



 **XV** INTERNATIONAL LUPIN
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SPECIES REVIEW OF LUPINUS GROWING IN BOLIVIA

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The taxonomy of *Lupinus* is one of the most complex of the Fabaceae (Leguminosae) Family. It is characterized by regular "papilionaceous" flowers located in a terminal raceme and by the digitaly-compound leaves.



ESTABLISHING THE TRUE NUMBER OF NATIVE SPECIES FOR SOUTH AMERICA

One of the reasons of *Lupinus* taxonomic complexity is the big differences between numbers of scientific species names, which have been increasing through time from the six species globally published by Linnaeus in 1753, to the today records of 1,500 to 1,700 names published in different floristic and monographic works.

GEOGRAPHY DISTRIBUTION OF NATIVE *LUPINUS* SPECIES

Taking into consideration the differences and similarity of the morphological structures of plants and flowers, the growing areas of natives *Lupinus* species were classified by Planchuelo (1994) in Regions and Sub-regions

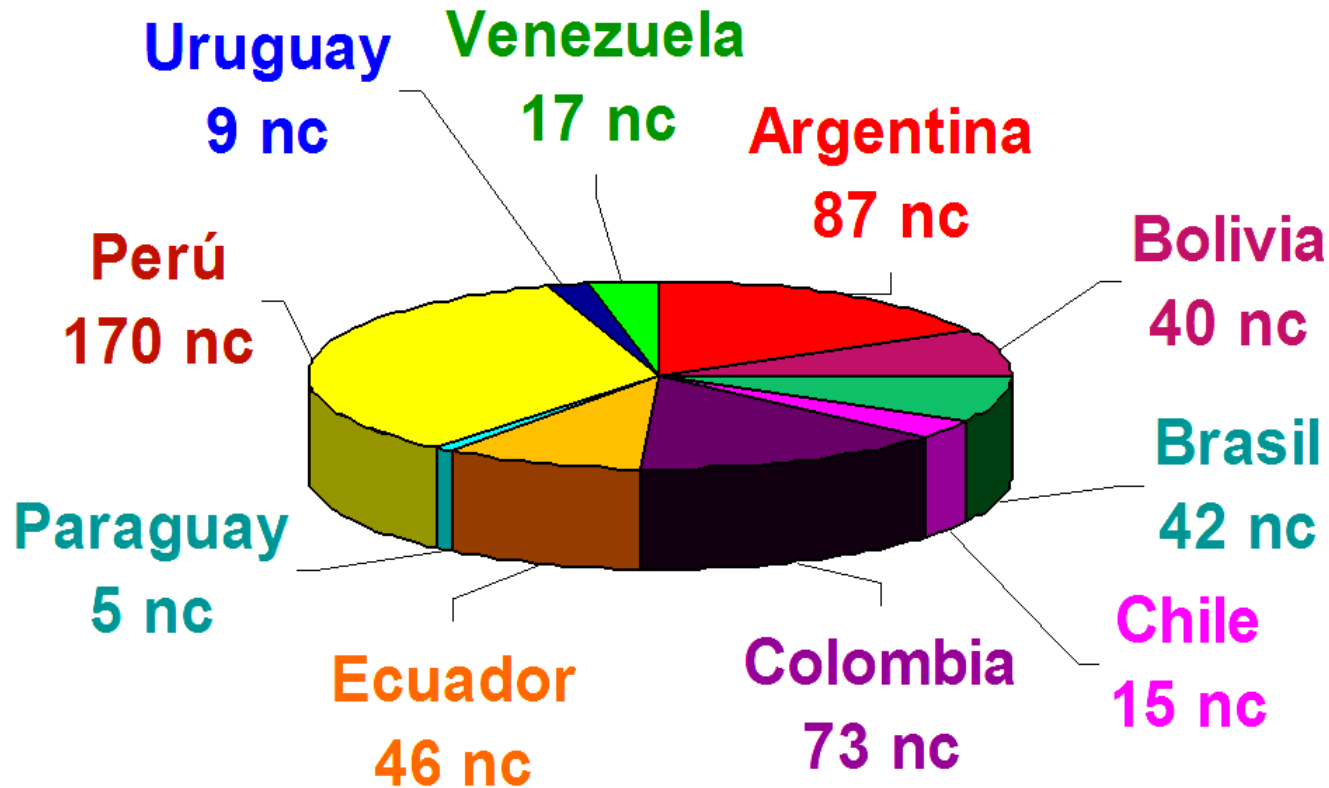


Planchuelo, A.M., 1994. Wild lupins distribution and its implication as germ-plasm resources. In Neves Martins, J.M. & M.L. Beirao Da Costa (Eds.), *Advances in Lupin Research*: 65-69. ISA-Press.

