny, arose out of an alteration of characters of the common stem species (ibid., 128).

The interpretation of synapomorphy: a problem of intuitive nature

In Hennig's own opinion: "... there is no simple and absolutely dependable criterion for deciding whether corresponding characters in different species are based on synapomophy. Rather it is a very complex process of conclusions by which in each individual case, 'synapomorphy' is shown to be the most probable assumption" (ibid., 128). Furthermore, "... the attempt to reconstruct the phylogeny, and thereby the phylogenetic relationships of species, from the present conditions of individual characters and the presumed preconditions of these characters has the nature of an integration problem. In mathematics, the most exact science, according to Michaelis (1927), 'integration... is an art... since one is often faced with the problem of combining, from the numerous possible manipulations, those that make possible the solution of the problem." (ibid., 128-129). The "manipulation" made available by the author for the distinction of the monophyletic groups between the higher taxa, is precisely the one based on the system of symplesiomorphy and synapomorphy. Hennig adds that the solution to a particular problem depends on capabilities that do not lie in the realm of the learnable (what we would call intuition), quoting the words of the mathematician Gauss: "I have the result, but I don't know yet how I got it" (ibid., 129). Similar positions are reiterated by Wiley & Liebermann (2011, 122-123) which, referring to Hennig, underline how the basic principle of phylogenetic empiricism is made up of the fact that discovering homologies is an observational hypothesis, not a fact, because we have no perfect method of observing real homologies as they exist in nature. And they add: "... the assertion that two or more organisms share a homology or the assertion that a particular synapomorphy is a character property of a particular monophyletic group are both probabilistic conjectures (Patterson, 1982; Haszprunar, 1998; Sober, 2000) whose veracities are always open to further testing as opposed to deductive conclusions

(e.g., Rieppel 1980)." (Wiley & Liebermann 2011, 123). On the basis of the selected characters to identify groups, Hennig defines those where similarity is based on synapomorphy as monophyletic; those in which similarity is based on symplesiomorphy as paraphyletic; if similarity is due to convergence then they are polyphyletic (1966, 146). The system based on symplesiomorphy / synapomorphy made available by the author to distinguish monophyletic groups in the phylogenetic study of the higher taxa, is in many cases indispensable, since it allows a possible interpretation of the evolutionary history of groups of taxa, even in the absence of fossils (as in the case of the family *Cactaceae*), but also of difficult and varied interpretation. Often, cladistic analysis based on morphological characters (Taylor & Zappi 1989), or molecular ones, have in our opinion been imposed with unreliable results. In fact, the application of a system designed for higher taxa (in Hennig 1966, mainly families, suborders, orders, subclasses, classes) it is not always possible for the analysis of infrageneric groups, genera or tribes. Therefore, groups consisting of a few species, which by themselves (sometimes by the author's own admission, ibid., 14, 29, 39) cannot show quantitative, and qualitative characters, in order to be interpreted as ancestral or derivatives, and then to draw reliable phylogenetic conclusions on the analyzed taxa. A principle that Hennig summarizes: "For phylogenetic systematics this means that the reliability of its results increases with the number of individual characters that can be fitted into transformation series" (ibid, 132). We discussed the characters used in the classification of the genera and species of the *Cactaceae* in the first text dedicated to taxonomy (Anceschi & Magli 2010, 14-18), asking ourselves if the current preference given to molecular results is correct. In this regard, we stressed that the molecular data cannot be considered as absolute data, but must be evaluated in a ratio of relations with all other data of the characters making up the holomorphology of a taxon. Similarly, Wiley & Liebermann (2011, 121) point out that the behavioral synapomorphy does not have less value in systematics than morphological homologies, and (citing McLennan et al. 1988) that homoplasy (convergence) phenomena do not necessarily occur at higher frequency in behavioral characters than in morphological characters. In underlining this they state: "Similarly, in this view, morphological homologies are no less suited for phylogenetic analysis than DNA sequence homologies. The idea that one kind of

data is inherently better than other kinds of data is not viable under this concept, and hypotheses of homology from whatever source can and should be allowed to compete on an even playing field as potential evolutionary innovations (e. g., discussion in Hillis, 1987)." (Wiley & Liebermann 2011, 121).

The interpretation of time's arrow in molecular analysis results

Although the methods based on chemical or molecular analysis in phylogenetic systematics that Hennig (1966, 104-107) founded were not particularly useful, it is clear that molecular characters exist, which are of great importance, occurring in what Hennig called "holomorphological characters" (ibid., 32), and which can be used in the system based on symplesiomorphy / synapomorphy. How is the exact chronology of the real historical events in the molecular data reconstructed? The nucleotide sequences that can be analyzed (after PCR, electrophoresis, sequence alignment) are photos of the current DNA, just as the species we can observe are just the current ones. In both cases the ancestral element no longer exists; some molecular characters are identified as ancestral, and others as derived. For example, in the previously cited study by Nyffeler & Eggli (2010), in the part concerning the tribe Notocacteae, the deletion of 23 nucleotides, highlighted in the representatives of *Parodia* s.l., is considered a derived character (sinapomorphy), and the presence of these in the other two groups in question, a primitive character (simplesiomorphy). We are not entirely convinced of the fact that molecular systematics (DNA sequences) almost completely avoid the similarity resulting from parallel evolution in order to infer relationships, because the molecular characters are not subject to the same external forces as the phenotype (Wallace 1995, 13: 2). We believe, in fact, that genes are part of the hardware of a living being, like any other biochemical substance, and that they receive instructions from the rest of the cell, no less than they give. The idea of an immutable DNA is not realistic, and the latest frontiers opened by epigenetic science seem to show a panorama that is a little more complex. In this regard Nyffeler & Eggli observes: "It is generally assumed that DNA sequences, in particular of 'non-coding' regions of the genome, are not affected by evolutionary processes interfering with the phenotype of the individual organisms. However, there are also molecular evolutionary phenomena currently not

yet well understood that may cast dust onto the preserved historical signal" (2010). We have seen that through the system based on symplesiomorphy / synapomorphy, using an interpretative approach of the holomorphological data, we can attempt to reconstruct the steps in the series of transformations linking the actual species to their extinct ancestors. The fossil records (not available in the family *Cactaceae*), when present and in a good condition, can help in the reconstruction of temporal events, but often this does not occur. As for the morphological characters, even the molecular ones, one of the most important methods for attributing homologies is the similarity in position; in the case of molecular characters it is used in the alignment of the sequences of the nucleotides (Wiley & Liebermann 2011, 124-129). In a group of taxa the similarity of the topographic position of a character relative to other characters, and of the body as a whole, is interpreted as evolutionary proximity; in the same way similar alignments are read in the sequences of the nucleotides. For molecular data, the temporal dimension of the splitting moments, by which new species are born, is given by a scan based on probability. As already said, the current molecular biology is able to handle a large amount of comparative information, from the molecular investigations through to appropriate software. Likelihood models of the analyzed DNA sequence evolution and statistical tests are used to explore and evaluate probabilities of competing phylogenetic hypotheses. Among the more used models we are using are: parsimony analysis, maximum likelihood analysis and Bayesian analysis. The common aim of these methods, albeit through different routes, is to reconstruct the best chances of parental relationships between the examined taxa, then showing the results through cladograms (diagrams of phylogenetic trees). We will briefly analyze the three approaches. Philosophically, in accordance with Wiley & Liebermann (2011, 152), the principle of parsimony is a methodological principle, which implies that simpler explanations of the data are to be preferred to more complex ones. In the construction of a phylogenetic tree, the principle is thus synthesized: "Parsimony differs from other approaches because trees are evaluated based on minimum length - the minimum number of changes in characters that are hypothesized to have occurred for any particular tree hypothesis. Trees of minimum length fulfill the principle. Parsimony is then built around the proposition that the 'best tree' is the tree that describes the

evolution of any particular set of characters using these smallest number of evolutionary changes of the characters analyzed" (ibid., 153). Maximum likelihood and Bayesian analysis are both parametric phylogenetic models, i.e. based on a specific evolution model chosen by the investigator. In the maximum likelihood methods, according to Wiley & Liebermann, the basic criterion is: "... the preferred tree is the tree that has the highest probability of producing the data we observe [the observed DNA sequences], given a specific [stochastic] model of evolution adopted by the investigator, the tree topology and the branch lengths between nodes" (ibid., 203). Maximum likelihood uses an explicit evolutionary model. We assume that the data we observe are identically distributed from this model. Even Bayesian analysis uses likelihood calculations, but the criterion employed is that of maximizing the posterior probability of the tree, given the data and model of influence. Returning to the arrow of time, likelihood calculates the probability that an event that has happened in the past would yield a specific outcome, while Bayesian analysis explores the posterior probability to find the model / tree topology, the largest posterior probability is conditioned by what the investigator is willing to accept as true before the analysis.

The latest taxonomic changes in the higher taxa of the Cactaceae. The genus level. The importance of molecular evidence

Since Wallace's study (1995, 13: 1-12), during the last decades, changes at the genus level and the higher taxa in the family *Cactaceae*, have almost always been followed by new evidence emerging from molecular analysis. As already said, probably the most comprehensive molecular biology study, applied to the higher taxa (genera, subtribes, tribes and subfamilies) on *Cactaceae*, is that of Nyffeler & Eggli, which appeared in Schumannia (2010, 6: 109-149). The two authors recognize, at the genus level, 128 taxa (ibid.) versus the 124 recognized in Hunt et al. (2006, text: 5), and the 125 recognized in Anderson (2001). 128 genera are still accepted by Eggli, as author of the latest German edition of Anderson's book, Das Grosse Kakteen Lexikon (2011), but removing 4 genera: *Borzicactus* Riccobono, *Rimacactus* Mottram, *Strophocactus* Britton & Rose, *Vatricania* Backeberg, and adding 4 others: *Acharagma* (N. P. Taylor) Glass, *Cintia* Knize & Riha, *Pygmaeocereus* H. Johnson & Backeberg, *Sulcorebutia* Backeberg

(in relation to the list of the genera accepted together with Nyffeler). The 2010 study by Nyffeler & Eggli substantially confirms the positions of the previous literature (Anderson 2001, 2005; Hunt et al. 2006), about the formation of certain macro-genera, including many ex-genera especially loved by the enthusiasts (who might demand their reintroduction). Among these genera, in the tribe Notocacteae Buxbaum, the authors confirm that *Parodia* Spegazzini s.l. (Nyffeler 1999, 7: 6-8) is a well-supported monophyletic clade, which includes the previous segregated genera *Brasilicactus* Backeberg, *Brasiliparodia* F. Ritter, *Eriocactus* Backeberg, *Notocactus* (K. Schumann) Frič, and *Wigginsia* D. M. Porter (ibid.). In the same tribe, the data of the analysis do not support *Eriosyce* Philippi s.l. (Kattermann 1994), nor the current expanded concept of the genus, which includes the previously segregated genera *Horridocactus* Backeberg, *Islaya* Backeberg, *Neoporteria* Britton & Rose, *Pyrrhocactus* (Berger) A. Berger and *Thelocephala* Y. Itô, nor a more restricted concept, since the relationships remain unresolved, requiring further analyses with additional data (ibid.). The most interesting news has arrived from the subtribe Trichocereinae Buxbaum (ibid.), where on the basis of previous molecular analyses (Ritz et al. 2007; Lendel et al. umpubl. data; Nyffeler et al. umpubl. data), it is clearly demonstrated that flower characters and pollination syndromes are highly plastic and evolutionarily labile, and therefore the presence or absence of a certain syndrome is not a sign of closeness or distance of two lineages. In this sense, distinctions based on the different floral syndromes, such as those used by Backeberg (1966) to separate genera (eg *Echinopsis* s.s., *Lobivia*, *Pseudolobivia*) now seem devoid of meaning. Nyffeler & Eggli (2010), point out that in the subtribe Trichocereinae, the most difficult group to interpret, the macro-genus *Echinopsis* Zuccarini s.l. appears, plus the genera currently recognized as segregates: *Acanthocalycium* Backeberg (separated from *Echinopsis* in Anderson 2001, 2005, 2011, but not in Hunt et al. 2006), *Denmoza* Britton & Rose, *Harrisia* Britton, *Samaipaticereus* Cárdenas, *Weberbauerocereus* Backeberg, and *Yungasocereus* F. Ritter. In recent molecular analyses the authors (Lendel et al. 2006; Schlumpberger 2009) agree that all these taxa are very closely related with *Echinopsis* s.l. being widely polyphyletic. Regarding the relationships highlighted, the authors argue prematurely to draw firm conclusions, preferring to wait for additional results, more comprehensive of molecular

studies (eg based on more species-dense sampling). Although choosing to not change the genus *Echinopsis* s.l. as currently conceived, (Anderson 2001, 2005, 2011; Hunt et al. 2006), the two authors show that both the molecular data, and the widespread occurrence of intergeneric hybrids (see Rowley 1994, 2004a, 2004b for listing), indicate that Trichocereinae has a relatively recent evolutionarily origin [ie about 7.5-6.5 Ma according to Arakaki et. al. (2011, 8380)], and that the genetic divergence between the various taxa is far lower than the difference shown by the same in morphological and floral characters. It seems in fact, that not only the floral syndromes are evolutionarily labile, but that also the growth forms appear to have changed repeatedly within this clade. In the data of Lendel et al. (2006, unpubl. data), the authors summarize their position as: "The close relationships between taxa of divergent growth forms (such as the voluminous columns of *Echinopsis tarijensis* and the tiny dwarf *Echinopsis chamaecereus*) within one and the same clade illustrates the previously formulated caveats as to 'logical' evolutionary pathways in character transitions in an exemplary manner" (Nyffeler & Eggli 2010). This approach is completely overturned by Schlumpberger (2012, 28: 29-31) with the option he chose, between the two possible highlighted by the results of his latest study in *Echinopsis* made with Susanne S. Renner (2012, 99 (8): 1335-1349). We'll see how what seems a taxonomical "revolution" in the genus *Echinopsis*, is nothing more than an attempt at "restoration" of old ideas, and how the evolutionary hypothesis is more convincingly eluded by the authors.

Dr. Schlumpberger's monsters

In September 2012 the awaited work of Schlumpberger & Renner on *Echinopsis* and related genera came out (2012, 99 (8): 1335-1349); a study which currently represents the most comprehensive analysis on the taxa in question. The aim is to attempt to define the real relationships between the heterogeneous components of *Echinopsis* s.l. as currently conceived (Anderson 2001, 2005, 2011; Hunt et al. 2006; Nyffeler & Eggli, 2010), and related genera of the tribe Trichocereeae (Anderson 2001, 2005, 2011; Hunt et al. 2006), or subtribe Trichocereinae (Nyffeler & Eggli 2010). The macro-genus currently comprises of between 7 (Nyffeler & Eggli 2010) and 11 (Anderson 2001) ex-segregated genera. Genera initially separated by distinctions in the growth form (eg

globular in *Echinopsis* s.s. / columnar in *Trichocereus* (A. Berger) Riccobono), diurnal vs nocturnal anthesis (*Lobivia* Britton & Rose / *Echinopsis* s.s.), or different pollination syndromes (eg. hummingbirds in *Cleistocactus* Lemaire / bats in *Espostoa* Britton & Rose). The number of species included starts from 77 in Hunt et al. (2006), to 129 in Anderson (2001), as well as various heterotypic subspecies. These molecular analyses consider the sequencing of 3866 nucleotides of cp DNA representing 144 species and subspecies in *Echinopsis*, including the type species of all relevant generic names, as well as representatives of all genera in recent years assigned to the Trichocereeae tribe, again including relevant generic type species, in addition to the outgroup. The data concerning chromosome counts, pollination syndromes and growth habits of the taxa in question, were traced on the phylogeny. PCR amplified 3 noncoding cp DNA regions, using 3 published standard primers: the trnS-G intergenic spacer (Hamilton 1999), the trnL region (Taberlet et al. 1991), and the rpl16 intron (Asmussen 1999). Phylogenetic inferences based on the maximum likelihood (ML), obtained by the alignments of 3866 nucleotides of cp DNA, for the 144 taxa, appear on a phylogram (ibid., 1342-1343). The absence of statistically supported topological contradictions is defined as > 70% maximum likelihood bootstrap support (the numbers at nodes in the phylogram). The tree is completed by the data on chromosome numbers, pollination syndromes and growth habits. The researchers used this data to address the following questions (ibid. 1336):

1) Is *Echinopsis* s.l. monophyletic?

2) What is the level of variation in growth habit and pollination syndromes, characters that have been used to define clades in *Echinopsis* s.l.?

3) How common are ploidy changes within the *Echinopsis* group, and are they clustered in certain subclades, perhaps indicating a role for hybridization in the evolution of certain species groups?

Regarding the first question, phylogenetic inference based on maximum likelihood produced the aforementioned tree, from which we observe that the genus *Echinopsis*, as currently conceived, is highly polyphyletic. According to the authors (ibid., 1336, 1341, 1346-1347) there are two possible options, which would allow for the interpretation of the taxa in question as natural (monophyletic) clades in Hennig's sense. a) To be

monophyletic, the genus *Echinopsis* should include: *Acanthocalycium* Backeberg (already included in Hunt et al. 2006), *Acanthocereus* A. Berger, *Cleistocactus* Lemaire (including *Borzicactus* Riccobono and *Cephalocleistocactus* F. Ritter, already included in Hunt et al. 2006), *Denmoza* Britton & Rose, *Espostoa* Britton & Rose (including *Vatricania* Backeberg, as already in Hunt et al. 2006), *Haageocereus* Backeberg, *Harrisia* Britton, *Matucana* Britton & Rose, *Mila* Britton & Rose, *Oreocereus* (A. Berger) Riccobono, *Oroya* Britton & Rose, *Pygmaeocereus* H. Johnson & Backeberg, *Rauhocereus* Backeberg, *Samaipaticereus* Cárdenas, *Weberbauerocereus* Backeberg, *Yungasocereus* F. Ritter. All of them form part, with the current species of *Echinopsis* s.l., of a well-supported monophyletic clade (100% bootstrap support). b) The alternative is to divide *Echinopsis* into smaller units. This solution requires the resurrection of old generic names, and the transfer of epithets at the specific level. The authors then discuss the major clades in which *Echinopsis* s.l. could be divided. These are: the *Echinopsis* s.s. clade (100 % bootstrap support); the *Echinopsis atacamensis* clade (100 % bootstrap); the *Harrisia* clade (97 % bootstrap); the *Cleistocactus* s.s. clade (100 % bootstrap), including *Espostoa guentheri*, *Samaipaticereus*, *Weberbauerocereus*, *Yungasocereus*, *Cephalocleistocactus*, *Cleistocactus*, but not *Borzicactus*; the *Reicheocactus* clade (100 % bootstrap); the *Oreocereus* clade (99 % bootstrap), including *Oreocereus*, *Borzicactus*, *Espostoa*, *Haageocereus*, *Matucana*, *Mila*, *Oroya*, *Pygmaeocereus* and *Rauhocereus*; the *Denmoza* clade (100 % bootstrap) that includes the monotypic *Denmoza rhodacantha*, *Echinopsis mirabilis* and *Acanthocalycium* with *Echinopsis leucantha* embedded, the *Trichocereus* clade (73% bootstrap), the *Helianthocereus* clade (76% bootstrap), and the *Lobivia* clade (93% bootstrap). Regarding the second question, the analysis shows that species grouped according to previous distinctive characters, i.e. growth habits, floral characters and pollination syndromes, do not form clades (ibid., 1341). The authors underline, however, that the growth habits appear to be more stable characters and therefore less subject to convergence phenomena compared with floral characters and pollination modes, which are highly plastic. For the third question, contrary to the conclusion about the importance of the hybridization role in the evolution of Cactaceae (Rowley 1994; Machado 2008), also hypothesized for *Echinopsis* (Friedrich 1974; Font & Picca 2001; Anderson 2005) and related genera

(Rowley 1994), and despite the various infrageneric hybrids found in nature, polyploidy seems infrequent in the *Echinopsis* alliance and hybridization may thus be of minor relevance in the evolution of this clade. In the conclusions we read: "A new generic classification of the Trichocereeae now requires finding morphological characters sufficiently conservative for distinguishing larger groups of species. Seed morphology and growth form, perhaps in combination, seem promising starting points" (Ibid., 1348). Schlumpberger opts for option b), considering it "a more practical approach" a new division of *Echinopsis* in small separate genera. The result is the publication in Cactaceae Systematics Inititives (2012, 28: 29-31) of 48 new combinations in the resurrected genera *Acanthocalycium*, *Chamaecereus* Britton & Rose, *Leucostele* Backeberg, *Lobivia* Britton & Rose, *Reicheocactus* Backeberg, *Soehrensia* Backeberg, in view of a possible (and probable) publication in NCL 2. At this point we would have some objections to advancing with this kind of interpretation; because it seems to us a way of bringing something back through the window which had been let out of the door (with great effort).

Objection N°1: Practicality. Schlumpberger (ibid., 29) states that, instead of considering the idea of a monophyletic genus *Echinopsis*, which would require the inclusion of 15 genera hitherto never incorporated before, a more practical approach is the splitting of it into separate smaller genera again. Disagreeing with this statement, we recall that one of the synonyms of *Denmoza rhodacantha* (Salm-Dyck) Britton & Rose is *Echinopsis rhodacantha* (Salm-Dyck) Förster, and that the basionym of *Oreocereus hempelianus* (Gürke) D. R. Hunt is *Echinopsis hempeliana* Gürke. Also, if it is true that a monophyletic *Echinopsis* requires the inclusion of 15 genera, it is also true that the division proposed by Schlumpberger requires the resurrection of at least 7 old genera (*Acanthocalycium*, *Chamaecereus*, *Leucostele*, *Lobivia*, *Reicheocactus*, *Soehrensia* and *Setiechinopsis*), but most importantly, it does not solve the internal relationships of the clades *Cleistocactus* s.s. and *Oreocereus* (Schlumpberger & Renner 2012, 99 (8): 1342). In fact, for consistency with the other solutions adopted, the *Oreocereus* clade (99% bootstrap) or, given the results of the analysis, *Borzicactus* (according to Kimmach), should include: *Borzicactus* (or *Oreocereus*), *Espostoa*, *Haageocereus*, *Matucana*, *Mila*, *Oroya*, *Pygmaeocereus* and *Rauhocereus*. The clade *Cleistocactus*

s.s. should include at least *Vatricania guentheri* (100% bootstrap), if not also *Cephalocleistocactus*, *Samaipaticereus*, *Weberbauerocereus*, *Yungasocereus* (100% bootstrap). Therefore, we see that under a practical perspective, the Schlumpberger's proposal does not solve the relationships within the group in question in a natural way. Objection N° 2: Communication, clearness, order. According to Hunt (1999, 7: 8), we think that names, even before classification, serve to communicate. But to communicate, they should have an internal coherence that links them to the reality that they want to identify. In this sense, they should indicate an order. In this context, the "new" genera proposed by Schlumpberger do not even express clearness, let alone order. In contrast to the original genera of Britton & Rose and Backeberg, which although not natural (in Hennig's sense), did show an internal coherence based on the recognisability of one or more characters that unite the members of the generic group. For example: more or less globular - diurnal anthesis = *Lobivia*; globular - white, funnel-shaped flowers - nocturnal anthesis = *Echinopsis* s.s.; columnar - large white flowers - nocturnal anthesis = *Trichocereus*; etc. But if we attempt to define, in the same way, to communicate the distinctions between the genera proposed by Schlumpberger, it generates chaos. In fact, the new genus *Chamaecereus* Britton & Rose, includes ex-members (and characters) of *Lobivia,* such as *Lobivia saltensis* Spegazzini, or *Lobivia stilowiana* Backeberg. The new genus *Lobivia* Britton & Rose, includes ex-members (and characters) of *Echinopsis*, such as *Echinopsis calochlora* K. Schumann, or *Echinopsis mamillosa* Gürke. The new genus *Soehrensia* Backeberg, includes ex-members (and characters) of Lobivia, such as *Lobivia crassicaulis* R. Kiesling, or of *Trichocereus*, such as *Trichocereus angelesiae* R. Kiesling, etc. We think that the aforementioned Schlumpberger & Renner's conclusion is at least questionable, the conclusion with which the authors wonder about the possibility of finding, (for the classification of the genera of the Trichocereeae): "morphological characters sufficiently conservative for distinguishing larger groups of species. Seed morphology and growth form, perhaps in combination, seem promising starting points" (2012, 99 (8): 1348). It does not seem to us a serious way of proceeding, changing the names of 48 taxa, and only then, to wonder which could be the characters that will identify them. Are the molecular characters not characters in all respects? So, why do they not suffice in defining

the groups in question? The answer is: they are not sufficient because the chosen phylogenetic hypothesis is less approximate to something that exist in nature. Instead: choosing the option of unifying the 15 genera in *Echinopsis*, the definition to identify them as part of the composed genus is simple: *Echinopsis* with floral characters and / or pollination syndromes modified.

Objection N° 3: Something approximating to the truth in nature. Among the results of molecular analysis, the phylogenetic hypothesis must be chosen, which leads to a valid estimate of something that exists in nature. In other words, the success of the evolutionary model chosen in predicting new data, requires that the fit of data to the model may lead to something approximating to the truth in nature (see also Sober 2008). What are *Cleistocactus*, *Denmoza*, *Haageocereus*, *Oreocereus*, *Weberbauerocereus*, etc., if they are not *Echinopsis* with floral characters and / or pollination syndromes modified? The hypothesis is confirmed both at the molecular level, then at the morphological one (or holomorphological, in Hennig's sense). For years, molecular analysis revealed the close relationship between *Echinopsis* s.l. and the other genera within the tribe Trichocereeae, or subtribe Trichocereinae, (Nyffeler 2002, 317, 319; Lendel et al. 2006, unpubl. data in Nyffeler & Eggli 2010); until the Schlumpberger & Renner's latest analysis (2012), which reaffirmed, even more clearly, that a large part of the genera constituting the tribe Trichocereeae, form with *Echinopsis* s.l. a single well supported monophyletic clade. In nature the most striking example is the monotypic *Denmoza rhodacantha*, a taxon otherwise attributed by various authors to *Cleistocactus*, *Echinopsis* and *Oreocereus*, and which, for us, is the perfect link between the current concept of *Echinopsis* s.l. (resulting as polyphyletic), and a new monophyletic macro-genus *Echinopsis*, which also includes species of *Echinopsis* with floral characters and / or pollination syndromes modified.

Objection N° 4: Coherence. Being the molecular biology results expressed through theories, methods and techniques which describe rules, and not laws (as for example the process by which are interpreted synapomorphies, or the phylogenetic inferences assigned to ML techniques, etc), in the interpretation of the results, the researchers coherence is essential. We recall that in a similar case, the aforementioned genus *Parodia*, the possible options / interpretations gave rise to opposite choices to those proposed for

Echinopsis. In 1999, Nyffeler in Cactaceae Consensus Initiatives, proposed to the IOS Cactaceae Working Party members, the molecular analysis results conducted using ITS (nuclear ribosomal DNA) and trnL-trnF (cp DNA) as molecular markers to investigate the relationships between the members of the subtribe Notocactinae, and especially among those internal to *Parodia* s.l. (i.e. *Brasilicactus*, *Brasiliparodia*, *Eriocactus*, *Notocactus*, *Parodia* and *Wigginsia*) (1999, 7: 6-8). After detecting the basal position of *Brasilicactus* / *Brasiliparodia* and *Eriocactus* in the group, which in the words of Nyffeler, "are not true parodias" (ibid.: 7), 3 options are proposed:

1) Include everything in *Parodia* s.l., including *Brasilicactus* / *Brasiliparodia*, *Eriocactus*, '*Notocactus*' s.s.,and *Wigginsia*.

