

43. STIPA L. Needlegrass, Feathergrass

Cespitose perennials; culms hollow or solid; leaves mostly basal; sheaths open, often persistent; ligules membranous, acute or truncate and often lacerate, sometimes consisting of a ring of hairs or a low crown; blades usually involute, long and narrow, usually disposed in a basal clump, non-auriculate; inflorescence a strongly contracted and spike-like to loose and open panicle; spikelets 1-flowered, large, disarticulating above the glumes; glumes subequal or the first longer than the second, both longer than the body of the lemma, narrow-acute to long-acuminate or infrequently aristate, mostly 1- to 5-nerved, membranous, often papery; lemma firm or indurate, relatively narrow, terete or angular, mostly faintly 5-nerved, the margins usually overlapping, the callus and rachilla long, usually sharp pointed from an oblique break and bearded with hairs usually longer than those on the lemma body; awn (5) 15–200 mm long, once or twice geniculate, usually several to many times as long as the body of the lemma (except in *S. webberi*), persistent or tardily deciduous, the lower segment(s) scabrous or pubescent, sometimes glabrous, twisted, attached terminally or subterminally, the junction of the lemma body and awn clearly evident, the terminal segment not twisted; palea shorter than the lemma, usually hidden by overlapping margins of the lemma, glabrous to pubescent; lodicules 2 or usually 3, slender and blunt, the lateral pair usually longer than the middle one; stamens 3; caryopsis tightly invested by the lemma and palea; $x = 7, 11$.

A genus of about 100 species, ranging from the tropics almost to the Arctic. Most of the U.S. species are distributed in the w. states (Name from the Greek *stipe*, tow, in reference to the feathery appearance of the plumose awns of the type species, *S. pennata* L.)

The needlegrasses are generally valuable forage species. *Stipa comata* and *S. neomexicana* should be grazed only when the plants are young, because the sharp callus of mature plants is capable of causing mechanical injury to mouth parts of livestock. Most of the other species are important and palatable throughout the growing season and often occur in abundance on the range. Species of *Stipa* often dominate in prairie communities beyond the Intermountain Region borders. They are common within our area, but rarely form extensive communities.

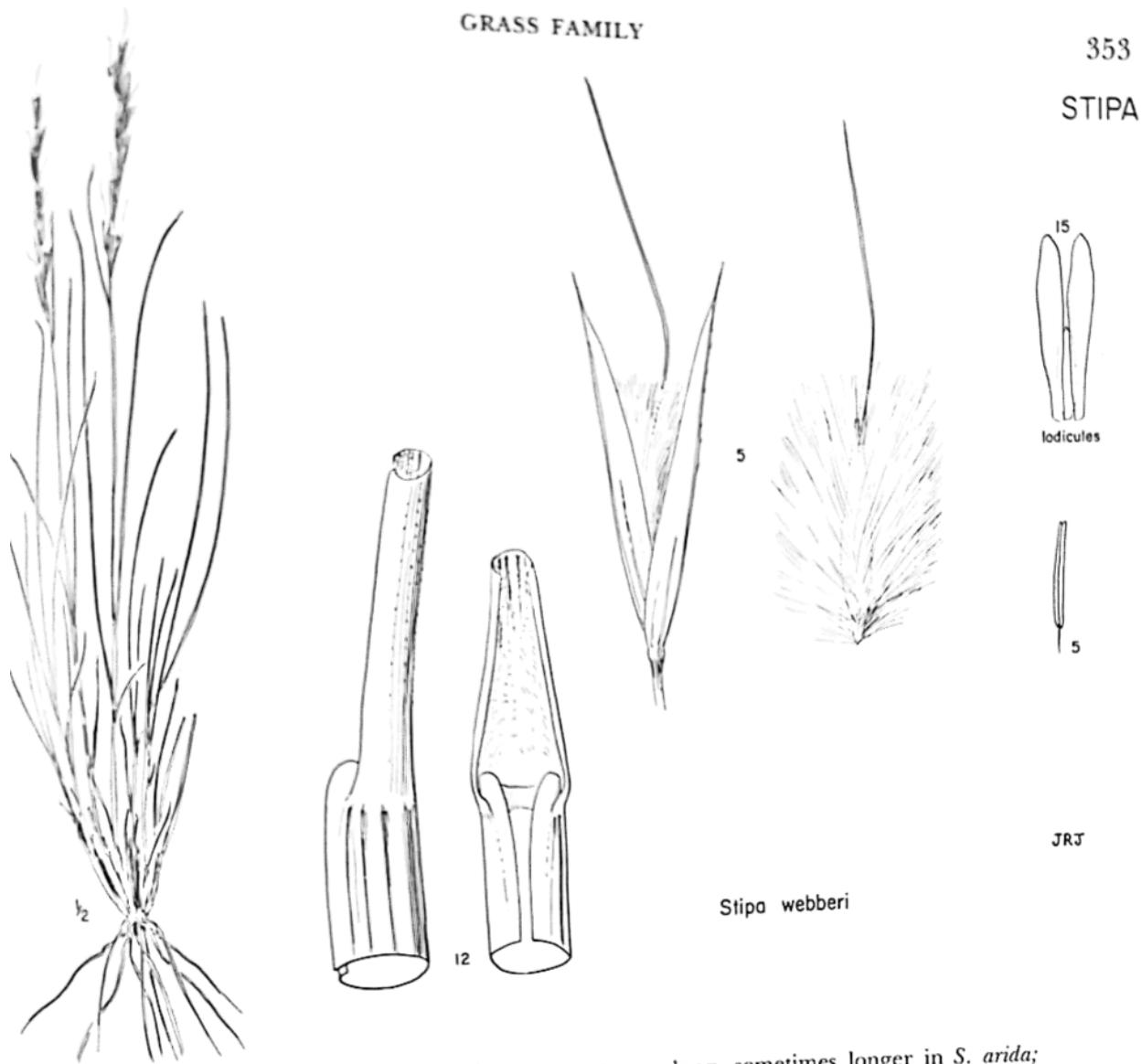
Several species of *Stipa* are known to hybridize freely among themselves and with the closely related *Oryzopsis hymenoides* (Roemer & Schultes) Ricker. The resulting intergeneric hybrids show dominating characters of the *Oryzopsis* parent and are often referred to *X Stiporyzopsis bloomeri* (Boland.) B. L. Johnson since they all look so much alike. All are completely sterile. Euploidy and aneuploidy run rampant in *Stipa* with chromosome numbers ranging from $2n = 22$ to 70.

We have deviated from the widely used sequence of species established by A. S. Hitchcock (1925) in order to better reflect the possible phylogeny of species. Hitchcock began his sequence with the more specialized species such as *S. neomexicana*, *S. speciosa* and *S. coronata* and ended it with some of the *Oryzopsis*-like species such as *S. pinetorum*. It seems more logical to more or less reverse this sequence in order to place the *Oryzopsis*-like species at the point of divergence between the two obviously closely related genera. Cytologically this places the lower chromosome numbers at the beginning.

References:

- Hitchcock, A. S. The North American species of *Stipa*. Contr. U. S. Natl. Herb. 24: 215–262. 1925.
 - Johnson, B. L. Natural hybrids between *Oryzopsis hymenoides* and several species of *Stipa*. Amer. J. Bot. 32: 599–608. 1945.
 - _____. Natural hybrids between *Oryzopsis* and *Stipa*. I. *Oryzopsis hymenoides* X *Stipa speciosa*. ibid. 47: 736–742. 1960.
 - _____. Amphiploidy and introgression in *Stipa*. ibid. 49: 253–262. 1962a.
 - _____. Natural hybrids between *Oryzopsis* and *Stipa*. II. *Oryzopsis hymenoides* X *Stipa nevadensis*. ibid. 49: 540–546. 1962b.
 - _____. Natural hybrids between *Oryzopsis* and *Stipa*. III. *Oryzopsis hymenoides* X *Stipa pinetorum*. ibid. 50: 228–234. 1963.
- 1 Terminal segment of the awn plumose; glumes (20) 30–60 mm long 13. *S. neomexicana*
 1 Terminal segment of the awn not plumose; glumes less than 25 mm long, except in some *S. comata*.
 2 Lower segment of the once-geniculate awn strongly plumose, the hairs 4.5–8 mm long .. 10. *S. speciosa*
 2 Lower segment of the awn glabrous, scaberulous, or if plumose the hairs not more than 2 mm long.
 3 Lemma densely villous with white hairs about 2–5 mm long.
 4 Spikelets (8) 11–20 mm long; awns (10) 17–42 mm long; culms 2–20 dm tall 11. *S. coronata*
 4 Spikelets 6–11 (12) mm long; awns 5–17 (22) mm long; culms 1–3.5 (5) dm tall.
 5 Awn deciduous (sometimes tardily so), 5–7 mm long, straight or only slightly bent, not twisted 1. *S. webberi*
 5 Awn persistent, 11–22 mm long, twice geniculate 2. *S. pinetorum*
 3 Lemma often villous, but the hairs not more than 2 mm long (except the apical hairs in *S. scribnieri*).
 6 Awn plumose on the lower two segments, the hairs 0.5–2 mm long.
 7 Ligules 2–7 mm long; glumes often purple 4. *S. thurberiana*
 7 Ligules 0.2–0.7 (2) mm long; glumes usually greenish.
 8 Pubescence of the lemma tip and the first awn segment similar, the hairs subequal in length; palea mostly less than half as long as the lemma 5. *S. occidentalis*
 8 Pubescence of the lemma tip and the first awn segment dissimilar, the hairs of the lemma longer; palea mostly more than half as long as the lemma 6. *S. nevadensis*
 6 Awn hirtellous to nearly glabrous, never plumose, the hairs, when present, less than 0.5 mm long.
 9 Lemma (8) 10–14 mm long; awn (60) 70–160 mm long; panicle (13) 18–40 cm long;
 glumes 15–35 mm long 12. *S. comata*