TAXONOMIC TREATMENT OF SOUTH AMERICAN *LUPINUS*

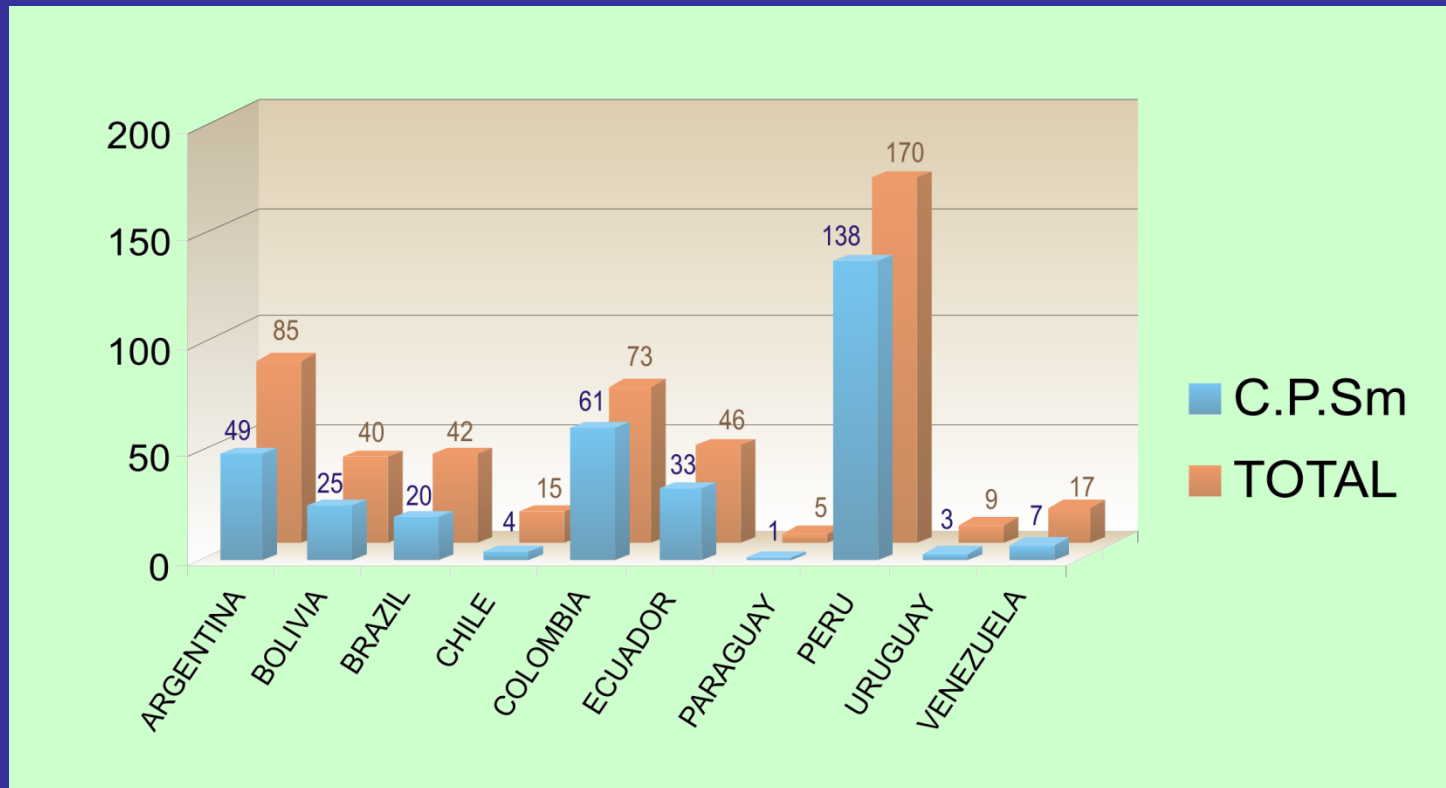
Many authors have contributed to *Lupinus* species descriptions for South America, but the large amount of names are from the “Species Lupinorum” (1938-1953) by C. P. Smith (1877-1955). This author with tireless effort studied collections in different herbaria and described new species based on superficial characters, and many of his taxa are now considered as synonyms.