2) Recognize *Brasilicactus* / *Brasiliparodia*, *Eriocactus* and *Parodia* s.l. (including '*Notocactus*' s.s., and *Wigginsia*).

3) Recognize *Brasilicactus* / *Brasiliparodia*, *Eriocactus*, and probably up to 5 different genera for the rest of the members from '*Notocactus*' s.s., *Parodia* s.s., and *Wigginsia*. At that time Hunt chose the first option, arguing: "And since, in biological nomenclature, the genus is part of the name, stability is best served by reserving that category for the largest readily recognizable 'natural' (i.e. evolutionary or phylogenetic) units, ... This would be my main reason for preferring the more inclusive options Reto identifies "(1999, 7: 8). Philosophically we agree with Hunt, and despite the diversity of *Eriocactus* compared with the other members of the group, for coherence we agree also with the phylogenetic option adopted (Anceschi & Magli 2013, 7: 27-29). Schlumpberger discussed his conclusions with the NCL "team" (2011, 25: 30; 2012, 26: 7; 2012, 28: 3-4), and the result is the 48 new proposed combinations in CSI (2012, 28: 29-31). We do not see any coherence of approach in this procedure. Maybe *Cleistocactus* and *Oreocereus* should be more "protected" than *Notocactus* and *Eriocactus*? As far as we are concerned we think that time cannot be reversed, and that the indications of the real relationships between the taxa involved in the Schlumpberger & Renner's study are rather clear. As highlighted, we prefer to opt for the solution of a monophyletic macro-genus *Echinopsis*, with the consequent inclusion of the genera indicated in the study of Schlumpberger & Renner, currently involved in cactusinhabitat.org (ie *Cleistocactus*,

Denmoza, *Haageocereus*, *Harrisia*, *Oreocereus*, *Vatricania* and *Weberbauerocereus*). For the new names and combinations required in *Echinopsis* see pp. 37-40.

The interpretation of the arrow of time in the methods of defining the lower taxa (the species). Hennig's semaphoronts

As we have seen, the temporal dimension and the reconstruction of an exact chronology of the real historical events are crucial in order to distinguish monophyletic groups in higher taxa (Hennig 1966, 238-239). The instruments at our disposal are the system based on symplesiomorphy / synapomorphy (ibid. 89), in addition to the best chances of parental relationships offered by the evolutionary models chosen in the elaboration of molecular data. But are there methods which will help us in the definition and distinction of species naturally, and if so what are they? At a biological level, the distinction between species, involves the same concept supporting the definition of species (Mayr et al. 1953), that the author summarizes: "Species can maintain themselves only if they have genetic isolating mechanisms" (Mayr 1957). But we also know how difficult it is in many cases to determine whether the populations, constituting a natural species, are really isolated from the populations of vicariant species surrounding them. At morphological level, or better holomorphological, the instrument made available by Hennig to define the lower taxa (species), is based on the concept of semaphoront (1966, 6-7, 32-33, 63, 65-67). The brick at the basis of the biological system is neither the species nor the individual but: "... the individual at a particular point of time, or even better, during a certain, theoretically infinitely small, period of its life. We will call this element of all biological systematics... *the character-bearing semaphoront*" (ibid., 6). The author specifies that a semaphoront is the individual during a certain, however brief, period of time, and "not at a point in time". Adding that there are no rules to define how long the semaphoront exists as a taxonomic entity, and that this depends on the rate at which the different characters change. In the maximum extreme it can take the entire life of the individual, but in many cases, especially in organisms that undergo metamorphic or cyclomorfotic processes, it would be notably shorter. The semaphoront's morphological characters are the synthesis of its physiological, morphological and ethological characters, and the totality of these characters is defined

as the holomorphy of the semaphoront (ibid., 7). The comparative holomorphology between semaphoronts is defined as the auxiliary science of systematic (ibid., 32-33). The author continues saying that differences in form between ontogenetically related semaphoronts in the same individual are called metamorphisms, adding that in everyday language the metamorphisms are the differently shaped age stages of an individual. Citing Naef: "We comprehend ontogenesis by fixing a series of momentary pictures on 'stages' out of an actually infinite number. In practice we select as many as seem necessary for understanding the process." (ibid., 33). And again, it highlights that the general tendency is to distinguish only a few stages in a metamorphosis, i.e. only if the differences that are relatively great, and if the duration of relative constancy of a character is appreciably longer than the period of transformation. Stressing that there are no general rules for determining what constitute a stage (ibid., 33). In the summary of Taxonomic Tasks in the Area of the Lower Categories, Hennig summarizes his idea: "The semaphoront (the character bearer) must be regarded as the element of systematics because, in a system in which the genetic relationships between different things that succeed one another in time are to be represented, we cannot work with elements that change with time. Accordingly the semaphoront corresponds to the individual in a certain, theoretically infinitely small, time span of its life, during which it can be considered unchangeable." (ibid., 65). All "the character bearers" appear so connected to each other by ontogenetic and tokogenetic (sexual relations between members of the same reproductive community) relationships, from the beginning of life's history up to the present. Even in relation to the use of this instrument, as for the use of symplesiomorphies / synapomorphies for the definition of the higher taxa, Hennig indicates that the limits of applicability must be determined empirically in each case. Furthermore, that the comparative holomorphy can be used as an accessory science for recognizing genetic relationships that are to be presented in the taxonomic system, and apart from the chorological system that we will go into in more depth in the future, Hennig does not provide additional instruments for the definition of species (ibid., 67). We do not understand why Hennig's successors did not give importance to the idea of the semaphoronts, which are the protagonists of the first 40 pages of Philogenetic Systematics (1966), and for the author the major instrument for defining

the lower taxa. It is as if the reality of the ongoing transformation or metamorphosis of living beings through endless stages, some of which being discrete and measurable (Hennig being an entomologist), were exclusively prerogative to the insect world. In Wiley & Liebermann (2011) the term semaphoront does not appear; the closer concept is the "ontogenetic homology", to which half a page is dedicated, summarized as follows: "The use of the concept of ontogenetic homology on the systematic level represents an attempt to study the differentiation and growth of the organism and to provide a basis for comparisons between organisms" (ibid., 116). In reality the Hennig's semaphoronts, though not always applicable, are the only instruments that allow us to make a comparison between species in a real-time, present, one of the distinct ontogenesis of the compared taxa. In this sense, the relationships shown are phylogenetically natural (in Hennig's sense). The semaphoronts can be used to define the relationships between species (usually of close evolutionary lines) in the following ways:

a) In an ontogenesis process in the same lineage (species), distinct growth phases can be identified, showing the relative constancy of one or more characters for quite a long time (i.e. distinct semaphoronts), phases that had previously been interpreted as distinct phyletic lines.

b) We can compare the ontogenetic processes of two lineages, and through the comparison of the semaphoronts constituting them (if recognizable), evaluate its proximity or distance.

During our research, we used Hennig's semaphoronts on several occasions. One example of case B is *Parodia calvescens* (N. Gerloff & A.D. Nilson) Anceschi & Magli, which is distinguished from *Parodia erinacea* (Haworth) N. P. Taylor [including *Parodia sellowii* (Link & Otto) D. R. Hunt and *Parodia turbinata* Hofacker], for showing 2 separate semaphoronts in the process of ontogenesis. The first displays a delicate spination comprised of 3-6 whitish radial spines, 2-5 mm long, until reaching puberty (approximately 2 years). The second, which occurs from puberty onwards, displays old areoles that lose their spines, and the new ones that cease to produce them, leaving the taxon completely bare. Instead, in the ontogenesis process of *P. erinacea*, the second semaphoront does not appear, i.e., a normal evolutionary progression of the spines exists, from the juvenile phase to adulthood. On the basis of this evidence the

two taxa can be recognized as two distinct lineages (Anceschi & Magli 2013, 6: 29-30). We would add that the populations constituting _P. erinacea_ can also provide us with an example of case A. In fact, in a first phase of the ontogenesis process, the taxon assumes a discoid-globular aspect (the semaphoront known as _P. erinacea_ / _P. turbinata_), then moves to a second phase indicated by a typical elongated shape (the semaphoront known as _P. sellowii_). The system based on symplesiomorphy / synapomorphy, and the priority given to the characters and to the molecular analyses are the methods and techniques currently used in the phylogenetic definition of the higher taxa. Concerning instead the philogenetic definition of lower taxa, where the system based on symplesiomorphy / synapomorphy can fail as a result of a lack of useful characters to be analyzed, and where we do not know how far the molecular data can be explanatory, at the specific level, we think it would be useful that accessory science, for recognizing genetic relationships that are to be presented in the taxonomic system, which Hennig defines as comparative holomorphy between semaphoronts (1966, 66-67).

Summary and conclusions

• We believe that a phylogenetic classification should be preferred over another (morphological, typological, etc.), as it is the only one that considers a correct interpretation of the arrow of time. Therefore it is the only one that takes account of real processes, fitted with individuality, which have a beginning, duration, and an end.

• In phylogeny an exact chronology of the real historical events distinguishes the real, natural groups, (monophyletics), from those that are abstract, non-natural (polyphyletics, paraphyletics) (Hennig 1966, 238-239).

• The monophyletic groups are those whose components are subordinated to one another, according to the temporal distance between their origin and the present; the sequence of subordination corresponds to the "recency of a common ancestry" of the species making up each of the monophyletic groups (ibid., 83).

• In the case of molecular data, the temporal dimension of the splitting moments from which new species are born is given by a probabilistic scan, a dimension suggested by the phylogenetic hypotheses produced by the evolutionary models chosen to process the analysis data. Likelihood calculates the probability that an event that happened in the past yields a specific outcome. Bayesian analysis explores the posterior probability to find the model / topology of the tree, the largest posterior probability, conditioned by what the investigator is willing to accept as true before the analysis.

• Concerning the two possible phylogenetic hypotheses that emerged from the results of the molecular analyses conducted by Schlumpberger & Renner in *Echinopsis* Zuccarini (2012, 99 (8): 1335-1349), we believe that the option chosen by the authors, i.e. a new subdivision of *Echinopsis* into small separate genera, is affected by various problems of internal coherence (see pp. 22-29). a) It does not fully resolve the relationships between the analyzed clades. b) It creates confusion, because the new proposed clades are not characteristically definable and therefore identifiable. c) Among the two options, it is the one that least approaches something approximately true in nature. d) It is incoherent with previous solutions adopted in relation to other groups of taxa (*Parodia* s.l.).

• We opt therefore for the solution of a monophyletic macro-genus *Echinopsis,* well supported (100% bootstrap), and for the subsequent inclusion of the genera indicated by the study of Schlumpberger & Renner and currently implicated in cactusinhabitat. org (*Cleistocactus*, *Denmoza*, *Haageocereus*, *Harrisia*, *Oreocereus*, *Vatricania* and *Weberbauerocereus*). For the new names and combinations required in *Echinopsis* see pp. 37-40.

• The genera involved in the study of Schlumpberger & Renner (ibid.) in a broader concept of a monophyletic *Echinopsis* are defined as: "*Echinopsis* with floral characters and / or pollination syndromes modified".

• The instrument made available by Hennig for the definition of lower taxa (species), is based on the semaphoront figure (1966, 6-7, 32-33, 63, 65-67) and on the comparative holomorphology (or holomorphy) between semaphoronts (ibid., 32-33, 67).

• Hennig considers the semaphoront figure the fundamental brick which is the basis of the biological system, identifying it as "... (the character bearer) ... the individual in a certain, theoretically infinitely small, time span of its life, during which it can be considered unchangeable." (ibid., 65). The semaphoront morphological characters are the synthesis of its morphological, physiological, ethological, ecological, chorological and genetical characters (ibid., 7, 32). The totality of these characters is defined as the holomorphy of the semaphoront. The comparative holomorphology (or holomorphy) between semaphoronts is the auxiliary science of the systematic (ibid., 32-33, 67).

• In the lower taxa (species) through the use of the comparative holomorphology between semaphoronts, we can: a) identify distinct semaphoronts within the same ontogenesis process, as belonging to a single evolutionary line, b) compare the ontogenesis processes of two phyletic lines, and through the comparison of semaphoronts constituting them, evaluate their proximity or distance.

• Contrary to what happens for the higher taxa, the instrument of the comparative holomorphology between semaphoronts is the only one through where the correct chronology of events is verifiable in the actual dimension of time.

• As in the case of synapomorphies, even for the semaphoronts, Hennig (ibid., 66-67) specifies that the applicability of the system must be determined in each case, and that the comparative holomorphology be used as accessory science for the recognition of genetic relationships to be presented within a taxonomic system.

Updates on Taxonomy. Summary and conclusions (2010)

• In relation to the third point, on the accepted genera in cactusinhabitat.org (Anceschi & Magli 2010, 18), we point out the inclusion of *Praecereus* Buxbaum in *Cereus* P. Miller (see pp. 44).

• In relation to the seventh point (ibid., 18-19), we consider that within the range of a species, any morphological and geographical variations are better defined by the term "population", rather than the term "form". The species are in fact constituted by populations, rather than forms. In addition the term "population" does not have any rank implication at the taxonomic level in ICBN.

• In relation to the last point (ibid., 19), based on the results of the current study, we think that the total number of species of cacti in habitat is probably lower by at least 15% compared to that proposed by Hunt et al. (2006, text: 5).

02. Nomenclatural novelties

New names and combinations in *Echinopsis* Zuccarini

Concerning the two possible phylogenetic hypotheses that emerged from the results of the molecular analyses conducted by Schlumpberger & Renner in *Echinopsis* Zuccarini (2012, 99 (8): 1335-1349), we believe that the option chosen by the authors, i.e. a new subdivision of *Echinopsis* into small separate genera, is affected by various problems of internal coherence (see pp. 22-29). We opt therefore for the solution of a monophyletic macro-genus *Echinopsis,* well supported, and for the subsequent inclusion of the genera indicated by the study of Schlumpberger & Renner and currently implicated in cactusinhabitat.org (*Cleistocactus*, *Denmoza*, *Haageocereus*, *Harrisia*, *Oreocereus*, *Vatricania* and *Weberbauerocereus*). Here follow the new names and combinations required in *Echinopsis*.

Echinopsis balansae (K. Schumann) Anceschi & Magli **comb. nov. Basionym:** *Cereus balansae* K. Schumann, Fl. Bras. (Martius) 4 (2): 210 (1890) (as "balansaei"). **Type:** PY, nr Asunción, *Balansa* 2504 (K).

Echinopsis baumannii (Lemaire) Anceschi & Magli **comb. nov. Basionym:** *Cereus baumannii* Lemaire, Hortic. Univ. 126, 315 (1844); Jard. Fleur. 1: t. 48 (1851). **Neotype**: *D. R. Hunt & N. P. Taylor*, Cactaceae Syst. Init. 21: 6 (2006): Jard. Fleur. 1: t. 48 (1851).

Echinopsis buchtienii (Backeberg) Anceschi & Magli **comb. nov. Basionym:** *Cleistocactus buchtienii* Backeberg, Kaktus-ABC 189, 411 (1936). **Type:** BO, between Arque and Cochabamba, 2000 m, [Buchtien?] (ZSS, fide Eggli, Trop. Subtrop. Pfl. 59: 35-36 (1987).

Echinopsis candelilla (Cárdenas) Anceschi & Magli **comb. nov. Basionym:**
Cleistocactus candelilla Cárdenas, Cact. Succ. J. (Los Angeles) 24: 146 (1952). **Type:**
BO, Santa Cruz, Florida, La Tigre (Pampa Grande), 1400 m, Oct 1950, Cárdenas
4819 (LIL, US).

Echinopsis celsiana (Salm-Dyck) Anceschi & Magli **comb. nov. Basionym:**
Pilocereus celsianus Salm-Dyck, Cact. Hort. Dyck. 185 (1850). **Type:** XC, hort. Cels.

Echinopsis guentheri (Kupper) Anceschi & Magli **comb. nov. Basionym:**
Cephalocereus guentheri Kupper, Monatsschr. Deutsch. Kakteen-Ges. 3: 159 (1931).
Type: BO, Chuquisaca, Rio Grande valley, 800-1000 m, 1927, *Troll*, np ?

Echinopsis horstii (P. J Braun) Anceschi & Magli **comb. nov. Basionym:**
Cleistocactus horstii P. J Braun, Kakteen And. Sukk. 33 (10): 208 (1982). **Type:**
BR, SW of Mato Grosso do Sul, lowlands of Rio Amoguija, 150 m, 1974, *Host &*
Uebelmann 373 (KOELN, ZSS).

Echinopsis leucotricha (R. Philippi) Anceschi & Magli **comb. nov. Basionym:**
Echinocactus leucotrichus R. Philippi, Anales Mus. Nac., Santiago de Chile 27 (1891).
Type: CL, Tarapacá, Naquiña and Usmagama, *Philippi* (SGO 41275).

Echinopsis nothochilensis Anceschi & Magli **nom. nov. Replaced synonym:**
Haageocereus chilensis F. Ritter ex D. R. Hunt, Cactaceae Syst. Init. 20: 19 (2005),
non *Echinopsis chiloensis* (Colla) H. Friedrich & G. D. Rowley, I.O.S. Bull. 3 (3): 94
(1974). **Type:** CL, Tarapacá, E of Arica, W of Chapiquiña, 2000-3000 m, 1953, *Ritter*
s.n. (U, sheet labelled "*Haageocereus chilensis*").

Echinopsis nothohyalacantha Anceschi & Magli **nom. nov. Replaced synonym:**
Cereus hyalacanthus K. Schumann, Gesamtbeschr. Kakt. 101 (1897), non *Echinopsis*
hyalacantha (Spegazzini) Werdermann, Gartenflora 80: 302 (1931); Neue Kakteen 85
(1931). **Type:** AR, Jujuy, *Kuntze* s.n., np.

Echinopsis nothostrausii Anceschi & Magli **nom. nov. Replaced synonym:**
Pilocereus strausii Heese, Gartenflora 56: 410, fig. 49 (1907), non *Echinopsis strausii*
Graessner, Hauptverz. 7, nomen. (1937). **Lectotype:** *D. R. Hunt & N. P. Taylor,*
Cactaceae Syst. Init. 21: 6 (2006): Gartenflora 1907: fig. 49.

Echinopsis parviflora (K. Schumann) Anceschi & Magli **comb. nov. Basionym:**
Cereus parviflorus K. Schumann, Gesamtbeschr. Kakt. 100 (1897). **Type:** BO, SW of
Cochabamba, near Parotani, 2400 m, *Kuntze* (B † ?).

Echinopsis platinospina (Werdermann & Backeberg) Anceschi & Magli **comb. nov.**
Basionym: Cereus platinospinus Werdermann & Backeberg, Neue Kakteen 50, 76,
fig. (1931); Fedde, Rep. Spec. Nov. 30: 61 (1932). **Lectotype:** N. Calderón, Zappi, N.
P. Taylor & Ceroni, Bradleya 25: 80 (2007): Backeberg, Neue Kakteen: 76, photo on
right side (1931).

Echinopsis pomanensis (F. A. C. Weber ex K. Schumann) Anceschi & Magli **comb.**
nov. Basionym: *Cereus pomanensis* F. A. C. Weber ex K. Schumann, Gesamtbeschr.
Kakt. 136 (1897). **Neotype**: (Kiesling, Darw. 34 (1-4): 391 (1966): AR, Santiago del
Estero, Ojo de Agua, Quebrada "Pozo Grande", 18 Dec 1981, *Ulibarri* 1366 (SI).

Echinopsis pseudomelanostele (Werdermann & Backeberg) Anceschi & Magli
comb. nov. Basionym: *Cereus pseudomelanostele* Werdermann & Backeberg, Neue
Kakteen 35, 74, fig. (1931); Fedde, Rep. Spec. Nov. 30: 61 (1932). **Lectotype:** *N.*
Calderón, Zappi, N. P. Taylor & Ceroni, Bradleya 25: 82 (2007): Backeberg, Neue
Kakteen: 75, photo (1931).

Echinopsis samaipatana (Cárdenas) Anceschi & Magli **comb. nov. Basionym:**
Bolivicereus samaipatanus Cárdenas, Cact. Succ. J. (Los Angeles) 23: 91 (1951).
Type: BO, Santa Cruz, Florida near "El Fuerte" de Samaipata, 1890 m, May 1949,
Anibal Corro 4395 (LIL, US).

Echinopsis santacruzensis (Backeberg) Anceschi & Magli **comb. nov. Basionym:** *Cleistocactus santacruzensis* Backeberg, Kakteenlexikon 89 (1966). **Type:** BO, Santa Cruz, *Ritter* 356 (U).

Echinopsis tetracantha (Labouret) Anceschi & Magli **comb. nov. Basionym:** *Cereus tetracanthus* Labouret, Rev. Hort. [Paris] ser. 4, 4: 25 (1855). **Type:** BO, Chuquisaca, seed-raised in hort. Cels, np.

Echinopsis tominensis (Weingart) Anceschi & Magli **comb. nov. Basionym:** *Cereus tominensis* Weingart, Monatsschr. Deutsch. Kakteen-Ges. 3: 117 (1931). **Type:** BO, Chuquisaca, E of Sucre, Tomina, 1800-2000 m, 1926-28, *Troll*, np.

Echinopsis trollii (Kupper) Anceschi & Magli **comb. nov. Basionym:** *Cereus trollii* Kupper, Monatsschr. Deutsch. Kakteen-Ges. 1: 96 (1929). **Type:** BO, Potosi, from Carolqui to Potosi, 3800-4300 m, *Troll*, np.

Echinopsis weberbaueri (K. Schumann ex Vaupel) Anceschi & Magli **comb. nov. Basionym:** *Cereus weberbaueri* K. Schumann ex Vaupel, Bot. Jahrb. Syst. 50 (2-3, Beibl. 111): 22 (1913). **Type:** PE, Arequipa, nr Yura, a station on the Arequipa-Puno rly, 2400 m, 31 Aug 1902, *Weberbauer* 1413 (B).

Echinopsis kieslingii (Rausch) Anceschi & Magli **comb. et stat. nov. Basionym:** *Lobivia kieslingii* Rausch, Kakteen And. Sukk. 28(11): 249 (1977). **Type:** AR, Tucumán, Sierra de Quilmes, 4300 m, Rausch 573 (ZSS). **Synonym:** *Echinopsis formosa* ssp. *kieslingii* (Rausch) Lowry, Cactaceae Syst. Init. 14: 13(2002). *Comment*: Distinguished from *Echinopsis formosa* (Pfeiffer) Jacobi ex Salm-Dyck as a species, smaller, with fewer and stiffer spines, and for its separated distribution in the Sierra de Quilmes (Tucumán) and Sierra de Cachi (Salta), Argentina.

03. Comments on species*

Cereus

***Cereus lamprospermus* K. Schumann: a mysterious species, probably not distinct from *Cereus stenogonus* K. Schumann (part II)**

In the previous commentary dedicated to *Cereus lamprospermus* K. Schumann, we had already noted (2010, 30-31), as Taylor also mentions (2007, 22: 10) that *Cereus lamprospermus* ssp. *colosseus*, known for its giant specimen of Mairana (Santa Cruz, Bolivia) (Ritter 1980, 2: 554) was nothing but a specimen of *Cereus stenogonus* K. Schumann in one of the most northwesterly areas of its distribution range. In 2011 we travelled for almost three months, around various distribution areas of *C. stenogonus* between Bolivia (Tarija and Santa Cruz, up to the border with Mato Grosso do Sul, BR) Paraguay (Dpts. Amambay, Concepción and Alto Paraguay) and Argentina (Misiones). We were also looking for the mysterious *C. lamprospermus* taxon, which is supposed to be in Paraguay, in the Dpt. Alto Paraguay, between Fuerte Olimpo and Cerro Leon (Schumann 1899, 166; Ritter 1979, 1: 259). We thought that a columnar cactus of this size (a tree of 6-8 meters) could not have escaped our attention. Unfortunately, we have to start this update with bad news: in 2010 the famous specimen of Mairana made well-known by Ritter and documented in Anderson (2001, 147); Hunt et al. (2006, Atlas: 134), Anceschi & Magli (2010, A&M 220, photos 01-03) was cut down by the landowners. But the surveys in the zone between Samaipata and Mairana, and more precisely between Agua Clara and Yerba Buena, revealed that the specimen formed part of a population of *C. stenogonus* where several individuals reach large dimensions (A&M 683, photos 27-31). Proceeding with the research, first through the Bolivian Chaco and the neighbouring Andean mountains, and then through the Paraguayan Chaco, we documented the cacti populations of arboreal or columnar growth, which are summarized in the **table**:

Arboreal or columnar cacti in the Chaco Biome in BO (including neighbouring Andean mountains) and PY	Distributions areas and related A&M numbers documented on cactusinhabitat.org
Castellanosia caineana **Cárdenas**	Bolivia (Santa Cruz): A&M 658, A&M 673, A&M 687; Paraguay (Boquerón): A&M 241*
Cereus stenogonus **K. Schumann**	Bolivia (Santa Cruz): A&M 220*, A&M 660, A&M 668, A&M 682, A&M 683, A&M 685, A&M 694, A&M 713, A&M 716; (Tarija): A&M 643 Paraguay (Alto Paraguay): A&M 739, A&M 745, A&M 746; (Concepción): A&M 732**
Neoraimondia herzogiana **(Backeberg) Buxbaum & Krainz**	Bolivia (Santa Cruz): A&M 223*, A&M 229*, A&M 686; (Tarija): A&M 639
Stetsonia coryne **(Salm-Dych) Britton & Rose**	Bolivia (Santa Cruz): A&M 653; (Tarija): A&M 647 Paraguay (Boquerón): A&M 233*, A&M 235*
Echinopsis guentheri **(Kupper) Anceschi & Magli**	Bolivia (Santa Cruz, only Rio Grande Valley): A&M 684

* A&M numbers recorded before 2011

** A&M 732 *Cereus stenogonus,* Paraguay, Concepción, Concepción, San Alfredo, 25-08-2011, survey not available on the website

The only arboreal species of the genus *Cereus* P. Miller, which is encountered in this part of the Chaco Biome, (and which in Paraguay should include the distribution areas of *C. lamprospermus*), is the dominant *C. stenogonus*. We also observed in the characters of some specimens of this taxon, that they have measurements that would identify them as *C. lamprospermus*. For example, the specimen documented in Bolivia, Tarija west of Palos Blancos (A&M 643, photos 14-19), has branches with 7 ribs (6-8 in the description of *C. lamprospermus*), and the areoles on the branches with 1 central spine and (9) -10 radial spines (8-11 spines in *C. lamprospermus*). From the collected

documentation, evidence has come to light that *C. lamprospermus* is not a species that exists, and that as *C. lamprospermus* ssp. *colosseus* must be considered a synonym of the dominant and widespread *C. stenogonus*, the dimensions of which are quite variable, and whose distribution areas cross the borders with the Chaco region into the Mata Atlantica Biome region.