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- 9 Lemma 3.5–8 mm long or less; awn 5–70 mm long, sometimes longer in *S. arida*; panicle 4–20 (30) cm long; glumes 5–15 (19) mm long.
- 10 Hairs on the lemma copious, 1.5–4 mm long at the summit.
- 11 Lemma about 3.5–5 (6) mm long; sheaths glabrous at the throat 2. *S. pinetorum*
- 11 Lemma (4.5) 6–8 mm long; sheath with a tuft of villous hairs at the throat 3. *S. scribnieri*
- 10 Hairs on the lemma not copious, rarely exceeding 1.5 mm at the summit.
- 12 Glumes broad, abruptly acuminate; awn subterminal; lemma indurate; approaching our area on the west and possibly entering *S. lemmonii* (Vasey) Scribn.
- 12 Glumes narrow, gradually acuminate; awn terminal; lemma usually not indurate.
- 13 Awn 10–35 (50) mm long, twice geniculate and usually tightly twisted below, the terminal segment straight.
- 14 Awn 20–50 mm long; lemma 5.5–7.2 mm long 7. *S. columbiana*
- 14 Awn 10–22 mm long; lemma 4.5–5.7 (6.7) mm long 8. *S. lettermanii*
- 13 Awn 40–75 mm long, obscurely geniculate and loosely twisted for 10–20 mm and flexuous beyond 9. *S. arida*

1. *Stipa webberi* (Thurber) B. L. Johnson
Eriocoma webberi Thurber in S. Wats. Bot. Calif. 2: 283. 1880.
Oryzopsis webberi Benth. ex Vasey, Grasses U. S. 23. 1883.
Stipa webberi B. L. Johnson, Bot. Gaz. 107: 25. 1945. (*Bolander*, Sierra Valley, Calif.)

Webber needlegrass.

Low, densely tufted perennials; culms 1–2.5 dm tall, solid, erect from a decumbent base and with

numerous innovations; leaves in basal tufts, numerous, the tufts clothed in old leaf sheaths; sheaths usually shiny and smooth; ligules short, 0.2–0.5 (1) mm long, somewhat higher on the conspicuous edges than towards the back, subentire; blades strongly involute-filiform, 5–9 cm long, straight or often flexuous, glabrous to scaberulous below and puberulent above; panicles short, 3–6 (7.5) cm long,

narrow, the few branches appressed and the base often enclosed in the upper sheath; glumes sub-equal, (7) 7.5–10 mm long, narrow-lanceolate, acuminate, glabrous, usually purplish, obscurely 3- to 5-nerved; lemma relatively small, (3.5) 4.5–6 mm long (including the callus), copiously spreading pilose, the whitish hairs 2–3.5 mm long and of about equal length throughout, the summit with 2 papery teeth, 0.5–1 mm long; callus 0.3 mm long, blunt, with shorter and more dense hairs than those on the lemma body; awn short, 5–7 mm long, straight or weakly once-geniculate, not twisted, glabrous, readily deciduous; lodicules 3, slender, the larger lateral pair about 1.5 mm long and the middle $\frac{1}{2}$ as long; anthers 1.4–2.4 mm long; $2n = 32$.

Dry, open sagebrush valleys and foothills, se. Oregon and s. Idaho, s. to e. Calif. and Nev., reported in w. central Colo. Mid June–Aug.

Stipa webberi has been treated as an *Oryzopsis* by most botanists, but we prefer to follow B. L. Johnson and treat it as a *Stipa* that is very closely related to *S. pinetorum*. Both species have $2n = 32$ chromosomes, a number not known in any species of *Oryzopsis*. *Stipa pinetorum* is found at high elevations and *S. webberi* is the desert counterpart of that species. Only in awn characters is *S. webberi* like an *Oryzopsis*; it is definitely a *Stipa* in all other respects. *Oryzopsis swallenii* C. L. Hitchc. & Spellenberg, which is barely outside of our area in central Idaho, is very closely related to *S. webberi*. *Oryzopsis swallenii* has $2n = 34$ chromosomes instead of $2n = 32$. Spikelets of *O. swallenii* have the appearance of an *Oryzopsis*, with relatively broader glumes and lemmas. The inflorescence stands well above the numerous basal leaves, giving the plant an appearance of a reduced *O. exigua*. It is through these species that *Oryzopsis* and *Stipa* appear to merge and it is likely that a species like *S. webberi* has *Oryzopsis* parentage in its distant past.

2. *Stipa pinetorum* M. E. Jones

Stipa pinetorum M. E. Jones, Proc. Calif. Acad. Sci. II, 5: 724. 1895. (*Jones* 6023p, "open places among the pine forests, Panguitch Lake, Utah, 8 Sept. 1894.)

Pine needlegrass.

Low perennials, often forming large circular tufts as the center dies out in old bunches; culms (1) 1.5–3.5 (5) dm tall, often puberulent below the nodes, otherwise usually glabrous; leaves mostly basal; sheaths often shiny, smooth, persistent and clothing the base of the plant; ligules short, only 0.1–0.5 mm long, membranous, sometimes merely a crown; blades involute, capillary, less than 0.5 mm broad and 4–12 cm long, straight or sometimes flexuous, scaberulous or sometimes puberulent; panicles short, 4.5–11 (15) cm long, narrow with relatively few spikelets; glumes subequal, 7–11 (12) mm long, narrow-lanceolate, acuminate, glabrous, often deep-purple, 1- to 3-nerved, the lateral nerves obscure; lemma relatively small, 3.5–5 (6) mm long (including the callus), pale or brownish, densely villous, the whitish hairs nearly uniform in length from top to bottom, 1–4 mm long, the summit bearing 2 slender teeth at the base of the awn, the callus relatively short, 0.5 mm long with shorter and more dense hairs than those on the body of the lemma; awn relatively short, 11–17 (22) mm long, twice-geniculate, the lower segment loosely twisted, the terminal segment 5–12 mm long, not twisted, glabrous or nearly so, usually deep-purple; palea about $\frac{1}{2}$ as long as

the lemma, villous above; lodicules 3, slender, the middle one $\frac{2}{3}$ the length of the lateral pair; anthers purple, 1.4–2.2 mm long; $2n = 32$.

High sagebrush slopes, open pine woods and rocky ridges, mostly from middle elevs. to near timberline, se. Oregon, s. Idaho, and sw. Wyo., and s. to e. Calif. (mostly Inyo and Mono cos.), Nev., Utah and Colo. Late June–Aug.

3. *Stipa scribnieri* Vasey

Stipa scribnieri Vasey, Bull. Torrey Bot. Club 11: 125. 1884. (Vasey, "on dry hillsides at Sante Fe, New Mexico," Aug 1884.)

Scribner needlegrass.

Tufted perennials; culms 3.5–8 dm tall, glabrous except at the finely puberulent, purplish nodes; sheaths smooth, strongly striate, persistent, becoming brown in age and clothing the base of the culms, the throat ciliate with long tawny hairs that diminish in size on down the margins; ligules 0.2–1 (2) mm long, irregularly truncate, finely ciliolate, becoming lacerate, sometimes merely a crown; blades involute, or if flat, 1.5–3.5 (5) mm broad, often involute towards the tip, 15–25 cm long, glabrous to scaberulous, the margins scabrous to ciliate; panicles 7–20 cm long, narrow with short, appressed branches; glumes distinctly unequal, linear-lanceolate, acuminate, glabrous to scaberulous, pale and often hyaline or somewhat purplish, prominently 3-nerved, the first glume (10) 12–15 (19) mm long, the second 9–12 (14) mm long; lemma (4.5) 6–8 mm long (including the callus), pale, villous, with hairs becoming more dense and longer at the tip (2–3.5 mm long) than below (0.5–1.5 mm long), the callus 0.7–1 mm long, densely pubescent; awn relatively short, 14–22 mm long, once- or rarely twice-geniculate, the lower segment(s) twisted, scaberulous to finely puberulent, the terminal segment 8–12 mm long, glabrous and untwisted; palea 2–3 mm long; lodicules 2, narrow-elliptic, about 1.5 mm long; anthers about 4 mm long; $2n = 40$.

Mesas and dry rocky mt. slopes; s. Utah, Colo., s. to n. Ariz. and N.M. Late June–early Sept.

