Adventures with *Lupinus*, from Populations to Publications

DKY Annual Meeting
Dec. 12th
2021
Teresa Sholars

*Lupinus albifrons* var. *austromontanus*

*Lupinus stiversii*
Lupinus arboreus thesis work
1986

Common garden experiments with *Lupinus arboreus, L. rivularis, L. littoralis*
My strategy for the last 35 years has been seeing taxa in the field, visiting herbaria; using CCH, SEINet, etc.

- Wading thru the nomenclatural and circumscription confusion that exist within *Lupinus*
- Writing keys and descriptions that try to differentiate taxa

I have learned a lot teaching Lupine classes To Botanists
Field work started 1987

1987
Death Valley

1987
L. Albifrons var. austromontanus

1987
Yosemite
L. latifolius

1989
A wonderful opportunity to go to all types of habitats!

*L. albifrons* var. *albifrons*

*L. littoralis*

*L. lepidus* var. *ramosus*
Alpine, riparian, desert

*L. polyphyllus*  
*var. saxosus*

*L. excubitus*

*L. polyphyllus*  
*var. polyphyllus*
Redwoods Nat. Park to central Sierra to Santa Monica Mts

L. rivularis

L. hirsutissimus

L. benthamii
New York to Florida

L. perennis

L. diffusus
Intermountain to the west

Warner Mts 2007
L. polyphyllus var. saxosus

2009 Oregon
L. polyphyllus
Alpine meadows to ocean bluff

L. gracilentus

❤️ Max to Lupin

L. bicolor
There is one thing that most people agree with and that is what is in the genus *Lupinus*.

A great genus! The boundaries between species are another matter.
The genus characters are clear

Leaf palmately compound (3-17 leaflets)

Upper petal (banner) outside lateral one (wing) in bud

Filaments fused

5 long with short anthers
5 short with long anthers

keel
Some characters that help delineate Lupine taxa

- Hair on banner back, keel, wing
- Leaf hair on surfaces
- Persistence of flower bracts
- Position of leaves (cauline or clustered at base)
- Annual perennial, shrub, perennial herb, erect, decumbent, low growing
Current thoughts

- *Lupinus* is a recent genus undergoing adaptive radiation
- Gene flow is taking place between Lupine taxa
- Molecular and morphological evidence don’t always track, probably because of reticular evolution, resulting in more of a gray, rather than a black and white taxonomy

*L. albifrons* var. *collinus*  
*L. a. austromontanus*  
*L. albifrons douglasii*  
*L. a. abramsii*
Nomenclature background
(according to the ICBN)

The Integrated Taxonomic Information System has 1,010 names for Lupines (and it does not have them all)

• **Basionym** means the 'original name’.
• **Synonym** is an alternate name for the circumscription, position, and rank of a taxon
• It is always "a synonym of the accepted scientific name", but which name is accepted depends on the taxonomic interpretation of the author
• There are so many names for *Lupinus* and so much variation, it is difficult to circumscribe the species boundaries.

*L. polyphyllus* var. *saxosus*
Circumscription is difficult, made problematic by the vast number of species recognized then lumped and split in various ways by different taxonomists.
There is sure to be a name out there

*Lupinus elmeri* Greene (*Pittonia* 3:159 (1897))

When I “rediscovered” this plant on South Fork Mt., I thought it was a new species. No surprise that it had already been named.
2020 New treatment in Jepson e flora: 113 taxa

70 species; 43 var.
14 changes

> 352 synonyms)
Flora North America

88 species
147 taxa

59 perennial species
108 taxa

28 taxa not in Ca

L. latifolius
Crosspollination between sympatric Lupines has contributed to diversity

- Generally bumblebee pollinated
- Lupines lack nectar
Herbarium work

• Visits to
• New York Botanical Garden herbarium
• Smithsonian
• College of Idaho
• UC Berkely Davis, Irvine, Riverside
• CSU Humboldt, Sonoma
• Cal Academy of Sciences
• RSA
Pima Co., Arizona, USA
Lupinus huachucanus Jones
Pinkish marley soil, boulders, oak, pine, juniper and yucca community. Madera Canyon, 4 mi. SSE of Contential.
K.H. Thorne 8259 18 Mar. 1991 4
HERBARIUM OF BRIGHAM YOUNG UNIVERSITY PROVO, UTAH

SOUTH CAROLINA
Charleston County

Pine barren, 2 miles west of U.S. Route 17, near the south bank of Santee River

Herbarium of the University of California, Berkeley
Lupinus sulphureus Dougl.
var. subarcticus (Savd) Hitch
WASHINGTOUS'S FLORA
Klickitat County
Lupinus bingensis Sukadorf sp. nov.
Dry hillside at Bingen.

