

THE DIANDROUS, HYPOSTOMATIC WILLOWS  
(SALICACEAE) OF THE CHIHUAHUAN  
DESERT REGION

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ABSTRACT

A key is provided for the five species of *Salix* in the Chihuahuan Desert Region with two-stamened flowers and leaves with stomates almost confined to the lower surfaces. One species, *S. lasiolepis* Benthams, was previously known and named; three new species are described from the state of Coahuila: *S. pattersonii*, *S. riskindii*, and *S. wendtii*. The fifth species, also from Coahuila, is discussed but remains nameless because it is known only from two sterile collections.

In the Chihuahuan Desert Region, delineated for floristic purposes by Johnston (1977), willows occur in a few mesic habitats, especially along the Rio Grande and its tributaries and in even more areally restricted and scattered montane canyons and high slopes. Climatic vagaries and logistical difficulties of exploration have so far prevented the gathering of comprehensive material of willows in this region and seem likely to inhibit such gathering for years to come. The challenge of future exploration is to visit each remote population at appropriate seasons in order to collect specimens representing both sexes at various stages of development with a high degree of confidence that the specimens are conspecific. Until such material is forthcoming, treatments of the willows of the Chihuahuan Desert Region must be considered even more preliminary and tentative than treatments of willows in other regions.

Notwithstanding the incompleteness of the herbarium stores, it has been necessary recently to prepare a taxonomic treatment of *Salix* for the *Chihuahuan Desert Flora* being compiled by Dr. James Henrickson and me. I present here some of the results of my study. Because of space limitations I omit further mention of the arboreal, pleiandrous "black" willows, all of which have been fairly well understood by Schneider (1918), Ball (1950, 1961) and Dorn (1976, 1977) and which in this region are found at relatively low altitudes along the Rio Grande and its tributaries. I also exclude from further consideration the species of the very poorly named *Salix* sect. *Longifoliae* Andersson, namely *S. taxifolia* Humboldt, Bonpland & Kunth, *S. exigua* Nuttall and *S. interior* Rowlee. These three species, although diandrous, have relatively loosely flowered catkins and their leaf-blades have almost as many stomates on the upper as on the lower surface. They are also

fairly well understood taxonomically, though far less well than are the "black" willows. With the exception of *S. taxifolia*, the members of sect. *Longifoliae*, like the "black" willows, are nearly restricted to the lower altitudes along rivers and creeks.

The subjects of this paper are the diandrous, multistemmed shrubs or low trees with dense ascending and spreading catkins and spreading leaves with stomates almost entirely absent from their upper surfaces. In the entire region, an area almost as large as California, only a few mountain ranges provide the mesic canyons and slopes suitable for these willows: in Texas, the Davis, Chisos, and Vieja mountains; in Chihuahua, the Sierra Rica; and Coahuila, the Sierra Maderas del Carmen, the Sierra de la Madera, and, at the extreme eastern margin, the Serranías del Burro. From the entire Mexican portion of this region, Johnston (1944) saw only one specimen of this species-group, a sterile specimen from the Sierra de la Madera. Since 1970, mainly through the strenuous and perceptive fieldwork of David H. Riskind, Tom Wendt, Tom Patterson, and Emily J. Lott, several collections have accumulated from northern Coahuila that represent three distinct new species. Study of a recent collection of the Sierra de la Madera population reinforces my suspicion that it represents still another new taxon, but because flowers and fruits are still not available, I refrain from proposing a name for it.

#### TAXONOMIC TREATMENT

##### Key to species

- Lower surfaces of leaves densely canescent-pubescent with antrorse, silky, white hairs, or glabrate.
- Aments appearing in February and March, rarely later, on leafless branches of the previous year; leaf-blades oblanceolate to linear-lanceolate; stamen-filaments joined 0.2–0.7 of their length.
- Ovaries wholly glabrous; filaments joined only 0.2–0.3 of their lengths . . . . . 1. *S. lasiolepis*.
- Ovaries hairy at least along lines of dehiscence, sometimes all over; filaments joined more than 0.5 of their length . . . . . 2. *S. riskindii*.
- Aments appearing in May or August at end of more or less leafy ament-tipped lateral twigs; leaf-blades more or less elliptic; filaments free (unknown in No. 3).
- Aments appearing in May with the leaves, much exceeding twig-leaves; leaves entire . . . . . 3. *S. pattersonii*.
- Aments appearing in August with mature summer leaves; leaves serrulate . . . . . 4. *S. wendtii*.
- Lower surfaces of leaves with closely appressed, scattered, rufous hairs. . . . . 5. Sp. nov.?