SCIENTIFIC NAMES (nc) FOR EACH COUNTRY IN SOUTH AMERICA



Scientific names (nc) do not mean that are good species, but each name need to be considered valid until a botanist discover that is the same of other species that have nomenclature priority and consequently is a synonym of the valid scientific name of the species

SCIENTIFIC NAMES FOR EACH COUNTRY IN RELATION TO THE SPECIES DESCRIBED BY C. P. SMITH



As can be see in almost all the countries more than a half of the species names were described by C.P. Smith

TAXONOMIC TREATMENT OF LUPINUS FOR BOLIVIA

For Bolivia Smith published 40 taxa, from which 25 were new ones. In his treatment the taxa growing in the country are in 14 groups, different mostly for vegetative and floral morphological characters.

SPECIES LUPINORUM 29-44

✓
Signature Twenty-nine April 1945 Page 449

By Charles Piper Smith

PAPER FORTY-ONE

Lupinus in Bolivia

Bolivia is, by location, the heart of South America. Eastward spurs of the Andes give extensive elevation and watersheds to the southwestern third or more, meaning better or worse lupine country. Most of its runoff contributes to the waters of the Amazon, but the Pilcomaya-system of Potosi and Tarija empties its flow into Argentine rivers. Several small streams drain into small lakes or sand- or gravel-sinks, the largest of these non-outlet lakes being Allagus, now called Lake Poopo. This large body receives the only outflow of the largest of South American lakes, Lake Titicaca, which has its surface-elevation about 12800 feet above sea level. The shores and islands of Titicaca have lupines, as also the high ridges and peaks eastward from Titicaca.

In 1857 (Colton's Atlas), Bolivia included seven departments and two independent provinces, namely: Beni, Chuquisaca, Cochabamba, La Paz, Oruro, Potosi, Santa Cruz, plus Cobija and Tarija, as provinces. In 1866 (Johnson's Atlas), these nine divisions were called departments, the names being somewhat changed, as follows: Atacama, Chuquisaca, Cochabamba, La Paz de Ayacucho, Oruro, Potosi, Santa Cruz de la Sierra, Tarija, and Veni or Beni. Since some old labels give subdivisions with the writing difficult to decipher, we list here the La Pazian provinces from a printed page: Larecaja, La Paz, Misiones, Munecas, Omasuyas, Sicasca, Yngavi, Ynquisibi. Cobija alias Atacama, was absorbed by Chile in 1880.

J. B. Pentland may have been the first European botanist to collect plants in Bolivia, he being Great Britain's representative to this country, 1836 to 1839, and sent plants from Bolivia to England (British & Irish Botanists, p 241). We found one "Pentland" lupine at Kew, not from Bolivia, but from Vilcanota, a peak on the Puno-Gazco boundaryline in Peru, about 70 miles NW of Lake Titicaca. H. A. Weddell, in 1845-46 visited in Bolivia, collecting a lupine in Chuquisaca, which lupine he described in 1857, probably the first "new species" for Bolivia. Our list of collectors follows.

TAXONOMIC PROBLEMS TO BE RESOLVED

The Andean ecosystems form patches of vegetation, and geographic barriers that can promote the generation of endemic species in relict locations, or support more scattered distribution of one species in areas with difficult access that are still no discovered.

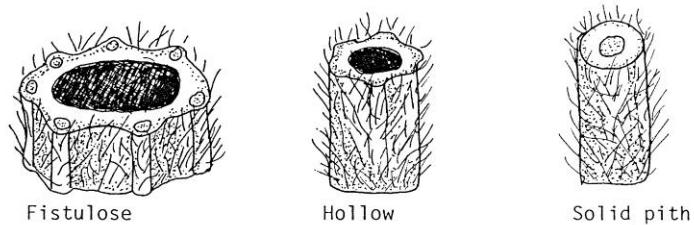
Due to the fact that most of *Lupinus* floristic and taxonomic reviews were done by countries and not by regions, happen that several species, which grown in scattered patches along the Andean ecosystems, were treated with different names and maybe bellowed to different ecotype population or the same taxon.

TAXONOMIC PROBLEMS TO BE RESOLVED

For these reasons, it is necessary to conduct taxonomic studies of types materials and herbarium specimens, as well as, field surveys to understand *Lupinus* germplasm variations. Some times to evaluate complex species it is necessary taking into account not only vegetative and floral structures but also the use of statistical approaches, numerical taxonomy, as well as, pollen morphology, chemical components and molecular biology analyzes such DNA and RNA sequences and phylogenetic analysis.