COLORADO STATE UNIVERSITY HERBARIUM
Flora of ARIZONA
Lupinus xemnonii Smith
Corrolas bluish; perennial to 0.5 meters tall; on steep, rocky N-facing slope with Rhus chlorphylla, Arctostaphylos pungens and Phlox discolor.
COCHISE COUNTY: Halfmoon Valley, 0.5 mile E of divide between Halfmoon Valley and High Lonesome Canyon. T21S R39E S3 N1/2
5700 feet 18 May 1985
D. H. Wilken & R. Fletcher 14384

HERBARIUM OF THE UNIVERSITY OF CALIFORNIA
ALASKA
Lupinus arcticus Wats.
Galen Smith 1816 22 June 1953
Research on type specimens


1833 TYPE LOCALITY: “Native of California.”
Research: old monographs, floras to efloras

Consortium of California Herbaria (CCH)

CCH1
Consortium of California Herbaria Portal 1 serves as a gateway to information from California vascular plant specimens that are housed in herbaria, warehouses. Currently, the database is based on the species occurrences database.

CCH2
Consortium of California Herbaria Portal 2 serves as a gateway to information from California vascular plant specimens that are housed in herbaria, warehouses. Currently, the database is based on the species occurrences database.

For more information about the CCH and its portal, see the about page (https://calflora.ucr.edu/consortium/cch/about/).

SEINet Arizona - New Mexico Chapter

Specimens & Observations

Search: California Flora and Supplement

1938-1953
778 pgs

INTERMOUNTAIN FLORA
Vascular Plants of the Intermountain West, U.S.A.

MUNZ

A California FLORA and Supplement

FABLES

INTERMOUNTAIN FLORA
Vascular Plants of the Intermountain West, U.S.A.

MUNZ

A California FLORA and Supplement

FABLES
1996 international symposium on Lupins

THE SYSTEMATICS OF PERENNIAL LUPINUS IN NORTH AMERICA*
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Worldwide more than 1500 Lupin species have been described. Two major factors have contributed to the confusion surrounding the systematics of the genus Lupinus. First, the natural outcrossing ability of especially perennial Lupinus leading to gradations in characters used for species delimitation. Second, the differences in circumscription parameters used by various taxonomists. A key will be presented here that separates perennial North American Lupin species into complexes of highly similar species. Morphological features will be identified that are used to separate species into complexes.

A species consists of one or more populations of individuals that can interbreed under natural conditions and produce fertile offspring, and that are reproductively isolated from other such populations. (Steele, 1995) This classical definition of a species becomes obscure when applied to Lupines because many of the perennial species are outcrossers, creating many inseminations. Another factor that contributes to the confusion surrounding the systematics of the genus Lupinus is that taxonomists have circumscribed the boundaries between the different species using inconsistent characters and varying criteria. They have lumped and split the same groups in many different ways.

The taxonomist that writes the basic descriptions and keys to local, regional and areal flora has a special challenge in front of him. They have to write a key that works relatively well. They have to deal with species in a coherent way so that the descriptions reflect what is actually seen in the field. They have to collect and synthesize evidences of synonyms since 1773. These names must be able to be contrasted to all past ones. And lastly, and certainly not the least important, scientifically but practically speaking the least “relevant” they have to name and circumscribe species that reflect phylogenetic. Or at least arrive in conflict with phylogenetic evidence. This is the job of the so called “alpha taxonomist”.

There are two important strategies to make keys work. One is to find a morphological character that is not too variable and unambiguous. The other is to find ecological characters like present habitats that can separate the taxa. Often the characters that are used to make keys have nothing to do with phylogeny. They must often be a combination of characters chosen because they work.

Lupinus circumscription challenges, indiscriminate outcrossing, and sheer numbers of taxa create the nightmare known as Lupinus

Northern California Botanists Symposium 2020
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53. LUPINUS Linnaeus, Sp. Pl. 2: 721. 1753; Gen. Pl. ed. 5, 322. 1754 • Lupine, bluebonnet [Derivation uncertain; Latin lupinus, wolf, or lupa, sadness, and inus, possession, perhaps alluding either to plants supposedly overrunning the ground as an animal might or to harsh taste of seeds causing facial contortion]

