557-563. 2010.
Lankesteriana 9 (3):
The discovery has *xerophyticum Mexipedium* been ranked as one of the most remarkable findings of neotropical orquideoflora in recent decades (Salazar and Hágsater, 1997). Although this species has some horticultural interest, their importance lies more in biological terms, as it has changed the ideas that took on the phylogenetic relationships and biogeographic Cypripedioideae subfamily (Albert, 1994, Albert & Chase, 1992 Chase, 1996; Salazar & Hágsater, 1997; Shefferson, 2007, Leitch, 2009).
The story of the discovery of this species was documented since its original description (Soto-Arenas *et al.,* 1990) yhasidoretomadaenotrasocasiones (Salazar-Chávez & Hágsater, 1997; Hágsater & Soto Arenas, 1998). Similarly, some descriptions detailed in this species have already been published (Soto-Arenas *et al.,* 1990; Soto, 2003 Soto-Arenas & Solano-Gómez, 2007). In this way, we now know *M*. is a genus *xerophyticum* paleoendemics, exclusive to the region of Los Chimalapas in the state Mexican Oaxaca. It should be noted that the description habitat was also conducted since the publication original of this species, however, information on their habitat has been deformed in publications subsequent up to consider *Mexipedium* as a kind of desert (Koopowitz, 2008). Others aspects of this species have also been studied, its cytology (Cox, 1997) or vegetative anatomy (Sandoval *et al.,* 2003), but due to their rarity still has many important unknown (Cox *et al.,* 1998; Shefferson, 2007).
The cultivation of this plant has caused some orchidologists and impact among the fans and already developed several papers on this topic (Koopowitz, 1995, 2008; Pasetti, 1995, LeDoux, 1996; Reddy, 2008; Anonymous 2009th, b). Therefore, This paper will address two key points the value of this species: (i) their particular phylogenetic position and evolutionary interpretation, and (ii) the habitat and conservation status of this species.

Evolution and phylogeny

Since its publication, *Phragmipedium xerophyticum*

has moved and has been general
also located in two genera: *Mexipedium*
Paphiopedilum, in chronological order of
respective publications. Until now, these are the
only known synonyms for this species:
Phragmipedium xerophyticum Soto Arenas, Salazar &
Hágsater. Orquidea (Mexico) 12 (1): 2. 1990.
Mexipedium xerophyticum (Soto Arenas, Salazar &
Hágsater) VA Albert & MW Chase, *lindleyana*
7 (3): 174. 1992.
Paphiopedilum xerophyticum (Soto Arenas, Salazar &
Hágsater) VA Albert & Pett Borge., Lindleyana
9 (2): 138. 1994.
Although his position in any of the three genera
is feasible consistent with the phylogenetic analysis,
has now accepted its location as a
monotypic genus different (Pridgeon *et al.,* 1999; Soto
2003). It is postulated that *M. xerophyticum* is a
relictual species representing the only survivor
of a basal clade among leaf cypripedioides
conduplicate, with features intermediate between
Phragmipedium are distributed exclusively
in the Neotropics and are *Paphiopedilum*
own old world (Salazar-Chávez & Hágsater,
1997, Shah *et al.,* 2003; Soto Arenas & Solano-
Gomez, 2007). The genome has *Mexipedium*
size of 1C ¼ 6.73 pg, 2n ¼ 26 chromosomes,
making it very similar to *Phragmipedium,* so
is regarded as its sister genus (Leitch *et al.*
2009). Consistent with these results, being based

E
Duardo
a. P
Erez
-G
Arcia
Department of Ecology and Natural Resources, Faculty of Sciences, National Autonomous
University
Mexico, Ciudad Universitaria, Mexico 04510, DF, Mexico.
eduardo.perez-Garcia @ ciencias.unam.mx

molecular studies, Albert (1994) found that
Paphiopedilum Mexipedium separation between data and
between 16.4 and 23 million years, so at
biogeography has been considered as an example
of the former early Miocene flora boreotropical
(Salazar-Chávez & Hágsater, 1997, Soto-Arenas &
Solano-Gómez, 2007). The presence of elements
boreotropical the flora, which relates to the flora of
Norteaméricaconlaasiática (Tiffney, 1985a, b; Cevallos-
Ferriz & Gonzalez-Torres, 2005), seems to be very
important habitat in the region *Mexipedium* (Wendt,
1989). In fact, one can argue that in general,
the Oaxacan orquideoflora has consistently
several of the most basal lineages in Orchidaceae
respective phylogenetic groups (Soto & Salazar, 2004).
Note that the Cypripedioideae are one of the
older groups of Orchidaceae, and therefore
the analysis of this group of plants is important for
understanding of the evolutionary history of a family
that has a source since the 111-119000000
years (Janssen & Bremer, 2004).