1. *Salix lasiolepis* Bentham, Pl. Hartweg. 335. 1857.—TYPE: USA, CA, banks of the Salinas and Carmel Rivers, near Monterey, Hartweg 1955 (Holotype: K!).  
*Salix lasiolepis* var. *braceliniae* Ball, J. Wash. Acad. Sci. 40:331. 1950.—TYPE: USA, CA, Contra Costa Co., Antioch, Eastwood 3729 (Holotype: US!).

Description of material from the Chihuahuan Desert Region: trees or shrubs, usually multi-trunked; one-year-old twigs brownish, rarely pruinose; older twigs olive-green to yellow-brown or commonly orange, internodes 3–8 mm long, with usually ascending-appressed but sometimes spreading, crisp, gray-white hairs 0.3–0.5 mm long when very young, then glabrate; axillary (winter) buds prominent, often 3–6 mm long, hairy like the youngest twigs. Leaf blades linear-lanceolate to linear-oblongate, (4–)5–8(–11) cm long, 6–12(–18) mm wide, usually inconspicuously gland-toothed with teeth antrorse-appressed, or nearly entire; abaxial surface with close, white, silky or crisped hairs 0.3–0.8 mm long to quickly glabrate in some specimens, epidermis glaucous to merely pale green; adaxial surface darker green, lustrous and essentially glabrous except on midveins, when very young some leaves with appressed-antrorse silky, white hairs 0.3–0.8 mm long; petioles 2–7 mm long; stipules almost always absent, extremely small when present. Staminate aments: precocious in March or less commonly appearing in July in axils of mature leaves, ascending-appressed, 9–18 mm long, 5–6(–8) mm thick; scales 1.3–1.6 mm long, obovate, blunt, appressed-ascending, abaxial surface with antrorse silky white hairs 0.7–1 mm long; adaxial pubescence similar except glabrous and glandular in lower third; filaments ca. 3–3.5 mm long, joined 1–1.3 mm at base, free 1.7–2.7 mm above; anthers rotundly or narrowly horseshoe-shaped, 0.3–0.4 mm long and wide. Pistillate aments: precocious in March; 1–1.5 cm long, 6–8 mm wide, ca. 50-flowered, dense; scales and flowers at first ascending, later spreading; scales obovate, blunt, 0.6–1 mm long, with antrorse, silky, white hairs 0.6–1 mm long; stipes ca. 0.5 mm long; styles 0.3–0.5 mm long, stigmas 0.2–0.3 mm long. Fruit 2.5–3 mm long, glabrous; seeds ca. 0.7–0.8 mm long.

In this region, *S. lasiolepis* is known from wooded creek-canyons in igneous-rock mountains, principally in the Davis Mountains of trans-Pecos Texas, but with smaller populations in the Chisos and Vieja mountains of trans-Pecos Texas, the Sierra Rica of extreme northern Chihuahua and the Sierra Maderas del Carmen of extreme northwestern Coahuila. The localities are all above 1400 m elevation.

## 2. *Salix riskindii* M. C. Johnston, sp. nov.

Frutices multicaules vel etiam arbores parvae, ramuli hornotini folioli dense pubescentes; laminae foliorum oblanceolatae 3–7 cm longae