Teresa Sholars
Rhonda Rigbins

Lupinus • Fabaceae

Flowers, annual, biennial, or perennial, shrubs, or subshrubs, unarmed usually from taproots or woody crowns, rarely rhizomes. Cotyledons usually decussate, usually petiolate. Stems erect to decumbent or prostrate, branched or unbranched, usually pubescent, sometimes glabrous. Leaves alternate, usually palmately compound, rarely 3-foliate or unifoliate, usually cauline, sometimes crowded near base or basal stipules present, setaceous, adnate to petioles; petiolates; leaflets (1 or) 3–4 (-11–17), stipels absent, blade margins entire, surfaces glabrous or pubescent. Inflorescences 3-10-flowered, terminal, racemes, erect, rarely axillary and reduced to 1 or 2 flowers, flowers spirally arranged or whorled; bracts present, persistent or deciduous. Flowers papilionaceous, chasmogamous; calyx bilabiate, lobes connate, entire or toothed, usually with appendages (often inconspicuous) between lobes; corolla usually blue to purple, sometimes white, yellow, pink or rose; banner with central groove, sides reflexed; wings connate at tips, corolla tube tailed, keel usually attenuate; stamens 10, monadelphous; anthers basifixed, dimorphic, alternately long on short filaments, short on long filaments; style bristly. Fruits legumes, sessile, straight, laterally compressed, usually oblong, splitting along both margins, valves usually twisted after dehiscence, usually pubescent, rarely glabrous. Seeds (1 or) 2–12, usually smooth, rarely ridged or tuberculate, spheric, lenticular, or angular. x = 6.

Species ca. 270 (88 in the flora): North America, Mexico, South America, Europe (Mediterranean), Africa; introduced in Asia (China), in Africa, Atlantic Islands (Ireland), Pacific Islands (New Zealand), Australia.

Most species of Lupinus occur in western North America and western South America. C. P. Smith (1944, 1938–1953) assigned North American lupines to subg. Lupinus, sect. Subgenus Plantago. S. Watson based on corolla structure (sessile versus petiolate) and 22 groups based on life span, flower arrangement, keel coloration, and banner and wing pubescence, as well as some vegetative features.

The taxonomy of Lupinus is complicated. Thousands of names have been coined for lupines; circumscription is difficult, made problematic by the vast number of species recognized, then lumped and split in various ways by different taxonomists. Some authors (for example, B. R. Dunn 1953, 1959) discussed widespread hybridization in the genus. Some studies have indicated that gene flow and introgression through outcrossing in perennial species does occur (A. Laston et al. 1995). Perennial species have shown a preponderance of interbreeding groups that have resulted in gradients of characters. Self-pollination is known to occur in annual species of Lupinus, which has resulted in the establishment of localized variants that have been recognized as distinct species. For example, L. affinis, L. guadalupensis, and L. spectabilis could easily be regarded as localized variants of L. leucophylla.

Phylogenetic analyses of molecular data for Lupinus included 50 North American species (C. S. Drummond et al. 2012). The species were assigned to three infragenic lineages. One lineage included two species from Florida that have unifoliolate leaves and 2n = 32. The second lineage included two 2n = 36 annual species from Texas that corresponds to group Subcarnosi...
LEGUMES OF ARIZONA: AN ILLUSTRATED FLORA AND REFERENCE

Galleys coming soon

LUPINUS Linnaeus. Sp. Pl. 2: 721. 1753. * (derivation uncertain; Latin lupus, wolf, or lyca, sadness, and ius, possession, perhaps alluding either to plants supposedly overrunning the ground as an animal might or to harsh taste of seeds causing facial contortion) LUPINE, BLUEBONNET; LUPINO

Teresa Sholars

Herbs, annual, biennial, or perennial, [shrubs, or subshrubs].

Unarmed; usually from taproots or woody crowns, rarely rhizomes.

Cotyledons usually deciduous, usually peltate but can be sessile fused into a cup or disk. Stems erect to decumbent or prostrate, usually pubescent, sometimes glabrous. Leaves alternate, usually palmately compound, [rarely 3-foliolate or unifoliolate], usually cauline, sometimes crowded near base, rarely sometimes basal; stipules present, bristle-like, fused to petiole; peltate.

Leaflets [(1 or 3)] 5–11(–17), stipels absent, blade margins
Lupines of California
Teresa Sholars text
Stewart Wilson photography

Will be published by CNPS

In progress
Thank you posthumously

The mentors who had faith in me and gave me advice

Larry Heckard

Jim Hickman who got me into this mess

L. albifrons var. austromontanus

Ledyard Stebbins

Lincoln Constance

Images courtesy of the University and Jepson Herbaria
My teachers and mentors at Berkeley who taught me the complexities of sorting out nomenclatural messes and circumscription challenges: Barbara Ertter, John Strother (all interpretations and possible errors are mine alone).
Thanks to my kids for their support for me as a Botanist and Mom

1986, the year I began my studies on *Lupinus*

today