4. *Stipa thurberiana* Piper

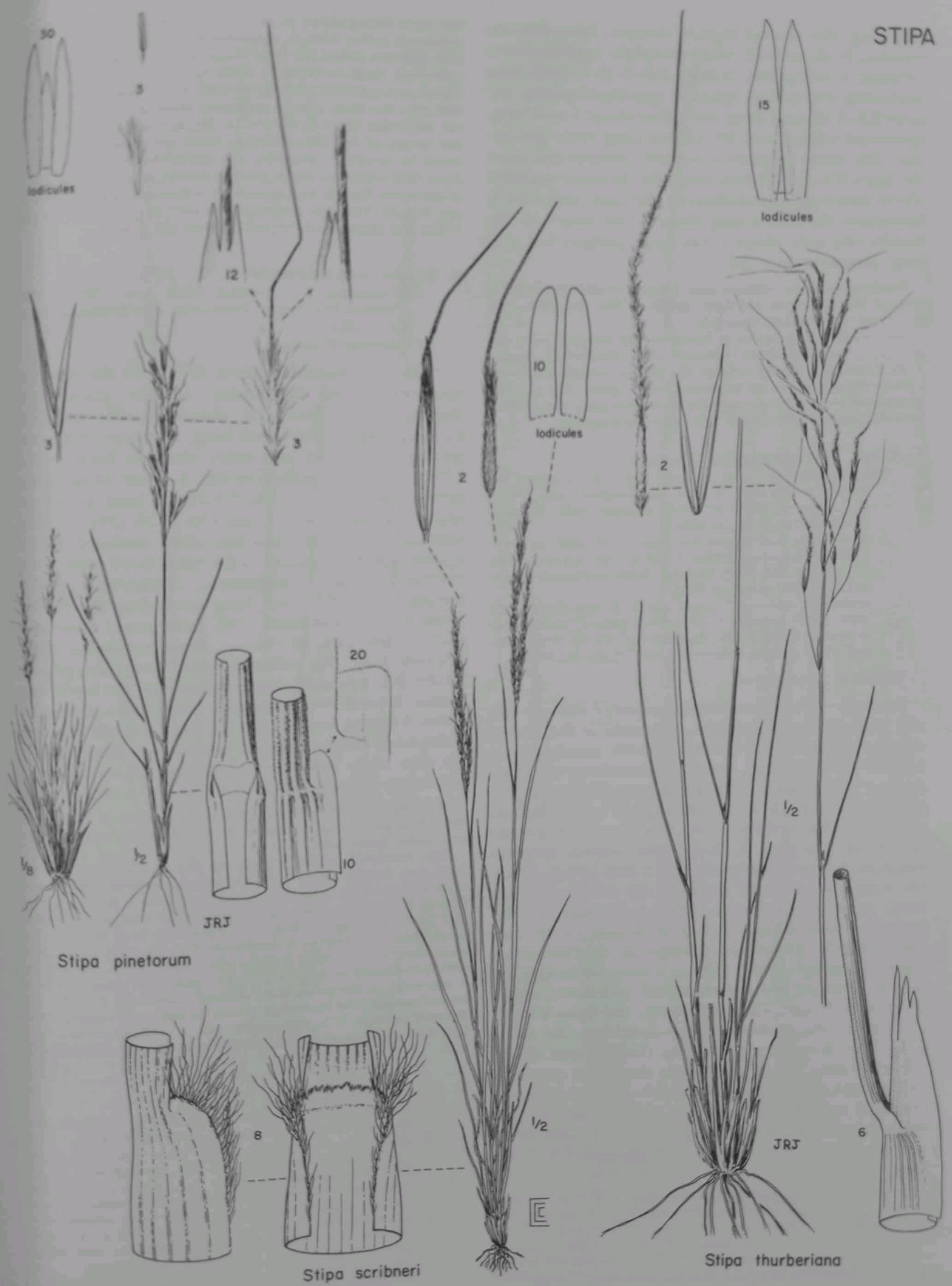
Stipa occidentalis Thurber in Wilkes, U.S. Explor. Exped. Bot. 17: 483. 1874; not Thurber, 1871. *S. thurberiana* Piper in Scribn. U.S.D.A. Div. Agrostol. Circ. 27: 10. 1900. (Piper & Brackenridge, "N. branch of the Columbia, Washington.")

S. occidentalis var. *montana* Merr. & Davy, Univ. Calif. Publ. Bot. 1: 62. 1902. (Watson 1296, Pah-Ute Range [East Range], 5000 ft., Nev.)

Thurber needlegrass.

Densely tufted perennials; culms 3.5–5.5 (8) dm tall, puberulent, at least at the nodes; sheaths usually glabrous, sometimes puberulent below, striate; ligules exceptionally long, 2–5 (7) mm, acute, sometimes truncate, lacerate at the tip, decurrent, thin-hyaline, glabrous to sparsely puberulent; blades filiform-involute, scaberulous, 10–25 cm long; panicles 7–16 (24) cm long, narrow, the branches erect and relatively few-flowered; glumes subequal, (8) 10–16

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mm long, the second slightly shorter, lanceolate-attenuate, 3- (5)-nerved, often purplish, hyaline above forming a soft point; lemma 6.2-8 (8.7) mm long (including the callus), sparsely appressed-pilose, the hairs 0.5-1 (2) mm long, the callus about 1 mm long, appressed-villous; awn 30-45 mm long, twice geniculate, the lower segments twisted, hirsute-plumose, the hairs 0.5-1.5 (2) mm long, the terminal segment 16-30 mm long, scaberulous to glabrous; lodicules 3, lanceolate, the lateral pair about 2 mm long and the middle one only about 1 mm long; anthers 3-4 mm long, purplish; $2n = 34$.

Sagebrush deserts, canyons and juniper wooded foothills; e. parts of Wash., Oregon and Calif., across n. Nev. to s. Idaho, sw. Mont. and ne. Wyo. Late May-July.

Stipa thurberiana is known to hybridize with *Oryzopsis hymenoides* (Roemer & Schultes) Ricker (Johnson, 1945). Thurber needlegrass is often abundant enough in parts of northern Nevada and southeastern Oregon to be an important range grass. The purplish glumes and plumose lower segments of the awn make this species a beautiful photographic subject with proper back-lighting.

5. *Stipa occidentalis* Thurber

Stipa occidentalis Thurber in King, Rep. Geol. Explor. 40th Parallel 5: 380, 1871. *S. stricta* var. *sparsiflora* Vasey, Contr. U. S. Natl. Herb. 3: 51, 1892. (*Bolander* 3038, Yosemite Trail, 8000 ft., Calif., in 1866.)

S. stricta Vasey, Bull. Torrey Bot. Club 10: 42, 1883; not Lam. 1791. *S. oryzoides* Scribn. U.S.D.A. Div. Agrostol. Bull. 17: 130, fig. 426, 1899. (*Suksdorf*, Wash. [erroneously given as Oregon by Vasey], in 1882.)

S. viridula var. *pubescens* Vasey, Contr. U. S. Natl. Herb. 3: 50, 1892; not *S. pubescens* R. Br. 1810. *S. elmeri* Piper & Brodbeck Scribn. U.S.D.A. Div. Agrostol. Bull. 11: 46, 1898. (*Suksdorf*, "Dry ground, Columbia River," Wash., in 1883.)

Western needlegrass.

Strongly tufted perennials; culms 2.5-4 (8) dm tall, glabrous to hispidulous, especially at the nodes; sheaths glabrous to hirsute; ligules mostly short, 0.2-0.7 (2) mm long, truncate, sometimes no more than a low crown, often projecting higher on the sides than in back, entire to slightly erose-ciliolate, sometimes flanked by tufts of hairs which extend down the margins of the sheath; blades filiform-involute, or rarely flat and up to 2 mm broad, 10-30 cm long, puberulent; panicles (5) 10-25 (35) cm long, narrow, sometimes rather loose and lax, the branches ascending; glumes subequal, 9-15 mm long, narrow-lanceolate, acuminate, 3- (5)-nerved, papery; lemma (5) 6-8 (8.5) mm long (including the callus), more or less indurate, soft pubescent, sometimes with longer hairs at the tip, the hairs 0.2-1.2 (1.7) mm long, yellowish to pale-brown, the callus 1-1.5 mm long, sharp, usually curved; awn 25-35 (50) mm long, twice geniculate, the lower segments twisted and plumose with hairs 0.5-1.2 mm long, the terminal segment glabrous to short plumose, not twisted; palea 2-3.2 mm long, pubescent; lodicules 2, narrow-elliptic, about 2 mm long; anthers 2.5-4 mm long; $2n = 36$.

In mts. on dry to moderately moist slopes and ridges in sagebrush-grass and coniferous woodland vegetation from middle to Wash., Idaho and Wyo., s. to Calif., Nev. and Utah. June-Aug.

Western needlegrass is an important bunchgrass of the palouse prairies. The species, as treated here, includes *S. elmeri*. *Stipa elmeri*

has been distinguished as being more than 4 dm tall and having pubescent culms, while *S. occidentalis* should be less than 4 dm tall with glabrous culms, but these characters are so variable that many collections could be keyed to either species. Johnson's (1962) ecological and statistical study gives evidence for this. Johnson found that what has been called *S. californica* Merr. & Davy [*S. occidentalis* var. *californica* (Merr. & Davy) C. L. Hitchc.] in the Great Basin and east slopes of the Sierra Nevada turns out to be an amphiploid which he named *S. nevadensis*. See under that species for discussions. *Stipa californica* has its greatest development on the west slope of the Sierra Nevada and apparently does not enter the Intermountain Region. The *Stipa occidentalis* complex is discussed by Johnson (1962) and Maze (Leafl. W. Bot. 10: 157-161, 1965).