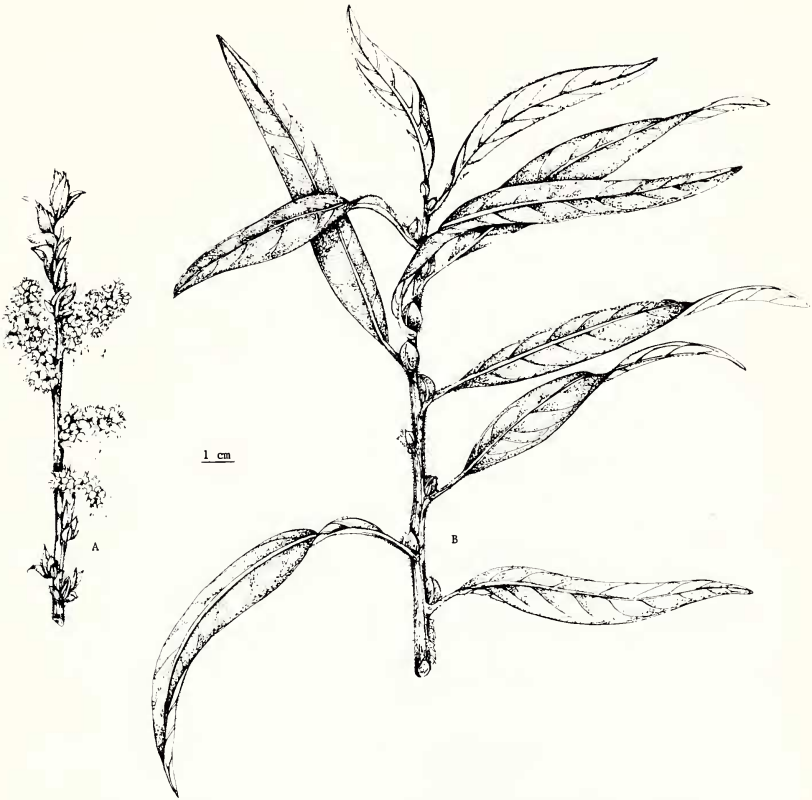


FIG. 1. *Salix riskindii* M. C. Johnston. A. Twig with inflorescences. B. Leafy twig.

9–15 mm latae persistente dense pubescentes (subtus densius) pilis antrorsis adpressis sericeis albis, petioli (1–)2–3 mm longi pubescentes. Amenta praecocia verna adscendentia staminata 15–25 mm longa 8–12 mm crassa; filamenta 2 fere glabra partibus coalescentibus 2–3 mm longis partibus liberis 1–2 mm longis; squamae fructiferes 1–1.5 mm longae ca 1 mm latae pubescentes pilis 1–2 mm longis; ovaria ca 3 mm longa omnino pubescentes vel pubescentes non nisi secus suturas (Fig. 1).

Multi-stemmed shrubs 1–3 m tall or even multi-trunked small slender trees to 7.5 m tall (*Wendt and Lott 126*); leafy twigs of the season brown-gray, densely pubescent with silky, gray-white, somewhat crisped, appressed, spreading hairs; axillary (winter) buds prominent, 5–8.5 mm long, hairy like the youngest twigs. Leaves expanding in April after flowering is completed, apparently ascending or spreading

(not drooping); leaf blades (3-)6-7(-12) cm long, 9-15 (-19) mm wide, oblanceolate, entire, persistently densely pubescent (more densely so beneath) with antrorse, appressed, silky, whitish hairs; stomates present beneath, rare or absent above; petioles (1-)3-11 mm long, pubescent like blades. Flowers appearing in February and March on leafless branches of previous year; aments abundant on twigs but solitary at nodes, dense, sessile, ascending (staminate) or drooping at tip (pistillate), cylindrical, 15-25 mm long, 8-12 mm thick, silky-hairy, rounded at tip; winter-bud scales subtending aments buffy brown, pubescent like the leaves, 5-7 mm long. Staminate flowers (*Riskind and Riskind 2052*): scales oblong, 2-3 mm long, blunt, pale brown, dorsally densely pubescent with white, silky, antrorse hairs 1-2 mm long; vestigial ovary slender, conical, yellow-green, gland-like, ca. 0.8 mm long; stamens 2, nearly glabrous, joined part of filaments 2-3 mm long, free parts 1-2 mm long; anthers purple-brown, ca. 0.6-1 mm long, ovate-orbicular. Pistillate flowers at stage of pollen-receptivity not known, present at a later stage with young fruit in *Riskind and Patterson 1944a* and *Wendt 126*: scales brown, more or less oblong-obovate, ca. 1.5 mm long (*1944a*) or 1 mm long (*126*), 1 mm wide, pubescent with antrorse, white, silky hairs 1-2 mm long either equally densely on both surfaces (*126*) or more densely so on back (*1944a*); gland minute, oblong, scale-like, ca. 0.3 mm long; ovary stipe ca. 0.5 mm long with white, silky hairs; ovary ca. 3 mm long, hairy all over (*126*) or only in vertical stripes along lateral sutures (*1944a*); style ca. 1 mm long of which upper 0.2 mm is forked and stigmatic. Seeds (*126* only) numerous, oblanceoloid, ca. 0.9 mm long of which lower 0.2 mm comprises narrowed stipe; hairs numerous, 2-3 mm long attached to disk- or callus-like funicle.

