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# kaktusy

special 2



*Lophophora williamsii*

Rod  
Genus  
Gattung

*Lophophora* COULTER

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## A Few Words of Introduction

When asked some time ago by the authors, my friends, to write some kind of introduction to this Special Issue, it took me a while to figure out where to begin. It was a challenge as we spent countless hours editing the text, and it seemed that each author had his own particular point of view on classification. But what is it that makes this Special so special?

Not one of our issues so far has dealt with such a narrow taxonomic unit, yet at the same time no other has probably advanced the knowledge of the genus quite so much. The authors have staked their personal reputations, and probably the conservative cactus growers' community will attempt to discredit them with a barrage of unsubstantiated opinions. I am prepared to stand by the authors, because many of the conclusions published so far may prove to have been fallacious after more thorough field research (just as everyone senses intuitively that the giraffe has a long neck in order to graze on acacia leaves, whereas the truth proven by rigorous methods of research is believed to be totally different).

The same applies to the species concept presented here. Whilst it is still difficult to be precise and the matter is quite controversial, the solution proposed hopefully respects Mayr's definition of a 'biological species',

which defines it as a group of individuals which are self compatible. But...! Even here, alas, one cannot avoid the problem with geographically isolated populations (alopatrics), where individuals simply don't meet and thus cannot interbreed. Even so, I think it would be too much to call them separate species. The thing is that they do not represent independent evolutionary lines of descent and the assumption must be that as soon as the geographic barrier disappears (as in cultivation), the two groups will simply merge again over a period of time.

So many hidden variables as well as clear inconsistencies abound among the few species in question that we might trust that readers of this Special Issue will wish to reconsider their earlier beliefs.

It is probably pointless for me to speculate on what should have been taken into account in the writing, such as which localities ought still to be visited, or how broad or narrow the genus or species delimitation ought to have been.

I am convinced that the work here presented will broaden the horizons of everyone who wants not only to grow but also to know these plants better. We offer readers this account, in the hope that those with a modern detached view of evolutionary biology will be able to form their own opinions.

*Yours sincerely, Libor Kunte*

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The Society (SČSPKS)  
would like to thank  
the authors  
for completing this  
special issue

Title page:  
*Lophophora williamsii*,  
Entronque Huizache, SLP, one  
of the most interesting forms  
with long petals.



1. The picture illustrates that all lophophoras do not look the same. You should be able to distinguish the three species after reading this Special Issue

## Taxonomy of the species *Lophophora* Coult.

Dividing lophophoras into two sections has not been common practice. There are a number of reasons why this concept has not been generally accepted in professional circles. The difficult process of accurately identifying individual lophophoras is the main reason. Only people with certain experience and keen observation are able to distinguish the four species at first sight.

That is hardly surprising. A number of characters which help to classify the genus *Lophophora* are not very obvious to the casual observer. We have built upon the work of our predecessors and friends, taking their long-term observations a bit further in several respects.

The genus *Lophophora* is divided into two basic groups, with sufficient differences to classify them at the infrageneric rank of section (sectio) in the botanical system.

The first group comprises the various forms of the species *L. williamsii* (Salm-Dyck) Coulter, which is further subdivided into infraspecific categories.

This group contains the type species and is therefore called by the autonym Sectio *Lophophora*.

Those species related to *Lophophora*

*diffusa* (Croizat) Bravo are classified in the other section, and we propose to call this group sectio *Diffusae*.

Sectio *Diffusae* Mysak et al. *sect. nov.*

Typus: *Lophophora diffusa* (Croizat) Bravo.

Differt a sectio *Lophophora* cum costis diffusis, numero ab 21, tenuidermis delicatis, receptaculo longioro, semper allogamis, texturis alkaloidibus praecipue pellotinibus.

Differs from sect. *Lophophora* in having diffuse ribs, not clearly defined, up to 21 in number, with a thin, delicate epidermis, easily bruised, a longer flower tube, always allogamous, and the tissues contain mainly pellotin alkaloids.

Sectio *Diffusae* includes three separate species:

*Lophophora diffusa* (Croizat) Bravo

*Lophophora fricii* Habermann

*Lophophora koehresii* (J. Říha) Bohata, Myšák et Šnicer

The following arguments support the recognition of two sections:

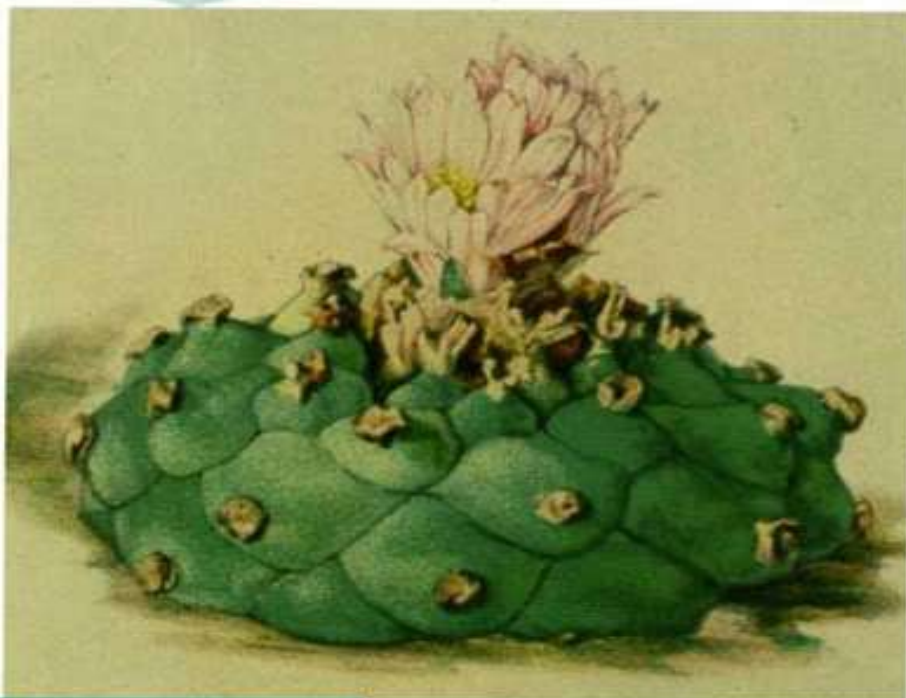
1. The sections *Lophophora* and *Diffusae* differ chemically in the composition of their alkaloids.

The *Diffusae* are a lot closer to each other in this respect and stand out clearly from sect. *Lophophora*. Sect. *Lophophora* contains the alkaloid mescaline. The mescaline content of the total alkaloids is 15–30 % in sect. *Lophophora*, compared with a maximum of only 1.3 % in the *Diffusae*. Sect. *Lophophora* contains 14–17 % of the toxic alkaloid pellotine in its total alkaloid content, but is as high as 65–88 % in the *Diffusae*!

2. Species of the *Diffusae* inhabit smaller, isolated habitats (ecological niches); *L. williamsii*, on the other hand, occurs over a vast geographical area.

3. *L. koehresii* has been observed occurring together with *L. williamsii*. Equally, the habitat of *L. fricii* is enclosed within the habitat of *L. williamsii*. Despite of this, not a single instance of hybridisation or transitional forms has been observed

2. Croizat named *Lophophora williamsii* v. *decipiens* from this picture in „The Cactaceae“ by Britton and Rose; only the 1922 first edition contained the picture in colour. This is a very hard-to-get book nowadays - a bibliophile's dream





wherever they are sympatric. This fact shows that they are **incompatible** and supports the present proposed classification.

4. *L. williamsii* retains the **dried flower remains** for much longer, while the perianth remnants are much more easily separated from the species of *Diffusae*. *Diffusae* plants shed their areolar wool more easily and earlier than in *L. williamsii*.
5. *Diffusae* species have more numerous **ribs** (up to 21) of mostly undulating (sinusoidal) form. *L. williamsii* produces a maximum of 13 ribs, which are generally straight.
6. The **soft tissues** of the *Diffusae* plants with their **delicate and thin epidermis** in shades of green to yellow-green contrast visibly with the hard and tough, greyish green epidermis of *L. williamsii*. *L. fricii* may have a greyish green epidermis similar to that of *L. williamsii*.
7. The plants behave **differently in cultivation**. Most of the forms of *L. williamsii* are relatively resistant

3. The typical colour of a flower on *Lophophora fricii*. Let's call it 'dark pink' for the purposes of this Special Issue

4. A descendant of the plants from which *Lophophora fricii* was described. Note the extremely long wool which shields the plant from weather





5. A typical flower on a *Lophophora koehresii* with long and narrow petals

6. All the stages of growth of the *Lophophora williamsii*, from *The Cacti of the United States and Canada*™ by L. Benson

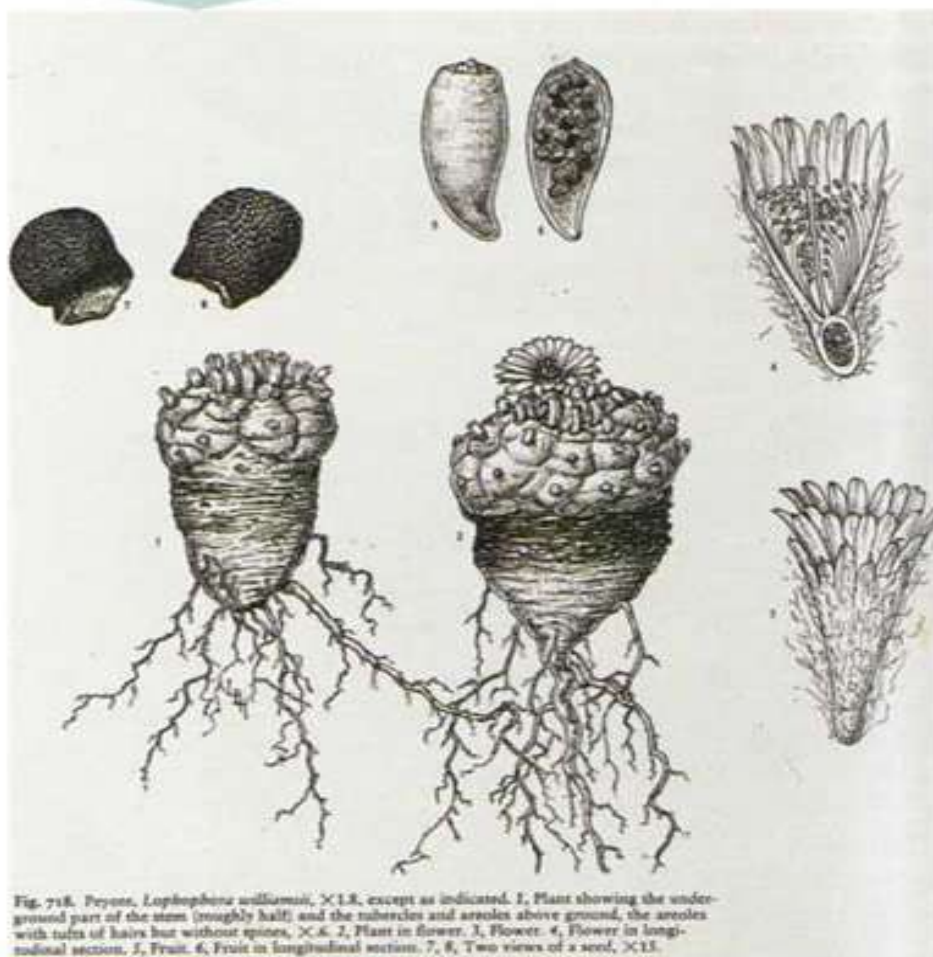


Fig. 718. *Peyote, Lophophora williamsii*, X1.8, except as indicated. 1. Plant showing the underground part of the stem (roughly half) and the tubercles and areoles above ground, the areoles with tufts of hairs but without spines, X0.6. 2. Plant in flower. 3. Flower. 4. Flower in longitudinal section. 5. Fruit. 6. Fruit in longitudinal section. 7, 8. Two views of a seed, X13.

