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A revision of the *Psoralea lanceolata* complex (Leguminosae)

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A REVISION OF THE *PSORALEA LANCEOLATA* COMPLEX (LEGUMINOSAE)[1]

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Abstract.— The *Psoralea lanceolata* complex is widely distributed in western North America from Saskatchewan to Texas and westward to Washington, Oregon, Nevada, and Arizona. The complex has received many interpretations, mostly on the basis of provincial floras and manuals. The present paper attempts to summarize the treatments of previous workers and to present an overview of the complex. The *Psoralea lanceolata* var. *stenophylla* is proposed. Distribution maps and illustrations of all entities are included.

The lemon scurf-pea or lemon-weed, *Psoralea lanceolata*, is a plant of arid regions and of sandy soils. It often invades disturbed sites and is an important pioneer on sand dunes, making it a significant plant in erosion control (Hopkins, 1951; Huelett and Coupland, 1966). The *P. lanceolata* complex is notable for its intraspecific variability (Isely, 1962; Matthews, 1969); indeed the variation within the complex has never been well understood or well documented. The treatment by Rydberg (1919) is the most recent work on *Psoralea* of North America, and his proliferation of species within this complex attests to its wide variation and to the inadequate understanding of that variation. More recent treatments of *P. lanceolata* have been in the form of regional floras (Boivin, 1967; Harrington, 1954; Hitchcock et al., 1966; Kearney and Peebles, 1960; Munz and Keck, 1959), which in the large part do not have to deal with the overall variation in the *lanceolata* complex. In any case, they are mostly only reiterations of Rydberg's original key, modified very little if at all. The most comprehensive and most recent treatment of *P. lanceolata* is that by Isely (1962). His treatment of *P. lanceolata* is not complete because of its regional nature, and the population of the north central states varies far less than the more western congeners of *P. lanceolata*.

Indications that the knowledge of variation within the *lanceolata* complex is inadequate are provided by specimens which do not fit well into the established concept of *P. lanceolata*. These specimens have been collected by a number of people at unrelated times and places and were consequently housed at various herbaria. It is the purpose of this study to examine in detail the variation within the *P. lanceolata* complex and to elucidate a current concept of this group. From the data gained in this study, it has been necessary to modify the key to embrace the actual rather than the purported variation within the group and to propose a new combination in recognition of a distinct infraspecific population of *P. lanceolata*.

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Methods

Herbarium specimens of *P. lanceolata* from the herbaria of Brigham Young University, Utah State University, University of Utah, and Iowa State University were examined. Acknowledgments are hereby made to the curators of the herbaria of these institutions. Various measurements and data were recorded from the specimens in an attempt to enumerate evident variation within the complex. The following data were recorded: (1) measurements of the length and width of the leaflets and calculation from the measurements of the ratios and the means of the ratios for various populations; (2) measurements of raceme and peduncle length and number of flower nodes per raceme and calculation of the ratios of the measurements to each other; (3) flower color; (4) the condition of pubescence of the pod; (5) time of flowering; (6) collection locality of each specimen; (7) chemotaxonomy of the alkaloids, flavanoids, and phenols of selected populations.

In addition, opportunity was taken to observe populations in the field, because the authors acknowledge the limitations of herbarium specimens in this type study. Collections for herbarium specimens are usually of only one plant or occasionally a small number of plants, and often these are not of the average type but rather of the most robust or most unusual specimen. Nearly the opposite conditions are required for an objective study of variation, specifically: large, random, and unbiased samples. However, the herbarium specimens are still the most important tool, given that their limitations are taken into account and if accurate field observations are used to supplement them.

The composite measurements were evaluated and attempts to correlate the above characters were made using several techniques including polygonal graphs, histograms, scatter diagrams, and range maps. In addition to the evaluation of the statistics of each plant, the authors beforehand separated the herbarium sheets into various piles on a purely visual basis, using "intuition" and accumulated experience with the group. Later, these segregates could be compared with the evaluated data, and in this way not only provide another means of correlation but also help to reduce any bias which might occur.

Taxonomy

Psoralea lanceolata Pursh Fl. 1814. Amer. Sept. 475.