The reintroduction of *Cereus forbesii Otto*

In the publication cactusinhabitat.org 2010, we recognised the population of *Cereus* P. Miller of Catamarca at the Dique El Jumeal (A&M 123, photos 1-2) as *Cereus hankeanus* K. Schumann, and not *Cereus forbesii* Otto. This is in agreement with the interpretation of Hunt et al. (2006, text: 39-40, 42) of the *C. forbesii*, *C. hankeanus*, *Cereus validus* Haworth group. The subsequent studies we conducted in habitat in 2011, between Argentina (Córdoba and Salta) and Bolivia (Tarija) highlighted, in accordance with Kiesling (1999, 2: 428), that the best description for the taxa in question is *C. forbesii*, and not *C. hankeanus*. The description of *C. hankeanus* is wrong, either it has less ribs or less spines than the actual population. Therefore we prefer to reintroduce *C. forbesii*, and insert *C. hankeanus* among its synonyms. With regards to *C. validus*, as is also mentioned by Hunt et al. (2006, text: 42) Haworth's description (1831) comparing it to *Cereus tetragonus* (Linnaeus) P. Miller (now *Acanthocereus tetragonus*) with reference to the spines on the hypanthium, leads us to think that he is not referring to *Cereus* as is currently conceived. Instead *Cereus validus* auctt. not Haworth is to be considered synonym with *C. forbesii*.

***Cereus kroenleinii* N. P. Taylor: a synonym of *Cereus phatnospermus* K. Schumann**

In the descriptions of *Cereus phatnospermu*s K. Schumann (1899, 9: 167, 186), and *Cereus kroenleinii* N. P. Taylor (1995, 50 (4): 819), the characters almost overlap. The reference of a similarity with *Cereus* spegazzini Weber made by the first authors of the two taxa should also to be noted. About the second taxon, Kiesling in 1994, describes *Monvillea kroenleinii* (name not validly published) also comparing it to *C. phatnospermus*. These elements leave little doubt that *C. kroenleinii* is only a very recent description of the Schumann taxon.

Is *Praecereus* Buxbaum distinct from *Cereus* P. Miller?

Whilst previewing the implications of his work on the tribe *Cereeae* in a presentation at the IOS Congress in 2006 (Machado et al. 2006) Marlon Machado reported that the results of molecular analysis in progress will affect various genera. Among the genera involved, there is the possible inclusion of *Praecereus* Buxbaum in *Cereus* P. Miller. We completely agree with the data. In fact, not even in the course of our studies in habitat, not even in the comparison of the data with the literature, could we find qualitative and quantitative characters that might highlight a possible distinction of *Praecereus*. By doing a brief review of the recent history of the genus, we can see how weak the distinctions made for the separation are. In 1986, the International Cactaceae Systematics Group initially included *Praecereus* in *Monvillea* Britton & Rose, keeping the latter separate from *Cereus* (Hunt & Taylor, 1986, 4: 70). In 1990 The ICSG included *Monvillea* in *Cereus* (Hunt & Taylor, 1990, 8: 90). The evidence that led Anderson (2001, 589) to differentiate *Praecereus* is based on the studies of Taylor and Zappi (1989): a cladistic analysis of the tribe *Cereeae*, where *Praecereus* is considered to be a subgenus of *Cereus*. And on those of Taylor (1992, 1997), a study for the definition of *Cereus* the first, on the proposal of the new combination of *Cereus euchlorus* F. A. C. Weber (and related subspecies), and *Cereus saxicola* Morong in *Praecereus*, the second. This evidence, based on Backeberg's observations of the members in its sub-genus *Hummelia* of *Monvillea* (which are taxa that have been in the most part assimilated in *Praecereus* by Buxbaum), consists of flowers with stout, curved floral tubes and oblong ovaries. Anderson also admits that despite the investigations of Taylor and Zappi, the boundaries between these genera willl remain fuzzy. Assuming that in classification any kind of distinction based on a single character is in itself artificial, we want to point out that the latest molecular analysis (Nyffeler & Eggli 2010; Schlumpberger & Renner, 2012, 1347-1348) shows that the characters of the flowers and the different pollination syndromes are not indicators of the proximity or remoteness of two evolutionary lines. Indeed, *Praecereus* is indistinguishable from the other species of *Cereus* with slender stems, previously attributed to the genus *Monvillea*. For these reasons, we believe that *Praecereus* must be put together with *Cereus*.

Echinopsis

Echinopsis fallax (Oehme) H. Friedrich and *Echinopsis aurea* ssp. *shaferi*: two synonyms of *Echinopsis aurea* Britton & Rose

Echinopsis aurea Britton & Rose is a relatively dominant species, widespread in various provinces of northern Argentina (Catamarca, Córdoba, La Rioja, Salta, San Luis, and Santiago del Estero). The populations show quite variable characters, even within the same population, as highlighted in our surveys, so much so that some of these characters were taken as indicative of infra-populational (var.), intra-populational (ssp.), or at species level, taxonomic distinction. In reality, these distinctions fail when it emerges that the different characters that should define the supposed taxa are detected within the same population. For example, in the surveys of Córdoba, San Marco Sierra, road to Rio Quilpo, 19/Mar/2011, A&M 379, the strongest form, with more offsets and with more stems (largest stem 23 x 10.5 cm, h x d), i.e. characters that should distinguish *Echinopsis fallax* (Oehme) H. Friedrich (photos 5-8), lives near to the classic form of *Echinopsis aurea* (photos 13-14). Even in the survey of La Rioja, Olta, road to the Dique de Olta, 31/Mar/2011, A&M 414, there are both of the forms, *E. fallax* (photos 15-17) and *E. aurea* (photos 18-19), as well as the intermediate forms (photos 20-24). In addition to the forms of growth, also the "distinguishing" dimensional values, the number of ribs, spines, etc., which would separate the three taxa, can be found within the same population. For these reasons, we believe that *E. fallax* and *E. aurea* ssp. *shaferi* are synonyms of *E. aurea*. The idea is not new. Anderson (2001, 258) had already arrived at the same conclusion, mantained in Das grosse Kakteen Lexikon (2005, 2011), the German edition of Anderson's book, translated and edited (with some taxonomic changes) by Eggli.

Is *Echinopsis bridgesii* ssp. *vallegrandensis* (Cárdenas) Lowry different from *Echinopsis bridgesii* Salm-Dyck?

In 2005, Martin Lowry, before publishing it in the New Cactus Lexicon (Hunt et al. 2006), identified several new combinations of *Echinopsis* Zuccarini in Cactaceae Consensus Initiatives (2005, 19: 11-12). Among these, page 12 lists *Echinopsis bridgesii* ssp. *vallegrandensis* (Cárdenas) Lowry, from which the following is the full text:

14049 **E. bridgesii** ssp. **vallegrandensis** (Cárdenas) Lowry **comb. et stat. nov. B:** 00615 *E. vallegrandensis* Cárdenas, Cactus (Paris) 14 (64): 163-164 (1959). **T:** Bolivia, Santa Cruz, Florida, between Mataral and Vallegrande, 2700 m, Apr 1957, Cárdenas 5501 (CARD, US). Distinguished from ssp. *bridgesii* by its applanate habit, short, thicker, spines and more numerous ribs.

Lowry points out that among the distinctive characters of the new taxon are its applanate habit and the higher number of ribs. If we compare the characters of *Echinopsis bridgesii* Salm-Dyck with those of the ssp. *vallegrandensis* in NCL (Hunt et al.2006, text: 92) we find that such distinctions do not stand up, rather they contrast with the data in the text. As we can see from the **scheme,** the elements of Lowry's distinction does not exist.

Data gathered from: The New Cactus Lexicon (Hunt et al. 2006, text: 92)	stem	ribs
Echinopsis bridgesii ssp. *bridgesii*	short cylindric, 12-13 cm	(9-) 12-14
Echinopsis bridgesii ssp. *vallegrandensis*	globose to shortly elongate, 5-7 [-20?] x 8-9 cm	12

We also arrived at these conclusions by studying *Echinopsis vallegrandensis* Cárdenas in some of its distribution areas in Bolivia (Santa Cruz and Chuquisaca) in the zones between Mataral, San Isidro, Pulquina and the Rio Grande Valley. In fact, we did not find many differences compared to the populations of *E. bridgesii* that we saw in June 2007 in the surroundings of La Paz (Valle de La Luna). For example, the population of *E. vallegrandensis* found between Mataral and San Isidro on 20/Jul/2011 (A&M 670, photos 1-17), shows an average number of ribs of 12-14 (the same number of ribs as *E. bridgesii*) and individuals can reach 39 x 8 cm (h x ø) (photos 3-4). For these reasons, we believe that *E. vallegrandensis* should be included among the synonyms of *E. bridgesii*.

Echinopsis guentheri **(Kupper) Anceschi & Magli. No separation in the distribution area within the group**

In July 2011, we were in Bolivia in the Rio Grande Valley, between the departments of Chuquisaca and Santa Cruz to study *Espostoa guentheri* (Kupper) Buxbaum, to evaluate how these populations were close, at an olomorphological level, to *Espostoa* Britton & Rose, as proposed by Hunt et al., even if they highlight a separation in the distribution area compared to the rest of the group (2006, text: 116), rather than *Vatricania* Backeberg, reintroduced by recent molecular studies (Lendel et al. 2006, umpubl. data in Nyffeler & Eggli 2010). At the time, we would not have thought that there might be another answer, a third, as clearly emerges from the molecular studies, even more recent and complete (Schlumpberger & Renner 2012). From these studies it appears that *Espostoa* and *Vatricania* and other genera of the tribe Trichocereeae (Anderson 2001, 2005, 2011; Hunt et. Al 2006) or subtribe Trichocereinae (Nyffeler and Eggli, 2010), together with the species included in the current idea of *Echinopsis* sensu lato (Anderson 2001, 2005, 2011; Hunt et al. 2006), constitute a unique well supported monophyletic clade in *Echinopsis* (100% bootstrap support). This would replace the current clade, which has proved to be highly polyphyletic. Returning to the Rio Grande Valley, the observations on the morphology of the cephalium, in all specimens viewed of *Espostoa guentheri,* have highlighted that none of them shows the character that, according with Backeberg (1966, 789, fig. 444), distinguishes *Vatricania* from *Espostoa*, i.e. the superficial cephalium that completely surrounds the upper part of the stem. What happens to the specimen in the greenhouse, shown in the Backeberg's photo, cannot be found in nature. In old plants, at the apex, the cephalium may involve a few more ribs than the centre of the stem (photo 14), but on average in mature specimens, the cephalium occupies about half of the ribs. For example in the stem of the photos 33-34, the cephalium at the apex includes 11 of 22 ribs, and going down it becomes narrower until it includes 7 of 22. Therefore, the distinction between *Espostoa* and *Vatricania*, does not lie in the form or in the dimension of the cephalium. For the definition of the taxon, taking into account the molecular results highlighted by Nyffeler & Eggli (2010), data reinforced by the separation of the distribution areas of the two genera, we were considering opting for *Vatricania* but as mentioned before, the results

by Schlumpberger & Renner (2012) have been illuminating. In this aspect, we had no difficulty in interpreting *Cleistocactus* Lemaire, *Denmoza* Britton & Rose, *Oreocereus* (A. Berger) Riccobono, or *Weberbauerocereus* Backeberg as possible Echinopsis, with floral characters and / or pollination syndromes modified. For example, we consider that *Denmoza rhodacantha* (Salm-Dyck)) Britton & Rose is clearly a perfect link between the current concept of *Echinopsis* sensu lato (Anderson 2001, 2005, 2011; Hunt et. al 2006) and the genera that the study by Schlumpberger & Renner (2012) add in order that the genus *Echinopsis* can really be monophyletic (for more details about our position, see pp. 22-29). It is remarkable that, in the ontogenesis of the new named *Echinopsis guentheri* (Kupper) Anceschi & Magli, some juvenile phases are identified (before the emergence of the cephalium) (photos 6-8, 25-26), in which the taxon is morphologically close to certain Andean *Echinopsis* (*Trichocereus*). Moreover, coming to define the taxon as an *Echinopsis*, the question of geographical isolation loses its meaning. The phytogeographical area of *Echinopsis guentheri* is a niche in the Chaco Biome that remains isolated in the first Andean mountains. This is demonstrated by the cacti which live sympatrically with it: *Cereus stenogonus* K. Schumann, *Castellanosia caineana* Cárdenas, *Gymnocalycium pflanzii* (Vaupel) Werdermann, *Neoraimondia herzogiana* (Backeberg) Buxbaum & Krainz, *Echinopsis bridgesii* Salm-Dyck; all taxa characteristic of the Chaco, with the exception of *E. bridgesii*. Between the columnar cacti that populate the Chaco, one of the major ecosystems of the South American continent (of approximately 1,000,000 square kilometers), it seemed that there wasn't any kind of *Echinopsis*, but now we think that a possible descendant of the Andean *Trichocereus* stopped in the Rio Grande Valley.

Echinopsis huascha ssp. *robusta* (Rausch) Lowry: a synonym of *Echinopsis huascha* (F. A. C. Weber) H. Friedrich & G. D. Rowley

In the populations of *Echinopsis huascha* (F. A. C. Weber) H. Friedrich & G. D. Rowley in Argentina, in the province of Catamarca distributed from Belén to Hualfín, we can see that the form known as *Echinopsis huascha* ssp. *robusta* (Rausch) Lowry (Lowry 2002, 14: 14) is not different from the form of the type species, populations which assume larger dimensions, proceeding gradually towards the north. In the Hualfín

region, the type locality of *Lobivia huascha* var. *robusta* Rausch, individuals live together bearing the distinct dimensional characters that should separate the two taxa. The group in the photos 23-29 (A&M 447), has the largest stem at 93 x 16 cm (h x ø), and an average number of ribs on the stems of 20-21; the dimensions belong to the range of the *robusta* form (Hunt et al. 2006, text: 96). In the same area small and medium adult individuals can be found, which fall within the parameters of the *huascha* form (ibid.). The medium sized specimen in the photos 39-42 (A&M 452), shows stems of (8.8 -) 10 cm in diameter and average ribs of (15 -) 16. Finally, the photos 43-47 (A&M 456) where the specimens' dimensions are even smaller. Even south of Hualfín, among populations of *E. huascha*, specimens include characteristics of the *robusta* form, such as the specimen documented at La Cienaga de Abajo (A&M 444, photos 16-20), where we find stems up to 12 cm in diameter. This evidence demonstrates that *E. huascha* ssp. *robusta* does not have a taxonomic value that can be distinguished from *E. huascha*.

Cleistocactus tarijensis Cárdenas, a synonym of *Cleistocactus hyalacathus* (K. Schumann) Roland-Gosselin, now *Echinopsis nothohyalacantha* Anceschi & Magli
Combining the descriptions of the types with the geographic references of the surveys, it would seem that *Cleistocactus tarijensis* Cárdenas differs from *Cleistocactus hyalacanthus* (K. Schumann) Roland-Gosselin as it has fewer spines (about 20 vs. 20-30) and a more northerly distribution in the province of Tarija, in Bolivia, compared to the provinces of Salta and Jujuy, the area of distribution of *C. hyalacanthu*s in Argentina. However, as demonstrated by the surveys of *C. hyalacanthus* in the provinces of Chuquisaca, Tarija and Tupiza (see Ralph Martin's field number search), the distinctions are not so evident. As can be noted in the survey of Tarija, Loc Portillo (A&M 525), the population includes very similar individuals (photos 23-27) to *C. hyalacanthus*, as it can be found in northern Argentina (A&M 171, photo 1-5). In the absence of elements of distinction, it is clear that *C. tarijensis* is part of *C. hyalacanthus*. For the phylogenetic hypothesis adopted for the assimilation of *Cleistocactus* Lemaire in *Echinopsis* Zuccarini see pp. 22-29.

***Echinopsis chacoana* Schütz, a synonym of *Echinopsis rhodotricha* K. Schumann**

The characters which should mainly distinguish *Echinopsis chacoana* Schütz from *Echinopsis rhodotricha* K. Schumann is that is has a larger number of ribs, 12-18 for the first taxon vs. 8-13 for the second (Anderson 2001, 278; Hunt et al. 2006, text: 100). The first has a distribution further north, in Bolivia (Santa Cruz) and Paraguay, vs Argentina (Entre Ríos and Formosa) for the second (Anderson 2001, 278, where Bolivia is not mentioned in the distribution of *E. rhodotricha* ssp. *chacoana*; Hunt et al. 2006, text: 100). Even the most northerly populations may have the same number of ribs as the most southerly; so then the supposed distinctive characters overlap, giving rise to a spatial continuity between the populations. Let us take as an example the population of *E. chacoana* (A&M 705), studied in the Tucavaca Valley (Bolivia, Santa Cruz), located at the extreme north of the taxon's distribution, in a niche of the Chaco Biome separated from the rest of its Biome, by the Serrania de Chiquitos, and by a strip of Cerrado between Santiago de Chiquitos and Roboré. The population carries an average of (10 -) 11-13 ribs (photos 1-27). Other specimens studied in Paraguay in the Dpts. of Concepción and Alto Paraguay, i.e. in the distribution area of *E. chacoana* (A&M 733, photo 28; A&M 737, photos 29-31; A&M 744, photos 32-34), all show 10 ribs, a character which should be distinctive of *E. rhodotricha*. The distinction between the two taxa reported in the literature does not correspond to the surveys in habitat, so we think that *E. chacoana* is just a synonym of *E. rhodotricha*.

***Echinopsis schickendantzii* F. A. C. Weber is a dominant species. The taxon also includes *Echinopsis smrziana* Backeberg and *Echinopsis walter*i (R. Kiesling) H. Friedrich & Glaetzle**

The current concept of *Echinopsis schickendantzii* F. A. C. Weber (Hunt et al. 2006, text: 100-101), includes plant populations that occupy a wide geographical area, extending from northern Argentina (from Catamarca to Jujuy) and southern Bolivia (Chuquisaca and Tarija). The taxon also shows a great variety in forms of growth. In fact, in addition to the form of the type, found in the province of Tucumán (Argentina), a low bush with slightly cylindrical stems 15-20 x <6 cm, there can also be found the forms known as *Trichocereus shaferi* Britton & Rose, a bush of large dimensions with

stems < 60 x 10-15 cm, forming groups of 1-2 metres, or as *Echinopsis fabrisii* (R. Kiesling) G. D. Rowley, another bushy plant, producing branches from the base, with stems up to 100 x 20 cm. The surveys on the species were conducted in Argentina and Bolivia between 2007 and 2011 by us, broadly confirming the distribution areas already known and the variability of the forms, with specimens that achieve <140 cm in height (A&M 507, photos 33-34, 38). In May 2011, we were in the Province of Salta (AR), in the areas between Cachipampa, La Cuesta del Obispo and the Quebrada de Escoipe, to try to clarify the relationships between *E. schickendantzi*i, *Echinopsis smrziana* Backeberg and *Echinopsis walteri* (R. Kiesling) H. Friedrich & Glaetzle. This reminds us that while in Anderson (2001, 280; 2005; 2011) *E. smrziana* is still recognized at species level, in Hunt et al. (2006, text: 101) it is assimilated into *E. schickendantzii*. Instead *E. walteri* is recognized as a good species both Anderson (2001, 286; 2005; 2011), and Hunt et al. (2006, text: 103). A note by Charles, accompanying the text (ibid.), reports that *E. walteri* hybridizes with *E. smrziana* in the Quebrada de Escoipe, which is also the type locality for the first taxon. The note adds that the photo used for the taxon in NCL (Hunt et al. 2006, atlas: 255, fig. 255.4), shows a plant grown in cultivation (Rausch 12), identified by the same Rausch in its field numbers list as *Lobivia smrziana*! The question that arises is: does *E. walteri* exist, and how does it differ from *E. smrziana = E. schickendantzii*? In its current definition, the expanded description of *E. schickendantzii*, it overlaps with all the characters of *E. walteri*, except for the flower, white for the first taxon, and yellow or red for the second. However, as mentioned before, we believe that the colour of a flower, by itself, is not a key factor in recognizing a species (Anceschi & Magli 2010, 17). So let's go back to the surveys in May 2011. Coming from Cachi, via Cachipampa, and proceeding towards the Cuesta del Obispo, down into the Quebrada de Escoipe, the only populations of *Echinopsis* Zuccarini detected, forming groups of a certain size, can be identified with *E. schickendantzii* (we remember that *E. walteri* forms groups with globose stems 16 x 16 cm, with about 11 ribs, with <15 spines or more, 1-2.5 cm). On the Cuesta del Obispo, the first population detected lives between the locality La Herradura and Peña de Caracol (A&M 505). The population in the highest area (La Herradura) is made up of groups with stems of about 12.5 cm in diameter, an average of 12 ribs, with 3 central

spines, the lower 3.3 cm, and 9 radial spines <2.3 cm (photos 13-15). In the same population, down towards Peña do Caracol (photos 19-26), the stems become stronger <25 x 18.5 cm, with 13-15 ribs, 1-2 central spines <4.5 cm, and 8-10 radial spines <3,4 cm (photos 19, 24-25). Past Peña do Caracol, some groups become even bigger still, with higher stems <40 x 19 cm (A&M 506, photos 27-28), while continuing to show also the globular form, detected at La Herradura, but with a greater number of ribs (photos 31-32). Once you arrive in the Quebrada de Escoipe, the stems can reach up to 140 cm in height, with an average of (13 -) 14 cm in diameter, about 14-16 ribs, areoles with 1 central spine and 6-8 radial (A&M 507, photos 33-38). In our opinion, we are not faced with distinct taxa interbreeding with each other but with *E. schickendantzii*, a single taxon that varies in the dimensional characters in the different distribution areas it populates, living between Cachipampa and the Quebrada de Escoipe. The more similar forms to the description of *E. walteri* are those of the upper part of the Cuesta, as noted by other researchers (see *Lobivia walteri* on Ralph Martin's field number seach). We would like to point out that in 2007 we found similar forms to *E. walteri* on the top of the Quebrada de Las Conchas, at 3600 metres above sea level, near La Cieneguita (A&M 198, photos 1-3; A&M 198b, photos 5-8). Even here (photos 4, 9-10) we see the same changes noted in the Cuesta del Obispo / Quebrada de Escoipe, even here we believe that all the specimens belong to a single species: the dominant and variable *E. schickendantzii*. As highlighted, as well as *E. smrziana*, *E. walteri* is to be considered as a synonym of *E. schickendantzii*.

Variability in the populations of *Echinopsis thionantha* (Spegazzini) Werdermann. The dominant globular *Echinopsis* of the Calchaquies Valleys

In northwestern Argentina, the Calchaquíes Valleys are an ecosystem formed by a set of valleys, rivers, mountains and coloured quebradas, which constitute a strongly xerophytic habitat. The Valleys run along the Andean foothills to the west of the provinces of Catamarca, Tucumán and Salta. They start at the threshold of Belén (Catamarca), and lead up to the Quebrada del Toro (Salta), approximately 400 km as the crow flies. For about 325 km, the various populations which make up the taxon known as *Echinopsis thionantha* (Spegazzini) Werdermann can be encountered in a

spatial continuum. Starting from La Cienaga de Abajo, 19 km north of Belén (Kiesling reports disjointed populations of the taxon in Famatina, La Rioja (2005, 88), there are globular populations with grey blue epidermis and black spines when it's young, known as *Echinopsis glaucina* H. Friedrich & G. D. Rowley or *Echinopsis thionantha* ssp. *glauc*a (F. Ritter) Lowry. Then we arrived at La Poma, 51 km north of Cachi (Salta) for the most northwesterly populations. Right after La Cienaga, in the direction of Hualfín, the taxon begins to elongate, <46 cm (A&M 451, photos 57-60), arriving at <65 cm (A&M 151, photo 19), or reaching a size of <39 x 25 (h x ø), with 25 ribs (photos 20-23), in the centre of the distribution area (Cafayate, Angastaco, Quebrada de Las Conchas). The body becomes a grey-green, and the areoles have a greater number of spines, although shorter, compared to populations at La Cienaga. *E. thionantha* is a perfect example of a dominant species. i.e. more opportunistic and therefore better at adapting to different habitats, resulting in a greater numerical progression of individuals and populations, and higher variability. This case gives us the opportunity to highlight how certain differences brought to distinguish groups of related taxa, once the verifications in habitat have been made, often have little consistency. As already mentioned, in the southernmost distribution area, the populations of the form *glaucina* or *glauca*, which we will call *glaucina* populations, are distinguished from *E. thionanth*a as being smaller, with less ribs (8-14 vs. 9-15), less spines, but longer > 1 cm (Hunt et al. 2006, text: 102-103). We have also already mentioned how these populations, whose distinctive characters (in addition to a generally globular form) are actually the grey-blue epidermis and the black young spines (A&M 442, photos 31-47) begin to elongate between La Cienaga de Abajo and Hualfín. In this area we are witnessing the intergradation of the *glaucina* populations into the *thionantha* populations (A&M 451, photos 48-60). Now, even though we do not recognize the need for infra or intra specific ranks, we would like to point out that in order for two subspecies of the same species to exist, they should benefit from a minimum of territorial autonomy. If there is a spatial continuum between populations, which makes up a natural species, and the "distinct" forms blend together, it is clear that we are talking about the same biological species, and that it is useless to demand different species or subspecies to indicate the variations in question. In our opinion, we are not even dealing with populations crossing with each other, giving

rise to intermediate forms, but the same population that has already been transformed in space and time. In truth, the species has also continued to change in other parts of the distribution area, but these trasformations did not lead to different forms being demanded. We also have the case of scattered individuals (not populations), which in some zones of the distribution area of the species were assumed to belong to the subspecies rank, under the name *Echinopsis thionantha* ssp. *ferrarii* (Rausch) Lowry (Hunt et al. 2006, text: 102-103), or to the species rank, in another genus such as *Acathocalycium ferrarii* Rausch (Anderson 2001, 105; 2005; 2011). In April 2011, we dedicated ourselves to the surveys in the area of Amaicha del Valle (Tucuman, AR), the range of the subspecies *ferrarii*. We were southeast of Amaicha in El Remate, in the eastern areas of El Tio and of the Observatorio. We went northwest to the Rio Calchaquies, then past Quilmes crossing the valley, and a further 10 km until we arrived at the Rincón de Quilmes. The taxon is indicated by the following characters: globose habit <12 cm, green, about 18 ribs, awl like spines, central 1-4 <1.5 cm, radial 7-9, <2 cm, flowers from yellow to orange red, to carmine <5.5 x 5 cm (Anderson 2001, 105; 2005; 2011). Among these, the only characters that might distinguish the taxon from *E. thionantha* are the colour of the stem, green to grey-green, and according to Kiesling and Ferrari (2005, 90) the fact that the stems are depressed or globose, never cylindrical like in *E. thionantha*, and not so grey. Regarding flowers, Kiesling and Ferrari tell us that on the western side of the valley (Rincón de Quilmes), where the type was detected, they are red, while on the other side (east of Amaicha) populations have flowers ranging from yellow to red, with all the intermediate tones in between. Populations of *E. thionantha* are living all over the examined area, which (of course) in addition to the globular shape, can lengthen in growing. Within these populations, one can identify some individuals (usually isolated), which show the characters that would be distinctive of ssp. *ferrarii*, or *A. ferrarii* (A&M 460, photos 67-70, 74-75, 81-84, 86, 97-102; A&M 471, photos 121-124), and living beside the more elongated conspecific examples (A&M 460, photo 86; A&M 471, photos 123, 125). To emphasize the variability of the populations, we would also cite the example of the survey carried out in the south of Amaicha, where some specimens have the characters of the *glaucina* populations (A&M 469, photos 115-120). It should be noted that also in this case the form can be

either glubular or elongated. As highlighted, *E. glaucina / E. thionantha* ssp. *glauca* and *A. ferrarii / E. thionantha* ssp. *ferrarii* are phases in the transformation process of *E. thionantha*, the first at the intra-populational level, the second at the infra-populational level. In both cases, it seems appropriate to consider the taxa concerned as synonyms of the dominant *E. thionantha*.