EXAMPLES OF DEFINING TAXONOMIC DIAGNOSTIC CHARACTERS

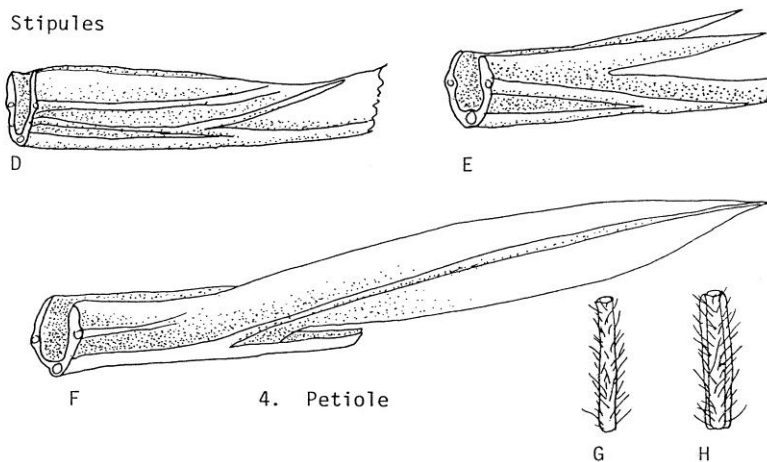
1. Stems



2. Pubescence



3. Stipules



4. Petiole

Figure 1. 1. Different kinds of stems; 2. Different kinds of pubescence, A-straight long hairs spreading, ascending or subappressed, and appressed with an undercoat of kinky short canescent hairs, B-different lengths of straight hairs, and C-soft lanate hairs; 3. Different kinds of stipules; D-without a free tip, E-with a free tip, and F-with a foliaceous free tip; 4. Petioles, G-cylindrical, and H-with a green wing on the sides.

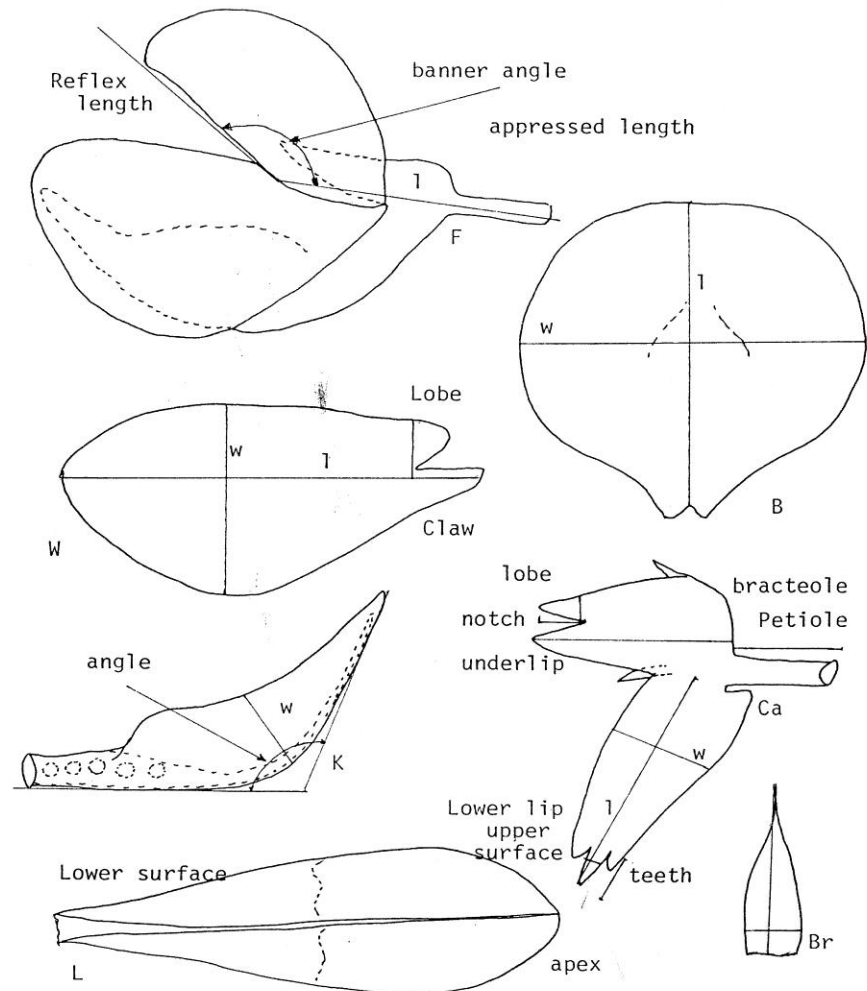


Figure 3. Diagnostic characters in the *Lupinus* flowers. F = whole flower, left lateral view; B = banner, inside view, cut open at the left lateral sinus; L = leaflet; and Br = bract. l = length; w = width.