Erect perennial from creeping branched rootstocks; stems 1-6 dm high (usually 2-3 dm), single or clustered, diffusely branched and often forming bushy clumps, inconspicuously strigose, glandular-punctate, aromatic; leaves mostly palmately 3-foliate; leaflets 1.5-4 cm long, the basal ones obovate to oblanceolate, narrower upward, the uppermost linear or remaining oblanceolate, acute to rounded or mucronate at apex, rounded to cuneate at base, strongly glandular-punctate, petioles 1-2.5 cm long; stipules linear-lanceolate to subulate, 3-10 mm long; peduncles 2-24 cm long, from barely exceeding

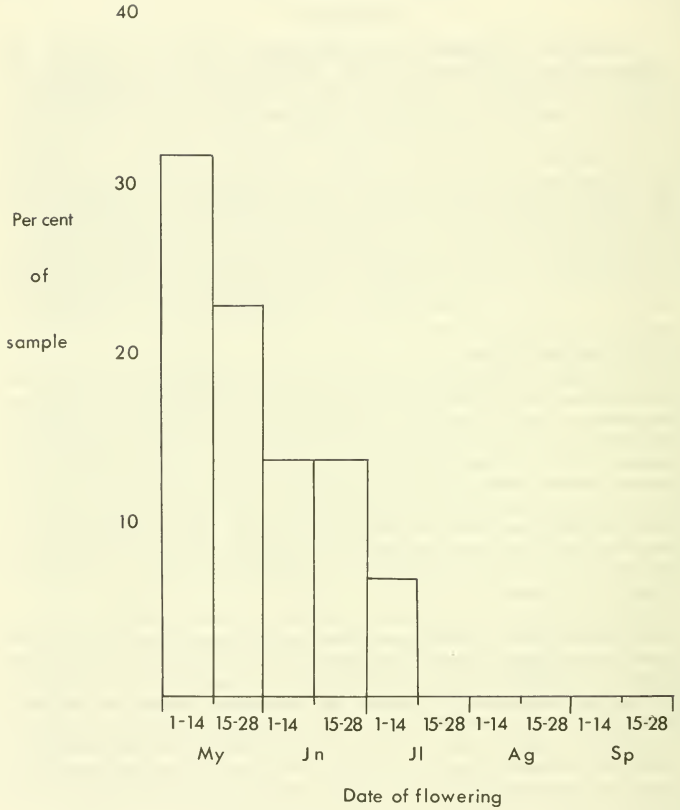

Fig. 1. Distribution of flowering dates of *Psoralea lanceolata* var. *stenophylla*.

the leaves to nearly as tall as the plant; racemes 0.5-17 cm long, from compact and short to lax and elongate; bracts minute, early deciduous; calyx campanulate, inconspicuously strigose, 2 mm long, not enlarging in fruit, teeth nearly equal, shorter than the tube, obtuse, glandular-punctate; corolla 3-7 mm long, whitish with purple-tipped keel or entire corolla dark blue to violet, banner almost orbicular, but with distinct auricles, blades of the wings obliquely oblong-oblanceolate, keel-petals scarcely lobed at base; stigma capitate, fruit exposed, subglobose when mature, with short beak, 4-6