and will tolerate growers occasional cultivation errors. The *Diffusae* species, on the other hand, are much more sensitive to trauma.

The above are some of the differences between the two groups. Further observations are still needed. We do, however, assert that the species *L. diffusa*, *L. fricii* and *L. koehresii* have features in common and, as a whole, are distinct from *L. williamsii*.

### Geographical distribution of the Genus *Lophophora*

This chapter will attempt to outline the factors which govern how lophophoras are distributed in the wild. An understanding of such factors is essential for a detailed study of any species of cacti. Field research, if this presumptuous term can be used to describe our humble efforts to date, is continuing, and some of our conclusions might have to change. Therefore, please consider this chapter as a preliminary report, based on today's data.

A glance at the map tells us that the distribution of the genus is almost identical to the extent of the geological-vegetational area known as the **Chihuahuan Desert**. On closer inspection, it is worth noticing that the **isolated enclave-like occurrence of the species of the section *Diffusae* (*L. diffusa*, *L. koehresii* and *L. fricii*), contrasts with the vast habitat of the section *Lophophora***. Finding lophophoras in the wild is not always entirely easy, so you will notice the many areas of doubt. We are only slowly filling in the blank spaces of the map, often an expensive process.

Before exploring the geographical incidence of the individual species, let us point out some important criteria that should not escape the readers' attention. First and foremost, we need to look at the overall geology of the area in which lophophoras are found. Barriers such as tall mountain ranges, high areas of precipitation, and faultlines of volcanic activity, for instance, constitute natural limits to habitats. We have marked the main limiting points on the map for clarity.



7. The habitat of the southernmost species, *Lophophora diffusa*, around seasonally dried up riverbeds (called 'arroyos') in the Río Extorax Basin

**Ecology** is another important aspect. Restrictions to distribution are quite common for the plants of the section *Diffusae*, but the section *Lophophora* is much more diverse and its presence cannot be easily described using a general or simplified model.

Let us start from the south with *L. diffusa*, which is the southernmost representative of the genus. Its distribution ceases at an insuperable obstacle in the form of a changed subsoil on the edge of a volcanic area (see map). The Central Mexican plateau, over which the area of *L. diffusa* extends, is geologically active and quite diverse. Changes brought about by geological rifts bring about the rerouting of river systems. Areas of Cretaceous sediments are rare, and associated mostly with river canyons. Claystone and slate formations can be observed frequently next to the Cretaceous sediments, which are the most typical home to *L. diffusa*. In the enclosed and very warm canyons or riverbeds, they colonise the slopes as well as flat deposited knolls. The plants

will often and happily make use of the shade under taller bushy vegetation (*Prosopis*, *Larrea*, etc.).

*L. diffusa* inhabits an area along a section of the Río Extorax river system. Sierra Azafrán, rising to the northwest of its distribution area, is a natural watershed. In theory, the species could permeate deeper into the Sierra Azafrán range at some points, following the river valleys, but it is probably incapable of getting over it and entering another river basin.

Looking southeast, you can see the Río Extorax and Río Moctezuma flowing and gathering strength before they empty into the Río Panuco. The broad floodplain and the proximity of the moist coastal climate have made this area uninhabitable to *L. diffusa*. It is going to be interesting to study the softer Cretaceous sediments accompanied by a variety of slate and claystone in the area, which, in addition to the river system, are an important indicator of the possible presence of the plant. Combined with the rain shadow, they

may affect the extension of the habitat in this direction. That is rather unlikely, however, and the north-eastern confine must be certainly considered.

The large Anáhuac Plateau has been spared the geological difficulties of the Río Panuco Basin. It covers a large part of the San Luis Potosí state plus the adjacent areas of the states of Tamaulipas, Zacatecas, and Guanajuato. Its formation has been calmer, and it is no coincidence that it is the last, northernmost boundary to the habitat of *L. diffusa*. It is a very distant boundary, and can only be called a boundary in geological terms, as the actual presence of *L. diffusa* terminates way further south. It is theoretically possible that the species could follow its companion *Astrophytum ornatum* and 'travel' further up north with it. However, this is only a speculation, for future explorers to determine.

*L. williamsii* comes into the picture on the Anáhuac Plateau, together with *L. koehresii* on its eastern boundary. It is surprisingly clear how

the southernmost distribution of *L. williamsii* follows that of the plateau. The interesting fact is that the habitats of *L. williamsii* and *L. koehresii* meet each other, and even overlap at San Rafael (SLP). In all our observations to date, however, no hybridisation has been noted. To the southwest, the range of *L. williamsii* is limited by a region of volcanic activity, extending along the entire western edge of the habitat down to the southern part of the state Chihuahua. The overall geographical range of *L. williamsii* is not confined to the Anáhuac Plateau, which represents only a small part of the habitat, but also to the Chihuahuan Desert. The species is quite abundant in the central area of its habitat, but thins out at the edges. This brings us to the northern limit of the species distribution, represented in the case of *L. williamsii* by the systems of the Río Grande and the Río Pecos. We believe that the northern parts of the habitat are much colder, and that

8. Landscape near Camargo, Chihuahua: the northwesternmost locality of *Lophophora williamsii*, where limestone outcrops are scarcer



9–12. all four *Lophophora* species in flower; top left to bottom right: *Lophophora diffusa*, *Lophophora fricii*, *Lophophora koehresii*, *Lophophora williamsii*. Although the plants flower almost nonstop all year round in the wild, getting a picture of a flowering plant is not easy

the river valleys are the last remaining places with suitable conditions for plant life. The situation at the eastern border of the habitat is a little more complicated. The Sierra Madre Oriental is not an unbroken mountain range: rather, it is a series of differently profiled ranges whose folding axes often intersect one another. *L. williamsii* is very scarce in these areas.

**The Tamaulipas Depression** is a revealing yet little researched area in respect of lophophoras, if only because it is here that we find an interesting form of *L. williamsii* near the town of Reynosa. The Tamaulipas Depression comprises a series of surface protrusions of Cretaceous limestone, which occur in the landscape between the Río Grande to the north and Tuxpan to the south. They constitute a sort of duplicate of the Sierra Madre Oriental on a smaller scale. Small ridges rise here, separated by broad saddlebacks. The most prominent mountain-like formations are present in the north near the Río Grande, Lomerías de Peyote, and in the Sierra de Lampazos. The formations decrease in both number and elevation to the south with the entire depression tapering away towards the Isthmus of Tehuantepec. It seems that the southern reaches of the Depression are not optimal for *L. williamsii*, but the plant has made its way north as far as the town of Reynosa. The landscape, making a somewhat drab impression at first sight, may, however, be concealing some surprises. We have witnessed one such outstanding example in *Digitostigma caput-medusae*.

**Without doubt, the area outlined by the towns of Saltillo, Torreón and Monclova can be taken to be the northern centre of distribution. *L. williamsii* has shown remarkable plasticity in this area,** manifested in high population densities as well as in the colonisation of various biotopes. It can be found in flat places in the company of *Ariocarpus kotschoubeyanus*, and again among rocks moderately high in the hills. The species is not rare here – quite the contrary.

The Río Grande (or the Río Bravo, to be correct) is the northern boundary, as has been said. The species spreads out along this border. The extension of the plants along the river valley, nevertheless, cannot be directly associated with the presence of water, but more likely, to be connected to the modified microclimate that is associated with river valleys.

There is a parallel with the distribution of the *Ariocarpus fissuratus* which should be mentioned at this point. The species extends along the river beyond Rio Grande City, and is an important indicator of the possible presence of lophophoras in this specific location. However unlikely it may seem, *A. fissuratus* is much easier to find in the north of the habitat than lophophoras. The north-western and western frontiers of the habitat have been little researched, which makes them all the more inviting. The tall range of the Sierra Madre Occidental is a clear limiting factor in the west. It consists of volcanic rocks, which are unacceptable as subsoil for the genus *Lophophora*, although there are certain areas with enclaves of calcite sediments. The confirmed presence of *A. fissuratus* near Rodeo, in the state of Durango, makes it therefore worth a look. Likewise, the discovery of *L. williamsii* near Camargo, in the state of Chihuahua, is confined to isolated calcite outcrops.

**The habitat of *L. fricii* is a relatively small area near the town of Viesca, in south-western Coahuila State.** Just as with *L. koehresii*, the representatives of the two different sections within the genus – *L. fricii* and *L. williamsii* – are nearly together. Some arguments based on this fact have been put forward to question the independence of the *L. fricii* as a species. We must protest resolutely against this. Nobody has ever found any evidence of the two species merging in the wild. Coexistence, which we have never observed, would be a strong evidence of each species' independence.