GEOGRAPHIC LOCATION AND BIOGEOGRAPHY

Bolivia is in the core of the Andes and where soil, topography and climate interact with the biological factors of *Lupinus* germplasm to distribute species and ecotypes in isolated patches at high altitudes.



Main area of distribution.

- La Paz (27 taxa)
- Tarija (7 taxa),
- Cochabamba &
- Potosí (3 taxa),
- Oruro (2 taxa)
- Chuquisaca (only one taxa)

SHRUBBY & LIGNOSE SPECIES FOR BOLIVIA, 14 SPECIES NAMES



Lupinus ballianus C.P.Sm.

THE SPECIES NAMES FOR BOLIVIA

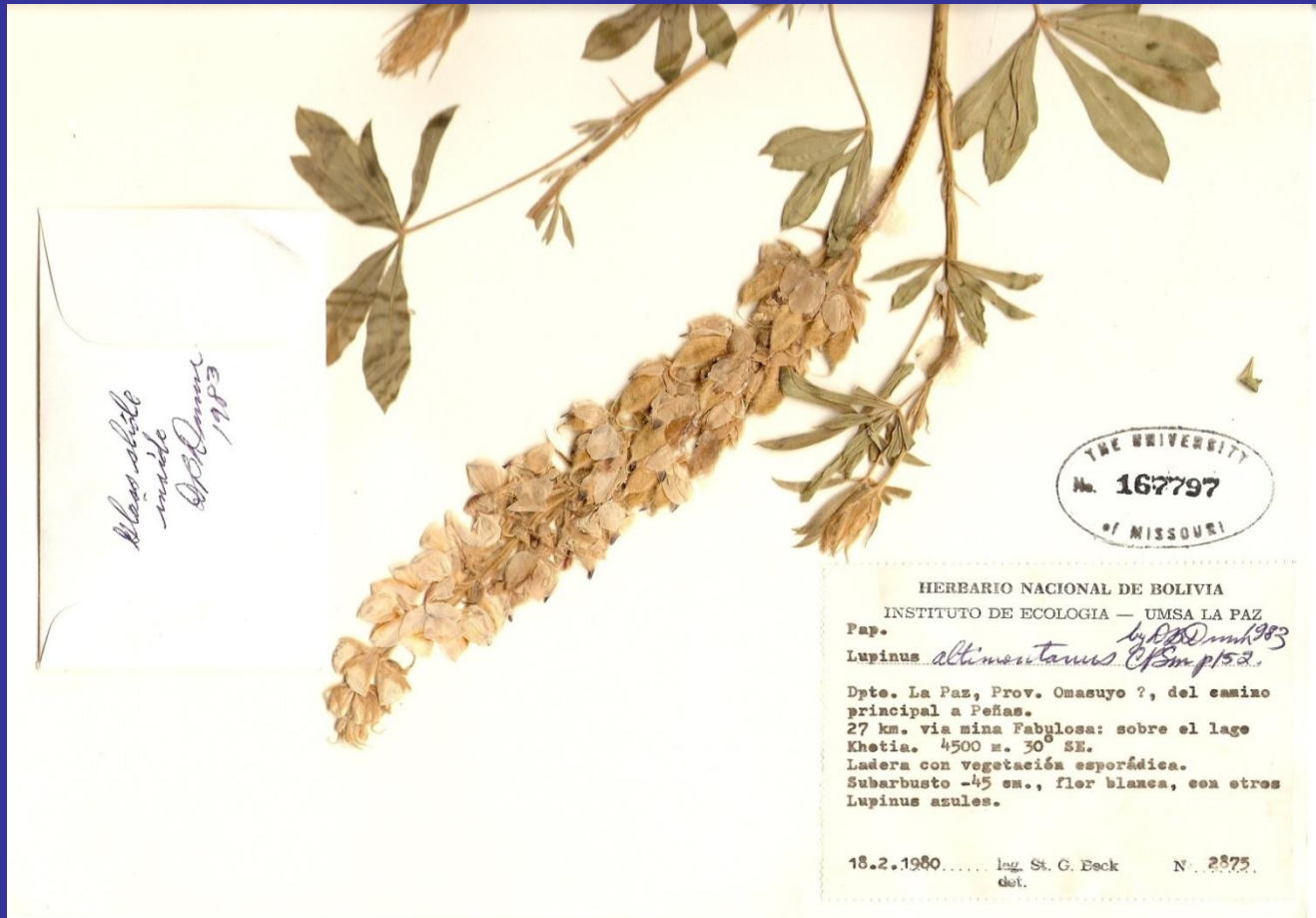
- L. alaristatus* C.P.Sm.
- L. altimontanus* C.P.Sm.
- L. cardenasianus* C.P.Sm.
- L. celsimontanus* C.P.Sm.
- L. erectifolius* C.P.Sm.
- L. guggenheimianus* Rusby
- L. imminutus* C.P.Sm.
- L. mandonanus* C.P.Sm.
- L. perissophytus* C.P.Sm.
- L. rusbyanus* C.P.Sm.
- L. soratensis* Rusby
- L. sufferugineus* Rusby
- L. tatei* Rusby
- L. willamsianus* C.P.Sm.