Habitat

Xerophyticum Mexipedium only been collected in
a town in the region of Los Chimalapas in
Isthmus of Tehuantepec, Oaxaca. In addition, only
hearing a particular limestone outcrop 320 m
asl The exact locations of *M. xerophyticum* has
kept guard at the Herbarium AMO, this with
collections in order to prevent poaching.
The *Mexipedium* are plants that produce modules
in the form of fans and since they occur
stolons with new fans, allowing for some
clonal expansion. However, this expansion appears
clonal is apparently somewhat limited in the habitat
the existence of a natural microbial mat (Salazar
& Hágsater, 1997). In the original issue
Search for this species in 1988 were only
seven clusters of plants that probably represent
different genotypes (genetic Soto-Arenas *et al.,* 1990).
This number was obtained considering genetos
spatial separation between floors, but without using any
molecular marker to see if they are truly genetos
different or not. In this expedition was extracted a genetic
Full and part of another (Salazar & Hágsater, 1997
Hágsater & SotoArenas, 1998). Apart from these plants
have spread all known in cultivation

outside Mexico, both as vegetative propagation
from seed (LeDoux, 1996; Salazar & Hágsater,
1997; Hágsater & Soto Arenas, 1998, Soto-Arenas &
Solano-Gómez, 2007).
Posteriormenteasudescubrimiento, dosgenetosmás
were extracted in its entirety by an amateur. Until
now there is no idea on the whereabouts of these
two floors, unless they were originally carried
Minatitlan, Veracruz (Soto Arenas & Solano-Gómez,
2007). In July 1996, a new survey
botany at the resort, Gerardo Salazar found two
genetos new, so that by that time only
had counted six different genetic state
wild. It should be noted that although there has been
fruit production in the country (in 1988, 1996,
1997; Soto Arenas & Solano-Gómez, 2007), all
plants observed are adults and there is apparently no
recruitment of new individuals from
sexual reproduction (Salazar & Hágsater, 1997). The
Mexipedium habitat area has been explored
detail and no new sites have been detected if
While their existence is not excluded, apparently these
outcrops are not common on the site and large
part of the forest that surrounds them has already been transformed
(Salazar & Hágsater, 1997). For these reasons, it has
considered likely *M. xerophyticum* not
viable population can maintain any state
wild (Soto Arenas, 1996).
The precarious situation of *M. xerophyticum* became
much more serious in 1998 when a fire swept
their habitat. From this date was not
returned to explore the town to assess if it
plants survived in the wild. In August
2009 there was a new expedition to this location
and found that of all the observed genetic
previously only one survived. This plant was
severely damaged by fire and apparently has not
flourished since then, but is currently
recovering. Mr. Heriberto Hernandez, who was a
original collectors of this kind, ran
places where they had met the other
genetos and concluded that they were gone. Along with his
son, Gerobuam, we further explore the rocky ground on
particularly in less accessible sites. Thus, in
a canyon with vertical walls were located several
plants (Fig. 1). A couple of them had flowers
and another had buttons (Fig. 2).

Lankesteriana *9 (3), January 2010. © Universidad de Costa Rica, 2010.*
P
Erez
-G
Arcia
- The redescubrimineto of *Mexipedium xerophyticum*
559
Considering that is *Mexipedium*
potential of cloning, it is difficult to know exactly
There are many different genetic locally
today. But considering a distance
relevance between clusters of plants could be
recognize at least six new groups of plants,
tentatively be considered as genotypes
different. In this sense, the preparation of studies
Molecular order to know how many genotypes
actually exist in the wild becomes very
relevant. Similarly, it requires a detailed
demographic study designed to show dynamic
of this population to establish their viability.
Unfortunately our visit to this locality
was very short, not much information could be extracted
the field. However, there are some observations
redeemable. One is that it was the first time
flowering is recorded during the month of August,
so it extends a bit the flowering period
observed in the field, and had previously only
F
igure
1. Images of different clusters of plants ("genetos?) Of *Mexipedium xerophyticum* grow in their habitat. In
Panel A shows the only survivor of the seven Geneto originally found.