Frailea

Frailea horstii F. Ritter: a synonym of *Frailea gracillima* (Lemaire) Britton & Rose
We had already expressed our doubt that *Frailea horstii* F. Ritter was really different from *Frailea gracillima* (Lemaire) Britton & Rose in the publication on our website in 2010, in the comments about the two taxa, while accepting that the first taxon as a good species. Subsequent surveys on the habitat of *F. horstii*, conducted in 2011, confirmed those doubts, pointing out that this is only one population of *F. gracillima* with more ribs: 20-33 vs 14-22, and more spines: 3-6 central and 15-20 radial vs. 2-5 central and 8-13 radial. The distribution of *F. horstii*, located in the zone of Caçapava do Sul, Rio Grande do Sul (BR), is included in the widespread *F. gracillima*. For these reasons we will include *F. horstii* among the synonyms of *F. gracillima*.

Frailea mammifera ssp. angelesiae R. Kiesling & Metzing: a synonym of *F. mammifera* Buining & Brederoo
As Kiesling and Metzing wrote (2005, 21: 17-18) "... a nice taxon was found by Angela Kiesling near Concordia (Entre Ríos, NW* Argentina). Comparisons with other species have shown that it is morphologically very similar to *Frailea mammifera* Buining & Brederoo, a species occurring near Don Pedrito, Rio Grande do Sul (Brazil)." To us, more than being similar it seems the same, since "The main difference is in the colour of the spination, which is reddish brown in the new taxon (*versus* yellow in *Frailea mammifera*)". The authors continue: "This *Frailea* has become common in cultivation and is often distributed with the provisional name 'Frailea angelesii'. In view of its disjunct distribution and distinctive characters, but also its overall similarity with *Frailea mammifera*, it should be classified as a subspecies rather than as species.

To make the name available for the use in the New Cactus Lexicon [Hunt et all 2006, text: 124], is described here at this rank". We find these arguments insufficient to justify the publication of a new taxon, for this reason we consider *Frailea mammifera* ssp. *angelesiae* R. Kiesling & Metzing an unnecessary synonym of *F. mammifera*.

----

*Entre Ríos is located in the northeast of Argentina.

Gymnocalycium

Notes towards a chorology of the populations of the genus *Gymnocalycium* Pfeiffer ex Mittler in the Chaco Biome

The Chaco Biome. *Gymnocalycium*: groups and populations in the Chaco region. Our synthesis

The Gran Chaco is a vast region with a clear ecological unit, which occupies approximately an area of about 1,000,000 square kilometers in the center of South America. It is located to the west of Rio Paraguay and to the east of the Andes, and consists mostly of floodplain sediment of 95% of which is divided between Argentina, Bolivia, Paraguay, with only 5% in Brazil. In Argentina (which owns 50%) the Chaco occurs in the provinces of Formosa, Chaco, Santa Fé, Santiago del Estero, Tucumán, Salta, Jujuy, Catamarca, La Rioja and Córdoba; in Paraguay it is in the Deptos. of Pte Hayes, Boquerón and Alto Paraguay; in Bolivia the Deptos. of Tarija, Chuquisaca and Santa Cruz; and in Brazil, the State of Mato Grosso do Sul. The region has a wide range of environments, with vast plains, sierras, large rivers that cross it, dry savannahs and floodplains, swamps, marshes and salt lakes, in addition to large and diverse forests. The climate is dry heat, with large temperature changes. In this region due to the heterogeneous water potential, the rainy season is limited to the summer. There are many phytogeographic areas in the Gran Chaco, as a result of the geographical vastness. The dominant vegetative structure is the xerophytic deciduous forests with multiple layers including canopy, sub-canopy, shrub layer and herbaceous layer. The ecosystem is appropriate for the spread of various genera of cacti, among

which *Gymnocalycium* Pfeiffer ex Mittler is widely present, albeit in a limited number of species, occupying the rocky slopes and the areas shaded by the bushes.

The *Gymnocalycium* species living in the Chaco all belong to 2 of the 5 seed groups, in which the genus is usually divided. In the *Microsemineum* group there are: *Gymnocalycium chacoense* Amerhauser, *Gymnocalycium chiquitanum* Cárdenas, *Gymnocalycium paediophilum* F. Ritter ex Schütz and *Gymnocalycium pflanzii* (Vaupel) Werdermann [including *Gymnocalycium pflanzii* ssp. *argentinense* H. Till & W. Till and *Gymnocalycium zegarrae* Cárdenas]. In the *Muscosemineum* group there are: *Gymnocalycium anisitsii* (K. Schumann) Britton & Rose [including *Gymnocalycium damsii* (K. Schumann) Britton & Rose], *Gymnocalycium megatae* Y. Itô [including *Gymnocalycium matoense* Buining & Brederoo], *Gymnocalycium marsoneri* Frič ex Y. Itô, *Gymnocalycium eurypleurum* Plesnik ex F. Ritter, *Gymnocalycium mihanovichii* (Frič ex Gürke) Britton & Rose, *Gymnocalycium stenopleurum* F. Ritter, *Gymnocalycium schickendantzii* (F. A. C. Weber) Britton & Rose [including *Gymnocalycium delaetii* (K. Schumann) Hosseus].

Gymnocalycium anisitsii (K. Schumann) Britton & Rose

Our idea of *Gymnocalycium anisitsii* (K. Schumann) Britton & Rose includes *Gymnocalycium damsii* (K. Schumann) Britton & Rose, already identified by Anderson (2001, 349; 2005; 2011). The fusion between the populations of the two taxa occurs in the transitional area between Puerto Casado, Puerto Risso (Paraguay) and Puerto Murtinho (Mato Grosso do Sul, BR). The taxon known as *Gymnocalycium damsii* ssp. *multiproliferum* P. J. Braun or *Gymnocalycium anisitsii* ssp. *multiproliferum* (P. J. Braun) P. J. Braun & Esteves is in our opinion a transitional form between *G. anisitsii* and *G. damsii* (A&M 267, photos 55-74). Conceived in this way, *G. anisitsii* is in the genus *Gymnocalycium*, the dominant species in the east of the Chaco Biome, in an area which stretches from the city of Concepción (Paraguay), through the Dept. of Concepción, Pte Hayes, Alto Paraguay in Paraguay and the State of Mato Grosso do Sul in Brazil, to the areas populated by the taxon of the Bolivian Chaco, in the Dept. of Santa Cruz in Bolivia, which includes the Serranias de Santiago and de Chiquitos and the Valle de Tucavaca, in the extreme tip of the Chaco, to the north. In this regard, as

a result of the surveys in habitat, we think that part of the populations of *G. anisitsii* are *Gymnocalycium pseudomalacocarpus* Backeberg (not valid published), a taxon attributed in recent literature to *Gymnocalycium marsoneri* Frič ex Y. Itô (Anderson 2001, 355), to *Gymnocalycium marsoneri* ssp. *matoense* (Buining & Bredenroo) P. J. Braun & Esteves (Hunt et al. 2006, text: 132; Anderson 2011), or to *Gymnocalycium marsoneri* ssp. *megatae* (Y. Itô) G. Charles (Charles 2009, 244-245, 287), and also *Gymnocalycium anisitsii* ssp. *holdii* Amerhauser, which Charles considered a synonym of *G. marsoneri* ssp. *megatae* (2009, 245, 289). As can be seen from the observation in the Valle di Tucavaca, Santa Cruz, BO, (A&M 704, photos 1-54), all of these forms, including the one known as *Gymnocalycium damsii* var. *rotundulum* Backeberg, live in the same population of *G. anisitsii*.

Gymnocalycium pflanzii (Vaupel) Werdermann

Gymnocalycium pflanzii (Vaupel) Werdermann includes *Gymnocalycium zegarrae* Cárdenas, as in Anderson (2001, 358) and *Gymnocalycium pflanzi*i ssp. *argentinense* H. Till & W. Till. The distinctive characters of the latter two taxa, compared to *G. pflanzii* are labile. The first is distinguished by the white pulp and the vertical splitting of the ripe fruit vs. red pulp and horizontal splitting in *G. pflanzii*, as well as a distribution further north (Charles 2009, 184.189). For ssp. *argentinense* it is really hard to find distinctions in habitat, and even Charles (ibid., 186) admits that the taxon is poorly differentiated and that it could be included in *G. pflanzii*. The major difference observed consists in the disjunct disitribution of the taxon, which is about 300 km away from other populations of *G. pflanzii*. As already noted (Anceschi & Magli 2013, 7: 38), the reason why the spatial continuity,which usually exists between the various populations that constitute a natural species, is broken may be different (populations that yet recognized, or that are extinct). However, the fact remains that the olomorphological characters of the two taxa are the same. The distinction of the fruit of *G. zegarrae* and *G. pflanzii* should be considered in the context of the natural variability that can distinguish some populations of a widespread species, such as *G. pflanzii*, in some of the discrete areas of its distribution. In addition, in classifications, any distinction based on a single character is to be considered artificial. Conceived in this way, *G. pflanzii* takes on the

characteristics of the dominant species of the genus *Gymnocalycium*, on the east end of the Chaco system. Populations are numerous and widespread from the provinces of Tucumán and Salta in Argentina, albeit with the mentioned void, to the Provinces of Tarija, Chuquisaca and Santa Cruz in Bolivia, going east to the Paraguayan Chaco in the Dept. Boquerón over the P. N. Tnte Enciso and Estancia La Patria. It is interesting to note that the taxon is adapted to living even in the Chaco's lowland, in the area bordering the first Andean sierra, such as in areas of the Cañon del Pilcomayo and in the Valle del Rio Grande.

Gymnocalycium megatae Y. Itô

At present the relationship between *Gymnocalycium megatae* Y. Itô and *Gymnocalycium marsoneri* Frič ex Y. Itô does not appears so evident to us. *G. megatae* is considered in Anderson (2001, 355) to be a synonym of *G. marsoneri,* in Hunt et al. (2006, text: 130) a synonym of *Gymnocalycium marsoneri* ssp. *matoense* (Buining & Brederoo) P. J. Braun & Esteves, and in Charles (2009, 241) subspecies of *G. marsoneri*. It is our opinion that *G. megatae* was probably a widespread species, which starting from the line Charagua-Boyuibe-Palos Blancos in the Bolivian Chaco, and crossing the Chaco Boreal (i.e. the Dptos of Boquerón and Alto Paraguay in Paraguay, where there are still populations of the taxon), it arrived in the area of Porto Murtinho, Mato Grosso do Sul (BR) where the Chaco becomes Pantanal. The taxon known as *Gymnocalycium matoense* Buining & Brederoo, which we could not to locate, and that is probably near extinction (Braun & Esteves, 2001, 63), was at the edge of the area, to the east of the populations of *G. megatae*. The photographic documentation available (ibid., 123; Charles 2009, 239-240) confirms that the two taxa are closely related. On the contrary, in addition to the distance of the distribution area, which by itself might be weak data [as in populations of *Gymnocalycium pflanzii* (Vaupel) Werdermann]; when not also supported by a real diversity between the taxa, in habitat the appearance *of G. megatae* (A&M 656, photos 1-21; A&M 664, photos 22-30) is completely different from *G. marsoneri* (A&M 509, photo 1-26). The first has acute, sharp, angular ribs (a character which unites it with *G. matoense*), the second has ribs that are divided into large rounded tubercles. The first has thin spines spreading from the stem, the second has large spines, wide at the

base, appressed on the stem surface. We do not understand where the idea that these two taxa are related came from. Concerning the distribution of *G. megatae*, we must stress that the taxon currently occupies a strip of land between the Charagua-Boyuibe-Palos Blancos line, in Bolivia, and the Mennonite colonies, in the Paraguayan Chaco. As highlighted in the comment on *Gymnocalycium anisitsii* (K. Schumann) Britton & Rose, the populations known as *Gymnocalycium pseudomalacocarpus* Backeberg and *Gymnocalycium anisitsii* ssp. *holdii* Amerhauser, attributed by Charles (2009, 244-245, 285) to *G. megatae,* are to be attributed to *G. anisitsii*.

Gymnocalycium marsoneri Frič ex Y. Itô

Among the tasks for future travels is a depth study of *Gymnocalycium marsoneri* Frič ex Y. Itô, we only know of the population at Campo Quijano (Salta, AR) at the moment. For the notes on the taxon please refer to *Gymnocalycium megatae* Y. Itô.

Gymnocalycium eurypleurum Plesnik ex F. Ritter

Gymnocalycium eurypleurum Plesnik ex F. Ritter is the least related to the other populations of the plains, among the Chaco *Gymnocalycium*. The heart of its distribution area is the P. N. Defensores del Chaco and adjacent areas in the north of the Depto Alto Paraguay (PY), reaching the border with Bolivia (Fortín Palmar de las Islas). In the area of the Cerro León, inside the park, we found the taxon only in the flat area of the deciduous forest (A&M 742, photos 1-21), where it lives in sympatry with *Gymnocalycium stenopleurum* F. Ritter, which is also located on the hills, together with *Gymnocalycium paediophilum* F. Ritter ex Schütz. From this area, down to the south west, some populations of the taxon can be found at the P. N. Medanos del Chaco (now joined to the P. N. Tnte Enciso), near the border with Bolivia. Here, in July 2007, we noted with surprise the presence of *G. eurypleurum*, living in sympatry with *Gymnocalycium megatae* Y. Itô.

Gymnocalycium stenopleurum F. Ritter

Gymnocalycium stenopleurum F. Ritter, is a taxon distributed between the Paraguayan protected areas of P. N. Defensores del Chaco and P. N. Tnte Enciso y Medanos del Chaco, in the north of Dptos Boquerón and Alto Paraguay, and in Bolivia along the line

Yapiroa (Rio Parapeti) - Mandeyapecua, Santa Cruz. The species is morphologically similar to *Gymnocalycium mihanovichii* (Frič ex Gurke) Britton & Rose with which it lives in sympatry in the far north area of the latter, but is distinguished by the rough vs. smooth epidermis (Charles 2009, 259).

Gymnocalycium mihanovichii (Frič ex Gürke) Britton & Rose

It is thought that the area of the populations of *Gymnocalycium mihanovichii* (Frič ex Gurke) Britton & Rose is vast. From the Provinces of Chaco, Formosa and part of Santiago del Estero (Kiesling 2005, 114), in the Argentinian Chaco Austral, it continues to the north after crossing the Rio Pilcomayo, to occupy a wide central band in the Depto Boquerón, and an area to the north west that extends into the Depto Alto Paraguay (where it meets with the populations of *Gymnocalycium stenopleurum* F. Ritter), in the Paraguayan Chaco Boreal. The extention of the occupied area might suggest *Gymnocalycium mihanovichii* (Frič ex Gurke) Britton & Rose is the dominant species of the genus *Gymnocalycium* in the central part of the Chaco Biome. In reality this hypothesis should be verified with surveys, especially in the southern part of the distribution. In fact, most of the surveys known are in Paraguay (see Ralph Martin's field numbers search), where the populations are widespread but the region is increasingly subject to the soils conversion to agricultural land (Charles 2009, 249). Even Charles (ibid.) reports the Chaco Austral in the distribution of the taxon, and mentions surveys in the province of Formosa in Argentina. Here, the surveys of the taxon really are few compared to to the vastness of the distribution area, and they are all concentrated in a vertical strip of land (50 x 175 km) between Castelli (Chaco) to the south, and the Pozo del Tigre - Estanislao del Campo (Formosa) line to the north (HU 1575, MAW 9/7, P 242, S 100, VOS 5-89, WP 97-272/585, data gathered from Ralph Martin's field numbers search). It is worth noting that on the same vertical axis, about 125 km north, the populations of the taxon begin in the Paraguayan land. Among our next objectives is the verification of the extension of *G. mihanovichii* between the provinces of Formosa, Chaco and Santiago del Estero in the Argentinian Chaco.

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

Gymnocalycium schickendantzii (F. A. C. Weber) Britton & Rose is the dominant species

of the genus *Gymnocalycium* Pfeiffer ex Mittler in the south of the Chaco Biome. Its range (all of it in Argentina) starts from the Province of Salta in the north, and finishes at the Provinces of San Luis, including a part in the far north east of Mendoza in the south. Its populations have colonized areas of neighbouring ecosystems as part of the Espinal region, between the provinces of Córdoba and San Luis to the extreme southwest of its range of expansion, and parts of the Monte region in the provinces of San Luis, Mendoza, San Juan and La Rioja, in the southwest. For this species, Charles (2009, 252-253), points out the genus's unusual tendency to live in flat or sandy areas, often in the shade of bushes, away from rocks and hills. Our idea of *G. schickendantzii* includes *Gymnocalycium delaetii* (K. Schumann) Hosseus, for us only populations in the northern range of the species. The differences brought to the distinction of the second taxon at the subspecies level (Hunt et al. 2006, text: 133; Charles 2009, 256), namely a flatter body and wider ribs divided into transverse furrows, are not so evident as to clearly distinguish the populations in habitat. As can be seen in the photographic material, even the type species can lead the distinctive characters of ssp. *delaeti* (A&M 402, photos 24-25; A&M 413, photos 30-33).

Gymnocalycium chiquitanum Cárdenas, *Gymnocalycium chacoense* Amerhauser, *Gymnocalycium paediophilum* F. Ritter ex Schütz. The *Microsemineum* group

"Ecologically, mountain ranges are like islands in the sky, and many of them support endemic species developed in isolation" (Benson 1983, 107). The Serrania of San José (668 m), is the homeland of *Gymnocalycium chiquitanum* Cárdenas, 150 km to the south is the Cerro San Miguel (839 m), homeland of *Gymnocalycium chacoense* Amerhauser, and 125 km to the southwest is the Cerro León (604 m), homeland of *Gymnocalycium paediophilum* F. Ritter ex Schütz, separated from each other by the plains of the Chaco Boreal, are an emblematic example of Benson's thought. In the panorama of species of the genus *Gymnocalycium* Pfeiffer ex Mittler, which populate the Chaco Biome, all belonging to the seed group *Muscosemineum*. These three species are the only ones, in addition to *Gymnocalycium pflanzii* (Vaupel) Werdermann, to belong to the group *Microsemineum*. It is worth noting that *G. pflanzii*, as already mentioned, is well adapted to living both the Chaco plain, and even in the steep-sided mountains with the deep

valleys of the region, which Charles called "Easten Andean Forest and Scrub" (2009, 25-27), and which we identify as an area in the first Andean sierra where the Monte region merges, to the south, with the Chaco system that comes from the west. The fact that members of the same seed group have similar territorial habits, might suggest a common ancestor, perhaps of Andean origin, although the diversity manifested in the form of growth of *G. paediophilum* is truly remarkable. In this regard, in contrast with Hunt et al. (2006, text: 128, 131) and in accordance with Charles (2009, 144, 180) we believe that *G. chacoense* and *G. paediophilum* are distinct from *G. chiquitanum*. In addition to the disjunction of the distribution area, *G. chacoense* differs (as attested by the experience and documentation of other researchers, being the only taxon in the Chaco *Gymnocalycium* that we have not directly studied) for the smaller flowers and the finer spination (ibid.: 144). *G. paediophilum* is distinct not only from *G. chiquitanum*, but for its particular growth form, from any other species of *Gymnocalycium* we have studied in habitat. The taxon in fact forms groups of small columns, <16 x 8 cm (h x ø) rather unusual for the genus (A&M 741, photos 1-32). The Cerro León consists of 40 square kilometers of hills, covered by xerophytic deciduous forest. Like all other researchers, we studied the taxon in the foothills, where the dirt roads end. In fact, no one has ever entered into the heart of the Cerro León, we know nothing about the number of the populations of *G. paediophilum*, or their conservation status, nor if there are other similar wonders to be discovered.

Gymnocalycium ochoterenae Backeberg: a synonym of *Gymnocalycium bodenbenderianum* (Hosseus ex A. Berger) A. W. Hill

Gymnocalycium bodenbenderianum (Hosseus ex A. Berger) A. W. Hill is a dominant species belonging to the seed group *Trichomosemineum* widespread in the provinces of Catamarca, Córdoba, La Rioja, San Juan and San Luis in Argentina. The phytogeographical region exists between the Monte region, the southern part of the Chaco, and the Espinal region to the extreme southwest of the range. Contrary to the latest literature (Anderson 2001, 349-350, 357-358; 2005; 2011; Hunt et al. 2006, text: 127, 131; Charles 2009, 209-217), we believe that the populations that make up the taxon known as *Gymnocalycium ochoterenae* Backeberg, are only the

southwestern extension of the range of *G. bodenbenderianum*. The ranges of the two taxa in fact overlap in the Cañada Larga (A&M 403, photos 01-21), a locality between Tuclame and Agua de Ramón, Córdoba (AR), as documented also by Charles (2009, 209, fig. 462, 215, fig. 482). We believe that the two taxa are distinct semaphoronts (Hennig 1966, 6-7, 33, 65), or in other words different growth phases, distinguishable within the ontogenesis process of the same taxon. As we highlight in the photographic documentation, the transition from the *bodenbenderianum* form (photos 01-09), to the *ochoterenae* form (photos 10-18) can be observed in the same population. Sometimes the two semaphoronts can be seen in individuals living side by side, manifesting themselves as growth phases of the same taxon (photos 13-21). It may also be noted that the semaphoront in the photos 19-21 (*G. ochoterenae* in juvenile phase) is the same as one of the intermediate phases (photo 06) in the group of the *bodenbenderianum* form (photos 01-09). Even the different attributions, made by specialists of the genus, such as *Gymnocalycium intertextum* Backeberg ex H. Till placed with *G. bodenbenderianum*, as *Gymnocalycium bodenbenderianum* ssp. *intertextum* (Backeberg ex H. Till) H. Till (Anderson 2001, 349-350; 2005; 2011), and then a synonym of *G. ochoterenae* (Hunt et al. 2006, text: 129; Charles 2009, 214-215), says enough about the fragility of the boundaries between these taxa. Under what has been shown, we consider it correct to add *G. ochoterenae* to the synonyms of *G. bodenbenderianum*.

Gymnocalycium buenekeri Swales: a good species, distinct from *Gymnocalycium horstii* Buining

Studies in habitat between 2006 and 2011 convinced us that, contrary to the conclusions of the recent literature (Hunt et al. 2006, text: 129; Charles 2009, 42-43), *Gymnocalycium buenekeri* Swales is not related to *Gymnocalycium horstii* Buining, and that, instead, the latter taxon is more closely related to *Gymnocalycium denudatum* (Link & Otto) Pfeiffer ex Mittler. There are two reasons: the first, and most important, is that in the populations of *G. buenekeri* studied in the area of São Francisco de Assis, the homeland of the taxon, all the individuals have a dull epidermis (A&M 781, photos 01-18; A&M 783, photos 19-45; A&M 785, photos 46-67). On the other hand, in the populations of *G. horstii*, in the area of Minas de Camaquã and Santana da

Boavista, all individuals show a glossy epidermis (A&M 797, photos 1-32), a character reminiscent of *G. denudatum* (A&M 84, photos 01-08; A&M 263, photos 09-17; A&M 788, photos 18-20; A&M 801, photos 21-27), with whom they sometimes share their habitat (Gerloff 1999). As in the case of *Gymnocalycium stenopleurum* F. Ritter and *Gymnocalycium mihanovichii* (Frič ex Gurke) Britton & Rose, where the two taxa, although morphologically very similar to each other, are distinguished by the diversity of the epidermis, rough in the first vs. smooth in the second, also in this case we believe that the distinctive characters shown in all the individuals of the two species, indicate that they come from distinct lineages. The second reason is that the distance between the distribution area of *G. buenekeri* and that of *G. horstii* is 200 km as the crow flies, where intermediate populations have not been detected. In the corresponding case mentioned, on the other hand, there are areas where *G. stenopleurum* and *G. mihanovichii* overlap, and where the two species live side by side (Charles 2009, 258-259, 258, fig 604), but despite this, based on the character of the different epidermis, they are defined as separate species. We are therefore faced with the same type of evidence, strengthened by the disjunction of the range. For these reasons we consider the taxon *G. buenekeri* from São Francisco de Assis distinct from *G. horstii*.

For the assessment on the conservation status of the two taxa see pp. 103-105.

Gymnocalycium valnicekianum Jajó: a synonym of *Gymnocalycium mostii* (Gürke) Britton & Rose

In agreement with Anderson (2001, 356), and Hunt et al. (2006, text: 135), and contrary to Charles and Meregalli (2008, 24: 25-27) and Charles (2009, 169-173), we consider the populations of *Gymnocalycium valnicekianum* Jajó to be the northwest extension of the dominant and variable *Gymnocalycium mostii* (Gürke) Britton & Rose. Even *Gymnocalycium prochazkianum* Sorma, not listed in Anderson (2001), considered still to be evaluated in Hunt et al. (2006, text: 132), and annexed to *Gymnocalycium mostii* ssp*. valnicekianum* (Jajó) Meregalli and Charles, by Charles and Meregalli (2008, 24: 25-27) and Charles (2009, 169), is in our opinion a synonym of *G. mosti*i. In fact, both taxa have just different forms of spination in respect to the type species: the *valnichekianum* form with more spines and the less spiny *prochazkianum* form, but in

both are recognizable the structure of the ribs and the tubercles of *G. mostii*. Instead, we believe that the populations which most stand out in the range of *G. mostii*, are those of *Gymnocalycium bicolor* Schütz (invalid name), in the area of Cruz del Eje. In fact, all individuals shows the distinctive character of the central and lower, dark and stouter radial spines, with respect to the clear upper radial; but even in this case all we are faced with is a variant of spination of the well-known structure of *G. mostii*. For these reasons we consider *G. valnicekianum* and *G. prochazkianum* synonyms of *G. mostii*.

Gymnocalycium castellanosii ssp. ferocius (H. Till & Amerhauser) G. Charles: just a variant in spination in the range of Gymnocalycium castellanosii Backeberg
Graham Charles (2005, 20: 17-18), anticipating the subsequent use in the New Cactus Lexicon (Hunt et al. 2006), published *Gymnocalycium castellanosii* ssp. *ferocior* (H. Till & Amerhauser) G. Charles, from which we quote the text:

14264 **Gymnocalycium castellanosii** ssp. **ferocior** (H. Till & Amerhauser) G. Charles **comb. nov. B**: 13959 *Gymnocalycium mostii* ssp. *ferocior* H. Till & Amerhauser, *Gymnocalycium* 15(1): 435 (2002). **T:** AR, Córdoba, Agua de Ramon, *H. Borth* s.n. (CORD). This transfer was suggested by Massimo Meregalli (pers. comm.). The taxon has the distinctive glossy seeds of *G. castellanosii* and occurs west of the *G. mostii* populations, on the border of Córdoba and La Rioja, nearer to the distribution of *G. castellanosii* ssp. *castellanosii*. Cultivated material certainly resembles *G. castellanosii* more than *G. mostii*.

Our surveys in the Cañada Larga, locality between Tuclame and Agua de Ramón, area of the discovery of *Gymnocalycium mostii* ssp. *ferocior* H. Till & Amerhauser, now *Gymnocalycium castellanosii* ssp. *ferocius* (H. Till & Amerhauser) G. Charles, and subsequent surveys of the taxon, showed the presence of populations of *Gymnocalycium castellanosii* Backeberg (A&M 405, photos 01-20), in all of the area involved. Even the form *ferocius* (photo 19-20) is identifiable among these, which appears to us to be only a population with a stronger and more regular spination, compared to other forms of the variable *G. castellanosii*. It is not surprising that the seeds of the form *ferocius* (photo 13) are similar to those of *G. castellanosii* (A&M 419, photo 103), whereas we

are faced with the same taxon, and that the two forms coexist in the same area; unlike *Gymnocalycium mostii* (Gürke) Britton & Rose, which is not present in the area. From the findings noted it appears that *G. castellanosii* ssp. *ferocius* has no relationship with *G. mostii,* but appears to be only a synonym of *G. castellanosii*.