Everyone who has been to the area surrounding Viesca will know how amazing the place is. **The flat bowl of**





the dried up Laguna de Viesca is encircled by a rugged wall of mountains to the north, east and south. Only the western side of this drainless basin is not hemmed in by mountains, but makes a smooth transition into the Laguna de Meyrán. Populations of *L. fricii* are found in the mountains surrounding the Viesca Basin. It is most interesting that the individual populations within the area are so very different from each other in their respective ecological niches. The white-flowered *L. fricii* south of Viesca inhabits clayey pockets and crevices even high up on the steep hill slopes (like the La Pe form). The northern Zavaleta form is



characterised by its occurrence in ravines. The last known form, growing near El Amparo, is found in the plains at the foot of the hills and also higher up the hillsides as well. It grows in the company of agaves, hechtias and bushy vegetation, making use of them for shelter. Such specialisation is astonishing in such a small area. The different ecological preferences of the plants is also very interesting, and we discuss this in the following chapter.

## Location preferences and growth strategies of lophophoras

Speaking in very simplified terms, the plants occur as follows:

- *L. diffusa* – „follows the water”
- *L. fricii* – „lines the lagoon”
- *L. koehresii* – „runs up the plain”
- *L. williamsii* – „colonises both the plains and hills”

Most professional botanists would scoff at such terms used to characterise the species, suggesting that they are trivial and over-simplified. Yet despite their apparent naivety, they aptly describe the natural distribution of lophophoras. How a plant lives is not random. It results from a long evolutionary process of each



13. *Lophophora diffusa* from Pena Miller, Querétaro: an old plant with 21 ribs



14. Young *Lophophora koehresii*, not yet in flower, at Las Tablas, SLP. The cracked ground around the plant is the result of the expansion of the plant after rain

*L. koehresii*, which grows in soft alluvial sediments of drainless basins. The two species, often perceived as one, differ in this respect fundamentally. During drought, *L. diffusa* will rely on the size of its stem, which explains why it also grows in clusters. Its habitat is a very hot and dry region. Smaller, solitary plants are found more often on slopes, which are poorer in moisture. In stark contrast, large, multi-headed clusters can be seen on islets in the moist riverbed. This is not taxonomically important, though, because it results from differences in water availability. Almost as a rule, plants tend to seek the modest shade offered by deciduous shrubs. Shading due to

15. *Lophophora fricii* at El Amparo, Coah., forming multiheaded clusters

species. The chosen survival strategy affects, to a certain degree, the physiology and nature of the plant. It is therefore an important taxonomic tool worthy of close observation. Let us now take a look at these constraints from the point of view of the division of the genus into two sections.

*L. diffusa* is a very specialised species, inhabiting the slate slopes and islets along the beds of seasonal rivers in the Río Moctezuma Basin. The dimensions of the stem, often up to 15 cm in diameter, and the fact they grow on slate, does not allow the plants to contract and hide underground, as is the case with the much smaller



the relief of the landscape also plays an important role, so projections and depressions are favoured.

Compared to the previously mentioned species, *L. koehresii* is considerably smaller (up to 6 cm, or rarely up to 10 cm in diameter), and lives exclusively at the bottom of flat valleys or basins rooted in soft alluvial sediments. In fact, it is so specialised in this respect that it works for its protection by making little holes in which it will hide from the scorching heat during the dry periods. It is worth remembering that the highest temperatures are right at ground level. Some cacti cope with the heat by growing



16. *Lophophora williamsii* at El Coyote, SLP. Finding a solitary plant this large is a great thrill.

cork, others, like *L. koehresii*, retract underground. The plant swells with water in the rainy season and pushes its green stems above ground level again. Similarly to most other lophophoras, the *L. koehresii* prefers moderately shaded positions in the vicinity of tall shrubs.

*L. fricii* is the third and last of the species of the section *Diffusae*, and is different again. *L. fricii* grows neither next to riverbeds, nor in flat plains. Its four main populations, which we visited, are distributed in the hills or mountains lining the Laguna de Viesca. We were astonished by the variability of some of its preferred habitat locations. This is most prominent in two of them. While

the white-flowered variety, which grows south of Viesca, only runs up open slopes, its eastern sister grows in the flat plains at the foothills as well as rising up the slope, protected by shrubs and other vegetation. The white-flowered variety grows more or less solitary, whereas the eastern variety nearly always grows in clusters. The former bears white flowers, and often has a peculiar yellowish epidermis. The flowers of the latter are purple-pink and its epidermis is silvery grey. Let us now abandon the differences between the sites and take a general look at the distribution of *L. fricii*. Its growth strategy is comparable to that of *L. diffusa*. It also withstands drought by producing larger stems and choosing more convenient sites in the landscape rather than retracting underground. Typically, limestone subsoil and stiff clayey substrates are found in the habitats of *L. fricii*. As in *L. diffusa*, the largest clusters will be found where there are better water sources, such as in the beds of dry ravines (as in the Sierra Zavaleta) and in gullies carrying runoff from the adjacent mountains in the rainy season (the eastern position below the Sierra de Parras). In other localities, the plant will choose the most convenient places among large rocks and in crevices (south of Viesca and near La Pe). Rock crevices are where water tends to gather.

The story of *L. williamsii* is much more complex. Due to its vast area of distribution and rich assortment of local forms, the locations are very varied. It is found both in flat drainless basins and on steep limestone cliff faces. In line with all the other species of the genus, it also prefers moderately shady positions.

It is, however, better adapted to life in the sun than any of the other lophophoras. It has a tough epidermis coated with a thick layer of cuticle, a powerful protective mechanism preventing excessive body fluid evaporation. The plant seeks convenient locations with good enough water supplies, such as in rock fissures. In the centre of the distribution (around Saltillo as far as we presently know), *L. williamsii*



Map 1:  
The overall distribution of the  
genus *Lophophora*:

1. *Lophophora diffusa*,
2. *Lophophora koehresii*,
3. *Lophophora fricii*,
4. *Lophophora williamsii*

Map 2:  
The basic geology of the area:

1. Sierra Madre Oriental,
2. Sierra Madre Occidental,
3. high volcanic plateaux,
4. Altiplano,
5. Tamaulipas Depression,
6. northern boundary  
of volcanic activity.





17. *Lophophora williamsii* at El Coyote, SLP. Clustering here is typical

18a. *Lophophora williamsii*, form of Entronque Huizache, has typical long tube, narrow petals, long style and very small white stigma (right)

18. *Lophophora williamsii* at Cedral, near Real de Catorce, SLP. A pilgrimage site popular with native gatherers. The plants are single although they are of the southern form

can be found virtually everywhere. On the other hand, it is very scarce in the outermost reaches of the habitat, partly due to the extreme, inhospitable conditions.

*In some parts of Central and Northern Mexico, L. williamsii is a relatively common species. That may be why many people tend to consider it perfectly commonplace. Whilst it is perhaps true in the central area of the habitat, quite the opposite holds in the outlying areas. That is to say, finding lophophoras at the periphery of the habitat is a hard task, and many of our journeys have proved fruitless.*

*We have reasonable evidence to dispute some of the previously quoted localities. This is primarily due to the ethnographic origin of much of the background information, where the actual presence of the plants was not necessarily natural. With the cult of Peyote use being so widespread, the plants could have been brought from faraway places in many cases. The alleged presence in the northern tip of Jalisco State is a good example. Although it has not been quite ruled out, we found out in 2000 that our searches in the region were probably in vain. Natives of the Huitcholes tribe informed us that since time immemorial, Peyote had*



*always been brought from the recognised places around Real de Catorce in San Luis Potosí. Elsewhere it is impossible to be sure without detailed research. Plants related to *L. williamsii*, such as the form 'texana', not satisfactorily accounted for to this day, are likely to inhabit localities that are still waiting to be rediscovered. Thus, paradoxically, plants first introduced by A. V. Frič have still not been found again, even after years of intensive searching.*

# Species Gallery:

## Section *Diffusae*:

### Common features and characteristics of the section *Diffusae*

Similar chemical composition of its alkaloid content, among which pellotinoids prevail. None of the species in the section is autogamous. The flowers have longer receptacle tubes. The epidermis is thin and vulnerable. The ribs are often diffuse or indistinct. If ribs are produced, they may reach up to 21 in old plants. No shallow podaria are formed on the ribs separated by transverse horizontal notches. The structure and shape of the roots are similar to the smooth and fine epidermis.

### *Lophophora diffusa* (Croizat) Bravo

Basionym:

*Lophophora echinata* var. *diffusa*  
Croizat, *Desert Plant Life*. 16: 44 (1944).

Name:

The species name *diffusa* describes the typical feature of the species, which is the indistinct or diffuse ribs.

Characteristics:

A large, appressed, spherical stem; solitary to clustered growth; peculiar yellowish green soft epidermis; diffuse ribs, often broken down into separate low podaria; off-white flowers, with shades of yellow and rarely pink; cylindrical, white to dark pink fruits.

Position within the genus:

The southernmost, disjunct, and longest-known species within the section.

Geographical distribution:

The basin of the Río Extorax, between the settlements of Vizarrón, Toliman, Ninas Las Palmas, Río Blanco and Bucareli, in the state of Querétaro.

Ecology:

Alluvial river islets, or slate covered slopes along the dry beds of seasonal

streams; seeks protection under taller vegetation.