6. *Stipa nevadensis* B. L. Johnson

Stipa nevadensis B. L. Johnson, Amer. J. Bot. 49: 237, 1962. (*Johnson* 211, Upper Twin Lake, near Bridgeport, Mono Co., Calif.)

S. californica of authors.

Tufted perennials; culms 2-7 (8.5) dm tall, puberulent below the nodes; sheaths glabrous to slightly scaberulous, the throat usually glabrous; ligules short, 0.2-0.7 mm long, truncate, often projecting higher on the sides than in back, erose-ciliolate; blades involute or flat, 1-3 mm broad, often involute towards the tip, 10-25 cm long, pubescent above, glabrous below; panicles 6-15 (20) cm long, narrow, the lower branches often enclosed by the upper sheath; glumes subequal, 8-14 mm long, narrow-lanceolate, acuminate, 3-nerved, papery; lemma 5.5-7 (8.5) mm long (including the callus), more or less indurate, soft pubescent, sometimes with longer hairs at the tip, these averaging about 1.5 mm long, the callus 0.7 mm long, sharp; awn 20-30 (35) mm long, twice geniculate, the lower segments twisted and plumose with hairs averaging about 0.8 mm long (0.5-1.2), the terminal segment glabrous to short plumose, not twisted; palea 2.8-4.2 (6) mm long; lodicules 2, narrow-elliptic, about 2 mm long; anthers 2.5-4 mm long; $2n = 68$.

Dry foothills and open woodlands up to 3048 m (10,000 ft.) elev.; from the e. slope of the Sierra Nevada, Calif., across n. Nev. to s. Idaho. June-Aug.

Stipa nevadensis has been confused with *S. californica*, differing from it in having longer paleas in relation to lemma length and slightly longer awn hairs. *Stipa californica*, which is best considered as a variety of *S. occidentalis*, remains to the west of our region. Johnson (1962) suggests that *S. nevadensis* with $2n = 68$ may be an amphiploid derivative of *S. occidentalis* with $2n = 36$ and *S. lettermanii* with $2n = 32$. *Stipa californica* may have had similar ancestry with *S. occidentalis* as one parent and *S. columbiana*, a close relative of *S. lettermanii*, as the other. Both of these parents are $2n = 36$. The idea of considerable backcrossing with the parents is consistent with the wide variation in *S. californica*. However small the characters are that separate *S. nevadensis* and *S. occidentalis*, they seem fairly consistent.

7. *Stipa columbiana* Macoun

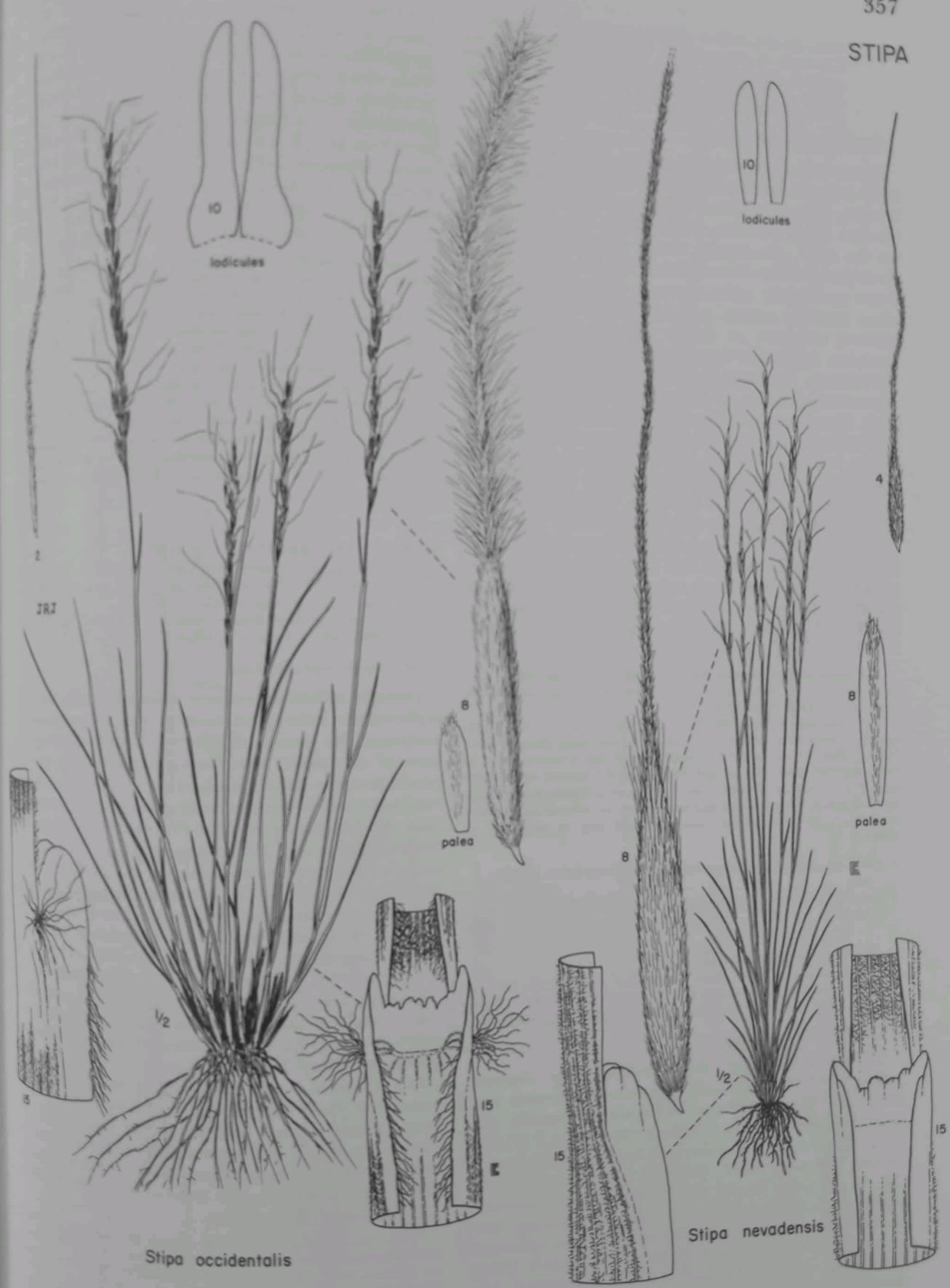
Stipa columbiana Macoun, Cat. Canad. Pl. 2(4): 191, 1888. *Macoun* 28940, "On rocks, Yale, B.C." 17 May 1875.)

S. viridula var. *minor* Vasey, Contr. U. S. Natl. Herb. 3: 50, 1892. *S. minor* Scribn. U.S.D.A. Div. Agrostol. Bull. 11: 46, 1898. *S. occidentalis* var. *minor* C. L. Hitchc. Univ. Wash. Publ. Biol. 17(1): 714, 1969. (*Letterman* 99, "Kelseo Mts., near Torrey's Peak, Colo." 13 Aug. 1885.) = var. *columbiana*.

S. williamsii Scribn. U.S.D.A. Div. Agrostol. Bull. 11: 45, 1898. (*Williams* 2804, "West side of Big Horn Mts. near Mountain Spring," Wyo., 3 Aug. 1897.) = var. *nelsonii*.

S. nelsonii Scribn. U.S.D.A. Div. Agrostol. Bull. 11: 46, 1898. *S. columbiana* subsp. *nelsonii* A. S. Hitchc. Contr. U. S. Natl.

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Herb. 24: 254. 1925. *S. columbiana* var. *nelsonii* St. John, Fl. S.E. Wash. & Adj. Idaho 61. 1957. *S. occidentalis* var. *nelsonii* C. L. Hitchc. Univ. Wash. Publ. Biol. 17(1): 715. 1969. (Nelson 3963, Woods Landing, Woods Creek, 8700 ft., Albany Co., Wyo., 9 Aug. 1897.)

Columbia needlegrass.

Stout, tufted perennials; culms relatively tall, (3) 4–10 (12) dm, erect; sheaths glabrous to densely pubescent, strongly ribbed; ligules mostly short, 0.2–1 (2) mm long, truncate, rather firm, usually longest on the sides, decurrent; blades involute but sometimes flat and 2.5–5 mm broad, 10–20 cm long, glabrous or slightly scaberulous to densely pubescent, often strongly striate; panicles 12–25 (30) cm long, narrow, compact or rather loose with the lower branches separated from the remainder of the inflorescence, the branches short and appressed with numerous spikelets; glumes subequal, 7–11 (14) mm long, acuminate or awn-pointed, somewhat purplish, scaberulous, papery, becoming somewhat hyaline above, 3-nerved; lemma 5.5–7.2 mm long (including the callus), appressed pubescent, the hairs usually longer at the tip (0.7–1.5 mm long) than below (0.2–0.5 mm long), the callus short, 0.7–1 mm long; awn 20–30 (50) mm long, thin, twice geniculate, the lower segments twisted and scabrous, the terminal segment 10–16 mm long, not twisted, scaberulous to glabrous; palea shorter than the lemma, pubescent; lodicules 2, about 1.5 mm long, slender; anthers 2.2–3 mm long; $2n = 36, 44$.