Lankesteriana *9 (3), January 2010. © Universidad de Costa Rica, 2010.*
560
Lankesteriana
flowers seen in September (Soto Arenas & Solano-
Gomez, 2007). However, this finding is not very
surprising, as the plants start growing
bloom from spring (Anónimo. 2009th) and
Flowering can be extended to November (Soto-
Arenas & Solano-Gómez, 2007). There is information
that flowering of this species may occur during

different times of year when grown under
constant light intensities (Anonymous, 2009b).
The habitat of this species is a karst rocky
less than two hectares, which makes
of *Mexipedium* the only "*Phragmipedium*" growing
in limestone (Anonymous, 2009th). In this rocky,
arborescent plants grow in stature as
Beaucarnea sanctomariana, Bursera simaruba,
Plumeria rubra and *Pseudobombax ellipticum*. In addition,
plants thrive in this environment of genres
Agave, Acanthocereus, Begonia, Catopsis, Peperomia,
Phylodendrum, Pitcairnia, Selaginella, Tillandsia,
several ferns and some other unidentified
orchids as *Bletia* sp. *macrobulbon Cyrtopodium*
and *Encyclia* cf. *parviflora*. Although vegetation
Mexipedium microhabitat can be classified
like a desert scrub, in reality it is
rupícola vegetation embedded in a matrix of forest
evergreen. Some detailed descriptions of
similar environments but seasonal forests
nuts can be consulted in Perez-Garcia and
Meave (2004) and Pérez-García et al (2009).
It is noteworthy that the calcareous outcrops
Isthmus of Tehuantepec home to numerous species
endemic, as *Beaucarnea sanctomariana* L.
Hernandez (Hernandez-Sandoval, 2001), *Agave*
Guiengola Gentry (Torres-Colin, 1989) and several more in
Nizanda region (Pérez-García & Meave, 2004).
With this information we can conclude that these
rocks are ancient environments that have allowed
diversification of a very special flora.
So far all the plants of *M. xerophyticum*
have been found are located on vertical walls

F
igure
2. *Xerophyticum Mexipedium* plants in reproductive state. Panel A shows a genetic flower, which is different from those shown in Figure 1. In Panel B shows a close up of a cluster of plants shown in Figure 1F and panel C shows a close up of an inflorescence of the plant shown in Figure 1B.

rock, with a north exposure. Due to the
latitude in this species found during a
of the year these plants do not receive direct sunlight
but this situation changes substantially during
the rainy season (concentrated in the summer;
see Garcia *et al.,* 2009). Perhaps for this reason, this
species has adapted well to capture light in the
leaves (Shah *et al.,* 2003) and morphology
very xeric.

Conservation

It is difficult to make predictions about the future of this
species in its natural habitat. With the information
have is clear that it is a plant that has very few
individuals. This is true even when considering
all fans rooted, irrespective
of their genetic origin. Moreover, all these plants
concentrated in a very small area under
one hectare of land. Thus, both their rarity
demographic, such as restricting the habitat
make them vulnerable. Therefore, this species
is listed as Endangered
Mexican Official Norm for species at risk
(SEMARNAT, 2002).

In contrast, there is some interest by the owners
the venue for attaining the conservation of this species
do not allow access to strangers and not
have an interest in transforming the site for some
agriculture. While the site is unsuitable
for agriculture or livestock, it is very
susceptible to fires which are done
around, as seen in fires
1998. Hágsater Salazar (1997) proposed
some measures for the conservation *in situ* of the
species. However, the area is part of a
ejido and many decisions must be taken
collectively and through some procedures
complicated to understand. Added to this point, the
ejido to which the town is very
politicized and not easy to be accepted guidelines of
exterior.

In stark contrast, *ex situ* conservation of
species has been very successful. The way followed
the discoverers of the species, to send plants to
growers and researchers of the group (see Hágsater,
1996; Hágsater & Soto Arenas, 1998) gave good
results. Today there are several commercial nurseries