Accompanying vegetation:

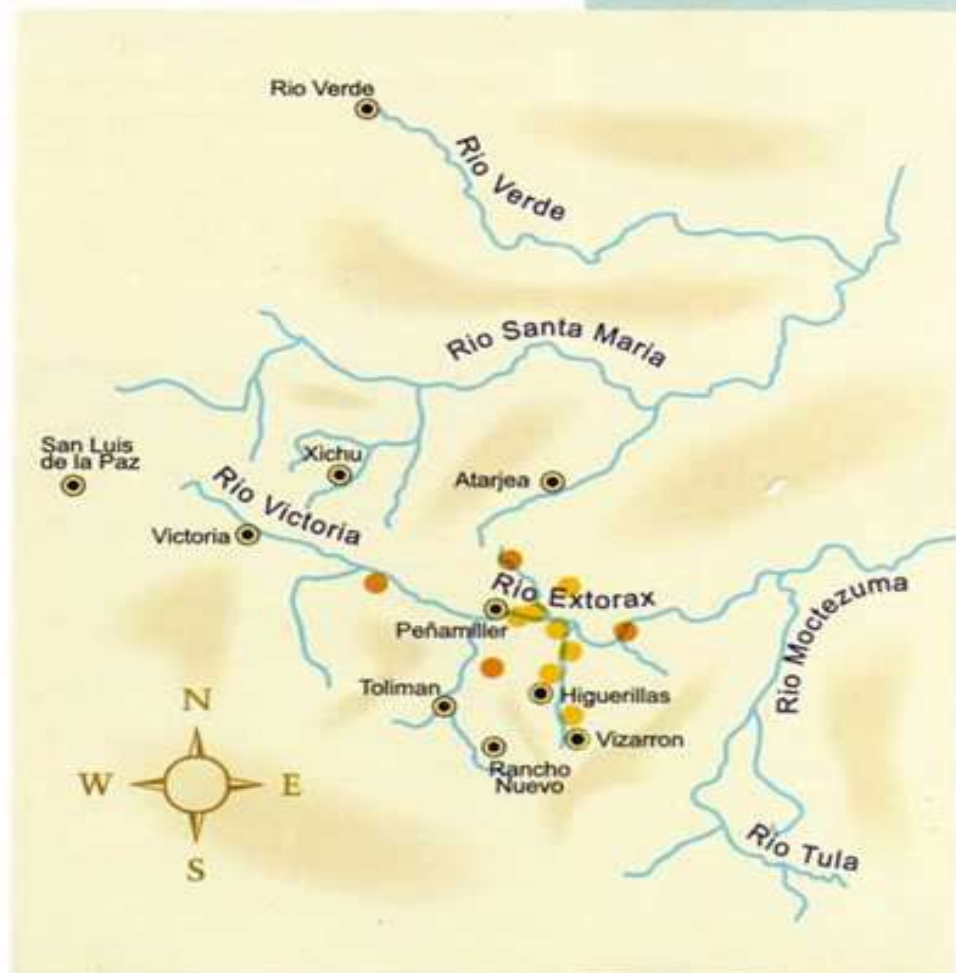
Thorny matorral with the prevalence of low bushes, including the following species of the *Cactaceae*: *Astrophytum ornatum*, *Coryphantha cornifera*, *C. clava*, *C. erecta*, *Echinocactus platyacanthus*, *Ferocactus echidne*, *Mammillaria parkinsonii*, *M. camptotricha*, *M. elongata* subsp. *echinaria*, *M. uberiformis*, *Opuntia microdasys*, *Strombocactus disciformis*, and *Thelocactus leucacanthus*.

Notes:

The first discovery of the plant was mentioned in Safford (1915), who wrote about a 'southern' type of the lophophora coming from the state of Querétaro. He wrote that the plant had been discovered on a scientific expedition by Dr. J. N. Rose

19. *Lophophora diffusa* near Pena Miller, Qro. The plant is partly shielded by the bush in full growth

Map 3:  
Extent of *Lophophora diffusa*. The species inhabits a relatively small area in the central Querétaro State. Moving around is extremely difficult unless you follow a road. The easiest way to penetrate deeper is to follow the dry riverbeds. Light spots indicate observed localities, darker spots are localities we have reports on





in 1905, who travelled with Altamirano.

The first to realise it was a new species was A. V. Frič, who described it as *Anhalonium* sp. fl. luteo Frič.

The name *Lophophora echinata* var. *diffusa* was validly published by Croizat in 1944. *Lophophora echinata* Croizat itself is a synonym of *Lophophora williamsii* (SD.) Coult.

The name only became widely acknowledged and widespread from the writings of Dr. Helio Bravo in 1967, who published the combination *Lophophora diffusa* (Croizat) Bravo.

Jan Říha and Rudolf Šubík circumscribed the species in detail in an



20.–21. *Lophophora diffusa*, north of Vizarrón, Qro., in the vicinity of a dry riverbed, on top of hummocks of alluvial sedimentation. The plants are often clustered, and flowers usually yellowish, while pinkish flowers are rarer

22. *Lophophora diffusa* on an elevated plateau hiding under bushes in the dry season at Pena Miller, Qro.



article (*Kaktusy* 15: 3, 1979) of outstanding quality, which forms the foundation of the following text.

Říha studied the populations of *L. diffusa* in Querétaro along the road between Vizarrón and Jalpán in 1977. The area can be outlined on the map by drawing a triangle connecting the settlements of Vizarrón, Río Blanco and Toliman. Occurrence was irregular, of varying density, and not peculiar to any particular type of substrate, subsoil or the type of accompanying vegetation!

According to Říha, the only morphological feature distinguishing *L. williamsii* from *L. diffusa* was the form







23.-24. *Lophophora diffusa*, Pena Miller, Qro. Beautifully symmetrical specimens. Note the number of ribs on all three plants on this page is 21. The variability in the plants in this locality is great

25. *Lophophora diffusa*, the Pena Miller diversion, Qro. The largest observed plants with the highest rib count. They grow largely solitary on a slope. All ten flowers observed were almost identical in colour.



of the stem, which grew 'diffuse' ribs in adulthood. This morphological difference, however, is also supported by other chemical, physiological, caryological, ecological and phytogeographical differences.

Great variability was observed in the size, number of stems, colour of the epidermis, flowers and fruits, and size of the seeds. This variability became especially obvious when the features and properties of plants from different sites were compared – proving geographical dependency.

Plants near Río Blanco (representatives of the northern populations), coming from less fertile, stony soils, are robust

and their stems grow up to 22 cm in diameter. They do not usually sprout, and their ribs are rather distinctive, up to 8 mm deep. The stem colour is mostly green to blue-green, but may also be grassy green with bluish hints in the sun. The plants grow a robust storage root. The perianth is rather long, 2.8 cm, translucent white to pink or cherry red. The proportion of pink-flowered plants is high among the northern populations, while white is the dominant colour in the central area. The fruit colour follows the same tendency, white to rosy red. The exceptional individual with a yellowish flower is also occasionally found throughout the area.

The southern plants (Vizarrón), growing in more convenient localities on sandy alluvium, produce massive clusters of up to 30 heads, each of which may be over 10 cm in diameter. Their ribs are indistinct, and the stem is often yellowish in colour. The beet-like rootstock is not developed quite so markedly.

At first the seedlings grow with straight ribs, but as they grow larger, these break down into separate podaria, and the typical diffuse ribs only develop after the plant has grown to 6–7 cm diameter. The areoles are bare at first, with more abundant wool and cotton appearing only in adolescence.

The colour intensity of the epidermis



26.–27. *Lophophora diffusa* near road no. 120, on a slate slope, within sight of *Strombocactus disciformis* v. *minus*



can change with the development of an individual, due to climate, damage, or the water supply (the stem colour, for instance, is most intense after the plant has shrunk). *L. diffusa* does not interbreed with any other lophophoras in the wild.

Řiha and Šubík suggested the definition of *L. diffusa* be refined with the following details:

"The stem can be single to intensely clustered; the epidermis is green, blue-green or even yellowish green; the characteristic diffuse appearance only develops in maturity; flowers are mostly white or pink, rarely yellowish; fruits are purple-red to white."

28.–29. *Lophophora diffusa*  
Higuerilas, Qro. The epidermis  
is often purple-tinted when not  
in growth



*Lophophora koehresii* (J. Říha)  
Bohata, Myšák et Šnicer, comb.  
nova

We raise this taxon to the level of species, because it differs sufficiently from *L. diffusa* to justify this rank.

*L. koehresii* is a separate species because:

1. it inhabits an area separate and disjunct from that of *L. diffusa*
2. it differs from *L. diffusa* in its ecological preferences
3. it has distinct morphological features, such as fruit shape, body colour, or seed testa.

Basionym:

*Lophophora diffusa* var. *koehresii* Říha,  
*Kaktusy* 32: 70 (1996).

Name:

The species was classified to honour its discoverer, Mr. Gerhard Köhres, a renowned cactus seed trader and a great specialist on the genus *Lophophora*. As a new taxon, it was discovered by Gerhard Köhres along with Professor Schreier in 1975.

Characteristics:

Dwarf, depressed spherical, solitary species with a marked **dark green epidermis**; does not sprout spontaneously in the wild; the initially distinct ribs later break down, sometimes almost disappearing and transforming into low podaria; flowers large with mostly long and narrow petals, the white to pink colouring supplemented with brown stripes shading from the outer petals inwards, and making a characteristic colour combination; unusual spherical fruits with the remnants of the perianth shed before it ripens; the seeds are largest of all lophophoras with a very characteristic testa.

Position within the genus:

A distinct species, and the last to be so classified, closely related to *L. diffusa*.

Area of extent:

The taxon inhabits a large flat basin between Rio Verde (SLP) and Tula (Tam.).

Presence:

The species prefers the flat terrain at

the bottom of basins. It seeks the shade of taller vegetation and only rarely will it grow in the sun. Individual micropopulations are scattered in the landscape in enclaves, sometimes not easy to find. It withstands extreme conditions in the dry season by retracting the stem into the ground in a typical geophyte fashion.

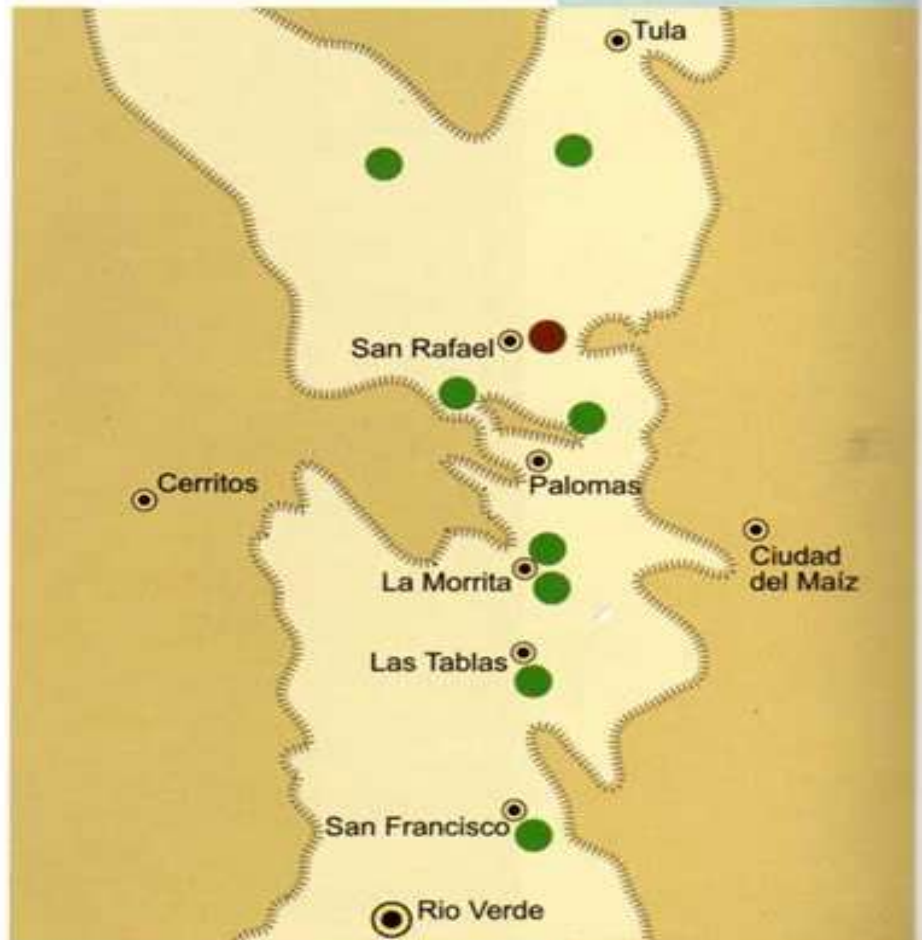
Accompanying vegetation:

Sparse, narrow-leaved matorral, dominated by bushes of the genus *Larrea*. The following *Cactaceae* are present in the accompanying vegetation: *Ariocarpus kotschoubeyanus*, *Ariocarpus retusus* subsp. *scapharostroides*, *Ancistrocactus uncinatus*, *Astrophytum myriostigma*, *Coryphantha delicata*, *C. wohlschlageri*, *C. vaupeliana*, *C. maiz-tablasensis*, *Echinocactus platyacanthus*, *E. horizontalonius*, *Echinocereus cinerascens*, *E. pectinatus*, *E. pentalophus*, *E. waldeisii*, *Echinofossulocactus erectocentrus*, *Ferocactus stainesii*, *F. hamatacanthus*,

30. *Lophophora koehresii* grows in completely flat 'kotschubeyanus' terrain, at La Morita, SLP

Map 4:

The limit of *Lophophora koehresii* is barred by a range of low hills, where no *Lophophora koehresii* is found. The find of *Lophophora williamsii* on one of them was a great surprise. Green spots *L. koehresii*, brown spot *L. williamsii*





*F. aff. echidne*, *Leuchtenbergia principis*, ***Lophophora williamsii***, *Mammillaria heyderii*, *M. picta*, *M. surculosa*, *M. microthele*, *M. albata*, *M. magnimamma*, *M. candida*, *Myrtillocactus geometrizans*, *Neolloydia conoidea*, *Opuntia imbricata*, *O. stenopetala*, *O. leptocaulis*, *O. tunicata*, *Thelocactus bicolor*, *T. tulensis*, *Turbinicarpus jauernigii*, *T. gielsdorfianus*.

Notes:

Surprisingly, this most recent of the lophophoras was imported to Bohemia as early as 1975, thanks to Vojtěch Myšák Senior, who devoted his time to studying the species already in the 1970's.



31. An adult *Lophophora koehresii* in the dry season, retracted into the ground, at La Morita, SLP

32. *Lophophora koehresii* in the growing period, at Las Tablas, SLP

33. *Lophophora koehresii*, younger plants with the diffuse ribbing clearly visible, at San Francisco, SLP



V. Myšák Senior used to order lophophora seeds from Köhres in Germany on a regular basis. In 1975, two strange plants germinated from the ten seeds marked as *Lophophora diffusa* var. *echinata*. At first he thought the seeds must have been included in error at Köhres' depot, since the seedlings resembled *L. williamsii* rather than *L. diffusa*. Until Jan Řiha described it, the two plants were grown with the provisional labels reading 'green diffusa'.

Two plants germinated in the collection of Mr. Marcel Brouma in Horšovský Týn at the same time. Mr. Bouma had identified them as *Lophophora ziegleri*, under which name he propagated them and passed





them around. He was the first to introduce the plant into Czech literature in 1994, describing it as 'the smallest of lophophoras, with the darkest stem and largest flower'.

The American botanist E. F. Anderson, who spent a long time studying the genus carefully, knew the lophophoras from near Las Tablas and had the opportunity to study them as well, as is evidenced by his collections, now deposited in the Herbarium of Pomona College, Claremont, California, with the following annotations:

– flood plain near Las Tablas, SLP,  
3400 ft. E. F. Anderson 1752, POM

34. *Lophophora koehresii*, at the northernmost known locality at Miguel Hidalgo, Tam.

35. *Lophophora koehresii*. The largest observed plant measured 9.5 cm in diameter in the dry season! At Las Palomas, SLP, where the plants are very rare

36. *Lophophora koehresii*. The westernmost known locality at Presa de Guadalupe, SLP. An adult plant measuring about 6 cm in diameter



– 13 mil. west of Ciudad del Maíz,  
3800 ft., E. F. Anderson 1182, 1615,  
POM.

(POM = Herbarium of Pomona College,  
Claremont, California.)

Anderson classified the plants as *L. williamsii*. The localities belong in the area of *L. koehresii*, and it is probable that Anderson did not notice that they are very different, and actually much more closely related to *L. diffusa* than to *L. williamsii*. Both in the Las Tablas (SLP) collection and that made in a location 13 miles west of Ciudad del Maíz (SLP; identical to the locality Palomas, SLP), the plants were probably *L. koehresii*. It should be noted that we

have not studied Anderson's material in the Herbarium.

The species colonises the flat terrain of the plains exclusively. Elongated hilly ridges rise from the plain in other parts of Mexico, too, but no *L. koehresii* are found there.

The typical halophyte *Turbinicarpus lophophoroides* grows in the plains in the broad environs of Las Tablas, but *L. koehresii* has not been spotted in its company. However, *Ariocarpus kotshoubeyanus*, on the other hand, has been observed in one place with *L. koehresii* at Morita. *L. koehresii* probably seeks less salty positions with fine loess. Gypsum particles are one of the important elements in loess.

The site is usually sparsely inhabited by bushes of *Larrea tridentata* and low-growing acacias.

Compared to other lophophoras, *L. koehresii* shows a very peculiar geophytic way of life, manifested when the plant is subjected to unfavourable periods of drought. A sort of 'piston mechanism' obviously plays an important role in the survival of even young plants, where the powerful root pushes the green assimilating part of the stem above the surrounding terrain after it has soaked up water. Conversely, the plant is hidden away in its little hole in the dry season, partly blown over with dust and dry leaves.

Small colonies of several dozen plants are present in the landscape in the form of isolated enclaves. Interestingly, a great number of young seedlings is always present in each population.

The plant's closest relative within the section is *L. diffusa*, differing in its strikingly dark green epidermis, sprouting, stem size, seed size and texture, fruit shape and flower colour.

We have observed no offsetting among *L. koehresii* in the wild. Young plants have five ribs, often straight, reminiscent of *L. williamsii*. The number of ribs increases to eight with age, when they also start showing the characteristic undulation. Adult plants typically grow up to around 6 cm in diameter and have 13 ribs (up to 10 cm and 21 ribs in quite exceptional cases). The ribs break down into separate podaria in some specimens so that the ribs are no longer discernable.



In its youth, the plant seems to invest more effort into developing its underground parts. The beet-like taproot is always wider in plants of two to six years of age than the above-ground stem. Compared to the stem, the long and thick root is very robust. The proportion of the root to the stem is the greatest in all the species of lophophora. This disproportion is even more striking in young specimens, where the root tends to be several times larger than the stem, but it diminishes gradually with later growth.

The flower of *L. koehresii* is relatively large, up to 4.5 cm, and often with narrow petals. The flower typically has a prominent brown midstripe, more visible on the outside than on the inside. The flower is white to pink, but most usually pinkish. The distinctly brownish tint of the outer petals can be also seen from the inside of the flower, giving it the characteristic dusky pink hue. The stamens are white, the long style, typically projecting beyond the anthers, is white to rose pink. The stigma is white, or rosy pink in exceptional cases, sometimes with a yellowish or greenish undertone. From observations made in cultivation, the flowers of plants from the northern fringe of the habitat are darker and more rosy in colour.

In the overwhelming majority of cases, the fruit isn't cylindrical, and we consider this to be one of the most important features. Instead, the fruit is spherical, on a short peduncle, pink to yellowish. The dry remnants of the flower will be very easily removed from the fruit even before it is

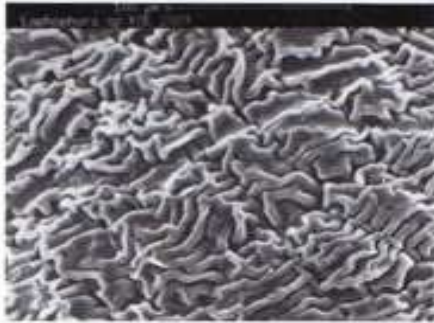
37. *Lophophora koehresii* at Miguel Hidalgo, Tam. The plants retract up to several centimetres underground in the dry season



38. *Lophophora koehresii* at Palomas, SLP. The intense colouring of the plants was surprising. Flower colour intensity may vary according to the season

Comparison of seed surface structure of *L. koehresii* (left) and *L. williamsii*

39. A *Lophophora koehresii* site near Presa de Guadalupe. Completely flat terrain again with sparse bushy vegetation



ripe. This attribute is more noticeable than in any other species within the genus.

The fruit is relatively small, the number of seeds usually under 20, which is the lowest total within the section.

The seeds of *L. koehresii* are the largest of all lophophoras, and are also totally different in the nature of the testa sculpturing.



***Lophophora fricii* Habermann**

## Basionym:

*Lophophora fricii* Habermann, *Kaktusy* 10: 123 (1974).

## Name:

The species was named to honour one of the greatest Czech cactus growers, Alberto Vojtěch Frič, who was the first to collect the plants in Mexico and bring them to Europe as a new species.

## Characteristics:

A flattened spherical species of solitary to markedly clustered growth and an immense diversity of features; the numerous ribs are conspicuous to absolutely diffuse; the colour of its thin epidermis varies from yellowish green to greyish green; flowers vary from nearly white to dark purple-pink; seeds are similar to those of *L. williamsii* at first sight, but differ in the shape of the hilum, which is reminiscent of a shark's maw, and in the texture of the testa.

## Position within the genus:

Separate, disjunct species of the section *Diffusae*, showing certain exterior similarities to *L. williamsii* in spite of its unequivocal position in this section.

## Geographical range:

Laguna de Viesca bounded by the Sierra El Mármol to the south, Sierra de Parras to the east, and Sierra de Zavaleta to the north of the lagoon.

## Ecology:

On the sides and base of the mountains bordering a lagoon; it seeks protection under taller vegetation, but can also grow in direct sun.