PHOTOS OF SOME TYPE SPECIMENS OF SHRUBBY & LIGNOSE *LUPINUS* FOR BOLIVIA



This type of species represents 35.89% of the taxa natives in Bolivia

HERBARIUM SPECIMEN OF *Lupinus altimontanus* C.P.Sm.



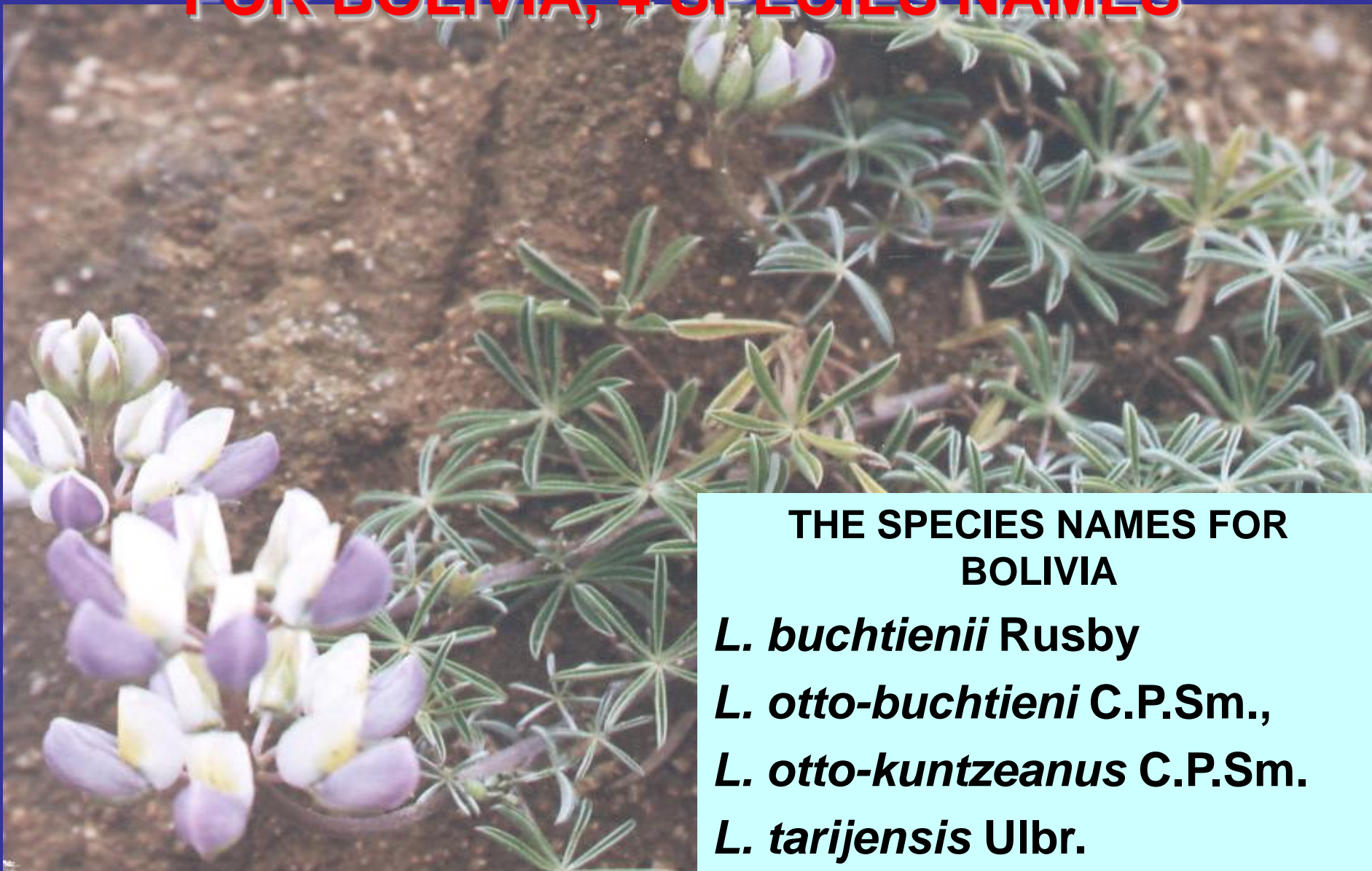
This species is considered endemic in La Paz, however is one of several other species names that form a complex very difficult to determine the boundary between each taxon.