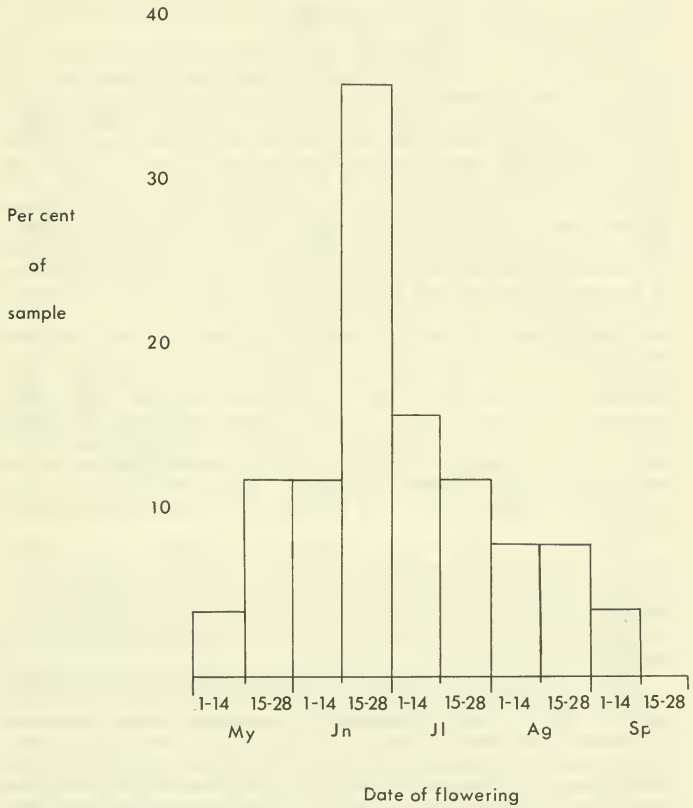

Fig. 2. Distribution of flowering dates of *Psoralea lanceolata* var. *lanceolata* within same geographical area as var. *stenophylla*.

mm in diameter, conspicuously glandular-warty, sparingly strigose to densely villous, pericarp rigid, not breaking at maturity.

Distribution and Habitat.— Saskatchewan, North Dakota, South Dakota, south to Texas, west to Washington, Oregon, California, Arizona. This species occupies a variety of habitats, almost all of which show signs of disturbance. In the eastern portion of its range, it may occupy native prairie (Isely, 1962). In arid regions, it is often found on sand dunes and in other sandy areas. However, where moisture is readily available, it may become weedy and ag-

gressive. It is often found on roadsides, bottomlands, and other disturbed areas (Isely, 1962).

Discussion.— In addition to the well-documented variation in leaflet width (Isely, 1962), the present study has indicated two significant types of phenotypic variation in the complex that were previously overlooked. They are flower color and raceme length. No flora or treatise which the authors have studied has acknowledged that *P. lanceolata* may have dark blue or violet flowers. Indeed, in regions where *P. lanceolata* and *P. tenuiflora* occur together, the regional keys are written in such a way that flower color separates the two species (Isely, 1962; Rydberg, 1919; Tidestrom and Kittell, 1941), with *P. lanceolata* having white flowers with purple-tipped keels and *P. tenuiflora* having dark blue or violet flowers. However, in the populations west of the Rocky Mountains, the blue flowered form may be far more prevalent than the white. In *P. lanceolata* var. *purshii*, the blue flowered individuals seem to be more common over most of its range. Also, in some small pockets of the Great Basin *P. lanceolata*, the two color phases grow side by side. This condition occurs in the *P. lanceolata* population of the white sand dunes of Juab County, Utah. In this isolated population, the specimens of *P. lanceolata*, which grow densely in the interdune areas, are mostly blue flowered; however, a white flowered form occurs on the edge of a blue flowered population. A similar situation occurs in Garfield County, Utah, and probably in other isolated pockets as well.

The variable raceme was recognized by Rydberg who named two species from the *lanceolata* complex on the basis of the lax and elongate raceme, *P. stenostachys* and *P. stenophylla*, respectively. However, subsequent authors have ignored raceme variability. In the present study raceme variation was investigated and found to be significant.

For the most part the total inflorescence length is quite variable; however, the flowers are almost always densely clustered on the raceme (Fig. 3). An exception to this was found in the population in southern and eastern Utah. In Utah there are two distinct forms of *lanceolata*, one which is typical with a dense raceme and one which has a very lax raceme (Fig. 3). The authors believe that this latter form is distinct and a separate entity from typical *lanceolata* for the following reasons: (1) It occurs only in a restricted geographic location, whereas typical *lanceolata* occurs uniformly over a much wider area (Figs. 3, 4). (2) The authors have never observed the phase with the lax raceme growing in the same habitat with typical *P. lanceolata*, even though the two types are apparently sympatric when plotted on distribution maps. It appears, therefore, that there is segregation of the phases on an ecological basis. (3) The phase with the lax raceme appears by all evidence to bloom at an earlier date than the typical *P. lanceolata* in that area (Figs. 1 and 2 summarize collection dates taken from specimens in flower on herbarium sheets for all plants collected in the area where the two forms are sympatric, i.e., Kane, Garfield, San Juan, Wayne, and Grand