selling plants, and in some cases prices
they have declined since 2002 (Reddy, 2008). In
short, no one knows exactly the probability
survival of this species in the wild,
but you can predict your future is assured in
crop.
This article is dedicated to the memory of Miguel Angel
Soto Arenas, who was one of the discoverers and
student of this species, but also was my
teacher and friend.
to
Cknowledgements
.
A H. Hernández González for guiding us
in the study site. We thank the Téc phthalate. G. Hernandez
Jiménez and the staff of the Oaxacan Isthmus RPC /
RFSIPS / of CONANP (SEMARNAT) for their assistance in
fieldwork. The DGAPA-UNAM funded the disposal
field through the program PAPITT (IN-216007-3).
l
itEratura cited
Anonymous. 2009th. *Mexipedium (Phragmipedium) xerophyticum*. Antec Laboratory and Ladyslipper Farm. http://www.
ladyslipper.com / mexipedium.htm (accessed October 2009).
Anonymous. 2009b. *Phrag. (Mexipedium) xerophyticum*. Orchids Limited. http://
www.orchidweb.com/orchidofweek.
aspx? id = 397 (accessed October 2009).
Albert, V. 1994. Cladistic Relationships of the slipper orchids (Cypripedioideae: Orchidaceae) from congruent morphological
and molecular data. Lindleyana 9: 115-132.
Albert, V. & MW Chase. 1992. *Mexipedium:* A new genus of Slipper orchid (Cypripedioideae: Orchidaceae). Lindleyana
7: 172-176.
Albert, V. & B. Peterson. 1994. Expansion of genus *Paphiopedilum* to include all the conduplicate-leaved slipper orchids.
Lindleyana 9: 133-139.
Cevallos-Ferriz, SRS & EA Gonzalez-Torres. 2005. Geological setting and phytodiversity in Mexico. Pp 1-18 *in:* FJ
Vega, TG Nyborg, M. C. Perrilliat, M. Montellano-Ballesteros, SR Cevallos-Ferriz and SA Quiroz-Barroso (Eds.).
Studies on Mexican Paleontology. Springer. Amsterdam.
Cox, AV 1997. Cytological characterization of *Mexipedium xerophyticum*. Lindleyana 12: 162-165.

Cox, AV, GJ Abdelnour, MD Bennett & IJ Leitch. 1998. Genome size and karyotype evolution in the slipper orchids

(Cypripedioideae: Orchidaceae). Amer. J. Bot. 85: 681-687
Cox, AV, AM Pridgeon, V. Albert & M. W Chase. 1997. Phylogenetics of the slipper orchids (Cypripedioideae:
Orchidaceae) nuclear rDNA sequences. Pl Syst. Evol. 208: 197-223.
Garcia-Cruz, JA, EA Perez-García & Meave JA. 2009. β-Diversity and vegetation structure as Influenced by Slope
aspect and altitude in a seasonally dry tropical landscape. Landscape Ecol. 24: 473-482.
Hágsater, E. 1996. Mexico (Regional Account). *In:* Hágsater, E. (Eds.) IUCN / SSC Orchid Specialist Group. Orchids - Status
Survey and Conservation Action Plan. IUCN.
Hágsater E. & MA Soto Arenas. 1998. Orchid conservation in Mexico. Selbyana 19: 15-19.
Hágsater, E., MA Soto Arenas, GA Salazar Chávez, R. Machorro Jiménez, MA López Rosas & RL Dressler. 2005.
The Orchids of Mexico. Chinoin Institute, Mexico, 304 pp.
Hernández-Sandoval, L. 2001. *Beaucarnea sanctomariana* (Nolinaceae), a new micro-endemic species of ponytail palm
from the Isthmus of Tehuantepec, Oaxaca, Mexico. Novon 11: 50-53.
T. Janssen & K. Bremer. 2004. The age of major monocot groups inferred from 800 + rbcL sequences. Bot. J. Linn Soc
146: 385-398.
Koopowitz, H. 1995. *Phragmipedium xerophyticum* and Its culture. Orchid Digest 59: 108-110.
Koopowitz, H. 2008. Tropical Slipper Orchids. *Paphiopedilum* and *Phragmipedium*. Timber Press. Portland.
LeDoux, M. 1996. The diminutive *Phragmipedium xerophyticum*. Orchid Digest 60: 122-128.
Leitch, IJ, I. Kahandawala, J. Suda, L. Hanson, MJ Ingrouille, MW Chase & MF Fay. 2009. Genome size diversity
in orchids: Consequences and evolution. Ann. Bot. 104: 469-481.
Pasetti, M. 1995. Le Cypripedioideae. Orchidee Amatori Associazione Lombarda. Varese.
Perez-Garcia, EA & JA Meave. 2004. Heterogeneity of xerophytic vegetation of limestone outcrops in a tropical
deciduous forest region. Pl Ecol. 175: 147-163.
Perez-Garcia, E. **A.,** AC Sevilha, JA Meave & A. Scariot. 2009. Neotropical Floristic Differentiation in continental
limestone outcrops of southern Mexico and central Brazil: a Beta diversity approach. Bull Soc Bot. Mex. 84:45-58.
Pridgeon, AM, PJ Cribb, MW Chase & F. Rasmussen (eds.). 1999. Generates Orchidacearum 1: Orchidoideae. Royal
Botanic Gardens, Kew. London.
Reddy, V. 2008. *Mexipedium xerophyticum*. Orchid Forum. The Newsletter of the Orchid Forum of Sacramento. April 3-4.
Sandoval, E., T. Terrazas, G. Salazar, A. Vallejo & B. Estrada. 2003. Vegetative Anatomy *xerophyticum Mexipedium*
(Soto, Salazar & Hágsater) VA Albert & MW Chase and related genera (Orchidaceae, Cypripedioideae).
Lankesteriana 7: 54-56.
Salazar-Chávez, G. & E. Hágsater. 1997. Diversity and Conservation of orchids Chimalapa region, Oaxaca,