KEY CHARACTERS BETWEEN SPECIES COMPLEX

Species Characters	<i>L. altimontanus</i> C.P.Sm. Sp. Lup.:152. 1940.	<i>L. rusbianus</i> C.P.Sm. Sp. Lup.: 157. 1940	<i>L. williamsianus</i> C.P.Sm. Sp. Lup.: 163. 1940.	<i>L. celsimontanus</i> C.P.Sm. Sp. Lup. 153. 1940.
Plant high	30-60 cm	50-60 cm	30-40 cm	40 cm
Petiole length	3.5-4.5 cm	3-6 cm	2-3.5 cm	2.5-3.0 cm
Leaflet number & Shapes	5-7 Linear-lanceolate	4-7 Oblanceolate	5-7 Oblanceolate-elliptical	5-7 Linear
Leaflet length & width	3 cm x 5 mm	5 cm x 10 mm	3.5 cm x 5 mm	2 cm x 5 mm
Bract persistence Shape & Size	Persistent Lanceolate 12-15 x 2 mm	Deciduous Lanceolate 10-12 x 2 mm	Deciduous/Persistent Lanceolate 5-7 x 2 mm	Persistent Ovato-lanceolate 8-10 x 2 mm
Pedicle length & Pubescence	4-6 mm Spreading pilose	4-7 mm Spreading pilose	5-8 mm Spreading pilose	5-7 mm Sm Spreading pilose
Flower size	12-14 mm	11-15 mm	11-13 mm	13-14 mm
Banner shape & Pubescence	Suborbicular Sericeous	Suborbicular Pubescent	Suborbicular Pubescent	Suborbicular Sericeous

The key characters used by C. P. Smith for each species name are overlapping and no allowed to identified each species in this complex group of scientific names which maybe are synonym species

PERENNIAL PROSTRATE SPECIES FOR BOLIVIA, 4 SPECIES NAMES



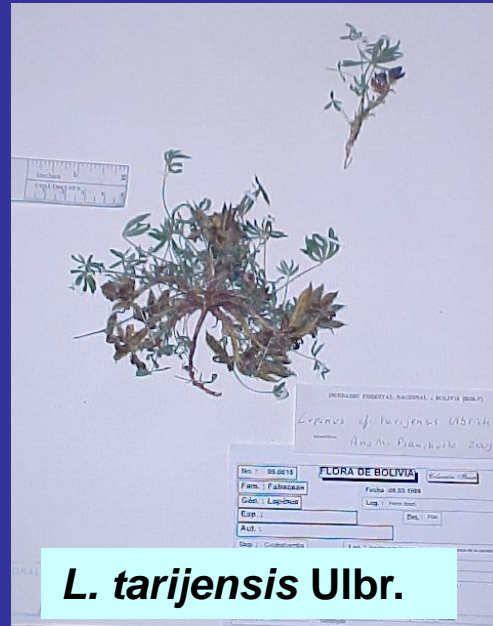
THE SPECIES NAMES FOR BOLIVIA

- L. buchtienii* Rusby**
- L. otto-buchtieni* C.P.Sm.,**
- L. otto-kuntzeanus* C.P.Sm.**
- L. tarijensis* Ulbr.**