Dry sagebrush plains and slopes at middle and high elevs.; B.C. to w. S.D., and s. to n. and e. Calif., Ariz., N.M. and reported to occur in w. Texas, June–Sept.

C. L. Hitchcock [Univ. Wash. Publ. Biol. 17(1): 714. 1969] relegated *S. columbiana* under *S. occidentalis* to var. *minor* (Vasey) C. L. Hitchc. The two are certainly closely related, but it seems better to us to separate them. We considered treating *S. williamsii* as a variety here but the degree of pubescence of the culms, blades and sheaths seemed rather trivial as the plants are like var. *nelsonii* in all other respects. Two varieties are discernible and may be separated as follows:

- 1 Awns mostly less than 2.5 cm long; callus blunt; culms 3–6 dm tall var. *columbiana*
- 1 Awns 2.5 or more cm long, up to 5 cm; callus sharp; culms as much as 1 m tall var. *nelsonii* (Scribn.) St. John

8. *Stipa lettermanii* Vasey

Stipa lettermani Vasey, Bull. Torrey Bot. Club 13: 53. 1886. *S. viridula* var. *lettermani* Vasey, Contr. U. S. Natl. Herb. 3: 50. 1892. (Letterman 102, Snake River, Idaho, Aug. 1885.)

Letterman needlegrass.

Tufted perennials, often forming large clumps; culms 2.5–6 (8.5) dm tall, glabrous or minutely scaberulous, with numerous innovations; sheaths glabrous, sometimes scaberulous; ligules 0.2–1.2 (2) mm long, firm, rounded, truncate, decurrent; blades involute, filiform, rarely flat and up to 2 mm wide, 10–20 cm long, hispid above, glabrous to minutely scaberulous below; panicles 7–19 (24) cm long, narrow, the branches erect with relatively few spikelets; glumes subequal, relatively short, (5) 6.5–9 (10.5) mm long, acuminate, glabrous or sometimes scaberulous, often purple with hyaline margins and apex, 3-nerved; lemma 4.5–5.7 (6.7) mm long (in-

cluding the callus), pale, only slightly indurate, sericeous with hairs longer at the summit (1–1.5 mm long) than below (0.2–0.5 mm long), the callus often with dense white hairs less than 1 mm long; awn relatively short, (10) 16–22 mm long, slender, twice-geniculate, the lower segments loosely twisted, scaberulous with hairs about 0.2–0.3 mm long, the terminal segment 7–12 mm long and glabrous; palea about 3.5 mm long, pubescent, sometimes exposed; lodicules 2, about 1.5 mm long, slender; anthers 1.7–2.5 mm long, purplish; $2n = 32, 66, 68$.

Sagebrush slopes, rocky ridges and open coniferous or aspen woods at middle and subalpine elevs. in the mts.; Oregon to Mont. and s. to s. and e. Calif., Ariz. and N.M. July–Sept.

Specimens of *S. lettermani* and *S. columbiana* are often misidentified as they approach one another in size. *Stipa lettermani* has a slender palea which is about $\frac{1}{3}$ the lemma length and is often exposed, and chromosome counts of $2n = 32, 66$ and 68 , whereas *S. columbiana* has a shorter palea, less than half as long as the lemma, and chromosome numbers of $2n = 36$ and 44 . Subalpine forms of *S. lettermani* are distinctive and rarely mistaken for the robust *S. columbiana*. The difference in hair length between the summit and midlength of the lemma in *S. lettermani* may not be easily discernible when the hairs are spreading at the base and somewhat appressed above.

9. *Stipa arida* M. E. Jones

Stipa arida M. E. Jones, Proc. Calif. Acad. Sci. II. 5: 725. 1895. (Jones 5377, "on very dry talus slopes in shingle," Marysville, Utah, 4 June 1894.)

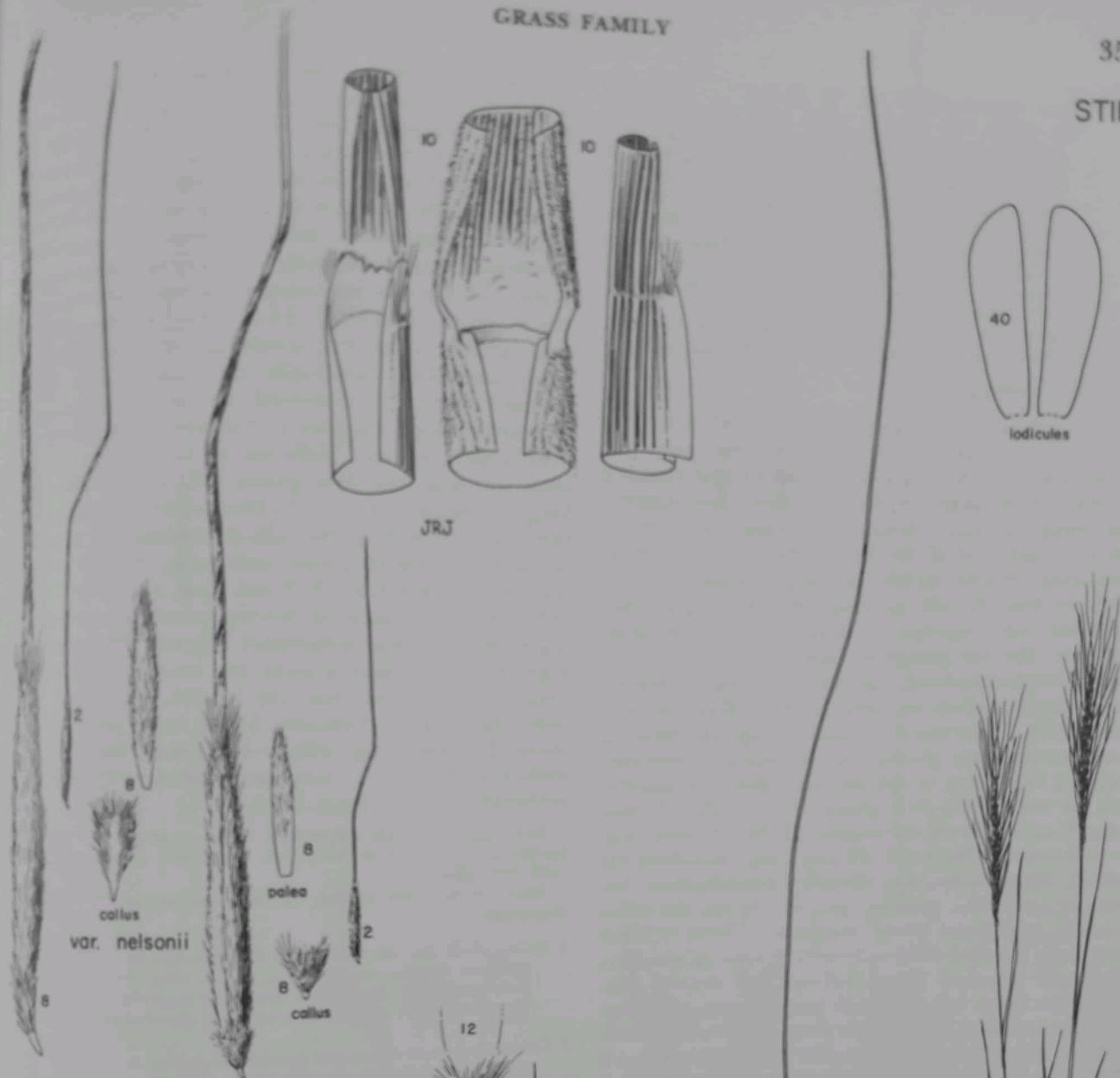
S. mormorum Mez, Repert. Spec. Nov. Regni Veg. Beih. 17: 209. 1921. (Jones 2106, Utah.)

Mormon needlegrass.