Our position on *Gymnocalycium quehlianum* (F. Haage ex Quehl) Vaupel ex Hosseus and *Gymnocalycium stellatum* Spegazzini

From the findings in habitat we agree with Charles (2009, 223) on the fact that the names *Gymnocalycium quehlianum* (F. Haage ex Quehl) Vaupel ex Hosseus and *Gymnocalycium stellatum* Spegazzini represent the same populations of the genus *Gymnocalycium* Pfeiffer ex Mittler of the group *Trichomosemineum*, widespread in the province of Córdoba (AR). The descriptions and distribution areas overlap, and the differences are marginal. The oldest name is *G. quehlianum*, and should therefore be the name to use, as stated by Charles (2009, 218-223). But in the original description of the taxon, the seed type is not mentioned, and we must also consider an interpretation of Till and others, who in 1993 attributed the name *G. quehlianum* to a similar plant of the group of seed *Gymnocalycium*. This belief is reiterated by Till (2002, 15 (2): 441-444) when he says that *Gymnocalycium robustum* Kiesling, Ferrari & Metzing (Kiesling et al. 2002), belonging to the *Gymnocalycium* seed group, it is nothing more than a redescription of *G. quehlianum*. Despite the neo-typification of Metzing et al. (1999) to fix the application of *G. quehlianum*, it is a fact that the interpretation of Till exists, creating confusion. We would add that the function of the classification, even before classifying or identifying (Anceschi & Magli 2010, 14), is to order. For the above, in accordance with Hunt et al. (2006, text: 132, 134, 323) and Hunt (2008, 24: 27), we prefer to use for the populations of the group *Trichomosemineum* in question, the name *G. stellatum*, and to consider *G. quehlianum* a name which creates confusion, and therefore should be rejected.

***Gymnocalycium hyptiacanthum* (Lemaire) Britton & Rose, *Gymnocalycium netrelianum* (Monville) Britton & Rose and *Gymnocalycium uruguayense* (Arechavaleta) Britton & Rose: three distinct names for the same biological species**

To understand which name to assign to the populations of the dominant species in the genus *Gymnocalycium* Pfeiffer ex Mittler, spread over almost the whole territory of the Republic of Uruguay, and partially in neighbouring territories (Argentina: Corrientes and Entre Ríos, Brazil: Rio Grande do Sul), a short chronicle of the interpretation in the recent literature of the taxa involved is useful. In Anderson (2001, 354, 357, 363; 2005; 2011) *Gymnocalycium hyptiacanthum* (Lemaire) Britton & Rose, *Gymnocalycium netrelianum* (Monville) Britton & Rose and *Gymnocalycium uruguayense* (Arechavaleta) Britton & Rose, are considered distinct species. In Hunt et al. (2006, text: 129, 131, 135, 323) it is only *G. uruguayense* that remains, to identify the populations in question. *G. hyptiacanthum* was abandoned to be of controversial application, and the neo-typification of Kiesling (1999, 2: 444) rejected as contrary to ICBN Art 57.1. In turn *G. netrelianum* has been abandoned as being of uncertain application. In Cactaceae Systematics Initiatives (2008, 24: 21-25) about the taxa in question, Charles and Meregalli give a different opinion from the NCL. In summary, among the populations that occupy more or less discrete areas within the range of the species, there is a degree of recognisability, related to the differences in the characteristics of the spination. The neo-typification of *G. hyptiacanthum* made by Kiesling is considered correct, and the taxon has been reclassified into three subspecies: *hyptiacanthum*, *netrelianum* and *uruguayense*. The same approach is then reconfirmed by Charles (2009, 45-51). Here the Key to the subspecies of *G. hyptiacanthum* (Meregalli) as published on CSI 24: 22

<div align="center">Key to the subspecies of G. hyptiacanthum (Meregalli)</div>

1. Spines numerous, usually >11, thin, flexible, irregular, with distinctly red bases; ribs <15, small (S Uruguay)..ssp. **hyptiacanthum**
Spines usually <7, when more numerous completely yellow from the base..................**2**
2. Spines usually 3, seldom 5, strong, subtriangular, flower yellow, white or pink (Central and NW Uruguay)... ssp. ***uruguayense***
Spines yellow from base, usually 7-9, ocasionally 5 (W and SE Uruguay) ... ssp. ***netrelianum***

On page 24, Meregalli informs us about the variation and distribution of the ssp. of *G. hyptiacanthum*: "The population of G. *hyptiacanthum* from the eastern part of Uruguay

are here assigned to ssp. *netrelianum*. The plants differ from those of the typical subspecies mainly for the completely yellow-grey spines, lacking a red base. It is a relatively variable taxon, which in the southern part of its range merges progressively into ssp. *hyptiacanthum*, whereas towards north it is more similar to ssp. *uruguayense*. The attribution of the specimens from the central and northen part of the range to this subspecies is questionable: There is in fact a rather continuous clinal change between the plant with the typical traits of ssp. *netrelianum* and those of the subspecies ssp. *uruguayense*." And more: "At the border with Brasil, near Acegua, a very interesting form was found. It is here referred to ssp. *netrelianum*, mainly for yellow spines, although there are some differences, namely the sub-campanulate yellow flower. This subspecies intergrades with ssp. *hyptiacanthum* in the southernmost part of the range, and with ssp. *uruguayense* in the central-western part of the range...". From the words of the author, it would be plausible to taxonomically distinguish, populations that gradually merge into each other, and that are indistinguishable in many areas. Given that two subspecies probably to exist should benefit from a minimum of territorial autonomy, we think that in an idea of biological species, considered as a process and not as a static unit, composed of populations, themselves composed of individuals, variables and not by types, it is evident that populations which merge into one another are to be considered as belonging a single taxon or clade. It is difficult for us to think that there are populations distinguishable within a natural species, on the main evidence that the spines are more or less red at the base. In this regard, the photo illustrating *G. hyptiacanthum* ssp. *netrelianum* (Monville ex Labouret) Meregalli on CSI (2008.24: 23), taxon that should be recognized to have the spines completely yellow, shows a plant with reddish base of the spines. In any case, in the era of molecular analysis, we think that certain distinctions could involve more the collectors' world than that of the biology. Given that we are talking about a single taxon, what name should we identify it by? The right publication should be given to *Echinocactus hyptiacantus*, described in 1839 by Lemaire, but in an incomplete manner and without a precise geographical indication. The neo-typification by Kiesling (1999) has tried to fix the application of the name, at least in the interpretation made by some collectors and South American botanists (Meregalli 2010, 1: 4-5, 11, 17). But apart from Kiesling's interpretation, there

is also another by Papsch of 2011, which is deemed correct even by Charles (2009, 46). Papsch considers the Kiesling's neotype invalid, and suggests that *E. hyptiacanthum* can be referred to the species described as *Gymnocalycium schroederianum* Osten, registering a new neotype, and proposing *G. hyptiacanthum* = *G. schroederianum*. The latest interpretation of the name is by Till & Amerhauser (2010), who in turn reject the neo-typification of Kiesling, bringing back the idea that *G. hyptiacanthum* is linked to the species now known as *G. schroederianum*. As in the case of *Gymnocalycium quehlianum* (F. Haage ex Quehl) Vaupel ex Hosseus / *Gymnocalycium stellatum* Spegazzini, we think that the different interpretations are equally plausible, but this, and what it implies, creates confusion. Therefore, in agreement with Hunt et al. (2006, text: 129, 131, 135, 323), we prefer the use of the less controversial *G. uruguayense* to identify the populations in question, and we consider the names *G. hyptiacanthum* and *G. netrelianum,* and the homotypic related synonyms, controversial in their application.

Parodia

The holomorphology of the dominant *Parodia erinacea* (Haworth) N. P. Taylor also includes *Parodia turbinata* (Arechavaleta) Hofacker, but not *Parodia calvescens* (N. Gerloff & A. D. Nilson) Anceschi & Magli. *Parodia turbinata* sensu NCL a confused taxon

In the article "*Parodia turbinata* (Arechavaleta) Hofacker: a confused taxon" (Anceschi & Magli 2012, 6:26-33), we discuss the application of the name *P. turbinata*, showing that the taxon with basionym *Echinocactus sellowi* var. *turbinatus* Arechavaleta, is actually a synonym of *Parodia erinacea* (Haworth) N. P. Taylor, one of the dominant species of the genus *Parodia* Spegazzini. *Notocactus calvescens* N. Gerloff & A. D. Nilson, a taxon previously mistaken for a synonym of *P. turbinata* (Hunt 1999, 254; Hunt et al. 2006, 311, 359), instead shows olomorphological characters (ie morphological, physiological, ecological and chorological) distinct from *P. erinacea*, deserving full recognition at the species level. *P. turbinata* in the sense of the NCL (Hunt et al. 2006, text: 224, 311, 359; atlas: 308, tab. 308.5, 309, tab. 309.1) results in it being a confused

taxon, as it comprises two distinct lineages. See the article for more information. Below is a summary of the implications for the genus *Parodia*.

Parodia calvescens (N. Gerloff & A. D. Nilson) Anceschi & Magli. *Parodia turbinata* (Arechavaleta) Hofacker: a confused taxon.The Cactus Explorer 6:33 (2012). **Type:** BR, Rio Grande do Sul, N of Barra do Quaraí, AN 384 (JBPA 32.896, holo.).

Distribution of *Parodia calvescens*
AR (Corrientes), BR (Rio Grande do Sul)

Synonymy in *Parodia calvescens*
Notocactus calvescens
Wigginsia calvescens

Conservation status of *Parodia calvescens*
Endangered, EN B2ab(ii,iii,v)

Synonymy to be transferred to *Parodia erinacea*
Echinocactus sellowii var. *turbinatus*
Notocactus schaeferianus
Wigginsia schaeferiana
*Notocactus turbinatu*s
Parodia turbinata
Wigginsia turbinata

Names whose current application is debatable
Parodia turbinata sensu NCL

The misunderstood populations of *Parodia claviceps* (F. Ritter) F. H. Brandt living in the Province of Misiones (Argentina)
The article "Observations Concerning *Parodia* (*Eriocactus*)" (Anceschi & Magli 2013,

7:27-39), developed from Graham Charles's suggestion, goes into more detail about the previous comment on the distribution area of *Parodia claviceps* (F. Ritter) F. H. Brandt and *Parodia schumanniana* (K. Schumann) F. H. Brandt (Anceschi & Magli 2010, 24-26). Studies in habitat between 2005 and 2011, on the compared olomorphology of the two taxa, have shown that the populations of the genus *Parodia* Spegazzini, located in the northeast of Argentina in the Province of Misiones, in the Reserva Natural Osununú-Parque Provincial Teyú Cuaré, attributed by the previous literature (Nicolai 1893; Kiesling 1995; Anderson 2001; Hunt et al. 2006) to *P. schumanniana*, are in reality related to *P. claviceps*. This latter taxon has its widest distribution about 250 km to the south in the river basin of the Jacuí and Jaguarí rivers, Rio Grande do Sul (BR), and has the northwestern point of its range in Misiones. We emphasize therefore, that *P. schumanniana* is a endemic taxon of Paraguay, which has never crossed the great natural barrier formed by the Rio Paraná, whose populations further south (Acatí, Capilla Tuya, Verá) are located between 170 and 200 km from the river, and from Osununú-Teyú Cuaré. Moreover, contrary to the current opinion (Anderson 2001; Hunt et al. 2006), which treats *P. claviceps* as a ssp. as *P. schumanniana*, it should be noted that the taxon historically related to the latter is *Parodia nigrispina* (K. Schumann) F. H. Brandt, as reported by Gerloff et al. (1995, 142). The comparison of the olomorphological characters (ie morphological, physiological, ecological and chorological), in the two taxa confirmed this analysis. Regarding the distance separating the populations of Misiones from the core of *P. claviceps* in the Rio Grande do Sul, we propose two hypotheses. Firstly, as highlighted by Larocca (1998, 64), populations still unknown may exist, between the northwestern location of *P. claviceps* in the Municipality of Jaguarí (Rio Grande do Sul) and the site of Misiones, in areas that have still not really been explored such as the Serra do Pirapó and the Ijuí and Icamaquã river valleys. Secondly, in the 16.0-14.8 Ma, reported by Arakaki et al. (2011, 8380), of the probable beginning of the diversification of the clade *Notocacteae*, extinction in *P. claviceps* may have intervened, interrupting the spatial continuity that is generally observed between the different populations which constitute a natural species. See the article for more information. Below is a summary of the implications for the genus *Parodia*. Revised distribution of *Parodia claviceps* and *Parodia schumanniana* from the previous sources.

	Gerloff et al. (1995)	Anderson (2001)	Hunt (1999)	Anceschi & Magli (2010)
Parodia claviceps	BR (Rio Grande do Sul)	BR (Rio Grande do Sul)	BR	AR (Misiones), BR (Rio Grande do Sul)

	Gerloff et al. (1995)	Anderson (2001)	Hunt et al. (2006)	Anceschi & Magli (2010)
Parodia schumanniana	PY (Paraguarí, Guairá, Misiones?) Including *Notocactus ampliocostatus* and *Notocactus grossei*	AR (northeastern), PY	AR (Misiones), BR (Rio Grande do Sul)*, PY	PY (Paraguarí, Guairá)

* According with Hofacker (2000, 10:12) there are no populations of *P. schumanniana* in Brazil. For the update of the risk assessment on the conservation status of *Parodia nigrispina* compared to previous sources see pp. 105-106.

Is *Parodia mairanana* Cárdenas distinct from *Parodia comarapana* Cárdenas?

Among the NCL updates appears an article by Martin Lowry on the identity of *Parodia mairanana* Cárdenas (2012, 28: 26-27). Contrary to Anderson (2001, 540-541), and Hunt et al. (2006, text: 221, 309), the author separates *P. mairanana,* and its forms with yellow flowers (i.e. *Parodia neglecta* Brandt and *Parodia neglectoides* Brandt), from *Parodia comarapana* Cárdenas. The first taxon is distinguished by the shorter spines, curved, sometimes hooked, besides the less woolly areoles and the propensity to form groups compared to *P. comarapana* (with longer and straighter spines, woolly areoles and usually solitary body). Lowry also claims that the populations do not overlap, and that in nature are divided by the populations of a third taxon: *Parodia columnaris* Cárdenas. Recognising Lowry's arguments, we provisionally separate *P. mairanana*, and its forms, from *P. comarapana*. On the distribution of the two taxa we observe instead that the areas are not so distinct. *P. comarapana* lives not only around Comarapa, as claimed by Lowry (2012, 28: 26) but as is illustrated by our survey of 27 June 2007, between Samaipata and Mairana, Loc. Agua Clara (A&M 222, photos 01-05). Furthermore, we are near the type locality of *P. mairanana*: BO, Santa Cruz,

Florida, nr. Mairana, above Agua Clara, 1500 m (Hunt et al. 2006, text: 221). It is evident that the populations of *P. comarapana* and *P. mairanana* overlap, overcoming the "barrier" of the populations of *P. columnaris*. So, even if *P. mairanana* should deserve recognition at the species level like *P. comarapana*, we cannot indicate the geographic disjunction between the distinctive elements.

Parodia graessneri (K. Schumann) F. H. Brandt: a synonym of *Parodia haselbergii* (F. Haage ex Rümpler) F. H. Brandt

To clarify the relationships between the populations of *Parodia graessneri* (K. Schumann) F. H. Brandt and *Parodia haselbergii* (F. Haage ex Rümpler) F. H. Brandt is not easy to solve. Hunt et al. (2006, text: 220) still distinguish *P. graessneri* at the level of ssp. from the type species, for the colour of the flower: yellow-green in the first taxon vs. orange, bright red, rarely orange-yellow in the second. And mainly for the structure / habit of the tepals: half-erect, somewhat speading, but none closely surrounding style, with the stamens visible in *P. graessner*i, vs. internal tepals remaining erect, closely surrounding the style and hiding the stamens at first, with the outer tepals spreading in *P. haselbergii*. Anderson (2001, 543) highlights only the difference in the colouring of the flower, and a greater number of radial spines in *P. graessneri* (60 vs. 20), which also in this case is distinguished at the subspecies level. Backeberg (1977, 84-85), confirms that his genus *Brasilicactus* Backeberg, substantially constituted by *Brasilicactus graessneri* (K. Schumann) Backeberg and *Brasilicactus haselbergii* (F. Haage ex Rümpler) Backeberg ex Schoff, is distinguished from *Notocactus* (K. Schumann) Frič, and other South American globular cacti, by the short floral tubes and the small spiny spherical fruits. For the characters distinguishing the two species, he reports the colour of the flower, green for *B. graessneri*, vs. from flame-coloured with orange margins to scarlet, for *B. haselbergii*, but does not mention the different structure / habit of the tepals in the two species. With regard to the radial spines of *B. haselbergii*, Backeberg reports that they can be 20 or more. In our experience, the two taxa in habitat are quite similar. In Rio Grande do Sul (BR), the populations of *P. graessneri* appear to be the northwest continuation of the populations of *P. haselbergii*.

Furthermore, while it is certainly noticeable, as shown in Hunt et al., that there is a diversity in the structure / habit of the tepals, we also know from the recent molecular analysis (Nyeffer and Eggli, 2010; Schlumpberger & Renner, 2012, 1347-1348), that the characters of the flowers and the different pollination syndromes, are not indicators of proximity or distance of two evolutionary lines. In this regard, the growth forms of the two taxa are practically indistinguishable. In addition, we observed that in all populations, indifferently, individuals that have greater exposure to the sun develop a greater number of radial spines (A&M 820, photos 03-13; A&M 255, photos 52-57) compared to those that are living in the shadow of rocks and bushes (A&M 820, photos 27-29, 41-44; A&M 255, photos 58-59). The greater or lesser shielding of the taxon seems to be a protection from the sun, rather than the low temperatures reached in the cold sub-tropical climate of the Serra Gaucha (Mata Atlantica Biome). As pointed out, it seems coherent to include *P. graessneri* in the synonymy of *P. haselbergii*.

Echinocactus orthacanthus Link & Otto: an ill-typified name

The taxon identified by Van Vliet (1970), as *Notocactus orthacanthus* (Link & Otto) Van Vliet (basionym *Echinocactus orthacanthus* Link & Otto), is in our opinion an infra-populational form of *Parodia mammulosa* (Lemaire) N. P. Taylor. Since the publication of *E. orthacanthus* was in 1827, i.e. earlier than *Echinocactus mammulosus* Lemaire (1838), one of the most famous and dominant species of the genus *Parodia* Spegazzini, should change its name. This idea had already been advanced by Hofacker at the time of the publication of *Parodia othacantha* (Link & Otto) Hofacker (2009, 54 (9): 225). Hunt (2005, 20: 22-23) has however pointed out that in the absence of preserved material as holotype in the original protologue of *E. orthacanthus*, the accompanying illustration must serve as lectotype; and after having designated it (ibid.: 23), he emphasizes the precedence over the neo-typification made by Van Vliet. Now, the drawing in question (1827, 3: 427, tab. 18, indicated as "Melocactus orthacanthus"), shows a very difficult plant to identify, and since the origin is "Montevideo", it could therefore represent a *Notocactus* (K. Schumann) Frič, the attribution of Van Vliet appears speculative. In accordance with Hunt, we believe that *E. orthacanthus* should be considered an ill-typified name, and should be rejected.

***Parodia maldonadensis* (Herter) Hofacker: a new name for the plant populations known as *Parodia neoarechavaletae* (Elsner ex Havliček) D. R. Hunt**

In the article "Some notes on *Wigginsia corynodes*", Andreas Hofacker (2012, 4: 26-34) discusses some errors in the work of Albesiano and Kiesling (2009), concerning the rehabilitation of *Wigginsia* D. M. Porter as a genus distinct from *Parodia* Spegazzini. One of the major implications for the genus *Parodia,* in the dissertation by Hofacker, consists of the observation, already highlighted by Albesiano and Kiesling, that *Notocactus neoarechavaletae* Havliček, under ICBN Art 52.1, and *Parodia neoarechavaletae* (Elsner ex Havliček) D. R. Hunt, are incorrect under ICBN Art. 11.4 because the oldest name available at the same rank to indicate the taxon in question is *Echinocactus maldonadensis* Herter. To fill the void in *Parodia*, Hofacker (2012, 4:32) publishes *Parodia maldonadensis* (Herter) Hofacker, designating a neotype: Heinz Ruoff 107 (FRP). In accordance with the Hofacker's reason we accept *P. maldonadensis*.

A new delimitation for the concept of *Parodia oxycostata* (Buining & Brederoo) Hofacker

The characters that distinguish *Parodia oxycostata* (Buining & Brederoo) Hofacker, from all other members of the group of *Parodia ottonis* (Lehemann) N. P. Taylor, in the description of *Notocactus oxycostatus* Buining & Brederoo (1972, 50-51), are a low number of ribs (6-7) with acute angles; i.e. very sharp, wide at the base (35-40 mm) and deep (20-22 mm). Without these precise characteristics, simple to identify, *P. oxycostata* cannot be recognized. On the contrary, as described in the last literature (Hunt 1999, 251; Anderson 2001, 550; 2005; 2011; Hunt et al. 2006, text: 222, 310; atlas: 314, tabs. 314.1, 314.2, 314.3), *P. oxycostata* appears to be a taxon with nebulous boundaries and is poorly understood. The boundaries that should divide some populations of the taxon conceived are easily labile (the ssp. *gracilis*), from the variable and dominant *P. ottonis*. The most tangible example of this confusion is the images that illustrate the taxon in the New Cactus Lexicon (Hunt et al. 2006, atlas: 314, tabs. 314.1, 314.2, 314.3). If we compare the two photos illustrating *P. ottonis* (ibid.: 313, tabs. 313.3, 313.4), with Fig. 314.3 *Parodia oxycostata* ssp. *gracilis*, we note that these three plants, in habitat, could be part of the same natural population (see A&M 764, photo 63). All carry at

least 11 ribs, and none of them show the sharp and deep rib of *P. oxycostata*. Also Fig. 314.1 *Parodia oxycostata* ssp. *oxycostata* (*P. nothominuscula*), is nothing more than one of the possible variants forms of *P. ottonis*, so much so that the ribs show exact opposite characteristics from what is required by the description of *P. oxycostata*. The taxon is finally illustrated in fig 314.2, *Parodia oxycostata* ssp. *oxycostata*: a specimen with few ribs (8), sharp and deep. The confusion arose from the idea of expanding the concept of one species, which is infrequently encountered in habitat, and whose populations (or groups) are composed of a small number of individuals, spreading over a relatively large portion of territory. This expanded concept now includes in *P. oxycostata*, groups of taxa with quite heterogeneous characters, the most part published by Ritter in Kakteen in Südamerika (1979, 1). They are: *Notocactus glaucinus* Ritter, *Notocactus glaucinus* var. *gracilis* Ritter, *Notocactus glaucinus* var. *depressus* Ritter (ibid.: 168-169, 309, figs. 107, 108, 310, fig. 109), *Notocactus securituberculatus* Ritter, *Notocactus securituberculatus* var. *miniatispinus* Ritter (ibid.: 169, 310, figs. 110, 111), *Notocactus acutus* Ritter (ibid.: 169-170, 355, fig. 235), this taxon has been added as a synonym of *P. oxycostata* only in Hunt et al. (2006, text: 310), but previously considered a synonym of *P. ottonis* (Hunt 1999, 97, 251; Anderson 2001, 549, 744; 2005; 2011), *Notocactus harmonianus* Ritter (Ritter 1979, 1: 176-177, 318, fig. 118) and finally *Notocactus campestrensis* Ritter (ibid.: 177, 312, fig. 119). The taxa in question, as just pointed out, are mutual bearers of rather heterogeneous characters. Ranging in fact from *N. glaucinus* with 9-12 ribs, straight, in triangular section, 1-2 cm high, up to *N. harmonianus* with 15 ribs, obtuse, 5-7 mm high. Probably this confused idea on the definition of the taxon was born with Hofacker's publication (1998, 6: 12) of one of the Ritter's taxa (*N. glaucinus* var. *gracilis*), as a subspecies of *P. oxycostata*, with the name *Parodia oxycostata* ssp. *gracilis* (F. Ritter) Hofacker. Now if *N. glaucinus* has little to do with *P. oxycostata*, except the height of the ribs, its var. *gracilis* has even less. Ritter tells us only that the overall body is smaller, and that the ribs are lower and less deeply dentate (Ritter 1979, 1: 168-169), therefore even further from the characteristics of *P. oxycostata*. All the taxa mentioned show less sharp ribs, and in greater numbers than in the description of *N. oxycostatus*, or rather, all except one. The only taxon that seems to be seriously morphologically related to *P. oxycostata* is

N. acutus, curiously the only one which initially, and for some still today, is considered a synonym of *P. ottonis*. The description of *N. acutus*, seems to be a natural extension of the description, maybe too restrictive, of *N. oxycostatus*. The ribs are in fact acute at the apex and sharp, as shown in the photo of the taxon in Ritter (1979, 1: 355, fig. 235), and the number of ribs goes from 6-7, 3,5-4 cm wide (in *P. oxycostata*), to 7-9, 3 cm wide (in *N. acutus*). We believe that the concept of *P. oxycostata* (for having a distinctive meaning, within the *P. ottonis* populations, and at the same time being close to the description of *N. oxycostatus*) could at most include *N. acutus*, the only taxon that seems to be really conspecific. This is a concept already highlighted by Mace (1975, 55), and by Gerloff et al. (1995, 64), even if the latter also included in *N. oxycostatus* the forms of *N. securituberculatus*. We believe that all the other taxa assigned by the recent literature to *P. oxycostata*, should be attributed to the dominant and variable *P. ottonis*, which can have 6-15 or more ribs, indifferently rounded or acute.