FIG. 3

Fig. 3. Summary of variation within the *Psoralea lanceolata* complex. A. var. *purshii*. Flowers (predominantly blue), racemes compact, pods densely villous, leaflets broad, uniform. B. var. *purshii* - var. *lanceolata* intermediates. Pods strigose, leaflets intermediate. C. var. *lanceolata*. Flowers predominantly white, racemes compact, pods sparingly strigose, leaflets narrow, variable. D. var. *stenophylla*. Flowers predominantly blue, racemes elongate, pods sparingly strigose, leaflets narrow, variable. E. var. *lanceolata*, western phase. Flowers commonly blue, racemes compact, pods sparingly strigose, leaflets narrow, variable.

counties of Utah). (4) The entity with lax racemes is morphologically well separated from typical *P. lanceolata*, and intermediate forms have not been observed.

The phase with the elongate raceme is the same entity which was described by Rydberg as *Psoralea stenophylla*. Thus, the correct name for this entity is *Psoralea lanceolata* var. *stenophylla* (Rydb.) Toft and Welsh comb. nov., based on *Psoralea stenophylla* Bull. Torr. Club 40:46. 1913.

A brief investigation of the alkaloid, flavinoid, and phenol chemotaxonomy was made. A solvent system of butanol-acetic acid-water (4:1:5) was used, and spots were detected by Dragendorf's reagent for the alkaloids and by ultraviolet light for the flavinoids and phenols. It was found that the infraspecific populations of *P. lanceolata* did not differ significantly in any of these. However, a spot detected by Dragendorf's reagent, presumably an alkaloid,

Fig. 4. Range of *Psoralea lanceolata* Pursh and *P. juncea* Eastw.
P. lanceolata var. *lanceolata* and var. *purshii* (solid dot).
P. lanceolata var. *stenophylla* (star).
P. juncea (asterisk).

was present in *P. lanceolata* samples at Rf = 0.4 and was missing for samples of *P. juncea*. Unfortunately, not all varieties of *P. lanceolata* could be investigated to determine if this spot had any taxonomic significance.

A key which embraces the variation in this study is proposed in order to distinguish *Psoralea tenuiflora* and *P. juncea* from *P. lanceolata* which may be readily confused with the former two in taxonomic treatments.

1. Plants dropping all but a few basal leaves by flowering time; raceme extremely elongate, almost as tall as plant; flowers usually dark blue; southeastern Utah and northern Arizona ..... *juncea* Eastw.

1.′ Plants retaining leaves at flowering time; racemes variable, not usually as tall as plant; flower color variable, white or dark blue; distribution various 2

2.(1) Fruits ovoid-elliptical; racemes lax, usually three flowers to a node; corolla dark blue; leaflets nearly uniform in size from base to top of plant, narrowly to broadly obovate to oblong ..... *tenuiflora* Pursh

2.′ Fruits subglobose; racemes variable, from densely clustered to lax, usually two flowers to a node; corolla variable, either white with a purple keel or entire corolla blue to violet (latter, common west of Rockies); leaflets variable from top to bottom on same plant, basal ones obovate to oblanceolate, those near the top of the plant narrowly linear ..... *lanceolata* Pursh

Key to the varieties of *Psoralea lanceolata* Pursh

1. Leaflets obovate at base to oblanceolate at top of plant; leaflet variation from base to top of plant only slight; fruits densely villose or, less commonly, sparingly strigose; plants of Idaho, Nevada, Washington, Oregon ..... var. *purshii*

1.′ Leaflets oblanceolate to linear at base, linear to narrowly linear at top; leaflet variation from base to top may be pronounced; fruits slightly strigose 2

2.(1) Racemes dense, flowers clustered closely; flowers white with purple keel (common in eastern portion of range) or entire flower dark blue to violet; typical *lanceolata* with wide range from Saskatchewan, North Dakota, South Dakota, south to Texas, and west to Utah and Arizona ..... var. *lanceolata*

2.′ Racemes lax, the flower nodes widely separated, the inflorescence extremely elongate; blue flowers predominating; known only from arid regions of southern and eastern Utah ..... var. *stenophylla*

Psoralea lanceolata var. *purshii* (Vail) Piper, Piper & Beattie. 1901. Fl. Palouse Reg. 106.