## Accompanying vegetation:

Xerophilous matorral (matorral xerófilo) with large proportions of the genera *Larrea*, *Fouquieria* and *Agave lechuguilla*. The following *Cactaceae* are found: *Ariocarpus fissuratus* subsp. *lloydii*, *A. kotschoubeyanus*, *Astrophytum coahuilense*, *A. capricorne* subsp. *senile*, *Ancistrocactus uncinatus* subsp. *wrightii*, *Coryphantha* aff. *borwigii*, *C. durangensis*, *C. poselegeriana*,

*C. difficilis*, *C. macromeris*, *Echinocactus horizontalonius*, *E. texensis*, *Echinocereus enneacanthus*, *E. pentalophus* subsp. *leonensis*, *E. stramineus*, *E. spec. „Zavaleta”*, *Escobaria strobiliformis*, *E. spec. nova*, *Epithelantha greggii*, *Ferocactus hamatacanthus*, *F. stainesii*, *Mammillaria coahuilensis*, *M. lenta*, *M. chica*, *M. candida*, *M. pottsii*, *M. grusonii*, *Neolloydia conoidea*, *Opuntia imbricata*, *O. aff. bulbispina*, *Thelocactus bicolor*, *T. bicolor* subsp. *bolaensis*. The presence of *Bursera fagaroides* and the compact form of *Agave victoriae-reginae* is also worth mentioning.

## Notes:

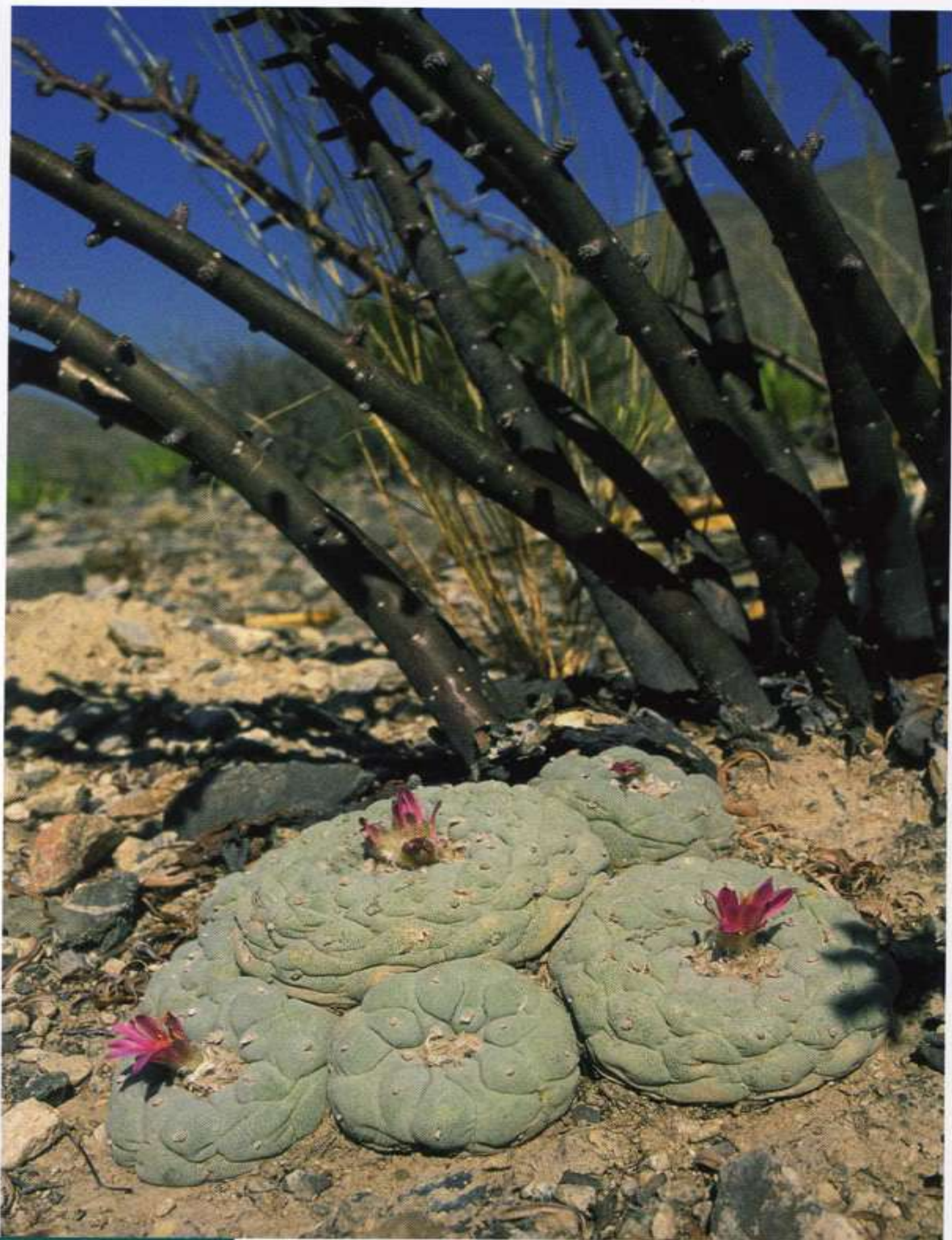
The cactus grower's world outside parts of Europe does not recognise *L. fricii* and does not seem to want to. It is often considered an insignificant variation of *L. williamsii* or is denied recognition altogether. However, the evidence of the exceptional nature of the taxon is conclusive.

Towards the end of the nineteenth century, the Norwegian ethnographer Carl

40. *Lophophora fricii* at the foot of the Sierra de Paras near El Amparo, Coah.

Map 5:  
The habitats of *Lophophora fricii* lining the Laguna de Viesca, Coah.  
1. south of Viesca,  
2. La Pe,  
3. Sierra Zavaleta,  
4. El Amparo





Lumholtz spent time among the half-wild native American tribe of Tarahumars. He was the first to bring the news of this plant in his paper 'Unknown Mexico' published in 1902. He wrote of a plant named by the Tarahumars 'hikuli walula saeliامي' (of masculine gender in their grammar), meaning 'the supreme' or 'the great master' among lophophoras and other narcotic cacti. Furthermore, Lumholtz stated, 'It is very precious among the Tarahumars and I have never seen one, but it was thus described to me: It grows in clusters of twenty to thirty centimetres in diameter, it looks like waname (hikuli waname = *Lophophora williamsii*) surrounded with many young offsets. All



41.–43. *Lophophora fricii* near El Amparo, Coah., plants with a beautiful silver-grey epidermis often form clusters, and the flower is often dark pink. The bottom picture shows the largest observed cluster measuring 60 cm in diameter

the other hikulis are its servants. The reason why so few of these plants are brought to the Tarahumar country is its gluttony. It requires bull [droppings] for food and is not content with mere sheep, goat or suchlike'.

A live plant of *Lophophora fricii* was discovered for European science by Alberto Vojtěch Frič during his only journey to Mexico in 1923. He named it *Anhalonium sp. fl. rosea* Frič.

Frič arrived in San Pedro in Coahuila, where he had had information about "a different variety of peyote growing in that country". Further, he wrote, "So I circled the Sierra de la Bola from the south, where the calcareous soil is drier





44.–45. *Lophophora fricii* at La Pe, Coah. They prefer rock crevices at this extreme site. The flower colour varies from light to dark pink

46. *Lophophora fricii* in the Sierra Zavaleta, Coah. An old plant that will soon form 21 ribs. Solitary plants like this one are exceptional at this site



and more elevated. A bridge fell apart in those parts a few months ago and the train that I was taking fell into a stream. I decided to use the four days needed for the train to be fixed to explore the area." Among other species, he found about three hundred plants of 'great master hikuli', the genuine *Anhalonium sp. fl. rosea*.

It is not known where Frič had received the news of 'a different variety of peyote'. Reading Frič's accounts, it seems possible that it might have been from the Tarahumar Indians, whom he had already met and may have asked, as he was aware of Lumholtz's spectacular description. Frič's all-season Renaissance-like personality not only incorporated the profession of

a 'cactus hunter' but also, maybe even more importantly, that of an ethnologist. He deftly combined these work styles, and information from the natives led him to make interesting discoveries time and again. Frič brought the plant, called by the natives „Hikuli hualala saeliami" (and strictly distinguished from *L. williamsii*) in his own account, to Europe. Unfortunately, a major part of his collection died from frost at the Podmokly customs station.

Frič also made a brief account (judged by current measures) of the characteristics of the plant and published some rather sketchy information on the place where it was found. He described the flower as dark red to pink. For the place of occurrence he

gave limestone rock formations near San Pedro in central Coahuila.

Frič's *Anhalonium* sp. fl. rosea did not make it into collections. Pechánek does write of one plant allegedly originating from Frič, but there is no other credible information to confirm that the red-flowering lophophoras from Frič had survived the Second World War.

In the mid 1960s, Vlastimil Habermann used the information published by Frič, and sent his rather inaccurate information concerning the habitat to several cactus explorers asking them to try to find the plant. Independently, two of them were successful.

The first of them was Dale B. Morrical,



47. *Lophophora fricii*. The only observed plant in flower in the Sierra Zavaleta, Coah.

in the locality south of Viesca in 1987, and Roman Stanik sighted them in the same spot in 1993. The plants bore white flowers in cultivation, although they were *L. fricii* in every other way. Rudolf Grym gave them the provisional title 'the white Frič' with the field number RS 404 corresponding to the find. Based on information received from Bušek, explorers Jaroslav Šnicer and Libor Kunte examined the *L. fricii* habitat on the mountain slopes south of Viesca in June 1992. The plants in the locality really bear flowers of rather light colours (ranging from white to very pale pink).

The ecological character is quite different from that of e. g. *L. williamsii*. In habitat, *L. fricii* colonises crevices of almost bare

48.–49. *Lophophora fricii* to the south of Viesca, Coah. Very pale to rarely white flowers are typical for this site

a retired army officer and a member of a cactus and mineral amateur collectors' club in Las Cruces, New Mexico, USA. Morrical discovered lophophoras in a locality near Parras de la Fuente, Coahuila, growing on eastern slopes shaded by bushes. He sent the plants to Habermann.

Denis Cowper was the other, a successful lawyer and the owner of a cactus nursery trading as 'New Mexico Cactus Research', who found a locality east of Viesca, Coahuila. He also sent a few plants to Habermann.

Habermann described *Lophophora fricii* in the journal *Kaktusy* in 1974.