The northern populations of *Parodia scopa* (Sprengel) N. P. Taylor. *Parodia rudibuenekeri* (W. R. Abraham) Hofacker & P. J. Braun and *Parodia succinea* (F. Ritter) N. P. Taylor, only populations, not taxonomically distinct in the range of the taxon

Parodia scopa (Sprengel) N. P. Taylor is a taxon with numerous and variable populations, but with a rather fragmented distribution. In contrast, the other dominant species of the genus *Parodia* Spegazzini of the Pampa Biome, i.e. *Parodia erinacea* (Haworth) N. P. Taylor as we conceived (Anceschi & Magli 2012, 26-33), *Parodia mammulosa* (Lemaire) N. P. Taylor and *Parodia ottonis* (Lehmann) N. P. Taylor (whose populations we also refer to in the note on *Parodia oxycostata* (Buining & Bederoo) Hofacker), in addition to populations numerous and variable in shape, manifest a certain spatial continuity. On the diversity in the spination of the various populations of *P. scopa*, and on the substantial uniformity of forms of growth, we have already expressed our position in the study on the *marchesii* populations living in Uruguay, in the quebradas of the Depto of Trenta y Trés (Anceschi & Magli 2010, 28; A&M 294, photos 10-25). A similar situation occurs in Brazil, in the northern part of the range of *P. scopa*. Among the rocky outcrops (serras and coxilhas) of the Pampa Biome, in the centre-south of the Rio Grande do

Sul, below the BR 290, which bisects the state from east to west. Even here, several populations of *P. scopa* occupy the territory distinguishing themselves essentially only by their spination. In fact, as we will see, in the case of *Parodia rudibuenekeri* (W. R. Abraham) Hofacker & P. J. Braun, forms and distribution areas are not so distinct. To the southwest of São Gabriel populations of *Parodia succinea* (F. Ritter) N. P. Taylor are living (A&M 787, photos 26-58), which quietly can be assimilated by the forms with clear spines of *P. scopa*. In fact, all the characters of the first taxon are included, or merged, with those of the second. In addition, the form of growth is typical of the taxon (A&M 55, photos 01-05; A&M 294, photos 10-25; A&M 787, photos 26-58; A&M 79, photos 59-83; A&M 793, photos 84-104). But while *P. succinea* is considered, in the latter literature, to be a subspecies of *P. scopa* (Hunt 1999, 253; Anderson 2001, 552-553; 2005; 2011; Hunt et al. 2006, text: 223), in contrast *Parodia rudibuenekeri* (W. R. Abraham) Hofacker & P. J. Braun was recognized at the rank of species (Hunt 1999, 252; Anderson 2001, 551; 2005; 2011; Hunt et al. 2006, text: 223). Reto Nyffeler in "Further referrals of 'limbo' species" in CCC 1 (1997, 4: 9), had already correctly identified *Notocactus rudibuenekeri* W. R. Abraham as a synonym of *P. scopa*. Then in "Nomenclatural adjustments in *Parodia*" Hofacker & Braun (1998, 6: 10) published *P. rudibuenekeri*, which is the text in full:

Parodia rudibuenekeri (Abraham) Hofacker & P. J. Braun **comb. nov. Basionym:** *Notocactus rudibuenekeri* Abraham, Succulenta 67 (6): 133-138 (1988). Comment: *P. rudibuenekeri* and *P. scopa* grow about 1 km apart at Pedra do Segredo (Brazil: Rio Grande do Sul). It is to be expected that there are points of contact. There are differences in various markings such as spination and flower. No hybrids or intermediates are known. Seed-grown plants always show the distinctive markings of their parents [A.H.].

The two taxa live really very close, in the area of Caçapava do Sul, Rio Grande do Sul (BR). Precisely on the rocky outcrops of sandstone conglomerates of the formation Pedra do Segredo. On one of these, the Pedra da Abelha, lives the population of *P. rudibuenekeri*; while on the surrounding outcrops, including the nearby Pedra do Segredo (about 1.5 km as the crow flies), are living populations of *P. scopa*. The

character that distinguishes the *rudibuenekeri* population from the *scopa* populations*,* is basically the colour of the spines: completely white for the first, with the centrals red-orange for the other. Given the morphological and spatial proximity of the two taxa and, as also Hofacker does not exclude, between the two populations there are points of contact, which we prefer to define as melting points. During the last surveys in the area (2011), we found, in discrete areas of the habitat, populations where there are the two forms. At the Pedra do Leão, another of the outcrops of the formation, in the same population (A&M 79, photos 50-74) coexist: Individuals with 4 central spines variegated in reddish yellow, and all radial white (photos 50-53), individuals with all white spines (photos 59-61), individuals with central spines orange-red and white radials (photos 62-65), and groups where individuals with completely white spines and others with red orange centrals (photo 69-70) co-exist side by side. It should be noted that even among the individuals of the Pedra da Abelha (*rudibuenekeri* population), can be observed central spines variegated in reddish yellow (A&M 793, photo 94), as between those of Pedra do Leão (photo 52). As pointed out for *P. succinea*, also *P. rudibuenekeri* shows the typical growth form of the stems of *P. scopa*. Regarding Hofacker's assertion "Seed-grown plants always show the distinctive markings of their parents", we emphasize that phyletic distinctions on such similar taxa, based on morphological features of a few pot-grown plants, are likely to bring us back to a typological, and not biological, concept of species. Following the foregoing, as the populations of *marchesii* from Uruguay, also *P. succinea* and *P. rudibuenekeri* are to be considered populations, with clear spines, not taxonomically distinguishable in the range of *P. scopa*. We recall that the other taxon connected by the recent literature (Hunt 1999, 253; Anderson 2001, 552-553; 2005; 2011; Hunt et al. 2006, text: 223) to *P. scopa*, always following a Hofacker's proposal (1998, 6: 10), namely *Parodia scopa* ssp*. neobuenekeri* (F. Ritter) Hofacker & P. J. Braun, is instead the only one that clearly shows that it does not belong to this phyletic line, i.e. because of the distinct form of growth. Smaller stems and more compact with each other, forming large groups (A&M 261, photo 1-14; A&M 796, photo 15-28). For this reason, we recognize it at the species level in the genus *Parodia* Spegazzini, *Parodia neobuenekeri* (F. Ritter) Anceschi & Magli (Anceschi & Magli 2010, 33), the taxon living between Minas de Camaquã and Santana da Boavista.

Opuntia

***Opuntia retrorsa* Spegazzini and *Opuntia discolor* Britton & Rose: the two taxa for the creeping *Opuntia* of the Chaco region**

In 1999, Kiesling (1999, 2: 423-489), assimilated *Opuntia kiska-loro* Spegazzini, *Opuntia retrors*a Spegazzini and *Opuntia utkilio* Spegazzini, as varieties of *Opuntia anacantha* Spegazzini, and *Opuntia canina* Spegazzini as a synonym of the latter. Kiesling's idea is accepted in Anderson (2001, 486; 2005; 2011) and in Hunt et al. (2006, text: 197, 199). A few years later, Hunt and other experts in *Opuntia* Mill (2008, 23: 18-27), wondered how *O. anacantha*, whose description indicated a spineless plant, included all the other taxa, which instead are provided.

For Hunt the implications for NCL (Hunt et al. 2006) are as follows:

a) For the moment it is better to abandon *O. anacantha*

b) *O. retrorsa* is probably not closely related to *O. anacantha* or *O. canina*

c) (ibid., atlas: 490, fig. 490.1) the creeping plant with flat stem segments, with retrorse spines, and orange flower is not *O. anacantha,* but *O. canina*, as indicated in brackets in the text, and originally submitted by Leuenberger.

d) (ibid., atlas: 490, fig. 490.2) the creeping plant with flat stem segments, with no retrorse spines, and unknown flower: if the flower were yellow it could be *O. retrorsa* or *O. utkilio* [and not *O. anacantha*]

e) (ibid., atlas: 490, fig. 490.3) as the plant is erect and the flower is orange-yellow, it looks more like *Opuntia elata* Link & Otto ex Salm-Dyck or *Opuntia vitelliniflora* (F. Ritter) P. J. Braun & Esteves [and not *O. anacantha*]

f) Reintroduced as a provisionally accepted species,*Opuntia discolor* Britton & Rose, is a taxon accepted in Anderson (2001, 495; 2005; 2011), referred to *O. anacantha* in Hunt et al. (2006 text: 201), in addition to the reintroduction of *O. retrorsa*.

g) *O. utkilio* is close to *O. anacantha* / *O. canina*, rather than to *O. retrorsa* for having the flowers yellowish-orange instead of yellow [!].

In 2011, we spent some months studying in the Chaco, between the western part in Argentina (Cordoba, Salta) and Bolivia (Tarija, west of Santa Cruz), the north-eastern part in Bolivia (east of Santa Cruz) and Paraguay (Concepción, Alto Paraguay). These

surveys are in addition to those conducted in 2007 and 2008 in the central part of the Biome, respectively in Paraguay (Boquerón) and Argentina (Formosa). There are rather widespread populations of creeping *Opuntia* in the Chaco ecosystem*,* related from our point of view to one, or at most two, taxa (which probably merge in some zones of the distribution area). The dominant species is a very variable taxon, which includes at morphological level a variety of the names published by Spegazzini. The one which identifies with it the most, with the due elasticity, is *O. retrorsa*, considering *O. utkilio* as synonym thereof. With an expanded range of characters, to include the two taxa, we arrive to an acceptable approximation of reality. In dominant species, so widespread and variable, distinctions based on the colours of the flowers, by now seem to us mostly useful to the collector's world. From the latest molecular analysis we know that the characters of the flowers, and the different pollination syndromes, are highly labile and not indicators of the proximity or remoteness of two lineages (Nyffeler & Eggli, 2010; Schlumpberger & Renner, 2012, 1347-1348). Furthermore, as already reported when discussing the identification characters of the species (Anceschi & Magli 2010, 17), we do not understand why (and we consider correctly) if the colour of the flower is not able to distinguish different populations olomorphologically similar in the genus *Parodia* Spegazzini, should instead prove the diversity in the *Opuntia* populations. In habitat, *O. retrorsa* shows a great variability, highlighted within the same population, on individuals living a few meters from each other and sometimes even on the same specimen, characters that should distinguish different taxa. The habit can be: either creeping or semi erect (A&M 735, photos 48-50, 53), that erect (A&M 735, photos 55-56); with branch segments either flattened (A&M 376, photos 08-09; A&M 485, photo 20), or cylindrical (A&M 376, photo 10; A&M 485, photo 20); with the spines sometimes retrorse (A&M 376, photo 08), sometimes erect (A&M 376, photos 03-07, 09-11), either retrorse or erect on the same branch segment (A&M 735, photo 52), rather than with erect spines (A&M 485, photo 20), or without spines (A&M 485, photos 23-25); with evident spots (A&M 485, photo 25), more or less evident (A&M 485, photo 24), or not spotted (A&M 485, photos 20-21). In this panorama of extreme variability *O. retrorsa* also includes *O. canina*, as in Ritter (1980, 2: 496) and *O. vitelliniflora* (ibid.: 498, 738 Fig. 345). In the Chaco region, the other taxon, consisting of populations of creeping

Opuntia and somehow distinguishable from *O. retrorsa,* is *O. discolor*. We accept this taxon in the awareness that the distinctions are due to practical and classification reasons. We assume that the populations of *O. discolor* are distinguished by having the stems divided into smaller branch segments, more cylindrical, more turgid, and more spiny (with erect spines) but, in accordance with Ritter (ibid.: 497), we think that the two taxa hybridize with each other in habitat, and that in some populations the characters of the two taxa have merged. The clearest example of this is given by the survey we conducted in 2011 in Bolivia, Santa Cruz, in the Tucavaca Valley, in the far north east of the Chaco Biome. This population (A&M 706, photos 33-47) shows the habit of *O. discolor* (tight and turgid segments, often not flattened), with some typical characters of *O. retrorsa*, such as the size of the fruit, which instead of being small as required by the description of *O. discolor*, is equal to those of the population of *O. retrorsa* found in Argentina, Córdoba, at the Rio Quilpo (A&M 376, photos 01-11). The fruits are 2.1 x 1.1 cm (h x ø) for the first and 2 x 1.3 cm (h x ø) for the second. Furthermore, the size of the branch segments of the population of Tucavaca: 5.5-10.9 cm x 1.9-3.1 cm (width x length), with a minimum thickness of 4.5 mm, joined with those of the Rio Quilpo population, which are 11 x 4-5 cm. The specimens of the Tucavaca population often show retrorse spines (photos 34, 37, 43, 45-47) as in *O. retrorsa*; and sometimes on stems side by side, we find either wide and flattened, or cylindrical and turgid segments (photo 42) and so on. We attributed the Tucavaca population to *O. retrorsa*, although some characters are those that would identify *O. discolor*. In turn, the populations of *O. discolor* are confined geographically and morphologically with those of *Opuntia pubescens* H. L. Wendland ex Pfeiffer, in the provinces of Santa Cruz and Chuquisaca in Bolivia (see also Taylor 2008, 23: 24-25). If it were proved that there were mergers between the two populations, *O. pubescens* could be an older name for *O. discolor*. We excluded *O. anacantha* from our conception of *O. retrorsa*, for the reasons expressed by Hunt, even if specimens without spines have been found. Regarding *O. kiska-loro* we never encountered populations that showed fruits of 5 cm in length, the distinctive character of the taxon. We do not know if, and how much, the latter might be related to *O. retrorsa*.

Pilosocereus

Some notes about the inclusion of *Cipocereus* F. Ritter in *Pilosocereus* Byles & G. D. Rowley in cactusinhabitat.org 2010

In 2010, on the basis of the studies conducted in habitat, in accordance with the opinion of some researchers (Braun in Hunt & Taylor 1990, 8: 99; Braun & Esteves, 2001, 3: 104-106, 160-162), and contrary to others (Taylor in Hunt & Taylor 1990, 8: 98-99; Taylor & Zappi 2004, 282-290), we considered it appropriate to include *Cipocereus* F. Ritter in *Pilosocereus* Byles & G. D. Rowley (Anceschi & Magli 2010, 18, 31, 33). We will add some notes to expand, conscious that soon *Cipocereus* [with the exception of *Cipocereus pusilliflorus* (F. Ritter) Zappi & N. P. Taylor] will probably be annexed to *Cereus* P. Miller, due to new molecular evidence (Machado et al., 2006). The conception of a genus *Cipocereus* distinct from *Pilosocereus* (Anderson 2001, 151-152; Hunt et al. 2006, text: 42-43) is based on studies by Taylor and Zappi (1989, 13-40; 2004, 282-290), but nothing adds to the distinctions highlighted by Taylor in 1990 (Hunt & Taylor 1990, 8: 98-99). The latter had synthesized the reasons for the separation of the taxa like this: "The autopomorphy which defines *Cipocereus* and distinguishes it from both *Pilosocereus* and *Cereus*, is indehiscent fruits with colourless, watery pulp. The latter genera have fruits with white or coloured pulp, which are dehiscent (indehiscent in some *Cereus* spp.). *Cipocereus* is further distingushed from *Cereus* by its small seeds." (ibid.: 99). On the same page instead, Braun pointed out that: "... for me it seems difficult to regard fruit differences sufficient to delimit genera... indehiscent fruit are not common in *Pilosocereus*, but you can find them. Conversely, I have also found dehiscent fruits in *Cipocereus minensis*. Colourless pulp also occurs in some *Pilosocereus* spp." (Braun in Hunt & Taylor 1990, 8: 99). So for Taylor the distinction between the two taxa exists in the fact that *Cipocereus* show "Indehiscent fruits with colourless, watery pulp". Besides Braun's denials, the recent molecular evidence tells us of the lability of the floral characters and pollination syndromes to define genera (Nyffeler & Eggli, 2010; Schlumpberger & Renner, 2012, 1347-1348), and we suppose that the fruits would not have had greater success if tracked beside molecular analysis. If, even with differences of this type, it is already questionable to distinguish species

and subspecies, as in the case of *Gymnocalycium zegarrae* Cárdenas / *Gymnocalycium pflanzii* (Vaupel) Werdermann, which some keep separated due to the white pulp and the vertical splitting of the ripe fruit for the first vs. red pulp and horizontal splitting for the second (Charles 2009, 184, 189), using them to distinguish genera seems artificial. In addition, results confirming the preliminary gene sequence studies employing the chloroplast gene segment rpl16 (Soffiatti umpubl.) cited by Taylor and Zappi (2004, 283), and reiterated in Hunt et al. (2006, text: 43), to support the monophyly of *Cipocereus* and its basal position within the Brazilian "*Cereeae*", have never seen the light. This is confirmed by a passage of the study on the anatomy of the stem in *Cipocereus* by Patricia Soffiatti with Veronica Angyalossy (2005, 26 (3): 299-308): "The genus is characterized by the occurrence of bluish indehiscent, ovoid to globose fruits with translucent pulp (Taylor 2000). The small amount of mucilage in the succulent tissues and high woodiness suggest a basal position of *Cipocereus* within *Cereeae* (Taylor e Zappi 1989); however, the position of the genus in the tribe is still uncertain, as shown by cladistic analysis based on morphological characters (Taylor e Zappi 1989)". Reaffirming that in the cladistic study mentioned nothing is added with respect to what is already known, which is thus summarized by the authors: "... *Cipocereus* is defined by indehiscent fruits with colourless, watery pulp and should not be sunk in *Pilosocereus*" (ibid: 13), from the passage of Soffiatti, it is clear that molecular evidence that provides substantial results confirming the monophyly of *Cipocereus* has never existed. So much so that recent molecular analysis, which includes the rpl16 among the markers, shows that *Cipocereus* is close to *Cereus* (Machado et al., 2006). Therefore the only distinction (if real), is the one based on the character of the fruit. Under what has been seen, we confirm the current inclusion of *Cipocereus* in *Pilosocereus*, waiting for the results of any future molecular analysis, for the inclusion of *Cipocereus* in *Cereus*.

Rebutia

Rebutia einsteinii Frič ex Kreuzinger & Buining: a synonym of *Rebutia pygmaea* (R. E. Fries) Britton & Rose

Rebutia pygmaea (R. E. Fries) Britton & Rose is a dominant species of the genus

Rebutia K. Schumann, whose populations, highly variable in growth forms and floral characters, range from the far north west provinces of Argentina (Salta and Jujuy), to the Andean departments of southern Bolivia (Potosi, Tarija, Oruro, Chuquisaca). The taxon occupies part of the Puna eco-region, consisting of high altitude grasslands with rocky outcrops, at an altitude between 3200 and 3500 meters. Also in the *R. pygmaea* range, live the populations of *Rebutia einsteinii* Frič ex Kreuzinger & Buining, another highly variable taxon of the genus. The variability of *R. einsteinii* is so clear, that Mats Hjertson in his last paper on the subject (2003, 15: 9-10), subdivides the taxon into three subspecies (*R. einsteinii* ssp. *einsteinii*, *Rebutia einsteinii* ssp. *aureiflora* (Boedeker) Hjertson, *R. einsteinii* ssp. *gonjianii* (Kiesling) Hjertson). In Argentina, populations of the two taxa are living sympatrically in several areas (Quebrada de Humahuaca, Iturbe-Iruya, Cuesta de Lipan, Ronqui Angosto, La Quiaca, etc). In some populations the characters of the two taxa merge, as for example in the area of Iturbe, where probable natural hybrids have been detected between *R. pygmaea* and *R. einsteinii* var. *gonjianii* (Kiesling) Donald as, for example, MN 171a (Mats Winberg, e-mail 24 Dec 2010). The doubts that the two species may be really distinct increase further if we consider that the first recording of *R. einsteinii* appeared in the protologue of E. Fries (Fries 871) right between the syntypes of *Echinopsis pygmaea* R. E. Fries (Hjertson 1994, 43: 455-457; Hjertson 2003, 15: 9-10). From Hjertson's article on the identity of *E. pygmaea* (1994, 43: 455-457) we learn that Fries (1905) had already (and we think correctly) interpreted *R. einsteinii* as a form of *E. pygmaea*, also including a form with relatively short spines of *R. einsteinii* [R. E. Fries 871 (Argentina, Prov. Salta, Nevado de Chañi; spirit]. in the latter. Hjertson believes that Fries mistakenly included Fries 871 in the protologue of *E. pygmaea*. The support of this theory emphasizes that on the label of Fries 871 the flower is indicated as bright yellow, a colour not listed in the original description. Contrary to Hjertson, we think that Fries was conscious of the inclusion of Fries 871 in the protologue of *E. pygmaea*, also because by Hjertson own admission the original description of *E. pygmaea* is based on "two" taxa. Therefore the vegetative characters are those of Fries 871, while the floral characters are closer to the other two syntypes (i.e. Fries 999 and Kurtz 11426). Considering the extreme variability and similarity between the two taxa (see also Hunt et al. 2006, altras: 262-

263), in addition to considerating the populations' overlaps in habitat, with probable merging points, we prefer to return *R. pygmaea* to the original conception, and consider *R. einsteinii,* and related subspecies, synonyms of the taxon thus conceived.

Rebutia robustispina F. Ritter a distinct taxon from Rebutia kupperiana Boedeker

In Anderson (2001, 607), *Rebutia robustispina* F. Ritter and *Rebutia kupperiana* Boedeker, are considered synonyms of *Rebutia pseudodeminuta* Backeberg. In Hunt et al. (2006, text: 250-251, 314; atlas: 364, figs: 364.4, 364.5, 364.6) *R. pseudodeminuta*, *R. kupperiana* and *R. robustispina* are considered synonyms of *Rebutia deminuta* ssp. *kupperiana* (Boedeker) Hjertson. According to Ritter (1980, 2: 611-613, 786 fig 532, 790, figs 541, 542) it is our opinion that *R. robustispina* is a taxon distinct from *R. kupperiana*.

Tunilla

Tunilla D. Hunt & Iliff: a genus probably constituted of only two species in habitat

The creation of the genus *Tunilla*, Hunt & Iliff (2000, 9: 8-12) was made up of 12 species of Andean opuntias of small dimensions, distinguishable from other opuntias substantially by the different structure of the pollen: tectate in *Tunilla*, reticulated in *Opuntia* P. Miller (Kiesling 1984; Hunt & Iliff 2000, 9: 8; Kiesling & Ferrari 2005, 29; Hunt et al. 2006, text: 273). They also reported a few distinctions in the fruit and in the seed (Hunt & Iliff 2000, 9: 8; Anderson 2001, 663; Hunt et al. 2006, text: 273). In Anderson (2001, 663-665) the number of the recognized species passes to 9, and in Hunt et al. (2006, text: 273-274) it is reduced to 5 (*Tunilla corrugata* (Salm-Dyck) D. R. Hunt & Iliff, *Tunilla erectoclada* (Backeberg) D. R. Hunt & Iliff, *Tunilla microdisca* (F. A. C. Weber) D. R. Hunt & Iliff, *Tunilla soehrensii* (Britton & Rose) D. R. Hunt & Iliff, and *Tunilla tilcarensis* (Backeberg) D. R. Hunt & Iliff). According to Kiesling & Ferrari (2005, 29), we found that in habitat the boundaries between species of the genus are not so well defined, and that there are not many species. More precisely, the boundaries are not so defined between *T. corrugata* and *T. microdisca*, as on the other hand, are those between *T. soehrensii* and *T. tilcarensis*. In Argentina, in an area between the provinces

of Tucumán and Catamarca, populations with the characters of *T. corrugata*, i.e. fragile body, ellipsoid segments, bright green colour, white spines directed downwards, etc.. (Hualfin, A&M 448, photos 01-06; Quilmes, A&M 464, photos 07-14), merge with others, which are joined to the previous characters, the flatter and more discoid segments of *T. microdisca* (between the Observatorio and Infernillo, A&M 476, photos 15-16). In the province of Salta, populations with the characters of *T. soehrensii*, i.e. flattened segments, inequilateral or crescent-shaped, sometimes tuberculate, with straight and spreading spines (Cachi Adentro, A&M 499, photos 01-15), show fruits that split either horizontally, or vertically on the umbilicus (ibid. photos 12-13), a character, this latter, that in Hunt et al. (2006, text: 274) is indicated as distinctive of *T. tilcarensis*. Following what has been shown, and as already in Anderson (2001, 663-665), we find it correct to include *T. microdisca* in the synonyms of *T. corrugata*, and *T. tilcarensis* in those of *T. soehrensii*. Regarding the two taxa we have to date detected in the genus *Tunilla*, we add that in some parts of the area occupied by the two species, merging points seem to exist. We do not know how, and if, *T. erectoclada* is related to the previous taxa.

Weingartia

Our position on *Weingartia* Werdermann as distinct from *Rebutia* K. Schumann confirmed from the latest molecular research.

Contrary to Anderson (2001, 599) and Hunt et al. (2006, text: 245; Atlas: X), in 2010 (Anceschi & Magli 2010, 18) we accepted *Weingartia* Werdermann as being a distinct genus from *Rebutia* K. Schumann. Our position is confirmed by Nyffeler & Eggli (2010), who in turn distinguished *Weingartia* (including *Cintia* Knize & Riha and *Sulcorebutia* Backeberg) from *Rebutia*, on the basis of the latest molecular research (Lendel & al. 2006; Ritz et al. 2007; Lendel et al. umpubl. data; Nyffeler & al. umpubl. data). We recall that in the latest edition of Das Grosse Kakteen-Lexicon (Anderson 2011), Eggli reproposes the idea of *Cintia*, *Sulcorebutia* and *Weingartia* as separate genera.

***Weingartia cintiensis* Cárdenas is not taxonomically distinct from *Weingartia fidana* (Backeberg) Werdermann**

In the comment on *Weingartia fidana* (Backeberg) Werdermann we considered the hypothesis that *Weingartia cintiensis* Cárdenas was only a synonym for the first taxon (cactusinhabitat.org 2010). Subsequent studies in the habitats of the two taxa convinced us that they actually form a single biological species, which is shown in the occupied areas a normal progression of the populations and of the variability of the individuals. The morphological distinctions reported from the latest literature to keep the taxon separate as two subspecies (Anderson 2001, 602; Hunt et al. 2006, text: 248), indicate 3-4 central spines and 9-14 radial for the ssp. *fidana* (data not specified in Hunt et al.), vs. 13-14 spines, indistinct between radial and central, for the ssp. *cintiensis* (but 5-10 in Augustin & Hentzschel 2002). Such differences are insignificant in distinguishing populations of a natural species, whose distribution starts from the province of Jujuy, in the far north Argentina, while they occupy several contiguous areas of the Depts. of Potosi, Chuquisaca and Tarija, in southern Bolivia. It could instead affirm that, in the far northwest distribution area (Tarija and Chuquisaca), some populations of *W. cintiensis* show forms of growth where the stems form extended groups (A&M 567, photos 48-49; A&M 572, photos 51, 54-55), <92 cm in length, compared to the populations of the zone of Tupiza, although showing within itself individuals poorly differentiated compared to those living in the south of the distribution area. Compare, A&M 567, photos 23, 30, 37-38, 40 (San Pedro, Chuquisaca) with A&M 189, picture 6-9, 18 (Tupiza, Potosi). In relation to what has been shown, we add *W. cintiensis* to the synonyms of *W. fidana*.

----

* All the photos mentioned are available on cactushabitat.org

04. Notes on classification

Taxa treated as synonyms in cactusinhabitat.org compared to NCL (II)

With the current publication the taxa evaluated in habitat at the specific level has risen to 292, of which we recognize 252 as good species (see pp. 93-102), i.e. + 101 compared to the previous booklet (Anceschi & Magli 2010, 20). While the number of species that we consider among the synonyms of the accepted taxa rises to 40, i.e. + 30 (ibid.), compared to the total of taxa (species and heterotypic subspecies) recognized by the ICSG (Hunt et al. 2006, text: 5; 2007, 22: 11-18; 2008, 23: 4-29; 2008, 24: 5-40; 2011, 25: 7-29; 2012, 26: 12-20; 2012, 27: 16-23; 2012, 28: 16-28).