Lotodes ellipticum var. *latifolium* Kuntze. 1891. Rev. Gen. 1:193.
Psoralea purshii Vail. 1894. Bull, Torr. Club 21:94.
Psoralea scabra Nutt. 1838. *In* T. and G. Fl. N. Amer. 1:300.
Psoralea lanceolata Pursh ssp. *scabra* (Nutt. T. & G.) Piper. 1906. Contr. U.S. Nat. Herb. 11:364.
Psoralidium purshii (Vail) Rydb. 1919. N. Amer. Fl. 24:14.

Description.— Differing from typical *P. lanceolata* in having broader leaflets, basal leaflets obovate, narrower upward, the uppermost oblanceolate, leaflet variation from top to base of plant only slight; racemes dense, flowers predominantly dark blue to violet, less commonly white with purple keel; fruits densely villose, less commonly, sparingly strigose.

Distribution and Habitat.— Idaho, Nevada, Washington, Oregon. Sandy areas often associated with *Artemisia* (Munz and Keck, 1959; Tidestrom, 1925).

Flowering Time.— May to July.

Discussion.—Data gained from leaflet measurement in this study reconfirm the previously recognized var. *purshii* (Isely, 1962;

Munz and Keck, 1959; Tidestrom, 1925) in the northwestern part of the range of the complex, a variety which has broader leaflets and more uniform leaflets from the top to the base of the plant than in var. *lanceolata*. In a restricted area in northern Utah and southeastern Idaho var. *purshii* and var. *lanceolata* appear to be intergrading (Fig. 3).

Representative Specimens.— California. Mono Co.: Reveal 526 (UTC); Idaho. Bingham Co.: Cronquist 2312 (UTC); Davis 1508 (UTC); Holmgren s.n. (UTC). Butte Co.; Atwood 913 (BRY); Atwood 1167 (BRY). Elmore Co.: Maguire and Holmgren s.n. (UTC). Fremont Co.: Maguire 17178 (UTC); Raven and Gregory 19562 (ISC). Jefferson Co.: Anderson 302 (UTC); Atwood 996 (BRY); Bench s.n. (BRY). Owyhee Co.: Davis 854 (UTC); Maguire and Holmgren 26264 (UTC). Nevada. Elko Co.: Holmgren 517 (BRY, UTC). Humbolt Co.: Constance, Molseed, and Ornduff 3695 (BRY, UTC); Gentry and Davidse 1539 (BRY, UTC, ISC); Holmgren and Maguire 10605 (UTC); Maguire and Holmgren 22481 (UTC); Moran s.n. (BRY). Oregon. Morrow Co.: Cronquist s.n. (UTC); Sherman Co.: Constance and Beetle 2687 (UTC). Washington. Grant Co.: Moran s.n. (BRY). Kittitas Co.: Maguire 17239 (UTC); Klickitat Co.: Suksdorf s.n. (ISC).

Psoralea lanceolata var. *lanceolata*

P. lanceolata Pursh. 1814. Fl. Amer. Sept. 475.
P. elliptica Pursh. 1814. Fl. Amer. Sept. 741.
P. arenaria Nutt. 1818. Gen. 2:103.
P. laxiflora Nutt. 1838. *In* T. and G. Fl. N. Amer. 1:299.
P. micrantha Gray. 1857. *In* Torr. Pacif. R.R. Rep. 4:77.
Lotodes ellipticum (Pursh) Kuntze var. *angustissium* Kuntze. 1891. Rev. Gen. 1:193.
Lotodes micrantha (Gray) Kuntze. 1891. Rev. Gen. 194.
P. stenostachys Rydb. 1913. Bull. Torr. Club 40:46.
Psoralidium lanceolatum (Pursh) Rydb. 1919. N. Amer. Fl. 24:13.
Psoralidium micranthum (Gray) Rydb. 1919. N. Amer. Fl. 24:14.
Psoralidium stenostachys Rydb. 1919. N. Amer. Fl. 24:14.

Description.— This is the typical and most widespread form of *P. lanceolata*. Leaflets oblanceolate to linear at base, narrower upward; leaflet variation from base to top may be pronounced; racemes dense, flowers closely clustered or less commonly lax; corolla white with purple-tipped keel (common in eastern portion of range) or entire corolla dark blue to violet (common in western portion of range); fruit sparingly strigose.