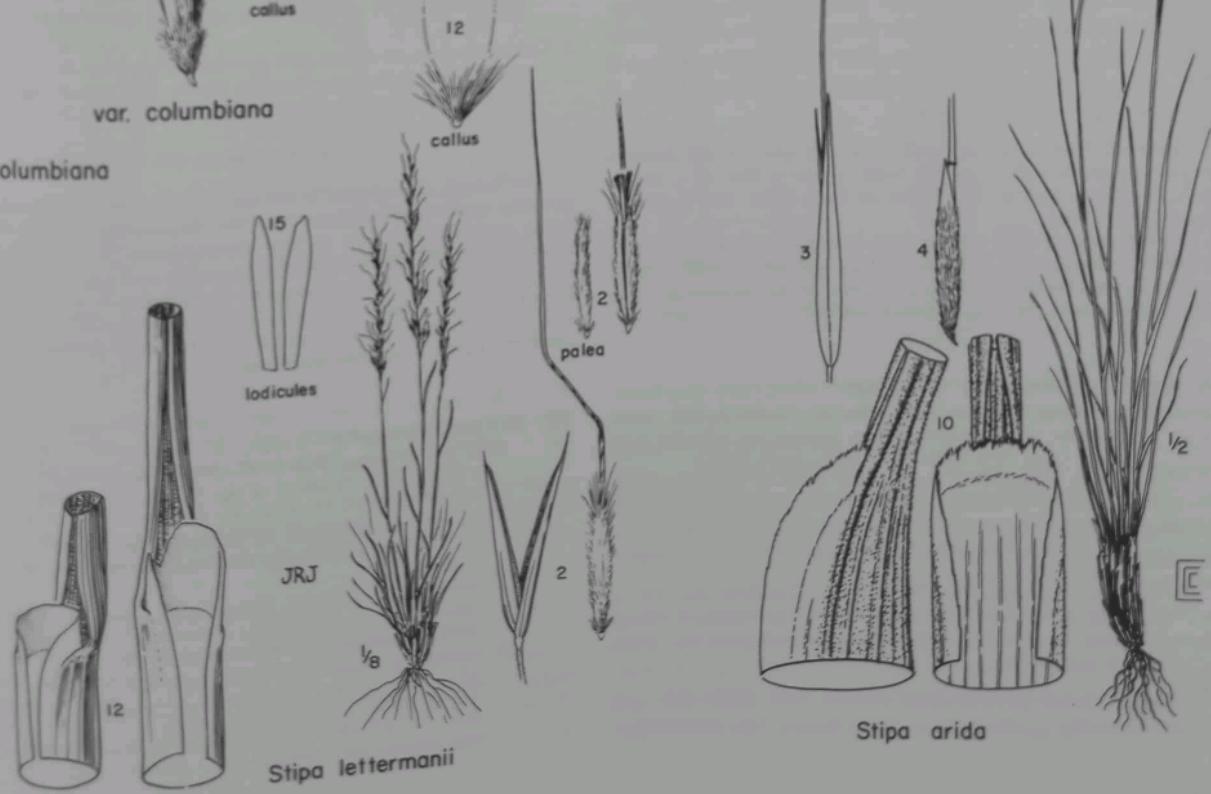
Densely tufted perennials; culms 4–7 (10) dm tall, scaberulous below the nodes; leaves mostly basal, scabrous, the persistent sheaths densely clothing the base of the plant; sheaths sometimes finely pubescent below the collar; ligules short, 0.2–0.8 mm long, variously lacerate-lobed with ciliolate edges, decurrent; blades mostly involute-filiform, the culm blades sometimes flat and 1–2 mm wide, 10–20 cm long, the margins scabrous; panicles short, 4–12 (16) cm long, narrow, compact with numerous, congested spikelets; glumes pale, linear-lanceolate, long-acuminate, papery, becoming hyaline above, glabrous or sometimes scaberulous, the first glume 9–10 (11.5) mm long, 3-nerved, the second 7–9 mm long, indistinctly 5-nerved; lemma relatively small, 4.5–5.7 mm long (including the callus), narrow, pale or light-brown, sparsely short appressed-hirsute below, glabrate above, the whitish hairs less than 0.7 mm long, the callus about 0.7 mm long, sharp, somewhat more pubescent than the lemma body; awn 40–75 mm long, arising from a distinct darker joint, capillary, weakly once- or twice-geniculate, glabrous, loosely twisted below, untwisted and flexuous above; palea about half as long as the lemma; lodicules 2, about 1.5 mm long, oblanceolate.

Rocky, shadscale and sagebrush deserts and foothills up to the pinyon-juniper woodland; se. Calif. and s. parts of Nev., Utah and sw. Colo., s. to n. Ariz., N.M. and reported to occur in w. Texas May–July.

This is one of our most distinctive desert stipas, readily recognized by the short, narrow panicle, long awns and short, narrow lemma.



Stipa columbiana



Stipa arida

10. *Stipa speciosa* Trin. & Rupr.

Stipa speciosa Trin. & Rupr. Mém. Acad. Imp. Sci. Saint-Petersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 5(1): 45. 1842. *S. humilis* var. *speciosa* Kuntze, Revisio Gen. Pl. 3(2): 371. 1898. (*Cuming*, Chile.) Fragments of the type at US have lemmas and awns that exceed ours in length.
S. californica Vasey, Proc. Amer. Acad. Arts 24: 80. 1889. nonnen nudum; not Merr. & Davy, 1902. (*Palmer* 505, Los Angeles Bay, Baja Calif., in 1887.)
S. speciosa var. *minor* Vasey, Contr. U. S. Natl. Herb. 5: 52. 1892. (*Jones*, Empire City, Nev., in 1882.)
S. humilis var. *jonesiana* Kuntze, Revisio Gen. Pl. 3(2): 371. 1898. (*Jones* 4111, Empire City, Nev., 20 June 1882.)

Desert needlegrass.

Stout, densely tufted perennials; culms 3.5–6.5 dm tall, erect; sheaths firm, striate, shiny, the upper glabrous, the lowermost pilose, persistent and clothing the base of the plant; ligules very short, less than 0.5 mm long, densely ciliolate, a conspicuous tuft of hairs on each side of the throat, the hairs 0.2–0.8 (2) mm long; blades tightly involute, slender, 1 mm thick or less, 20–40 cm long, very firm, glaucous, glabrous on exposed surface with scaberulous margins, the tip pungent; panicles (7) 10–20 cm long, compact, narrow, scarcely exceeding the leaves, lower portion often included in the inflated sheath, the short, appressed branches spikelet-bearing nearly to the base; glumes long-acuminate, terminating in a fine point, scaberulous to glabrous, papery, pale or tawny, the first glume (12) 15–20 (25) mm long, 1- to 3-nerved, the second 11–18 (23) mm long, 3- to 5-nerved; lemma 7–10 mm long (including the callus), terete, indurate, short appressed-pilose, becoming somewhat glabrate towards the tip, the callus densely appressed-pilose, the hairs about 1.5–2.5 mm long; awn 30–43 (50) mm long, once geniculate, the lower segment tightly twisted and densely plumose, the hairs 4.5–6 (8) mm long, the terminal segment not twisted, 20–30 mm long, scaberulous; lodicules 3, narrow-ob lanceolate, the lateral pair about 2 mm long, the middle one shorter; anthers about 4 mm long; $2n = 60, 64$.

Sagebrush deserts, canyons and pinyon-juniper wooded foothills in rocky or sandy soils; s. and e. Calif. across s. Nev. to s. and e. Utah, sw. Colo. and n. Ariz.; also in Baja Calif. and S. Amer. (April-) May-June.

Hybridization of *Stipa speciosa* with *Oryzopsis hymenoides* (Roemer & Schultes) Ricker has been studied by Johnson (1960). Desert needlegrass is a beautiful, plump grass that should be used as an ornamental in desert planting of native species.

11. *Stipa coronata* Thurber

Stipa coronata Thurber in S. Wats. Bot. Calif. 2: 287. 1880. (*Bolander*, "in a cañon around springs on hillsides near Julian City," San Diego Co., Calif., April 1872.)
S. parishii Vasey, Bot. Gaz. 7: 33. 1882. *S. coronata* subsp. *parishii* A. S. Hitchc. Contr. U. S. Natl. Herb. 24: 227. 1925. (*Parish Bros.* 1079, Bear Valley, Mill Creek Falls, San Bernardino Mts., Calif., Aug. 1882.) = var. *dapauperata*.
S. parishii var. *dapauperata* M. E. Jones, Contr. W. Bot. 14: 11. 1912. *S. coronata* var. *dapauperata* A. S. Hitchc. J. Wash. Acad. Sci. 24: 292. 1934. (*Jones*, Detroit, Juab Co., Utah, 25 May 1891.)

Stout, tufted perennials; culms 2–7 (20) dm tall, erect; sheaths glabrous or sometimes retrorsely pu-

berulent, persistent, becoming smooth and brown and clothing the base of the plant; ligules 0.5–1 mm long, membranous and ciliate, flanked by tufts of whitish hairs, the hairs 1–3.5 (6) mm long and sometimes spreading down the margins of the sheath; blades usually flat, 2.5–5 (6) mm broad, 30–50 cm long, often glaucous, striated, becoming somewhat involute towards the long slender tips, glabrous to scaberulous on the surfaces and strongly scabrous on the margins; panicles (7) 14–23 (35) cm long, narrow and densely flowered, somewhat nodding; glumes linear-lanceolate, gradually tapering into a long, slender point, 3- (5)-nerved, often keeled, pale or purplish below, scarious to hyaline on the margins and upper portion, glabrous or minutely scaberulous, unequal, the first glume (10) 12–18 (20) mm long, the second (8) 11–15 (18) mm long; lemma 5–8 mm long (including the callus), obscurely 5-nerved, densely appressed-villous with long, whitish hairs, the longer apical hairs 3–5 mm long; awn (10) 17–35 (42) mm long, once or twice geniculate, the lower segment scabrous, sometimes hispid, the terminal segment scaberulous at most, not twisted, 10–15 mm long; palea shorter than the lemma, pubescent between the nerves; lodicules 3, the large lateral pair about 2.5 mm long, elliptic-lanceolate, the shorter middle one about 1 mm long, subulate-lanceolate; anthers 3.5–5 mm long; $2n = 40$.

Dry, rocky or sandy slopes and ridges, mostly in the piñon-juniper zone; s. parts of Utah, Nev. and Calif., n. Ariz. and Baja Calif. June–July.

We have two varieties that may be separated by the following characters.