Cereus kroenleinii = Cereus phatnospermus
Cereus lamprospermus = Cereus stenogonus
Cleistocactus hyalacathus ssp. *tarijensis = Echinopsis nothohyalacantha*
Echinopsis rhodotricha ssp. *chacoana = Echinopsis rhodotricha*
Echinopsis aurea ssp. *fallax = Echinopsis aurea*
Echinopsis thionantha ssp. *ferrarii = Echinopsis thionantha*
Echinopsis thionantha ssp. *glauca = Echinopsis thionantha*
Echinopsis huascha ssp. *robusta = Echinopsis huascha*
Echinopsis aurea ssp. shaferi = Echinopsis aurea
Echinopsis bridgesii ssp. vallegrandensis = Echinopsis bridgesii
Echinopsis walteri = Echinopsis schickendantzii
Frailea mammifera ssp. *angelesiae = Frailea mammifera*
Frailea horstii = Frailea gracillima
Gymnocalycium pflanzii ssp. *argentinense = Gymnocalycium pflanzii*
Gymnocalycium anisitsii ssp. *damsii = Gymnocalycium anisitsii*
Gymnocalycium schickendantzii ssp. *delaetii = Gymnocalycium schickendantzii*
Gymnocalycium castellanosii ssp. *ferocius = Gymnocalycium castellanosii*
Gymnocalycium marsoneri ssp. *matoense = Gymnocalycium megatae*

Gymnocalycium ochoterenae = Gymnocalycium bodenbenderianum

Gymnocalycium pflanzii ssp*. zegarrae = Gymnocalycium pflanzii*

Parodia oxycostata ssp*. gracilis = Parodia oxycostata*

Parodia haselbergii ssp. graessneri = Parodia haselbergii

Parodia rudibuenekeri = Parodia scopa

Parodia scopa ssp*. succinea = Parodia scopa*

Rebutia einsteinii ssp*. aureiflora = Rebutia pygmaea*

Rebutia einsteinii = Rebutia pygmaea

Rebutia einsteinii ssp. *gonjianii= Rebutia pygmaea*

Tunilla microdisca = Tunilla corrugata

Tunilla tilcarensis = Tunilla soehrensii

Weingartia cintiensis = Weingartia fidana

Taxa treated as good species in cactusinhabitat.org compared to NCL

Among the 251 taxa we accepted in this publication at the specific level, 6 are considered synonyms by the ICSG (Hunt et al. 2006). Here is the list of taxa rehabilitated as good species.

Gymnocalycium chacoense ≠ Gymnocalycium chiquitanum

Gymnocalycium paediophilum ≠ Gymnocalycium chiquitanum

Gymnocalycium megatae ≠ Gymnocalycium marsoneri

Opuntia prasina ≠ Opuntia elata

Parodia (Notocactus) calvescens ≠ Parodia turbinata

Rebutia robustispina ≠ Rebutia deminuta ssp. *kupperiana*

05. Accepted taxa

List of accepted taxa of Cactaceae in cactusinhabitat.org in the publications 2010 and 2013. The taxa currently accepted are printed in **bold italic**.

Genus	species	pubblication year
Armatocereus	*matucanensis*	2010
Arrojadoa	*penicillata*	2010
Austrocylindropuntia	*exaltata*	2010
Austrocylindropuntia	*shaferi*	2013
Austrocylindropuntia	*verschaffeltii*	2010
Austrocylindropuntia	*vestita*	2010
Brasilicereus	*markgrafii*	2010
Brasiliopuntia	*brasiliensis*	2013
Browningia	*candelaris*	2010
Castellanosia	*caineana*	2010
Cereus	*aethiops*	2010
Cereus	*euchlorus*	2013
Cereus	*forbesii*	2013
Cereus	hankeanus	2010
Cereus	*hildmannianus*	2010
Cereus	*lanosus*	2013
Cereus	*phatnospermus*	2013
Cereus	*saxicola*	2013
Cereus	*spegazzinii*	2010
Cereus	*stenogonus*	2010
Cleistocactus	baumannii	2010
Cleistocactus	buchtienii	2010

Cleistocactus	*hyalacanthus*	2010
Cleistocactus	*parviflorus*	2010
Cleistocactus	*santacruzensis*	2010
Coleocephalocereus	**aureus**	2010
Coleocephalocereus	**purpureus**	2010
Copiapoa	**cinerascens**	2010
Copiapoa	**cinerea**	2010
Copiapoa	**columna-alba**	2010
Copiapoa	**grandiflora**	2010
Copiapoa	**taltalensis**	2010
Corryocactus	**brevistylus**	2010
Corryocactus	**erectus**	2010
Corryocactus	**melanotrichus**	2010
Corryocactus	**tarijensis**	2013
Cumulopuntia	**boliviana**	2010
Cumulopuntia	**chichensis**	2013
Cumulopuntia	**echinacea**	2010
Cumulopuntia	**rossiana**	2013
Cumulopuntia	**sphaerica**	2010
Cylindropuntia	**tunicata**	2013
Denmoza	*rhodacantha*	2010
Discocactus	**boliviensis**	2013
Discocactus	**ferricola**	2013
Discocactus	**hartmannii**	2010
Discocactus	**horstii**	2010
Discocactus	**placentiformis**	2010
Echinopsis	**albispinosa**	2013
Echinopsis	**ancistrophora**	2013

Echinopsis	*angelesiae*	2010
Echinopsis	*aurea*	2010
Echinopsis	*balansae*	2013
Echinopsis	*baumannii*	2013
Echinopsis	*bertramiana*	2013
Echinopsis	*bridgesii*	2013
Echinopsis	*bruchii*	2010
Echinopsis	*buchtienii*	2013
Echinopsis	*calochlora*	2013
Echinopsis	*camarguensis*	2013
Echinopsis	*candelilla*	2013
Echinopsis	*candicans*	2010
Echinopsis	*caulescens*	2013
Echinopsis	*celsiana*	2013
Echinopsis	*chrysantha*	2010
Echinopsis	*chrysochete*	2013
Echinopsis	fallax	2010
Echinopsis	*ferox*	2010
Echinopsis	*formosa*	2010
Echinopsis	*guentheri*	2013
Echinopsis	*haematantha*	2013
Echinopsis	*hempeliana*	2013
Echinopsis	*horstii*	2013
Echinopsis	*huascha*	2013
Echinopsis	*kieslingii*	2013
Echinopsis	*korethroides*	2010
Echinopsis	*lateritia*	2013
Echinopsis	*leucantha*	2010

Echinopsis	*leucotricha*	2013
Echinopsis	*mamillosa*	2013
Echinopsis	*mirabilis*	2013
Echinopsis	*nothochilensis*	2013
Echinopsis	*nothohyalacantha*	2013
Echinopsis	*nothostrausii*	2013
Echinopsis	*obrepanda*	2013
Echinopsis	*oxygona*	2010
Echinopsis	*parviflora*	2013
Echinopsis	*pasacana*	2010
Echinopsis	*platinospina*	2013
Echinopsis	*pomanensis*	2013
Echinopsis	*pugionacantha*	2013
Echinopsis	*quadratiumbonata*	2013
Echinopsis	*randallii*	2013
Echinopsis	*rhodacantha*	2013
Echinopsis	*rhodotricha*	2013
Echinopsis	*rojasii*	2010
Echinopsis	*samaipatana*	2013
Echinopsis	*santacruzensis*	2013
Echinopsis	*schickendantzii*	2013
Echinopsis	*spiniflora*	2010
Echinopsis	*stilowiana*	2013
Echinopsis	*strigosa*	2013
Echinopsis	*tacaquirensis*	2010
Echinopsis	*tarijensis*	2010
Echinopsis	*terscheckii*	2010
Echinopsis	*tetracantha*	2013

Echinopsis	*thelegona*	2013
Echinopsis	*thionantha*	2010
Echinopsis	*tominensis*	2013
Echinopsis	*trollii*	2013
Echinopsis	*weberbaueri*	2013
Echinopsis	*werdermanniana*	2013
Eriosyce	*bulbocalyx*	2010
Eriosyce	*strausiana*	2010
Eriosyce	*umadeave*	2010
Eulychnia	*iquiquensis*	2010
Frailea	*cataphracta*	2013
Frailea	*chiquitana*	2013
Frailea	*concepcionensis*	2013
Frailea	*fulviseta*	2013
Frailea	*gracillima*	2010
Frailea	*horstii*	2010
Frailea	*mammifera*	2013
Frailea	*phaeodisca*	2010
Frailea	*pumila*	2010
Frailea	*pygmaea*	2010
Frailea	*schilinzkyana*	2010
Gymnocalycium	*anisitsii*	2013
Gymnocalycium	*baldianum*	2010
Gymnocalycium	*bodenbenderianum*	2013
Gymnocalycium	*buenekeri*	2013
Gymnocalycium	*capillaense*	2013
Gymnocalycium	*cardenasianum*	2013
Gymnocalycium	*castellanosii*	2013

Gymnocalycium	*chiquitanum*	2013
Gymnocalycium	*denudatum*	2010
Gymnocalycium	*eurypleurum*	2013
Gymnocalycium	*ferrarii*	2013
Gymnocalycium	*glaucum*	2013
Gymnocalycium	*horstii*	2013
Gymnocalycium	*marsoneri*	2013
Gymnocalycium	*megatae*	2013
Gymnocalycium	*mihanovichii*	2010
Gymnocalycium	*monvillei*	2010
Gymnocalycium	*mostii*	2013
Gymnocalycium	*nigriareolatum*	2010
Gymnocalycium	*paediophilum*	2013
Gymnocalycium	*paraguayense*	2010
Gymnocalycium	*pflanzii*	2010
Gymnocalycium	*pugionacanthum*	2013
Gymnocalycium	*rhodantherum*	2013
Gymnocalycium	*robustum*	2013
Gymnocalycium	*saglionis*	2010
Gymnocalycium	*schickendantzii*	2013
Gymnocalycium	*spegazzinii*	2010
Gymnocalycium	*stellatum*	2010
Gymnocalycium	*stenopleurum*	2010
Gymnocalycium	*uruguayense*	2010
Gymnocalycium	*zegarrae*	2010
Haageocereus	*chilensis*	2010
Haageocereus	*platinospinus*	2010
Harrisia	*tetracantha*	2010

Hylocereus	*setaceus*	2013
Lepismium	*cruciforme*	2013
Lepismium	*lumbricoides*	2013
Maihuenia	*patagonica*	2010
Maihuenia	*poeppigii*	2010
Maihueniopsis	*glomerata*	2010
Melocactus	*amethystinus*	2010
Melocactus	*ernestii*	2010
Micranthocereus	*auriazureus*	2010
Micranthocereus	*violaciflorus*	2010
Neoraimondia	*arequipensis*	2010
Neoraimondia	*herzogiana*	2010
Opuntia	*aurantiaca*	2013
Opuntia	*discolor*	2010
Opuntia	*elata*	2010
Opuntia	*ficus-indica*	2013
Opuntia	*prasina*	2013
Opuntia	*quimilo*	2013
Opuntia	*retrorsa*	2010
Opuntia	*salmiana*	2013
Opuntia	*schickendantzii*	2013
Opuntia	*stenarthra*	2013
Opuntia	*sulphurea*	2013
Oreocereus	*celsianus*	2010
Oreocereus	*hempelianus*	2010
Oreocereus	*leucotrichus*	2010
Oreocereus	*trollii*	2010
Parodia	*alacriportana*	2013

Parodia	**allosiphon**	2013
Parodia	**arnostiana**	2013
Parodia	**aureicentra**	2013
Parodia	**buiningii**	2010
Parodia	**calvescens**	2013
Parodia	**carambeiensis**	2010
Parodia	**chrysacanthion**	2010
Parodia	**claviceps**	2010
Parodia	**columnaris**	2013
Parodia	**comarapana**	2010
Parodia	**commutans**	2013
Parodia	**concinna**	2013
Parodia	**crassigibba**	2010
Parodia	**erinacea**	2010
Parodia	**fusca**	2013
Parodia	**haselbergii**	2010
Parodia	**herteri**	2010
Parodia	**horrida**	2010
Parodia	**horstii**	2010
Parodia	**langsdorfii**	2010
Parodia	**lenninghausii**	2010
Parodia	**linkii**	2010
Parodia	**maassii**	2010
Parodia	**magnifica**	2010
Parodia	**maldonadensis**	2013
Parodia	**mammulosa**	2010
Parodia	**microsperma**	2010
Parodia	**mueller-melchersii**	2010

Parodia	*muricata*	2013
Parodia	neoarechavaletae	2010
Parodia	*neobuenekeri*	2010
Parodia	*neohorstii*	2010
Parodia	*nigrispina*	2010
Parodia	*nivosa*	2010
Parodia	*nothorauschii*	2013
Parodia	*otaviana*	2013
Parodia	*ottonis*	2010
Parodia	*oxycostata*	2013
Parodia	*penicillata*	2010
Parodia	*rechensis*	2013
Parodia	*ritteri*	2013
Parodia	*schumanniana*	2010
Parodia	*scopa*	2010
Parodia	*stockingeri*	2013
Parodia	*stuemeri*	2010
Parodia	*subterranea*	2013
Parodia	*tenuicylindrica*	2013
Parodia	turbinata	2010
Parodia	*warasii*	2010
Parodia	*werdermanniana*	2010
Pfeiffera	*ianthothele*	2013
Pilosocereus	*aurisetus*	2010
Pilosocereus	*crassisepalus*	2010
Pilosocereus	*fulvilanatus*	2010
Pilosocereus	*jauruensis*	2013
Pilosocereus	*laniflorus*	2010

Pilosocereus	*magnificus*	2010
Pilosocereus	*minensis*	2010
Pilosocereus	*pachycladus*	2010
Pterocactus	*tuberosus*	2010
Quiabentia	*verticillata*	2010
Rebutia	*deminuta*	2013
Rebutia	*fabrisii*	2013
Rebutia	*fiebrigii*	2013
Rebutia	*minuscula*	2010
Rebutia	*pygmaea*	2010
Rebutia	*robustispina*	2013
Rhipsalis	*shaferi*	2013
Stetsonia	*coryne*	2010
Tacinga	*inamoena*	2010
Tephrocactus	*alexanderi*	2010
Tephrocactus	*articulatus*	2010
Tephrocactus	*molinensis*	2010
Tephrocactus	*weberi*	2010
Tunilla	*corrugata*	2013
Tunilla	*soehrensii*	2013
Uebelmannia	*gummifera*	2010
Uebelmannia	*horrida*	2010
Uebelmannia	*meninensis*	2010
Uebelmannia	*pectinifera*	2010
Weberbauerocereus	*weberbaueri*	2010
Weingartia	*fidana*	2010

06. Updates and comments on the conservation status of taxa

Discocactus hartmannii (K. Schumann) Britton & Rose (part II)

Following what we had already investigated in Paraguay in 2008 for *Discocactus hartmannii* (K. Schumann) Britton & Rose (Anceschi & Magli 2010, 39) in August 2011, we conducted surveys in the Pantanal area, between the Depto Santa Cruz in Bolivia and the State of Mato Grosso do Sul in Brazil, on a group of taxa of the genus *Discocactus* Pfeiffer. In the far south west of Mato Grosso do Sul, in the area between Bela Vista, Caracol and Porto Murtinho, we found *D. hartmannii*, a taxon that we had already documented in the area of Capiibary, in the extreme southeast of the Depto. San Pedro (PY). As found in Paraguay, even here, for the ever-increasing land conversion into agricultural use, the populations have been fragmented into groups of few individuals, surviving only in bands of land left as dividers between one cultivated field and another. It is evident that this fragmentation and the reduction in the number of individuals cause local extinctions, with the consequent reduction of the genetic variability. Having surveyed, in 2008, only the Paraguayan habitat of the species, we have been cautious in assessing the degree of risk, passing from Least Concern, LC (Hunt et al. 2006, text: 326) to Data Deficient, DD (Anceschi & Magli 2010, 39). Experiencing later the serious Brazilian situation, and in accordance with a previous evaluation by Braun & Esteves which assigned Critically Endangered, CR (2001, 3: 60-61), to populations included in the current concept of *D. hartmannii* (*D. hartmannii* ssp. *giganteus*, *D. magnimammus*, *D. magnimammus* ssp. *bonitoensis*, *D. mamillosus*, *D. patulifolius*), we prefer to update our evaluation as: Critically Endangered, CR B2ab(ii,iii,iv,v).

Gymnocalycium buenekeri Swales

In October 2011, we were dedicated to the study of *Gymnocalycium buenekeri* Swales (for the relationship of this taxon with *Gymnocalycium horstii* Buining see pp. 64-65). The surveys conducted in the district of São Francisco de Assis led us to identify three

small populations, two of which are unknown in the literature. It is painful to note that in many places known for being reported by a Field Number, the taxon no longer exists. All populations are living in sandy soil, among sandstone outcrops, on private grazing land properties. The populations all comprise a small number of individuals (6-7); two of these (A&M 783, A&M 785), are constituted mostly by large specimens of <46 x 63 cm (A&M 785, photos 46-56), while the third (A&M 781) is composed of younger individuals, mostly of single heads. The plants were ready for an abundant flowering, and despite the fact that the small populations seem to be in good health, the species appears to be limited in the number of populations and individuals. Following what we highlighted, we prefer to update the assessment of the conservation status of the taxon as follows:

Braun, P. J. & Esteves Pereira, E. (2001): Vulnerable, VU

Hunt et al. (2006): Endangered, EN-D

Charles, G. (2009): Critically Endangered, CR

Anceschi & Magli (2013): Critically Endangered, CR B2ab(ii,iv,v)

We thank the Prefeitura of São Francisco de Assis for their help and for their commitment to safeguarding the taxon.

Gymnocalycium horstii Buining

At the end of October 2011 in the area of Guaritas- Minas de Camaquã-Santana da Boavista we studied some populations of *Gymnocalycium horstii* Buining, a species that is increasingly more difficult to observe in habitat. The taxon is morphologically very similar to *Gymnocalycium buenekeri* Swales but, for us, not so closely related to the previous one as some believe (see pp. 64-65). *G. horstii* lives mainly on rocks in grassland, usually in the shade of bushes in grazing land. Conditions are similar to those of *Gymnocalycium denudatum* (Link & Otto) Pfeiffer ex Mittler. According to the testimony of residents and farmers of the zone, it seems that the scarcity of individuals, rather than the soil conversion into agricultural land, may be attributed to theft by collectors, which has persisted over the years. During the recent surveys (following those of 2008), we found two groups of the taxon in the area of Santana da Boavista.

The first consists of a few individuals with single heads of modest dimensions in a zone already recognized in the literature; the second, a new small population, composed also of large specimens: <71 cm in width, with the major stem of 8.2 x 15 cm (h x ø) (A&M 797, photos 16-18). Given the scarcity of the populations in habitat, we find it appropriate to update the assessment of the conservation status as follows:

Braun, P. J. & Esteves Pereira, E. (2001): Vulnerable, VU

Hunt et al. (2006): Data Deficient, DD

Anceschi & Magli (2013): Critically Endangered, CR B2ab(ii,iv,v)

Parodia calvescens (N. Gerloff & A. D. Nilson) Anceschi & Magli

In the article "*Parodia turbinata* (Arechavaleta) Hofacker: a confused taxon" (Anceschi & Magli 2012, 6: 26-33), see also pp. 70-71, we assessed the conservation status of *Parodia calvescens* (N. Gerloff & A. D. Nilson) Anceschi & Magli as follows:

Endangered, EN B2ab(ii,iii,v)

Parodia nigrispina (K. Schumann) F. H. Brandt

In the article "Observations concerning *Parodia* (*Eriocactus*)" Anceschi & Magli 2013, 7: 27-39), see also pp. 71-73, confirming our previous assessment on the conservation status of *Parodia nigrispina* (K. Schumann) F. H. Brandt (Anceschi & Magli 2010, 40), we have updated the information related to the conservation of the taxon in habitat as follows:

Metzing D. (1994): Endangered, EN

Hunt et al. (2006): Vulnerable, VU D2

Anceschi & Magli (2010): Critically Endangered, CR B1ab(iii,v)+2ab(iii,v);C2a(i)

"In September 2011, we once again visited the distribution area of *P. nigrispina* in the distribution zone between Piribebuy, Caacupé, Tobatí and Atyrá. While in Piribebuy (Esser 1982, 60) the taxon is extinct, in Tobatí, in the same zone we monitored between 2007 and 2008, we recorded small but encouraging improvement. The population has increased from 7 to 15 plants. The population that was difficult to access near the Cerro Tobatí has also shown a slight increase compared to the 2008 survey (from 20

to 25 individuals approximately). At the market in Asunción we saw specimens of *P. nigrispina* and *Discocactus hartmannii* (K. Schumann) Britton & Rose on sale piled in a basket. The two taxon are almost extinct in Paraguay" (Anceschi & Magli 2013, 7: 38)

Parodia oxycostata (Buining & Brederoo) Hofacker

The surveys conducted in habitats between 2005 and 2009, and in 2011 on the genus *Parodia* Spegazzini in the eastern part of its range (Pampa Biome), led us to change the boundaries of the concept of *Parodia oxycostata* (Buining & Brederoo) Hofacker (see also pp. 76-78) compared to the recent literature (Hunt 1999; Anderson 2001; 2005; 2011; Hunt et al. 2006). We consider *P. oxycostata* to be a taxon infrequently encountered in habitat, whose populations are fragmented, spread over a relatively large portion of the territory, and composed of a small number of individuals. For this reason, it seems appropriate to update the risk assessment of the conservation status of *P. oxycostata* as follows:

Hofacker in Braun & Esteves (2001): Vulnerable, VU

Hunt et al. (2006): Vulnerable, VU D2

Anceschi & Magli (2013): Endangered, EN B2ab(ii,iii,v)

Parodia rechensis (Buining) F. H. Brand*t*

In the article "The last populations of *Parodia rechensis* (Buining) F. H. Brandt "(Anceschi & Magli 2012, 5: 30-34), we report the results of the research conducted in November 2011 on *P. rechensis*, a taxon which is being eradicated in habitat, and which gave very poor results in the ex-situ cultivation attempts. According to Celli Marchett (2008: 1-2), we believe that the robberies and the expansion of urbanization and agriculture have isolated the favourable areas for the survival of the populations, causing local extinctions and reducing the genetic variability. In addition, we advance the hypothesis that these factors have compromised a species already genetically "weak", as shown in the comparison with the luxuriant population of *Parodia linkii* (Lehmann) R. Kiesling, with which it lives sympatrically. *P. linkii* is a dominant species in Darwinian sense, that is, the more opportunistic, and the most widespread of the genus *Parodia* Spegazzini, of the 6 living on the rocky outcrops of the municipality

of Caxias do Sul (ibid: 44), and which in the same environmental conditions did not show the difficulties of *P. rechensis*. The survey and the information gathered led us to updating the risk assessment of the conservation status of *P. rechensis* as follows:

Gerloff, Hofacker in Braun & Esteves (2001): Extinct in the Wild?, EW?

justifications: fire, habitat destruction, grazing and urbanization

Hunt et al. (2006): Data Deficient, DD

Anceschi & Magli (2012): Critically Endangered, CR B1ab(ii,v)+2ab(i,ii,v); C2a(i);E

justification: the extent of occurrence is 8.5 km^2 , the only two known populations are very small and in the last 7 years have decreased with percentages ranging from 65% to 75%, the area of occupancy of the two populations combined is estimated to be a few square metres, the quantitative data shows that there is a 50% probability that the taxon will disappear from its habitat in the next 10 years.

07. cactusinhabitat.org 2010 (website data) updates, addenda and corrigenda

Austrocylindropuntia verschaffeltii (Weber) Backeberg 1939

synonyms added: *Tephrocactus verschaffeltii*

Cereus forbesii C. F. Först 1846 replace **Cereus hankeanus** K. Schumann 1897

synonyms added: *Cereus hankeanus*, *Cereus validus* auctt replace *Cereus validus*

Cereus stenogonus *K. Schumann 1899*

distribution, added: Tarija

Cleistocactus assimilated in **Echinopsis**

Cumulopuntia sphaerica (Förster) E. F. Anderson 1999

distribution, added: Moquegua

Denmoza assimilated in **Echinopsis**

Echinopsis angelesiae (R. Kiesling) G. D. Rowley 1980

synonyms added: *Soehrensia angelesiae*

Echinopsis aurea *Britton & Rose 1922*

synonyms added: *Echinopsis fallax, Lobivia fallax, Echinopsis aurea* ssp*. fallax, Lobivia shaferi* ssp*. fallax, Lobivia shaferi* ssp*. rubriflora, Lobivia shaferi, Echinopsis aurea* ssp*. shaferi*

distribution, added: Salta

surveys added: Argentina, Catamarca, Catamarca, Dique El Jumeal, 2007-02-11, AM 124

Echinopsis baumannii (Lemaire) Anceschi & Magli 2013 assimilates **Cleistocactus baumannii** (Lemaire) Lemaire 1861

synonyms added: *Cleistocactus baumannii*

Echinopsis buchtienii (Backeberg) Anceschi & Magli 2013 assimilates **Cleistocactus buchtienii** Backeberg 1936

synonyms added: *Cleistocactus buchtienii*, Cleistocactus tupizensis* sensu

Backeberg replace *Cleistocactus tupizensis*

* Basionym

synonyms transferred to *Echinopsis celsiana*: *Cereus tupizensis*

Echinopsis candicans (Gillies ex Salm - Dyck) F. A. C. Weber ex D. R. Hunt 1987

synonyms added: *Soehrensia candicans*

Echinopsis celsiana (Salm-Dyck) Anceschi & Magli 2013 assimilates ***Oreocereus celsianus*** (Salm-Dyck) Riccobono 1909

synonyms added: *Oreocereus celsianus, Cereus tupizensis* (transferred from *Echinopsis buchtienii*)

Echinopsis chrysantha Werdermann 1931

synonyms added: *Hymenorebutia kuehnrichii, Lobivia kuehnrichii, Echinopsis kuehnrichii, Lobivia haematantha* ssp*. kuehnrichii*

Echinopsis fallax (Oehme) H. Friedrich 1974 included in ***Echinopsis aurea** Britton & Rose 1922*

Echinopsis hempeliana Gürke 1906 assimilates ***Oreocereus hempelianus*** (Gürke) D. R. Hunt 1987

synonyms added: *Oreocereus hempelianus*

Echinopsis leucantha (Gillies ex Salm-Dyck) Walpers 1843

synonyms added: *Acanthocalycium leucanthum*

Echinopsis leucotricha (R. Philippi) Anceschi & Magli 2013 assimilates ***Oreocereus leucotrichus*** (R. Philippi) Wagenknecht 1956

synonyms added: *Oreocereus leucotrichus*

Echinopsis nothochilensis Anceschi & Magli 2013 assimilates ***Haageocereus chilensis*** F. Ritter ex D. R. Hunt 2005

synonyms added: *Haageocereus chilensis* *

* Basionym

Echinopsis nothohyalacantha Anceschi & Magli 2013 assimilates ***Cleistocactus hyalacanthus*** (K. Schumann) Roland - Gosselin 1904

synonyms added: *Cleistocactus hyalacanthus, Cleistocactus compactus, Cleistocactus tarijensis, Cleistocactus hyalacanthus* ssp*. tarijensis*

distribution, added: Bolivia (Chuquisaca, Tarija, Tupiza)

Echinopsis parviflora (K. Schumann) Anceschi & Magli 2013 assimilates
   Cleistocactus parviflorus (K. Schumann) Roland - Gosselin 1904
   synonyms added: *Cleistocactus parviflorus, Cleistocactus vallegrandensis*

Echinopsis platinospina (Werdermann & Backeberg) Anceschi & Magli 2013
   assimilates ***Haageocereus platinospinus*** (Werdermann & Backeberg) Backeberg 1936
   synonyms added: *Haageocereus platinospinus*

Echinopsis rhodacantha (Salm - Dyck) Förster 1846 assimilates ***Denmoza***
   rhodacantha (Salm - Dyck) Britton & Rose 1922
   synonyms added: *Denmoza rhodacantha*

Echinopsis rojasii Càrdenas 1951
   synonyms added: *Lobivia rojasii*, *Lobivia boyuibensis, Echinopsis calorubra,*
   Echinopsis rojasii ssp*. calorubra, Lobivia coronata*

Echinopsis santacruzensis (Backeberg) Anceschi & Magli 2013 assimilates
   Cleistocactus santacruzensis Backeberg 1966
   synonyms added: *Cleistocactus santacruzensis*, Cleistocactus chacoanus* var.
   santacruzensis
   * Basionym

Echinopsis tarijensis (Vaupel) H. Friedrich & G. D. Rowley 1974
   synonyms added: *Soehrensia tarijensis*