TYPE: México, Coahuila, Sierra Maderas del Carmen, Cañón Carboneras, ca. 1 km s. of El Uno, along perennial stream in pine-oak woodland, 28°59'30"N, 102°33'W, 1500-2100 m, 2 Apr 1974, *Tom Wendt 126* with Emily J. Lott and David Riskind (holotype: TEX).

PARATYPES: México, Coahuila, Municipio de Villa Acuña, Serranías del Burro, Rancho El Bonito, Cañón El Bonito ca. 2.5 km above first dam, 29°1'30"N, 102°7'30"W, 1700 m, 11 Apr 1976, *D. J. Riskind and T. F. Patterson 1944a* (TEX); same locality, 20 Feb 1977, *D. H. Riskind and J. Riskind 2052* (LL); same canyon, 29°0'30"N, 102°7'30"W, 1800 m, 20 Sep 1977, *J. Valdés R. and A. L. Metcalf 2249* (LL).

The label of *Wendt 126* indicates that these willows are shrubs to small trees, sometimes exceeding 7 m in height, abundant in the "main" arroyo, extending from at least 1500 m elevation, where the plants were fully leafed on 2 April, to 2100 m where they were only in bud; the foliage is said to be "silvery light green". The associates are said to be *Quercus* spp., *Cupressus arizonica* Greene, *Pinus arizonica* Engelm., *P. cembroides* Zuccarini and *Vitis* sp. The label



of *Riskind and Patterson 1944a* notes that these are abundant shrubs to 3 m tall on margins of wet meadow in woodland of *Quercus muehlenbergii* Engelman in upper reaches of Cañón El Bonito. The label of *Riskind and Riskind 2052* says that these are abundant multi-stemmed shrubs to 3 m on margins of intermittent stream and ciénega in deciduous woodland in upper reaches of Cañón El Bonito along logging road ca. 2.5 km upstream from first dam, associated with *Quercus gravesii* Sudworth, *Prunus mexicana* Watson, *Quercus muehlenbergii*, and *Pinus arizonica* var. *stormiae* Martínez.

The shorter stature and the slightly different ovary pubescence of the plant of the Serranías del Burro lead to the suspicion that they may deserve recognition as taxonomically distinct from the plants of the Sierra Maderas del Carmen only some 70 km farther west, but the material available is not adequate for a critical evaluation of this point. I await receipt of more adequate specimens from both areas, especially staminate plants from the Sierra Maderas del Carmen.

In Schneider's (1918) treatment of Mexican willows, *S. riskindii* keys to *S. paradoxa* H.B.K. but it differs from *S. paradoxa* in the smaller, sessile aments and much denser, more persistent pubescence of silky hairs as well as the height of joining of the stamen-filaments. *Salix riskindii* may be more closely related to *S. lasiolepis* with which it shares the features of basal filament-joining and over-all habit. But it is quite distinct in a number of other features.

### 3. *Salix pattersonii* M. C. Johnston, sp. nov.

Frutices multicaules ad 2.25 m alti, ramuli hornotini pilis multis demum glabrati. Laminae foliorum elliptico-oblanceolatae 2–6.5 cm longae 1–2.5 cm latae supra praeter costam glabrae nitidae costis albopubescentibus, subtus persistente dense canescento-pubescentes integrae. Amenta staminata ignota; amenta pisitillata ut videtur inter mensem maii emergentia coetanea in extremitatibus ramulorum ramulis pedunculiformibus 1–2(–3)-nodatis 3–5-mm longis folia ramulorum superantia, in statu fructifera 4–5 cm longa 10–15 mm diametro; capsulae 6–7 mm longae dense pubescentes (Fig. 2).

Multi-stemmed shrubs to 2.25 m tall; twigs of the season slender, dark brown, striate when very young with spreading to retrorse, silky, whitish hairs 0.2–0.3 mm long, older portions glabrate; internodes ca. 2–10 mm long; axillary buds pale brown, sparsely pilose, ca. 3 mm long. Leaves ascending; leaf-blades elliptic-lanceolate, 2–6.5 cm long, 1–2.5 cm wide, with acute tips and cuneate-rounded bases, entire-margined, olive-green, lustrous and essentially glabrous above when nearly mature except for white-pubescent larger veins, on abaxial surface waxy-papillose, glaucous and persistently densely canescent-pubescent with antrorse, silky, white hairs 0.3–0.8 mm long; stomates abundant beneath, absent above; petioles 2–9 mm long, with pubes-