1 Culms 10–20 dm tall; panicles 20–35 cm long, with numerous spikelets; lemma mostly about 8 mm long; awn usually twice-geniculate, 25–35 (42) mm long; Monterey, Calif. to Baja Calif., e. to n. Ariz. and entering our area in s. Utah var. *coronata*

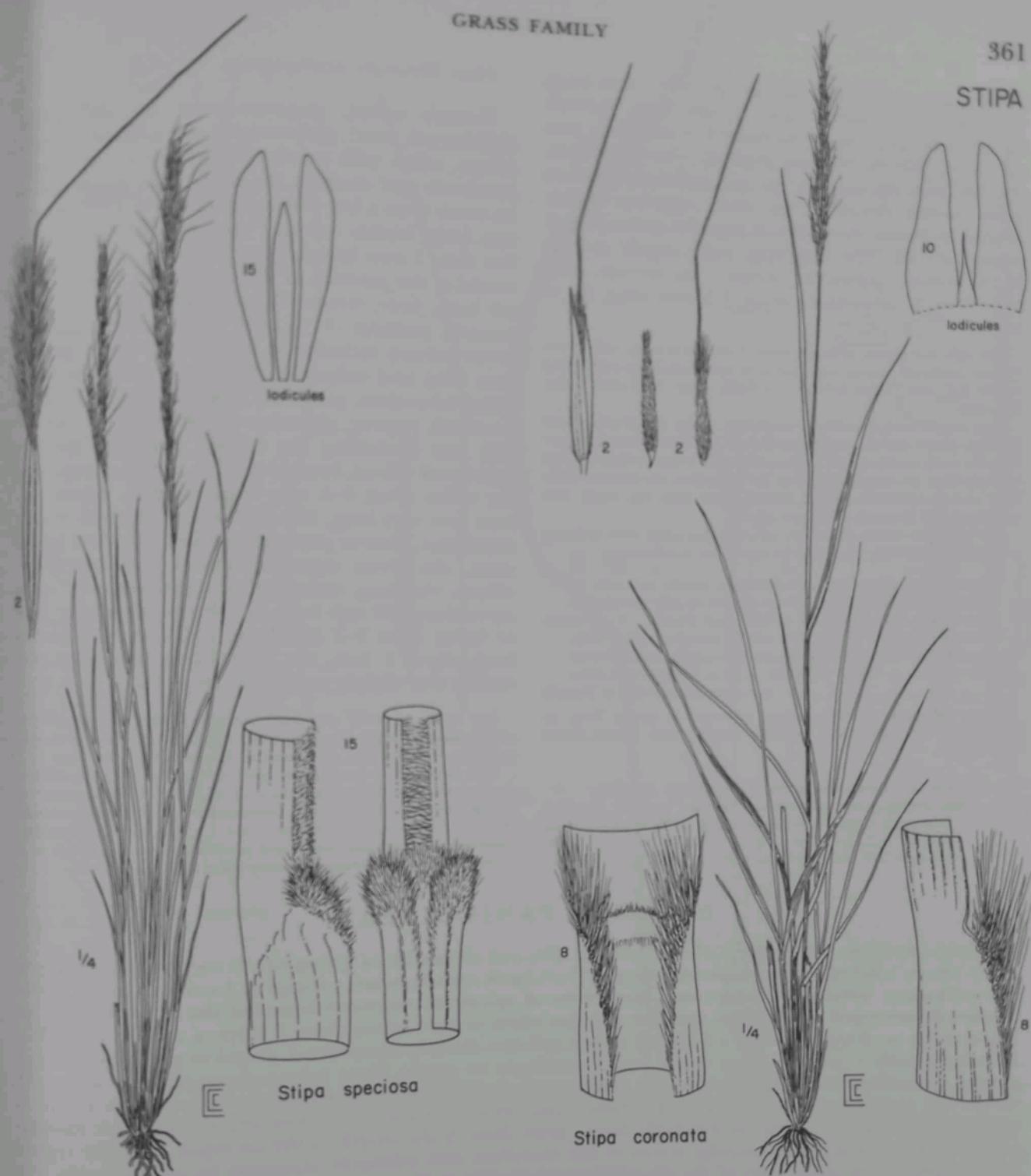
1 Culms shorter, 2–6 dm tall; panicles less than 20 cm long, with fewer spikelets; lemma about 5–7 mm long; awn usually once-geniculate, about (10) 17–25 mm long; Utah, Nev., Ariz. and s. Calif. var. *dapauperata* (M. E. Jones) A. S. Hitchc.

The variety *dapauperata* is recognized here with some misgivings as many intermediates occur, and the *dapauperata* plants may be a mere modification due to the environment. *Stipa coronata* var. *coronata* is the largest of our needlegrasses and probably the largest in North America. It is common in the grasslands of southern California. It would make a beautiful ornamental that should lend itself well to cultivation in the native wild landscape scene across the southern part of the Intermountain Region.

12. *Stipa comata* Trin. & Rupr.

Stipa juncea sensu Pursh, Fl. Amer. Sept. 72. 1814; not L. 1753. (*Lewis*, "Valleys of the Missouri in the Rocky Mts." 8 July 1806.)
S. capillata sensu Hook. Fl. Boreali-Amer. 2: 237. 1840; not L. 1762. (*Drummond*, "Carlton House Fort ad fl. Saskatchewan.")
S. comata Trin. & Rupr. Mém. Acad. Imp. Sci. Saint-Petersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 5(1): 75. 1842. (*Drummond*, Saskatchewan River.)
S. comata var. *intermedia* Scribn. & Tweedy, Bot. Gaz. 11: 171. 1886. *S. tweedyi* Scribn. U.S.D.A. Div. Agrostol. Bull. 11: 47. 1898. *S. spartea* var. *tweedyi* M. E. Jones, Contr. W. Bot. 14: 11. 1912. (*Tweedy* 610, Junction Butte, Yellow stone Park, July 1885.)

STIPA



S. comata subsp. *intonsa* Piper, Contr. U. S. Natl. Herb. 11: 109. 1906. (*Suksdorf* 1026, "On dry, sandy ground near Rockland," Klickitat Co., Wash., 3 June 1890.) = var. *comata*.

S. comata var. *suksdorffii* St. John, Fl. S. E. Wash. & Adj. Idaho 61. 1937. (*Suksdorf* 8990, "In a grove southwest of Philleo Lake," Spokane Co., Wash., 3 Aug. 1916.) = var. *comata*.

Needle-and-thread grass.

Tufted perennials; culms 3–8 (11) dm tall, glabrous, often puberulent at the nodes; sheaths smooth to scabrous, strongly ribbed, usually longer than the internodes; ligules relatively long, 1–5 (6) mm, usually acute, becoming lacerate, decurrent,

more or less puberulent; blades involute, or if flat up to 3 mm broad, 10–30 cm long, smooth to scaberulous beneath, scabrous on the upper surface; panicles relatively long, (13) 18–34 (40) cm, narrow, usually partly enclosed in an inflated sheath, the branches usually slender and ascending, the spikelets sometimes drooping at anthesis; glumes long and narrow, tapering to a fine point, 5-nerved, slightly convoluted, glabrous, papery, the margins and tip hyaline, the first glume 18–30 (35) mm long, the second 15–27 (34) mm long; lemma relatively long, (8) 10–12.5 (14) mm (including the callus), pale green to yellowish or brownish, sparsely appressed-pilose,

often glabrate apically, the hairs 0.2–0.5 mm long, the callus very sharp, about 3 mm long, densely barbed with tawny hairs, the hairs 1–2 mm long; awn very long, (60) 70–160 mm, once or twice geniculate, the first joint distinct, the second indistinct or more often merely flexuous, the lower segment tightly twisted, scabrous, the terminal segment scabrous, not twisted, 40–90 (120) mm long; palea nearly as long as the lemma, pubescent between the nerves; lodicules 2 or 3, lanceolate, about 1.5 mm long; $2n = 44$ –46.

Dry hills and plains, in sandy (sand dunes) and stony soils, from the low sagebrush valleys and deserts to open subalpine coniferous woods; B.C. and Yukon to Ont., s. to Calif., Ariz., N.M. and Texas. May–July.

Stipa comata is an important component of the mixed prairies of the high plains and the palouse prairie of the Northwest. It is perhaps the most common and widespread of the western stipas. It can be a problem on rangelands when the caryopses are mature. With their sharp, retrorse-barbed lemma bases they can work into mouthparts of livestock and cause injury.

We have two rather distinctive varieties that come close to being acceptable as species. They may be separated as follows:

- 1 Terminal segment of the awn flexuous, usually well over 50 mm long; lower branches of the panicle usually included in the sheath; B.C. to Ont., s. to Calif. and Texas var. *comata*
- 1 Terminal segment of the awn nearly straight, rather firm, usually less than 50 mm long; panicle usually exserted from the sheath; e. Wash. to Mont., s. to e. Oregon and Wyo. var. *intermedia* Scribn. & Tweedy

Some accounts of early surveys reported *S. spartea* Trin. in the region, but they were probably dealing with robust forms of *S. comata*.

13. *Stipa neomexicana* (Thurber) Scribn.

Stipa pennata var. *neo-mexicana* Thurber in J. M. Coulter, Manual Bot. Rocky Mt. Region 408. 1885. *S. neo-mexicana* Scribn. U.S.D.A. Div. Agrostol. Bull. 17: 132. 1899. (Thurber 269, Rio Mimbres, N.M., April 1851.)

New Mexican feathergrass.