Echinopsis terscheckii (Pfeiffer) H. Friedrich & G. D. Rowley 1974
   synonyms added: *Leucostele terscheckii*

Echinopsis tetracantha (Labouret) Anceschi & Magli 2013 assimilates ***Harrisia***
   tetracantha (Labouret) D. R. Hunt 1987
   synonyms added: *Harrisia tetracantha*

Echinopsis trollii (Kupper) Anceschi & Magli 2013 assimilates ***Oreocereus trollii***
   (Kupper) Backeberg 1929
   synonyms added: *Oreocereus trollii*

Echinopsis weberbaueri (K. Schumann ex Vaupel) Anceschi & Magli 2013
   assimilates ***Weberbauerocereus weberbaueri*** (Vaupel) Backeberg 1957
   synonyms added: *Weberbauerocereus weberbaueri*

Frailea gracillima (Lemaire) Britton & Rose 1922

synonyms added: *Frailea buiningiana, Frailea horstii* ssp. *fecotrigensis, Frailea horstii, Frailea gracillima* ssp. *horstii*

surveys added: Brazil, Rio Grande do Sul, Caçapava do Sul, Pedra do Leão, 2006-12-01, A&M 83

Frailea horstii F. Ritter 1970 included in **Frailea gracillima** (Lemaire) Britton & Rose 1922

Gymnocalycium pflanzii (Vaupel) Werdermann 1935

synonyms added: *Gymnocalycium pflanzii* ssp. *argentinense, Gymnocalycium millaresii, Gymnocalycium pflanzii* ssp. *millaresii, Gymnocalycium pflanzii* var. *millaresii, Gymnocalycium riograndense, Gymnocalycium pflanzii* var. *riograndense, Gymnocalycium zegarrae, Gymnocalycium pflanzii* ssp. *zegarrae*

distribution, added: Argentina (Salta, Tucumán); Cochabamba

surveys added: Bolivia, Santa Cruz, Ruta 4, between Samaipata and Mairana, Loc. Agua Clara, 2007-06-27, A&M 221; Bolivia, Santa Cruz, Comarapa, Pulquina Abajo, 2007-06-27, A&M 226

Gymnocalycium stellatum Spegazzini 1925

synonyms tranferred to *Gymnocalycium bodenbenderianum: Gymnocalycium occultum, Gymnocalycium stellatum* ssp. *occultum*

Gymnocalycium uruguayense (Arechavaleta) Britton & Rosse 1922

distribution, added: Argentina (Entre Ríos); Brazil (Rio Grande do Sul)

comment added: In cactusinhabitat.org 2010, the *Gymnocalycium* population of Young, Rio Negro, Uruguay (2008-11-16, A&M 278, photos 01-09), now identified with *Gymnocalycium uruguayense*, was incorrectly attributed to *Gymnocalycium schroederianum* Osten.

surveys added: Uruguay, Rio Negro, Young, 2008-11-16, A&M 278

Gymnocalycium zegarrae Càrdenas 1958 included in **Gymnocalycium pflanzii** (Vaupel) Werdermann 1935

Haageocereus assimilated in **Echinopsis**

Harrisia assimilated in **Echinopsis**

Maihueniopsis glomerata (Haworth) R. Kiesling 1984

synonyms removed: *Maihueniopsis molfinoi, Opuntia molfinoi*

distribution, added: Catamarca, La Rioja, Mendoza, Salta, San Juan

distribution, removed: from Jujuy to Neuquén; Bolivia (Potosí, Tarija)

Opuntia discolor Britton & Rose 1919

distribution, added: (Alto Paraguay, Boquerón)

Opuntia elata Salm-Dyck 1834

synonyms tranferred to ***Opuntia prasina***: *Opuntia atrovirens;* tranferred to ***Opuntia retrorsa***: *Platyopuntia interjecta, Opuntia vitelliniflora* ssp*. interjecta, Opuntia vitelliniflora, Platyopuntia vitelliniflora*

Opuntia retrorsa Spegazzini 1905

synonyms added: *Opuntia canina*; tranferred from ***Opuntia elata***: *Platyopuntia interjecta, Opuntia vitelliniflora* ssp. *interjecta, Opuntia vitelliniflora, Platyopuntia vitelliniflora*

distribution, added: (Córdoba, Formosa, Jujuy, Salta, Tucumán); (Cochabamba, Santa Cruz, Tarija); (Alto Paraguay, Boquerón, Concepción)

Oreocereus assimilated in **Echinopsis**

Parodia claviceps (F. Ritter) F. H. Brandt 1982

surveys, captions photos 18-39: replaced P. P. Teyu Cuaré with R. N. Osununú

Parodia comarapana Càrdenas 1951

synonyms removed: *Parodia mairanana, Parodia neglecta, Parodia neglectoides*

Parodia erinacea (Haworth) N. P. Taylor 1987

synonyms tranferred from ***Parodia langsdorfii***: *Notocactus pulvinatus;* tranferred from ***Parodia turbinata***: *Wigginsia schaeferiana, Notocactus schaeferianus, Parodia turbinata, Wigginsia turbinata, Malacocarpus turbinatus, Notocactus turbinatus, Echinocactus sellowii* var. *turbinatus*

distribution, added: Colombia ?

Parodia haselbergii (Rümpler) F. H. Brandt 1982

synonyms added: *Parodia elachisantha, Brasilicactus elachisanthus, Echinocactus elachisanthus, Notocactus elachisanthus, Brasilicactus graessneri, Echinocactus graessneri, Malacocarpus graessneri, Notocactus graessneri, Parodia graessneri, Parodia haselbergii* ssp. *graessneri*

Parodia langsdorfii (Lehmann) D. R. Hunt 1997

synonyms tranferred to ***Parodia erinacea***: *Notocactus pulvinatus*

Parodia lenninghausii (K. Schumann) F. H. Brandt ex Eggli & Hofacker 2010
replace **Parodia leninghausii** (K. Schumann) F. H. Brandt 1982
synonyms added: *Parodia leninghausii*

Parodia maldonadensis (Herter) Hofacker 2012 replace **Parodia neoarechavaletae**
(Havlicek) D. R. Hunt 1997
synonyms added: *Parodia neoarechavaletae*

Parodia mueller-melchersii (Backeberg) N. P. Taylor 1987
synonyms added: *Parodia permutata, Notocactus permutatus, Notocactus rubropedatus*

Parodia ottonis (Lehmann) N. P. Taylor 1987
synonyms added: *Notocactus campestrensis, Notocactus eurypleurus, Notocactus glaucinus, Notocactus gracilis, Parodia oxycostata* ssp. *gracilis, Notocactus glaucinus* var. *gracilis*, *Notocactus harmonianus, Notocactus ibicuiensis, Notocactus incomptus, Notocactus miniatispinus, Notocactus securituberculatus* var. *miniatispinus, Notocactus minusculus, Parodia nothominuscula, Notocactus securituberculatus*

Parodia scopa (Sprengel) N. P. Taylor 1987
synonyms added: *Parodia rudibuenekeri* ssp. *glomerata, Notocactus glomeratus, Notocactus rudibuenekeri, Parodia rudibuenekeri, Parodia succinea, Parodia scopa* ssp. *succinea, Notocactus succineus*

Parodia turbinata (Arechavaleta) Hofacker 1998 included in **Parodia erinacea
(Haworth) N. P. Taylor** 1987
synonyms tranferred to **Parodia erinacea**: *Wigginsia schaeferiana, Notocactus schaeferianus, Parodia turbinata, Wigginsia turbinata, Malacocarpus turbinatus, Notocactus turbinatus, Echinocactus sellowii* var. *turbinatus;* tranferred to **Parodia calvescens**: *Notocactus calvescens, Wigginsia calvescens*
surveys tranferred to **Parodia calvescens**: Brasile, Rio Grande do Sul, Barra do Quaraí, 2008-11-09, A&M 275

Rebutia pygmaea (R.E. Fries) Britton & Rose 1922
synonyms added: *Lobivia auranitida, Mediolobivia auranitida, Rebutia auranitida, Mediolobivia aureiflora, Rebutia aureiflora, Rebutia einsteinii* ssp. *aureiflora,*

Lobivia conoidea, Mediolobivia conoidea, Lobivia einsteinii, Rebutia einsteinii, Rebutia einsteinii ssp*. einsteinii, Mediolobivia elegans, Rebutia aureiflora* ssp*. elegans, Lobivia euanthema, Mediolobivia euanthema, Rebutia euanthema, Rebutia fischeriana, Rebutia gonjianii, Rebutia einsteinii* ssp*. gonjianii, Mediolobivia neopygmaea, Rebutia oculata, Mediolobivia sarothroides, Rebutia sarothroides, Lobivia schmiedcheniana, Mediolobivia schmiedcheniana, Rebutia tilcarensis*

Stetsonia coryne (Salm-Dyck) Britton & Rose 1920

distribution, added: Catamarca, Córdoba, Chaco, Corrientes, Formosa, Jujuy, La Rioja, Salta, Santiago del Estero, Santa Fé; Santa Cruz, Tarija

Weberbauerocereus assimilated in **Echinopsis**

Weingartia fidana (Backeberg) Werdermann 1937

synonyms added: *Sulcorebutia cintiensis, Weingartia cintiensis, Rebutia fidaiana* ssp*. cintiensis, Rebutia fidana* ssp*. cintiensis, Weingartia fidaiana* ssp*. cintiensis*

08. Bibliography

Albesiano, S. & Kiesling, R. 2009. Rehabilitation and synonymy of *Wigginsia corynodes* (Cactaceae). Haseltonia 15: 33-40.

Anceschi, G. & Magli, A. 2010. South America 2005/2010. Bologna. MODO infoshop.

Anceschi, G. & Magli, A. 2012. The last populations of *Parodia rechensis* (Buining) F. H. Brandt. The Cactus Explorer 5: 30-34. [epublished].

Anceschi, G. & Magli, A. 2012. *Parodia turbinata* (Arechavaleta) Hofacker: a confused taxon. The Cactus Explorer 6: 26-33. [epublished].

Anceschi, G. & Magli, A. 2013. Observations concerning *Parodia* (*Eriocactus*). The Cactus Explorer 7: 27-39. [epublished].

Anderson, E. F. 2001. The Cactus Family. Portland, Oregon: Timber Press.

Anderson, E. F. 2001. The Cactus Family. trs. Eggli, U. 2005. Das grosse Kakteen-Lexikon. Stuttgart: Eugen Ulmer KG.

Anderson, E. F. 2001. The Cactus Family. trs. Eggli, U. 2011. Das grosse Kakteen-Lexikon. Stuttgart: Eugen Ulmer KG.

Arakaki, M. et al. 2011. Contemporaneous and recent radiations of the world's major succulent plant lineages. Proceedings of the National Academy of Sciences of the United States of America 108 (20): 8379-8384.

Augustin, K. & Hentzschel, G. 2002. Die Gattung *Weingartia* Werdermann: Teil 1. Besprechung und Neuordnung. Gymnocalycium 15 (3): 453-472.

Backeberg, C. 1966. Das Kakteenlexikon. Enumeratio Diagnostica Cactacearum. Jena: G. Fischer.

Backeberg, C. 1966. Kakteenlexicon. trs. Glass, L. 1977. Cactus Lexicon. Poole: Blandford Press.

Benson, L. 1982. The Cacti of the United States and Canada. Stanford: Stanford University Press.

Braun, P. J. & Esteves Pereira, E. 2001. Kakteen und andere Sukkulenten in Brasilien. Schumannia 3: 1-235.

Buining, A. F. H. & Brederoo, A. J. 1972. *Notocactus oxycostatus.* In: Krainz, H., Die Kakteen: C-VI-c.

Celli Marchett, F. 2008. A Família Cactaceae Juss. no Munícipio de Caxias do Sul, RS, Brasil. Centro de Ciências Biológicas e da Saúde, Universidade de Caxias do Sul, Rio Grande do Sul, Caxias do Sul, Brasil.

Charles, G. & Meregalli, M. 2008. Our latest thoughts on *Gymnocalycium*. *In*: Hunt, D. R. et al., NCL addenda, corrigenda and miscellaneous comments. Cactaceae Systematics Initiatives 24: 21-27.

Charles, G. 2009. *Gymnocalycium* in habitat and culture. Stamford, England: published by the author.

Eggli, U. & Hofacker, A. 2010. Validation of the Name *Parodia lenninghausii* (Cactaceae), with a Note on the Lectotypification and Orthography of the Name. Novon 20 (1): 30-32.

Font, F. & Picca, P. 2001. Geographical distribution and state of conservation of the populations of *Lobivia walteri* Kiesling and *Trichocereus smrzianus* (Backeb.) Backeb. (Cactaceae) in the province of Salta, Argentina. British Cactus and Succulent Journal 19: 2-14.

Friedrich, H. 1974. Zur Taxonomie und Phylogenie der Echinopsidinae (Trichocereinae). IOS Bulletin 3(3): 79-93.

Fries, R. E. 1905. Zur kenntnis der alpinen flora im nördlichen Argentinien. Nova Acta Regiae. Soc. Sci. Upsal. ser. IV, 1.

Gerloff, N., Neduchal, J. & Stuchlik, S. 1995. *Notokakteen*. Gesamtdarstellung aller *Notokakteen*. Ludwigsburg: Kveten Verlag.

Gerloff, N. 1999. Where *Gymnocalycium horstii* Buining has its roots. Cactus & Co. 3 (4): 179-186.

Hartmann, N. 1942. Systematische Philosophie. Stuttgart u. Berlin.

Haszprunar, G. 1998. Parsimony analysis as a specific kind of homology estimation, and the implications for character weighting. Molecular phylogenetics and evolution 9(3): 333-339.

Haworth, A. H. 1831. Philosophical Magazine 10: 420.

Hennig, W. 1950. Grundzüge einer Theorie der Phylogenetischen Systematik. Berlin: Deutscher Zentralverlag.

Hennig, W. 1966. Phylogenetic Systematics. trs Davis, D. D. & Zangler, R. Urbana: University Illinois Press.

Hillis, D. M. 1987. Molecular versus morphological approaches to systematics. Annual Review of Ecology and Systematics 18: 23-42.

Hjertson, M. 1994. The identity of *Echinopsis pygmaea* R. E. Fr. (Cactaceae). Taxon 43: 455-457.

Hjertson, M. 2003. Notulae Systematicae Lexicon Cactacearum Spectantes III. *Rebutia* subg. Mediolobivia. Cactaceae Systematics Initiatives 15: 9-10.

Hofacker, A. & Braun, P. J. 1998. Nomenclatural adjustments in *Parodia*. Cactaceae Consensus Initiatives 6: 10.

Hofacker, A. 1998. Further nomenclatural adjustments in *Frailea* and *Parodia*. Cactaceae Consensus Initiatives 6: 11-12.

Hofacker, A. 2003. *Parodia orthacantha* und *Parodia mammulosa*: zwei altbekannte Parodien aus Brasilien und Uruguay. Kakteen und andere Sukkulenten 54 (9): 225–231.

Hofacker, A. 2012. Some notes on *Wigginsia corynodes*. The Cactus Explorers 4: 26-34. [epublished].

Hunt, D. R. & Iliff, J. 2000. *Tunilla*: a new generic name for the "Airampo Group". Cactaceae Systematics Initiatives 9: 8-12.

Hunt, D. R. & Taylor, N. P., eds. 1986. The Genera of Cactaceae: towards a new consensus. Bradleya 4: 65-78.

Hunt, D. R. & Taylor, N. P., eds. 1990. The genera of Cactaceae: progress towards consensus. Bradleya 8: 85-107.

Hunt, D. R. et al. 2006. The New Cactus Lexicon. Milborne Port: DH Books.

Hunt, D. R. et al. 2007. NCL addenda, corrigenda and miscellaneous comments. Cactaceae Systematics Initiatives 22: 11-18.

Hunt, D. R. et al. 2008a. NCL addenda, corrigenda and miscellaneous comments. Cactaceae Systematics Initiatives 23: 4-29.

Hunt, D. R. et al. 2008b. NCL addenda, corrigenda and miscellaneous comments. Cactaceae Systematics Initiatives 24: 5-40.

Hunt, D. R. et al. 2011. NCL updates etc. Cactaceae Systematics Initiatives 25: 7-29.

Hunt, D. R. et al. 2012a. NCL updates etc. Cactaceae Systematics Initiatives 26: 12-20.

Hunt, D. R. et al. 2012b. NCL updates etc. Cactaceae Systematics Initiatives 27: 16-23.

Hunt, D. R. et al. 2012c. NCL updates etc. Cactaceae Systematics Initiatives 28: 16-28.

Hunt, D. R. 1999a. Cites Cactaceae Checklist. Second Edition. Kew: Royal Botanic Gardens.

Hunt, D. R. 1999b. One man's genus is another man's section. Cactaceae Consensus Initiatives 7: 8.

Hunt, D. R. 2005. Notulae Systematicae Lexicon Cactacearum Spectantes VI. *Parodia*. Cactaceae Systematics Initiatives 20: 22-23.

Kiesling, R., Ferrari, O. & Metzing, D. 2002: *Gymnocalycium robustum* (Cactaceae), a new species from Córdoba. Cact. Succ. J. (US) 74 (1): 4–9.

Kiesling, R. & Ferrari, O. E. 2005. 100 Cactus Argentinos. Buenos Aires: Albatros Saci.

Kiesling, R. & Metzing, D. 2006. A new subspecies of the genus *Frailea* Britton & Rose. Cactaceae Systematics Initiatives 21: 17-18.

Kiesling, R. 1984. Estudios en Cactaceae de Argentina: *Maihueniopsis*, *Tephrocactus* y géneros afines (Opuntioideae). Darwiniana 25: 171-215.

Kiesling, R. 1995. Argentine notocacti of the genus *Parodia*. Cactus and Succulent Journal (U.S.A.) 67: 14-22.

Kiesling, R. 1999. Cactaceae. *In* Zuloaga, F. O., & Morrone, O. Catálogo de las Plantas Vasculares de la República Argentina, II. Monographs in Systematic Botany from the Missouri Botanical Garden, 74: 423-489.

Larocca, J. 1998. Cactáceas em paredões rochosos da Serra Geral do Rio Grande do Sul: uma abordagem fitogeográfica. Departamento de Botânica, Universidade Federal do Rio Grande do Sul, Porto Alegre, Dissertação de Mestrado.

Lemaire, C. 1839. Cactearum genera nova speciesque novae et omnium in Horto Monvilliano cultarum ex affinitatibus naturalibus ordinatio nova indexque methodicus. Lutetiis-Parisiorum: J. Loss.

Lendel, A., Eggli, U. & Nyffeler, R. (2006). Phylogenetic relationships in the tribe Trichocereeae (Cactaceae) inferred from cpDNA sequence data analysis. Botany 2006 Abstracts: 233. St. Louis Botanical Society of America.

Link, H. F. & Otto, C. F. 1827. Verhandlungen des Vereins zur Beförderung des Gartenbaues in den Königlich Preussischen Staaten 3.

Lowry, M. 2002. Notulae Systematicae Lexicon Cactacearum Spectantes II. *Echinopsis*. Cactaceae Systematics Initiatives 14: 13-14.

Lowry, M. 2005. Notulae Systematicae Lexicon Cactacearum Spectantes V. *Echinopsis*. Cactaceae Systematics Initiatives 19: 11-12.

Mace, T. 1978. *Notocactus*. A review of the Genus incorporating *Brasilicactus*, *Eriocactus* and *Wigginsia*. 2nd edition. The editorial board & the Sussex zone of the Nacional Cactus & Succulent Society.

Machado, M. C., Lendel, A. & Nyffeler, R. 2006. Presentation to the IOS Congress in Septrmber 2006.

Machado, M. C. 2008. What is the rule of hybridization in the evolution of the Cactaceae? Bradleya 26: 1-18.

Mayr, E. et. al., 1953. Methods and principles of systematic zoology. New York: McGraw-Hill.

Mayr, E. 1957. Die denkmöglichen Formen der Artentstehung. Revue Suisse de Zoologie 64: 219-235.

Mayr, E. 1982. The growth of biological thought. Diversity, evolution, and inheritance. 1st editions. It. tr. Continenza, B. et al. 2011. Storia del pensiero biologico. Diversità, evoluzione, eredità 1-2. Torino: Bollati Boringhieri.

McLennan, D. A. et al. 1988. The benefits of communication between comparative ethology and phylogenetic systematics: a case study using gasterosteid fishes. Can. J. Zool. 66: 2177-2190.

McNeill, J. et al. 2012. International Code of Nomenclature for algae, fungi, and plants (Melbourne Code). Regnum Vegetabile 154. Koeltz Scientific Books.

Meregalli, M. 2010. The *Gymnocalycium* of Uruguay. 1. *Gymnocalycium hyptiacanthum* (Lemaire) Britton & Rose: history of the name, historical interpretations, the neotype and nomenclatural considerations. Schütziana. The Gymnocalycium Online Journal 1 (1): 4-20. [epublished].

Metzing, D., Meregalli, M. & Kiesling, R. 1999. Typification of *Gymnocalycium quehlianum* (Cactaceae). Hickenia 3: 9-11.

Metzing, D. 1994. Cactaceae in Paraguay - specie, ecologia e minaccia di estinzione. Piante Grasse 13 (4 suppl.): 5-63.

Michaelis, L. 1927. Einführung in die Mathematik für Biologen und Chemiker 3rd editions, Berlin.

Nicolai. 1893. Monatsschrift für Kakteenkunde 3: 175. Neudamm: J. Neumann.

Nyffeler, R. & Eggli, U. 2010. A farewell to dated ideas and concepts: molecular phylogenetics and a revised suprageneric classification of the family Cactaceae. Schumannia 6: 109-149.

Nyffeler, R. 1997. Further referrals of "limbo" species in CCC1. *Notocactus*. Cactaceae Consensus Initiatives 4: 8-9.

Nyffeler, R. 1999. *Notocactus* versus *Parodia* - the search for a generic classification of the subtribe Notocactinae. Cactaceae Consensus Initiatives 7: 6-8.

Nyffeler, R. 2002. Phylogenetic relationships in the cactus family (Cactaceae) based on evidence from trnK/matK and trnL-trnF sequences. American Journal of Botany 89 (2): 312-326.

Papsch, W. 2001. Die Pampinen *Gymnocalycien* 3. *Gymnocalycium hyptiacanthum* (Lemaire) Britton et Rose. Gymnocalycium 14. (1): 385-392.

Patterson, C. 1982. Morphological characters and homology. *In*: Joysey K. A. & Friday, A. E. eds, Problems of phylogenetic reconstruction: 21–74. London: Academic Press.

Plate, L. 1914. Prinzipien der Systematik mit besonderer Berücksichtigung des Systems der Tiere. *In*: Die Kultur der Gegenwart 3: 92-164.

Rieppel, O. 1980. Homology, a deductive concept? Zeitschrift für Zoologische Systematik und Evolutionsforschung 18: 315-319.

Ritter, F. 1979. Kakteen in Südamerika 1. Spangenberg: Friedrich Ritter Selbstverlag.

Ritter, F. 1980. Kakteen in Südamerika 2. Spangenberg: Friedrich Ritter Selbstverlag.

Ritz, C. M. L. et al. 2007. The molecular phylogeny of *Rebutia* (Cactaceae) and its allies demonstrates the influence of paleogeography on the evolution of South American mountain cacti. American Journal of Botany 94 (8):1321-1332.

Rowley, G. D. 1994. Spontaneous bigeneric hybrids in Cactaceae. Bradleya 12: 2-7.

Rowley, G. D. 2004a. Intergenic hybrids in Cactaceae - an update. Cactaceae Systematics Initiatives 18: 11-28.

Rowley, G. D. 2004b. Intergenic hybrids in Cactaceae - 2004 update. British Cactus and Succulent Journal 22: 64-65.

Schlumpberger, B. O. & Renner, S. S. 2012. Molecular phylogenetics of *Echinopsis* (Cactaceae): Polyphyly at all levels and convergent evolution of pollination modes and growth forms. American Journal of Botany 99 (8): 1335-1349.

Schlumpberger, B. O. 2009. More on the phylogeny and evolution of *Echinopsis* s. l. IOS Bulletin 15 (2): 48.

Schlumpberger, B. O. 2012. New combinations in the *Echinopsis* alliance. Cactaceae Systematics Initiatives 28: 29-31.

Schumann, K. M. 1899. Monatsschrift für Kakteenkunde. Neudamm: J. Neumann.

Sober, E. 2000. Phylosophy of Biology. 2nd edition. Boulder, CO: Westview Press.

Sober, E. 2008. Evidence and Evolution: The Logic Behind the Science. New York: Cambridge University Press.

Soffiatti, P. & Angyalossy, V. 2005. Wood anatomy of *Cipocereus* (Cactaceae). IAWA Journal 26 (3): 299-308.

Taylor, N. P. & Zappi, D. C. 1989. An alternative view of generic delimitation and relationships in tribe Cereeae (Cactaceae). Bradleya 7: 13-40.

Taylor, N. P. & Zappi, D. C. 2004. Cacti of Eastern Brazil. Kew, Royal Botanic Gardens.

Taylor, N. P. 1992. *Arthrocereus*, *Cereus*. *In*: D. R. Hunt and N. P. Taylor (eds). Notes on miscellaneous genera of Cactaceae (2). Bradleya 10: 17, 20–25.

Taylor, N. P. 1995. Kew Bulletin 50 (4): 819.

Taylor, N. P. 1997. Nomenclatural adjustments in *Copiapoa*, *Echinocereus*, *Escobaria* and *Praecereus*. Cactaceae Consensus Initiatives 3: 8-10.

Taylor, N. P. 2007. Cactaceae of Bolivia: additional departmental records. Cactaceae Systematics Initiatives 22:10-11.

Till, H. 2002. Zur Klarstellung von *Gymnocalycium quehlianum* (Haage ex Quehl) Vaupel ex Hosseus. Gymnocalycium 15 (2): 441-444.

Till, H. & Amerhauser, H. 2010. Die verworrene Geschichte des *Gymnocalycium hyptiacanthum* (Lemaire) Britton & Rose. Gymnocalycium 23 (1): 897-908.

Uhlmann, E. 1923. Entwicklungsgedanke und Artbegriff. Z. Naturwiss 59: 1-114. Jena.

Van Vliet, D. J. 1970. *Notocactus orthacanthus* (Link & Otto) Van Vliet, Succulenta (NL) 49 (11): 185-190.

Wallace, R. S. 1995. Molecular systematic study of the Cactaceae: Using chloroplast DNA variation to elucidate Cactus phylogeny. Bradleya 13: 1-12.

Wiley, E. O. & Liebermann, B. S. 2011. Phylogenetics: the theory of phylogenetic systematics. New Jersey: John Wiley & Sons, Inc., Publications.

Wiley, E. O. 1981. Phylogenetics. The Theory of Phylogenetic Systematics. New York: Wiley-Interscience.

... cactusinhabitat has been the activity of our lives, and after another year spent in the habitats of South America, we return to devote ourselves exclusively to the elaboration of the data collected. With the 2013 output we present more than 100 new taxa, bringing the total number of species recognized in cactusinhabitat.org to 252 (from the 292 taxa studied in habitat), many of which are accompanied by related comments. The new surveys are documented by more than 4500 photos, in addition to the existing 2000. Although we documented some new genera, the total number we are presenting is still 40, as in the first publication. We have in fact chosen to assimilate some genera in *Echinopsis* Zuccarini as a consequence of the phylogenetic hypothesis adopted on the basis of the evidence of the latest molecular analyses...

Giovanna Anceschi & Alberto Magli