Distribution.— Saskatchewan, North Dakota, South Dakota, south to Texas, and west to Utah and Arizona.

Representative Specimens.— Arizona. Coconino Co.: Carter 1599 (UTC); MacDougal 217 (ISC); Toft 144 (BRY). Mohave Co.: Deaver 6251 (BRY). Colorado. Brown 120 (BRY); Alamosa Co.: Isely 8184 (ISC); Ramaley and Johnson 14994 (BRY). Denver Co.: Letterman s.n. (ISC). Douglas Co.: Osterhout and Clokey 3803 (UTC, ISC). Elbert Co.: Owneby 1369 (UTC). El Paso Co.: Jones 142 (UTC). Morgan Co.: Isely 6488 (ISC). Weld Co.: Welsh, Moore, and Mat-

thews 9320 (BRY). KANSAS. Fairchild s.n. 1888 (ISC); Hurr E287 (ISC). Edwards Co.: Welsh 665 (BRY, ISC). Osborne Co.: Shear 114 (UTC). MONTANA. Dawson Co.: Aeton s.n. (ISC). NEBRASKA. Banner Co.: Welsh 1067 (ISC). Box Butte Co.: Churchill s.n. (ISC); Welsh 1077 (BRY, ISC). Cherry Co.: Tolstead 4-470 (ISC); Tolstead 380 (ISC). Dawes Co.: Tolstead s.n. (ISC). Holt Co.: Burzlaff s.n. (UTC). Kearney Co.: Hapeman s.n. (UTC). Lincoln Co.: Brown 53-6 (ISC). Morril Co.: Maguire s.n. (BRY, UTC). Rock Co.: Clements 2874 (ISC). Sioux Co.: Rittenhouse 206 (UTC). Sheridan Co.: Buchanan s.n. (ISC). Thomas Co.: Isely 6070 (ISC). NEW MEXICO. Colfax Co.: Foster s.n. (ISC). Rio Arriba Co.: Flowers and Hall 130 (BRY). OKLAHOMA. Cimarron Co.: Jespersen 2715 (UTC). Logan Co.: Carleton 151 (UTC). Texas Co.: Isely 6394 (BRY, ISC). Woods Co.: Stratton 1326 (ISC), 6383 (ISC). SASKATCHEWAN. Ledingham and Yip 2225 (ISC). SOUTH DAKOTA. Badlands Natl. Mon.: Lindstrom 329 (BRY). Butte Co.: Brown 52-22 (ISC). Clay Co.: Van Bruggen 5604 (BRY). Todd Co.: Isely 6058 (ISC); Tolstead 4-30 (ISC); Welsh 1095 (ISC). UTAH. Daggett Co.: Smith s.n. (UTC); Smith s.n. (UTC). Emery Co.: Welsh and Atwood 9841 (BRY, ISC). Garfield Co.: Atwood 459 (BRY); Coles 123 (BRY); Collotzi, John, and Atwood 512 (UTC); Holmgren, Reveal, and La France 2044 (BRY, UTC); Stanton 335 (BRY, UT); Woodruff 1179 (BRY). Grand Co.: Jotter 2098 (UT); Rydberg and Garrett s.n. (UT); Welsh and Atwood 9949 (BRY, ISC); Welsh and Moore 2027 (BRY). Juab Co.: Harrison 11350 (BRY); Harrison 6550 (BRY, ISC); Harrison 354H (BRY, ISC); Harrison 11777 (BRY, ISC, UTC); Smigelski 63 (BRY); Smigelski 67 (BRY); Toft 17 (BRY); Toft 16 (BRY); Toft 148 (BRY); Toft 149 (BRY); Welsh and Moore 5128 (BRY). Kane Co.: Barnum 1324 (BRY); Castle 170C (BRY); Cottam 2712 (BRY); Harrison 11077 (BRY); Holmgren and Nelson 7191 (UTC); Maguire 12292 (BRY, UTC); Maguire 18893 (UTC); Toft 135 (BRY); Toft 136 (BRY); Toft 137 (BRY); Toft 139 (BRY); Toft 142 (BRY); Toft 143 (BRY); Welsh 1696 (BRY, ISC); Welsh and Welsh 9431 (BRY). Millard Co.: Cottam 1006 (BRY); Cottam 3782 (BRY, UT); Garrett 3937 (BRY, UT). Salt Lake Co.: Dunn 1940 (BRY); Harrison 10586 (BRY, UT, UTC); Howard s.n. (UT); McKnight 10586 (ISC). San Juan Co.: Cottam 5962 (UT); Welsh, Moore, and Canter 2927 (BRY); Welsh, Moore, and Canter 3010 (BRY, ISC). Tooele Co.: Flowers 898 (UT); Flowers 8 (BRY, UT). Uintah Co.: Jones s.n. (UTC); Welsh 446 (BRY). Washington Co.: Pendleton s.n. (UT); Weight 9192 (UT); Weight 10903 (UT). Wayne Co.: Beck and McArthur 150 (BRY); Cottam 4476 (BRY, UT); Holmgren, Boyle, and Will 7792 (UTC); Maguire 19251 (UTC); Markham s.n. (BRY); Welsh and Atwood 9850 (BRY, ISC); Welsh and Moore 3595 (BRY). Weber Co.: Brizzee 7814 (UT); Flowers 1277 (UT); Garrett 6289 (BRY, UT). WYOMING. Crook Co.: Porter and Porter 7574 (UTC). Carbon Co.: Porter 3725 (UTC). Natrona Co.: Gooding 177 (UTC, ISC); Isely 6535 (ISC); Welsh, Moore, and Matthews 9217 (BRY). Niobrara Co.: Isely 3948 (BRY, ISC). Park Co.: Greever 32 (BRY).