Alexander Lux, too, found plants



rock on steep precipices, from the middle of the slopes upwards. The plants are predominantly solitary, sometimes forming small clusters, and always preferring the eastern slope. They certainly do not grow everywhere. The size of the stems of individual plants is up to 8 cm in the most turgid state, but otherwise mostly 4–6 cm in diameter.

The character of the other habitat in the same mountain range south-east of Viesca, examined by Staník in 1995, is similar. The plants are also very similar, except they are more inclined to sprouting. The only plant in flower to be observed in this locality had a pink flower.

Our team (Bohata, Myšák, Šnicer) has

been directing its exploration to lophophora habitats since 1996. We had tried to find them in many places throughout the entire area of Laguna de Viesca.

Four localities of *L. fricii* are precisely known at the present, all of them in the south-western part of the state of Coahuila. Two are located south of Viesca in the mountainous massif of the Sierra El Marmol, one is north of Viesca in the Sierra Zavaleta, and one is east of Viesca at the foot of the Sierra de Parras. According to our present findings and consultation with Köhres in Germany, the two latter localities are nearest to the *L. williamsii* habitats as the crow flies.

In the Sierra Zavaleta, the plants take advantage of the favourable micro-climate of ravines and dry watercourses, coming down to the very bottoms of their mouths at the foot of the hills. Predominantly, they colonise rock crevices. They make clusters of several dozen heads, reaching total widths of up to 40 cm and heights of 15 cm in the plump state, but solitary plants are also present. The epidermis of the plants is of a greyish green colour. The flowers seen in habitat in November 2002 were deep pink. We suppose that it was the high proportion of caespitose plants in the population that led Reppenhagen to call them *L. williamsii* var. *caespitosa*.

The plants east of Viesca form immense mounds of dozens of greyish heads of a nearly monumental impression. The clusters reach as much as 60 cm in length and 20 cm in height in the saturated state. The plants are chiefly found in plains. Solitary plants are rare, but the greatest of them was fully 15 cm in diameter. Lophophoras were observed to stretch over a distance of approximately two kilometres. We assume today that the plants Bouma got from Gerhard Köhres in 1983 had come straight from this locality. We have also managed to get hold of a detailed drawing by Cowper, which shows clearly that he had collected *L. fricii* in this very spot. The plants in this locality bear deep pink flowers.

50. *Lophophora fricii*, south of Viesca, Coah., in rock crevices which only offer a very limited potential for growth



## Section *Lophophora*

### Common features and characteristics of the section *Lophophora*:

Similar chemical composition of alkaloids, with mescaline alkaloids prevailing. With few exceptions, the various forms of *L. williamsii* are autogamous. The flowers have a shorter flower tube. The epidermis is rather thick and tough, often with a purplish undertone. The ribs are distinct, straight or spiralled in a maximum number of 13. Typically, horizontal notches form in the ribs. Sometimes the areolae merge into a nearly unbroken line. The wool is sticky, solidifying into tough crests and staying on the plant for a long time. The roots typically have quite a rough texture.

### *Lophophora williamsii* (SD.) Coult.

#### Basionym:

*Lophophora williamsii* (Lem. ex SD.) Coult., *Contr. U.S. Nat. Herb.*, 3: 131 (1894).

#### Name:

Charles Lemaire named the species after Sir C. H. Williams, the British Ambassador to the state of Bahia.

#### Characteristics:

Flattened or depressed, spherical plants with solitary to clustering stems; the ribs are distinct, only occasionally broken into podaria; the greyish green epidermis is of a firm nature and bears a thick layer of cutin and surface waxes. Flowers rather small with a short tube in pinkish white to richly pink hues. The pink cylindrical fruit bears the remnants of the perianth. Seeds black, distinct from those of the other species.

#### Position within the genus:

Separate species in a monotypic section. It is further divided into two types (northern and southern) and other forms, which we have been unable to distinguish reliably.

#### Geographic range:

The species spreads over an enormous area encompassing the following Mexican states: San Luis Potosí,

Tamaulipas, Nuevo León, Zacátecas, Coahuila, Durango, Chihuahua and Texas (USA).

#### Ecology:

Variable; the species is found both on the flat valley bottoms (e.g., Real de Catorce, Hipolito, and Huizache), and also on limestone rock faces (e.g., Sierra de la Paila, Cuatro Ciénegas, and San Ignacio de Texas). Like all the other lophophoras, it prefers moderately shaded positions.

#### Accompanying vegetation:

It is doubtful that a complete list could be compiled, as we are speaking about a large part of the Chihuahuan Desert. The following listing of cacti is to provide a rough overview: *Ariocarpus retusus*, *A. retusus* subsp. *scapharostroides*, *A. retusus* f. *elongatus*, *A. kotschoubeyanus*, *A. fissuratus*, *A. fissuratus* subsp. *hintonii*, *A. fissuratus* subsp. *bravoanus*, *A. fissuratus* subsp. *lloydii*, *Ancistrocactus scheerii*, *A. uncinatus*,

51. *Lophophora williamsii* at the northern tip of the Sierra de la Paila near El Sacrificio, Coah. The several observed plants bore intensely pink flowers

#### Map 6:

*Lophophora williamsii* colonises a vast area with the highest population density in its centre. Red spots – some of localities we observed:

1. Area north of Saltillo,
2. Mina,
3. Paila – El Oso,
4. Tangué Menchaca,
5. Cedros – Tecolotes,
6. Cardona,
7. Cedral – Real de Catorce,
8. Las Cruces,
9. El Tronque Huizache – El Coyote,
10. San Rafael,
11. La Soledad,
12. La Perdida,
13. Cuatrociénegas,
14. Reynosa,
15. La Prieta,
16. Camargo,
17. Presidio Co.,
18. Starr Co., Tx









*A. uncinatus* subsp. *wrightii*,  
*A. brevihamatus*, *Astrophytum*  
*myriostigma*, *A. myriostigma* subsp.  
*columnaris*, *A. myriostigma* aff.  
*strongylogonum*, *A. asterias*,  
*A. capricorne*, *A. capricorne* f. *major*,  
*A. capricorne* f. *minor*, *A. capricorne*  
 subsp. *senile* v. *aureum*, *A. capricorne*  
 subsp. *niveum*, and many others. We  
 have intentionally included taxa that  
 demonstrate the great diversity  
 in the occurrence of *L. williamsii*.

#### Notes:

The history of *L. williamsii* is long and complex, but let us start with the first ever description:

Hernández, the private physician to King Felipe II of Spain, gave peyotl its first name in 1638: **Peyotl zacatensis**. In his book „*De historia plantarum novae Hispaniae*,“ he describes *Peyotl zacatensis* as follows: „*The root is roughly medium-sized, and does not sprout branches or leaves above the ground. It is covered with a tightly fitting coating of feltlike cotton which is why I cannot portray it distinctly. It is said*

*to be harmful to both men and women. To my taste, it was sweetish and slightly savoury. It is alleged that when ground and applied to sore joints, it brings relief. Magical qualities are attributed to the root, as it makes those who have eaten it capable of seeing the future and foretell events ...*“

As mentioned before, the area of extent of *L. williamsii* is enormous, which does not mean that the density and type of location are homogenous throughout the area. Typically, the centre of distribution is the place of greatest plant density for the species. This centre for *L. williamsii* is in the northern part of the state of San Luis Potosí, the south-western part of Nuevo León, and the south-eastern part of Coahuila.

Within its extensive habitat, *L. williamsii* takes on a number of localised forms, which are described in the comments to the sites below. Nonetheless, the individual forms can be assigned to either of two major groupings. In rough terms, we call

52. *Lophophora williamsii* at El Nunez, SLP. Although this site is not very far from Huizache, SLP, the plants cannot be unambiguously associated with the southern form



53. *Lophophora williamsii*, at Huizache SLP. The many-headed clustering formation is typical. The latest increment can be observed very well on this specimen. This extremely precious site is seriously endangered by human activity

them *L. williamsii* 'southern type' (with its centre at Entronque Huizache, SLP), and *L. williamsii* 'northern type' (centred around Saltillo, Coah.).

The species can also be divided into the eastern and western lines (J. Šnicer), since the disputable sites of La Perdida (Tam.) and Reynosa (NL, Tam.) are also to be associated with the Huizache form. The sites are situated along the eastern edge of the overall habitat of *L. williamsii*.

### The 'southern type', centred around Huizache (SLP)

#### Entronque Huizache (SLP)

Among all the habitat forms, the population of *L. williamsii* from this site is the most typical. It has been long known to locals as well as to growers. One cannot fail to notice it in the area.

The plant inhabits the edges of a flat, drainless basin (so-called tanque), where the soil is fine, light ochre-coloured loess. Specimens will occasionally be found higher up the crevices in the rocky

limestone hills that jut out of the plain.

Adult plants form large clusters in the wild, with up to several dozen stems. In its youth, a plant will initially develop a single head up to 6–8 cm in diameter. It then grows several side shoots, which grow to a certain diameter then start to sprout themselves. Over decades, clusters are thus formed measuring as much as 40 cm in width and about 15 cm in height, often growing in a cushion-forming manner in the moderate shade of low bushes.

The plants from Huizache do not have a single root, instead, the individual sprouts will develop their own tuberous roots, becoming quite independent of the mother plant. This is in sharp contrast to the growth strategy of the other forms. In cultivation, plants are known which, although they sprout, develop a single huge beet-like root which only grows flat heads from the single stock.

Among all the forms of *L. williamsii*, the Huizache form is the most variable in

the regularity of ribbing. Heads with 5, 7, and 10 ribs can be found in a single cluster, and heads with 5, 8, or 13 ribs on another. Such variability in the rib count is unique, and no other form does this.

In contrast to the so-called northern type, the *L. williamsii* from Huizache is always heterogamous (the northern type plants are usually autogamous). Moreover, they differ in the structure of the flower, whose style is longer and the white stigma much smaller than in the northern form. In the shape and configuration of its flower, it is closer to the section *Diffusae* than it is to the 'northern type' of *L. williamsii*.

The plant develops more seeds in each fruit, which are about one-third smaller



54. *Lophophora williamsii* The southern form at Villa de Arista, SLP

55.–56. *Lophophora williamsii* at Cedral, near Real de Catorce, SLP. These plants are classified as being close to the southern Huizache, SLP, form, due to their flower shape and long petals

than in the other forms of the species.

The flower is dark pink to nearly white, with a characteristic pinkish tone to the petals (also sometimes lacking a distinct central stripe).

At the edges of the habitat, the form inhabits separate sites, where the individual differences are less marked. For instance, it grows predominantly singly at La Soledad (NL), Villa de Arista (SLP), Real de Catorce (SLP), and Cedral (SLP).