FIG. 2. *Salix pattersonii* M. C. Johnston. Twig with leaves and pistillate inflorescences.

cence like that of the leaves; stipules minute. Staminate aments unknown. Pistillate aments at anthesis not seen, apparently emerging in May with the leaves, terminating 1-3(-3)-noded 3-5-mm-long axillary ascending-spreading twigs, vastly exceeding twig leaves, cylindric, when in fruit 4-5 cm long, 10-15 mm thick; scales 1.5-2 mm long, lanceolate, acute, appressed, with antrorse, silky, white hairs ca. 1 mm long, less densely hairy on adaxial surface; pedicels ca. 1.6-2 mm long; gland absent; capsule 6-7 mm long, densely hairy with antrorse, silky, white hairs ca. 0.5 mm long, after dehiscence with widely recurved valve-beaks; stigmata ca. 0.3-0.4 mm long, deltoid, about as wide as long. Seeds narrowly falcate-ovoid, compressed, nearly black,

at base with numerous, silky, white ascending hairs joined at central whitish easily detached, basal callus-like funicle; embryo green.

TYPE: México, Coahuila: Municipio de Ocampo, Sierra Maderas del Carmen, 102°33'N, 28°59'W, Campo 4, in cut-over, open, mixed conifer-oak woods, 27 May 1975, *Riskind and Patterson 1809* (Holotype: LL).

The label states that the shrubs are locally common and are associated with *Cupressus arizonica*, *Pseudotsuga menziesii* (Mirb.) Franco, *Pinus* spp., *Quercus sideroxyla* Humboldt & Bonpland, *Q. rugosa* Née and *Abies durangensis* Martínez var. *coahuilensis* (I. M. Johnston) Martínez. The species is currently known only from the type collection.

On the basis of over-all vegetative similarity and the shape of the bracts, this pistillate material is perhaps related to *Salix oxylepis* Schneider, which was known to Schneider only by material from the region near the Peak of Orizaba. *Riskind and Patterson 1809* also keys to *S. oxylepis* in the more extensive treatment by Espinosa (1979), who reports *S. oxylepis* from six states and the federal district in central Mexico. As compared with *S. oxylepis*, however, *S. pattersonii* has shorter petioles, shorter and narrower leaf blades with persistently pubescent abaxial surfaces, and shorter pistillate aments.

Two sterile collections also from the Sierra Maderas del Carmen are similar enough vegetatively to *Riskind and Patterson 1809* to be placed here tentatively: México, Coahuila, Sierra Maderas del Carmen, rhyolitic s. peaks, nw. side of upper Carboneras Canyon, 28°57'N, 102°34'W, 2400 m, uncommon small tree in mixed conifer-oak forest, 2 Apr 1974, *T. Wendt 124a* (TEX); along road above Catedrales Canyon in nw. part of range due w. of Campo Tres, above 2200 m, common multi-stemmed shrubs along intermittent water-courses with *Pinus*, *Pseudotsuga*, *Quercus*, *Cupressus*, *Arbutus*, *Cornus*, 3 Aug 1974, *D. H. Riskind, B. Burluson, and J. T. Baker 1720* (LL). I think that these two collections very likely represent *S. pattersonii*.

#### 4. *Salix wendtii* M. C. Johnston, sp. nov.

Arbores parvissimae fruticoideae ad 3 m altae ad basem multiramosae; ramuli hornotini primitus pilis multis demum glabrati. Laminae foliorum ovato-ellipticae vel ellipticae vel obovato-ellipticae (4.5–) 5–7(–8) cm longae 2–3.5 mm latae supra praeter costam glabrae nitidae costis albo-pubescentibus, subtus persistente dense canescento-pubescentes serrulatae dentibus parvis antrorsis glandularibus. Amenta staminata inter mensem Augusti emergentia coetanea cum foliis maturis in extremitatibus ramulorum ramulis pedunculiformibus 2–3 cm longis 2–5-nodatis folia superiora breviora 20–24 mm longa 9–13 mm lata; squamae ovatae 2–2.5 mm longae acutae acuminatae pubescentes; stamina 2, filamenta omnino libera 5–8 mm longa (Fig. 3).





FIG. 3. *Salix wendtii* M. C. Johnston. A. Staminate flower. B. Twig with leaves and one staminate inflorescence.