Psoralea lanceolata var. *stenophylla* (Rydb.) Toft and Walsh Comb. nov.

Psoralea stenophylla Rydb. 1913. Bull. Torr. Club 40:46.
Psoralidium stenophyllum Rydb. 1919. N. Amer. Fl. 24:14.

DESCRIPTION.— Differing from typical *lanceolata* in having elongate and lax racemes, flower nodes widely separated; flowers most commonly dark blue to violet; leaflets oblanceolate to linear at base, narrower upward, leaflet variation from base to top may be pronounced; fruits sparingly strigose.

DISTRIBUTION AND HABITAT.— Known only from arid regions of southern and eastern Utah, i.e., Emery, Wayne, Garfield, Kane, Grand, and San Juan counties. This form is almost always found growing in sandy soils: on roadsides, in canyon and wash bottoms, talus slopes, and sandstone cliffs. It has been reported to be associated with *Amelanchier*, *Chrysothamnus*, *Coleogyne*, *Artemisia*, *Pinus*, *Juniperus*, *Quercus*, *Phragmites*, *Rhamnus*, and *Vanclevia*.

FLOWERING TIME.— This form appears to bloom at an earlier date than typical *lanceolata* (Figs. 1, 2), beginning in early May and tapering off by mid-June.

DISCUSSION.— Records for *P. lanceloata* var. *stenophylla* and those for *P. juncea*, an endemic plant of southeastern Utah and northern Arizona are largely sympatric (Fig. 4). This range correlation and a similarity in morphology, where var. *stenophylla* appears to be intermediate in raceme length between *P. juncea* and *P. lanceolata* var. *lanceolata*, suggest the possibility that var. *stenophylla* may be the product of hybridization between these two. However, this assertion cannot safely be made until more detailed study is made and actual hybridization attempted; thus, the authors are merely posing the question here as an impetus to further study.

REPRESENTATIVE SPECIMENS.— UTAH. Garfield Co.: Holmgren and Goddard 9955 (UT); Kaneko 28 (BRY); Welsh and Moore 7110 (BRY, ISC). Grand Co.: Harrison 11367 (BRY). Kane Co.: Beck and Tanner s.n. (BRY); Harrison 12114 (BRY); Murdock 371 (BRY); Welsh 1689 (BRY). San Juan Co.: Welsh 5387 (BRY, ISC); Wilson 120 (UTC). Wayne Co.: Beck s.n. (BRY, ISC); Cottam 9275 (UT); Welsh and Atwood 9879 (BRY, ISC).

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