Mexico. Mexico. Project final report submitted to the CONABIO G024.
SEMARNAT 2002. Mexican Official Standard NOM-059-ECOL-2001, Environmental Protection-native species of Mexico
wildlife-risk categories and specifications for inclusion, exclusion or change in species-Schedule at risk. Official Journal of the Federation, March 6, 2002.
Shefferson, RP, DL Taylor, M. Weiß, S. Garnica, MK McCormick, S. Adams, Gray HM, McFarland JW, T. Kull, K.
Tali, T. Yukawa, T. Kawahara, K. Miyoshi and Y.-I Lee. 2007. The evolutionary history of mycorrhizal specificity Among
lady's slipper orchids. *Evolution* 61: 1380-1390.
Soto Arenas, MA 1996. Mexico (Regional Account). Pp 53-58 *in:* E. Hágsater & V. Dumont (eds.). Orchids - Status
Survey and Conservation Action Plan. IUCN / SSC Orchid Specialist Group. UCN, Gland, Switzerland & Cambridge, UK
Soto, MA 2003. *Mexipedium xerophyticum* (Soto Arenas, Salazar & Hágsater) VA Albert & MW Chase. Plate 623 *in:*
E. Hágsater & M. Soto (eds.). Icones Orchidacearum fascicles 5 & 6, Orchids Of Mexico Parts 2 & 3. Herbario AMO,
Mexico City
Soto, MA & GA Salazar. 2004. Orchids. Pp 271-295 *in:* AJ Garcia-Mendoza, MJ & M. Ordonez Briones-Salas
(Eds.). Biodiversity of Oaxaca. Institute of Biology, National Autonomous University of Mexico, Oaxaca Fund
for the Conservation of Nature and World Wildlife Fund. Mexico City
Soto-Arenas, M., G. Salazar-Chávez & E. Hágsater. 1990. *Phragmipedium xerophyticum,* a new species from southern
Mexico. Orquidea (Mex) 12: 1-10.
Soto-Arenas, MA & AR Solano-Gómez. 2007. *Xerophyticum Mexipedium* data sheet. *In:* Soto-Arenas, MA
(Ed.). Updated information on orchid species PROY-NOM-059-ECOL-2000. Institute
Chinoin AC, Herbarium of the Mexican Association of Orchid AC Databases SNIB-CONABIO. Project
No. W029. Mexico. DF

Soto Arenas, MA, R. Gómez & E. Solano Hágsater. 2007. Risk of extinction and patterns of diversity loss in Mexican
orchids. Lankesteriana 7:114-121.
Tiffney, BH 1985a. Perspectives on the origin of the Floristic Similarity Between eastern Asia and eastern North America. J.
Arnold Arbor. 66: 73-94.
Tiffney, BH 1985b. The Eocene north Atlantic land bridge: Its Importance in Modern and Tertiary phytogeography of the

Northern Hemisphere. J. Arnold Arbor. 66: 243-273.
Torres-Colin, LM 1989. Floristic Survey and Description of Vegetation of Cerro Guiengola, on the Isthmus of Tehuantepec,
Oaxaca. Thesis (Biology). National Autonomous University of Mexico. Los Reyes, Iztacala, State Mexico.
Wendt, T. 1989. The forests of Uxpanapa, Veracruz-Oaxaca: Evidence from Cenozoic floristic refuges. Ann Inst Biol
be. Bot. 58: 29-54.
R. *Mexipedium xerophyticum* Zuiderwijk. http://www.phragweb.info/mexipedium (accessed October 2009).