Densely tufted, glaucous perennials; culms 4–8 (10) dm tall, erect, glabrous; sheaths glabrous to pilosulous, often with a few villous hairs at the throat, persistent and clothing the base of the plant; ligules no more than a low ciliolate ring of hairs, 0.2–0.5 (2) mm long; blades strongly involute, filiform, slightly less than 1 mm broad when unrolled, abruptly narrowed at the junction of the sheath and blade, 10–30 cm long, firm, retrorse-hispidulous to glabrate or smooth; panicles (11) 15–26 (30) cm long, narrow, lower portion included in an inflated sheath; glumes very long and subequal, (20) 30–50 (60) mm long, linear-lanceolate, gradually tapering to a point, 4- to 7-nerved, papery, glabrous; lemma long, (10) 14–17 (19) mm (including the callus), 5-nerved, sparsely appressed-villous, becoming dark brown at maturity, the callus often 4–5 mm long, tapered, densely pilose; awn very long, 120–200 mm, sometimes readily deciduous, once or sometimes indistinctly twice geniculate, the lower segment twisted and appressed-villous, the long, untwisted terminal segment often more than 100 mm long, densely plumose, the pale or tawny hairs 2–3 mm long; lodicules 3, relatively long, about 3 mm, the lateral pair lanceolate, the middle one slightly narrower; $2n = 44$.

Dry sandy or rocky sagebrush mesas, canyons and hillides at middle elev.; s. Utah (Marysvale and the Colorado River drainage) and Ariz., e. to s. Colo., N.M. and w. Texas and n. Mex. June.

Stipa neomexicana is an important component of the Southwest desert grasslands. Weber (Rhodora 59: 273–277, 1957) reported an intergeneric hybrid involving *S. neomexicana* and *Oryzopsis hymenoides* (Roemer & Schultes) Ricker on a hill 6 miles north of Boulder, Colorado, in which the length and plumose characters of the awn, so distinctive of *S. neomexicana*, were completely suppressed.

Subfamily II. PANICOIDEAE

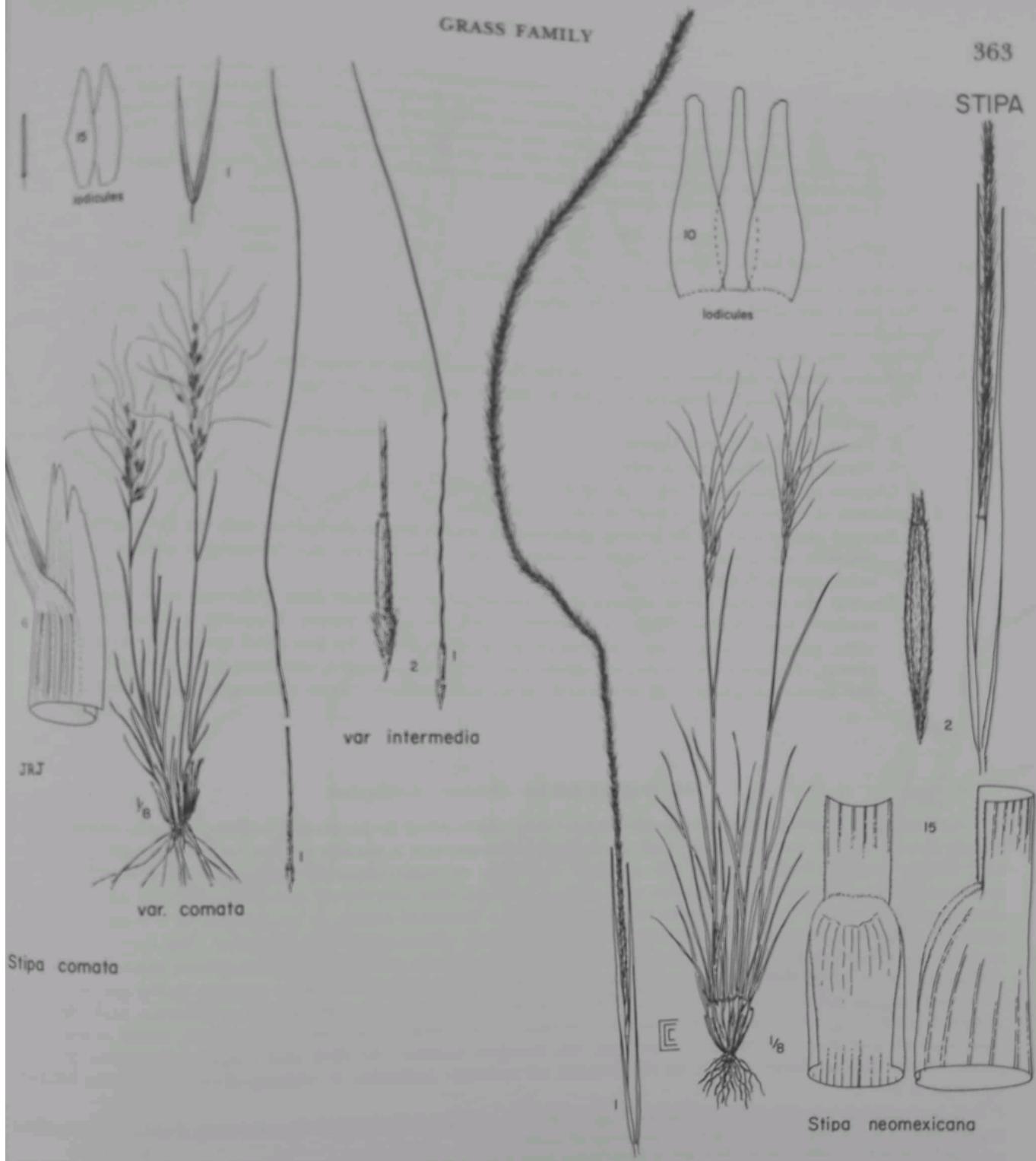
Epidermal cells in the region of root hairs all alike and all capable of giving rise to root hairs; culm internodes mostly solid or nearly so; sheath margins free; ligule membranous, a fringe of hairs, or absent; blades non-auriculate; inflorescence a panicle, sometimes of spicate or racemose branches that are digitately or racemosely arranged on a central axis, the spikelets often in pairs, often along 2 sides of a midrib of a flattened rachis or along 2 sides of a 3-angled rachis; spikelets dorsally compressed, turgid to plano-convex, (1-) 2-flowered with 1 perfect floret above and 1 staminate or sterile floret below; disarticulation below the glumes, sometimes at the rachis node, the rachis segment falling with the spikelet pair; lemmas (1-) 3- to 5- (9)-nerved, indurate or membranous; lodicules mostly short, truncate, thick and with considerable vasculature; stamens usually 3; embryo relatively large, more than $\frac{1}{3}$ the length of the caryopsis, with the typical panicoid morphology with vascular traces to the scutellum and coleoptile separated by an internode, the epiblast absent, the lower part of the scutellum and coleorhiza separated by a cleft, and the embryonic leaf margins overlapping; $x = 9$ or 10, the chromosomes mostly small.

The Panicoideae subfamily is composed of genera centering in trop. or subtrop. regions and therefore is not well represented in our region. Slightly less than $\frac{1}{10}$ of our grass species belong to the Panicoideae and most of them enter the region in the southern parts. Eight of the 13 genera of the Panicoideae in our area contain weedy species, several of which are among our most troublesome grasses.

In the new system the Panicoideae remains nearly the same as in A. S. Hitchcock's treatment (Manual Grasses U.S., 1951), with some minor changes in the Andropogoneae tribe. *Zea mays* L. (cultivated corn), which was included in the Tripsaceae or Maydeae in older treatments is now placed with the Andropogoneae. Corn is treated only briefly here as it does not become established as a part of our flora.

KEY TO THE TRIBES OF PANICOIDEAE

- 1 Glumes and lemma of the reduced floret similar in texture, soft; lemma of the perfect floret indurate; spikelets usually not organized into pairs Tribe 6. PANICEAE, p. 363
- 1 Glumes, at least the first, firm and indurate; lemma of the reduced and perfect florets membranous; spikelets in pairs of 1 sessile (or subsessile) and 1 pedicelled Tribe 7. ANDROPOGONEAE, p. 382



Tribe 6. PANICEAE

Annuals or perennials, cespitose or rhizomatous; culms solid to hollow, sometimes pith filled; sheath margins free; ligule membranous, a fringe of hairs, or absent; blades non-auriculate; inflorescence a diffuse panicle or a panicle of digitately or racemously arranged spicate-racemes with the spikelets along 2 sides of a midrib of a flattened rachis, or along 2 sides of a 3-angled rachis, some of the inflorescence branches sometimes modified to form bristles that subtend the spikelets in *Setaria*, or a bur (involucr) that surrounds the spikelets in *Cenchrus*; spikelets dorsally compressed, 2-flowered, the lower floret staminate or sterile, disarticulating below the glumes; glumes usually membranous, soft, the first glume often much reduced or absent; lemma of the first floret similar in size and texture to the second glume, awnless or awned in *Echinochloa*; lemma of the fertile floret indurate, the margins overlapping the palea, usually smooth and shiny, sometimes rugose, indistinctly 3- (5)-nerved, awnless; palea of the first floret membranous, or often absent, the palea of the fertile floret indurate, smooth and shiny; lodicules 2, thick, truncate, vasculated; embryo panicoid; $x = 9$ or 10 .