One of our latest discoveries are the new sites of *L. koehresii* near Palomas, Encarnacion, and Presa de Guadalupe. Thus, the habitat of *L. koehresii* has expanded to such an extent, that the habitats of *L. koehresii* and





*L. williamsii* at Huizache almost come together. The confirmed presence of the *L. williamsii* 'southern type' within the habitat of *L. koehresii* at San Rafael (SLP) is of great importance.

**The 'northern type' centred around Saltillo (Coah.)**

The northern form is most numerous in Czech collections, mainly due to its resistance to unfavourable conditions of drought, cold, water, pests and fungi, and also because it is autogamous. The flowers are robust with broad rounded petals of a very pale pink to white colour, and bear a prominent pink midstripe. The tube is short, the style is short and white, and

57. *Lophophora williamsii* north of Saltillo, Coah. A rare cristate form



58. *Lophophora williamsii* at El Oso, Coah. Huge clusters with large heads. The site has been almost destroyed by agricultural activity

the stigma is fleshy and pink-tinted. The stamens are white, reaching beyond the stigma. The anthers are yellow to orange. The fruits are pink and cylindrical, and the seeds are black, about 1 mm in diameter.

### El Oso (Coah.)

We heard about this site from Jiří Krechovský, who made our mouths water by telling tales of plants of at least 15 cm in diameter!!! As we had never seen lophophoras that big before, the decision was made. We visited the place during our 2002 journey to Mexico. And indeed, the plants were massive, the largest



59.–60. *Lophophora williamsii* at El Oso, Coah. Beautiful solitary plants, the largest (top) measuring 14 cm in diameter

61.–62. *Lophophora williamsii* at Hipolito, Coah., where it occurs without a break from the plains up into the hills





measured diameter of a single head being 14.5 cm.

They grow in the plains, largely under bushes of *Larrea tridentata* and acacias. Most of the plants are solitary, but visibly prominent are clusters up to 40 cm in diameter and 15 cm in height. The clusters develop large heads, almost all of which have flowers.

The form is without doubt associated with the northern type of *L. williamsii*. Similar plants are known around Hipolito, Coah. At the nearby localities at the foot of the Sierra de la Paila (Coah.) they seem to be less similar, but the deviations observed may only be the result of different nutrition or habitat conditions.

63. *Lophophora williamsii* at Tecolotes, Zac. An old plant at a hill summit in an exceptional position



64.–65. *Lophophora williamsii* at La Prieta, Coah. The dense population, very small in extent, was made up of solitary and clustering plants. Plants are rare at the northern edge of the habitat



### Tecolotes (Zac.)

This is one of the westernmost localities, where the plants on a shallow slope (and also in the plains around, it is said by other explorers) in a rocky, hilly terrain. The younger plants bear straight ribs, becoming sinusoidal in some of the older ones. They grow singly.

The flowers, borne on a short tube, are darker than the usual colour in cultivated *L. williamsii*.

**This plant is also related to the northern form**

### La Prieta (Coah.)

The second northernmost locality in Mexico that we have observed. The plants

inhabit the slope of a low rise, among stones and limestone outcrops. The plants are relatively variable. They grow singly, or occasionally form clusters of tiny heads. The flowers are pale pink on short tubes. It grows here with *Ariocarpus fissuratus*.

### Camargo (Chih.)

This is the northernmost locality in Mexico that we have observed, for which information we thank Gerhard Köhres. The place is very far away from the other known sites. The plants are present in isolated medium height limestone hills. Volcanic rocks prevail over limestone sediments in the area.



66.–68. *Lophophora williamsii* at Camargo, the only verified site in the state of Chihuahua. Not a single plant among the hundred observed were sprouting.





69. *Lophophora williamsii* at Cuatrociénegas, Coah. A large plant in the growing period



70.–71. *Lophophora williamsii* at the centre of its total distribution in the Sierra de la Paila, Coah. Plants on the hillsides are highly variable





72.–73. *Lophophora williamsii* at Arteaga, Coah. The plant is plentiful near Saltillo

74.–75. *Lophophora williamsii* at Cuatro de Marzo, Coah., showing an interesting dark shade to the flower

The plants were found on the slope towards the summit, accompanied by the typical vegetation of the Chihuahuan Desert (*Bursera*, *Larrea*, *Fouquieria*).

Out of interest, let us quote A. V. Frič: '*Anhalonium spec. 6*, geographical extent over the state of Chihuahua, the body is blue-green, max. 13 lines, wool not shed, forming large crests which stick together and solidify. The flower is yellowish, and the fruit transparent white. This species is the closest to the description of *Anhalonium lewinii* Hen.' The kind reader may get a good impression of it from the photograph. We found the features fitting Frič's description, except for the colour of the fruit and flower.



76.-77. *Lophophora williamsii*  
at La Perdida, Tam. Largely  
clustered plants which seek  
dense accompanying  
vegetation



78. *Lophophora williamsii*,  
south of Reynosa, NL/Tam.  
A surprisingly uniform, "naked"  
look to the plants



In addition, well known sites are inhabited by the northern form of *L. williamsii*, such as those at Cuatrociénegas, Saltillo, Sierra de la Paila (all in Coah.), and numerous others.

**Forms so far not classified:  
La Perdida (Tam.)**

The plants here grow in a flat valley, almost on the plain, among a thick growth of tall bushes and *Agave lechuguilla*. Approximately 50 plants were seen at this site, mostly distinctly clustered with the largest clusters measuring 25 cm in diameter and 10 cm in height. The dark green colour of the stem was conspicuous. The only

flower so far noticed corresponds to the typical northern form of *L. williamsii*.

Vojta Myšák adds: 'What surprised me enormously was that 3–4 months after germination, the tiny seedlings grew even smaller sprouts from almost every areole. Over the 14 years I have been raising lophophoras, I have only seen this kind of behaviour in the cultivated plants of *L. williamsii* var. *caespitosa*, which do it regularly. This is in no way to say that the *L. williamsii* from La Perdida correspond to what we know as *L. williamsii* var. *caespitosa* from cultivation.

(Note: J. Šnicer is not certain of the plant's kinship to the northern



79. *Lophophora williamsii*, south of Reynosa, NL/Tam. The easternmost visited site in the Tamaulipas Depression, in gently rolling terrain with bushy vegetation

80.–81. *Lophophora williamsii*, San Rafael, SLP, growing on the summit of a low hill. Although *Lophophora koehresii* is present in the surrounding plains, the flower shows a close relation to the plants from Huizache

form, preferring to associate it with the southern form from Entronque Huizache.)

### Reynosa (NL/Tam.)

In this so far northeasternmost locality in Mexico, the plants grow on moderate rises within the so-called Tamaulipas Depression. The surface below them is formed by fine loess with small pebbles mixed in. They grow predominantly singly, but occasionally form groups of several heads. The largest plants do not exceed 8 cm in diameter. Older plants usually have sinusoidal ribs and areoles devoid of wool. Flowers have not been observed.



82. *Lophophora williamsii* at Cardona, Zac., a site at the edge of the overall area of extent. One hour of intense searching only resulted in two plants being found



83. *Lophophora williamsii* at Sacrificio, Coah., a sloping site



84. *Lophophora williamsii*, San Ignacio de Texas, NL. An interesting form on a low limestone outcrop





85.–87. *Lophophora williamsii* at Tanque Menchaca, Coah. A robust solitary-growing form characterised by transverse notches in the ribs, found at the bottom of a valley, bearing small flowers with shorter petals

### San Rafael (SLP)

This earlier find by J. Chvastek has grown in importance since the discoveries here of new sites of *L. koehresii*. This population of *L. williamsii* intrudes into the habitat of *L. koehresii* in the form of an isolated enclave. It colonises the summits of low hills, pressed among limestone boulders. This site is typical of the differences between the preferred localities of *L. williamsii* and *L. koehresii*. The plants tend to change colour to purple in the dry season. The population is likely to be related to the southern form from Entronque Huizache.



### Tanque Menchaca (Coah.)

The plants are scattered in enclaves over the bottom of a flat valley, amounting up to ten specimens per square meters in places. They are rarely found on slopes. They grow predominantly singly, and where several plants are found growing together, they seem to be separate individuals, as all the heads are nearly the same size. Smaller sprouting was not observed. The plants reach over 10 cm in diameter, with straight or slightly spiralled ribs, distinctly transversally notched in old age. The flowers are small, with short tubes and numerous petals. The plant could belong in either group, and is one of the most beautiful forms.



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## Cultivation

The cultivation of lophophoras cannot be declared entirely easy. There are two groups of plants differing in their demands. The most widespread form of *L. williamsii* is a relatively resistant and adaptable cactus, which is why it is by far the most frequent species in Czech collections. The other species, including *L. diffusa*, *L. fricii*, *L. koehresii*, and the Huizache form of *L. williamsii*, on the other hand, are much more sensitive and prone to loss. Patience is needed. Here are several basic observations of their cultivation requirements:

- fresh air, sufficient light and warmth are the fundamental prerequisites,
- careful watering is important,
- generally, coarse, largely mineral substrate is safest; the plants do not grow as fast in it, but it prevents rotting through its good drying ability,
- watch out for temperature drops associated with watering,
- too much sunlight is especially

dangerous for *L. fricii*, which is sunburnt more easily than the other species,

- also, watch out for cracking in *L. fricii*, there is no safe way to prevent it (the wound must be left to heal in the dry,
- *L. diffusa*, coming from the warm southern areas, is more prone to root rot when the temperature drops than the other species. Therefore be careful with the spring and autumn watering,
- totally dry substrate is an absolute must for all lophophoras in winter,
- maintain the genetic quality of cultivation material by cross-pollinating plants only from the same sites,
- grafting succeeds can be employed to speed up the flowering; *Peireskiopsis* is best for tiny seedlings, *Eriocereus jusbertii*, *Echinopsis* hybr. or *Trichocereus pasacana* are most suitable for mature plants or sprouting plants (the latter is especially good for *L. fricii*).

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Thank you all the Authors

Dear friends, we hope you found our dissertation on the genus *Lophophora* interesting. We will continue our research and would like to ask you for your help. Should you find any information from overseas or elsewhere, which you consider useful for us, please, let us know. We would like to ask in particular travellers in habitat, who see lophophoras on their journeys, to let us know and if possible to take a picture of the plant for us. Thank you very much for your help in advance!

Please, send your comments, information and question to:  
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