“Shrubby trees” to 3 m tall, much branched at base; twigs of the season slender, dark brown, striate, when very young with numerous, spreading, silky, whitish hairs 0.5–1 mm long, later glabrate; internodes ca. 1–2 cm long; axillary buds dark brown, glabrous, 4–6 mm long. Leaf blades ovate-elliptic to elliptic to obovate-elliptic, (4.5–)5–7(–8) cm long, 2–3.5 cm wide, firm, membranous, at margins serrulate with small, antrorse gland-tipped teeth (teeth numerous on rapidly growing shoots, less so elsewhere), at tip weakly cuspidate, at base rounded, on upper surfaces olive-green, essentially glabrous and lustrous at maturity except for white-pubescent midvein, on lower surface waxy-papillose, glaucous and persistently densely canescent-pubescent with antrorse, silky, white hairs 0.5–1 mm long; stomates abundant beneath, absent above; petioles (3–)5–8 mm long, with pubescence

like that of leaves; stipules on rapidly growing shoots elliptic-falcate, 4–6 mm long, highly asymmetrical, green, leaf-like in texture, serrulate, lower surface white-hairy especially near base; stipules on slower-growing shoots essentially absent. Staminate aments: appearing in August with mature leaves, terminating 2–5 noded, 2–3-cm-long twigs, ascending, shorter than uppermost twig leaves, subcylindric, 20–24 mm long, 9–13 mm wide (including stamens), with a peduncle 3–4 mm long, silky-hairy. Staminate flowers: subtending bract-scale appressed, ovate, 2–2.5 mm long, acute and acuminate, yellow-brown when dry (said to be green when fresh), pubescent with antrorse, silky, white hairs 0.8–1.3 mm long, less densely hairy above; gland ventral, truncate or even concave at tip, more or less rectangular, ca. 0.3 mm long; stamens 2, filaments wholly free, 5–8 mm long, in basal half with many antrorse silky, white hairs ca. 0.5 mm long; anthers ovoid, 0.7–0.8 mm long, yellow, each with an apical gland. Pistillate aments, flowers, and fruits unknown.

TYPE: México, Coahuila, Sierra Maderas del Carmen, 29°00'N, 102°36'W, near Campo Tres on ridge between camp and "Hell's Kitchen" to the north, common at bases of cliffs of the ridgetop, wsw. slopes, 2600 m, 6 Aug 1974, *T. Wendt and A. Adamcewicz 518* (Holotype: TEX).

*Salix wendtii*, known only from the type collection, cannot be accommodated in the key or descriptions of Schneider (1918). In Espinosa (1979) it keys to *S. oxylepis* but has longer petioles, shorter, narrower leaf blades, shorter staminate aments and shorter floral scales.

##### 5. *Salix* sp. nov.?

Two sterile specimens represent this entity: México, Coahuila, Municipio de Cuatro Ciénegas, Sierra de la Madera, Cañón del Agua, 27°3' or 27°4'N, 102°24'W, 9 Sep 1934, *C. H. Muller 3242* (GH, LL); same locality, above the canyon on n. slopes, 2450–3100 m, with *Cupressus*, *Quercus*, *Pseudotsuga*, *Pinus*, and *Abies*, 14 Aug 1980, *T. Wendt and E. J. Lott P29* (TEX).

Muller notes on his label that these are trees to 4.5 m tall with smooth, tawny trunks to 10 cm thick. Wendt and Lott (label and pers. comm., 1980) state that these are small trees 2–6(–9) m tall with 5–100 or more stems from the base, with smooth, grayish bark. These willows are not common in the Cañón del Agua at 2450–2900 m, but on the slopes above the canyon, even up to 3100 m on the Pajarito Peak, they are co-dominant with *Cupressus* and other conifers. The lowest, earliest leaves of the newly expanding shoots often have narrowly obovate or oblong blades 2–4 cm long. Somewhat later leaves have longer, narrowly obovate blades usually 4–9 cm long and 2–3 cm wide. The last-formed leaves are broadly lanceolate, 6–10 cm long, 1–2 cm wide and rather regularly serrulate with small, remote teeth.

The upper surfaces are essentially glabrous. The lower surfaces are non-papillate and nearly glabrous but with closely appressed, scattered, pale rufous hairs ca. 0.4 mm long.

According to Johnston (1944), *Muller 3242* "appears to be referable to *S. paradoxa*", but I find that it differs from that species in many features. Because *Muller 3242* and *Wendt & Lott P29* do not correspond with any previously known willows, I suspect that they represent still another local endemic taxon. It is to be hoped that flowers and fruits will be made available for study.

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