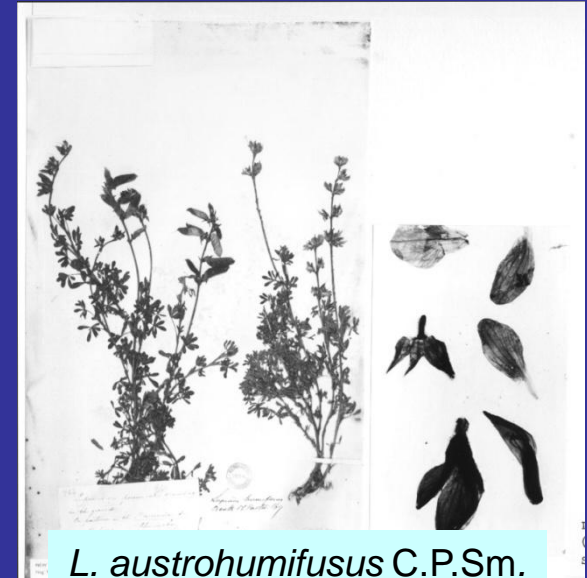
PHOTOS OF SOME SPECIMENS OF DWARF & PROSTRATE SPECIES OF LUPINUS FOR BOLIVIA



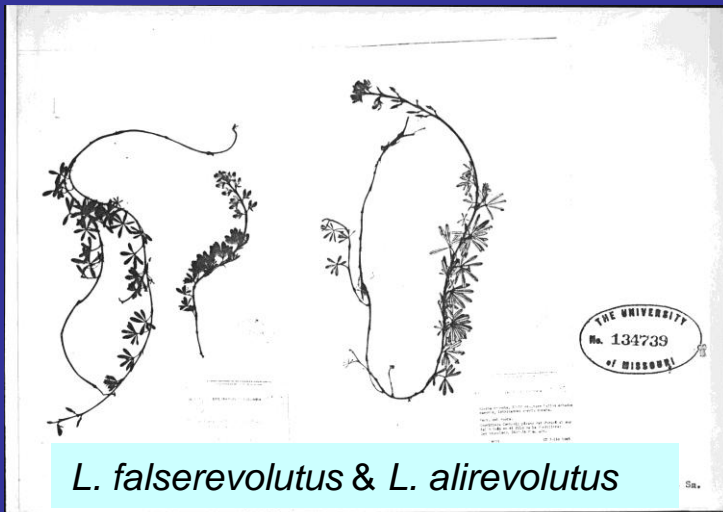
***L. revolutus* C.P.Sm.**



***L. tarijensis* Ulbr.**



***L. austrohumifusus* C.P.Sm.
= *L. humifusus* Benth.**



L. falserevolutus* & *L. alirevolutus



***L. buchtienii* Rusby**

FISTULOSE OR SUBFISTULOSE SPECIES FOR BOLIVIA, 4 SPECIES NAMES



Lupinus alopecuroides Desr.

THE SPECIES NAMES FOR BOLIVIA

- *L. altiplani* C.P.Sm.
- *L. herzogii* Ulbr.,
- *L. tominensis* Wedd.
- *L. umidicola* C.P.Sm.

PHOTOS OF ONE SPECIMEN THAT REPRESENT DE PRIORITY SPECIE FOR THE FISTULOSE GROUP

Several species present fistulose or subfistulose inflated stems, 2 cm or more in diameter which represent arround 10.25 % of Bolivian lupines, although this life form of *Lupinus* is highly represented in other Andean countries. Almost all are related to *L. alopecuroides* Desr.



ANNUAL SPECIES FOR BOLIVIA, 9 SPECIES NAMES

SPECIES NAMES FOR BOLIVIA

- *L. mutabilis* Sweet
- *L. bolivianus* Rusby
- *L. asplundianus* C.P.Sm.
- *L. bandeliera* C.P.Sm.
- *L. cuspidatus* Rusby
- *L. nubilorum* C.P.Sm.
- *L. pearceanus* C.P.Sm.
- *L. poopoensis* C.P.Sm.
- *L. xenophytus* C.P.Sm.

PROBLEMS FOR ANNUAL SPECIES IDENTIFICATION

In relation with life span, sometimes the identification of annual condition is difficult because, in some perennial species the vegetative aerial part died but the root and caulex remain alive and grows as an herbaceous annual plant.

Several annual are endemic in Bolivia but *L. xenophytus* C.P.Sm., which were collected near the Bermejo river can be related with some species of the Atlantic Subregion such the ones in the *L. gibertianus* C.P.Sm. complex.

PHOTOS OF SPECIMENS OF *Lupinus mutabilis*

Lupinus mutabilis Sweet as its scientific name indicates, has a great capacity to mutate; consequently, several wild breeds are part of a gene pool with random intercrossing. It has several cultivated and wild races or ecotypes, some of them perennials and closely related with other endemic Andean species



***L. mutabilis* Sweet**



CONCLUSION

This presentation is a first review for species identification of *Lupinus* growing in Bolivia and is the base for future multidisciplinary taxonomic studies of the approximately 400 scientific species names described for the Andean Subregion. One of the major task is to verified the identity of each scientific name and after a taxonomic studies and clarification of the nomenclature status, make the list of synonyms that may will reduce the number of true species to approximately 250. After the names clarification, key characters can defined each one of the taxa growing in the Andean Subregion.



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THANK YOU

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