7. CALOCEDRUS Kurz, J. Bot. 11: 196. 1873 · [Greek *callos,* beautiful, and *kedros,* cedar]

John W. Thieret

Trees evergreen, large. Branchlets flattened, in fan-shaped flattened sprays. Leaves opposite in 4 ranks (although apparently in whorls of 4). Adult leaves dimorphic, appressed, overlapping, scalelike, lateral leaves overlapping facial leaves, free portion of long-shoot leaves to ca. 3 mm; abaxial glands present. Pollen cones with 6–8 pairs of sporophylls, each sporophyll with 4 pollen sacs. Seed cones maturing and opening first year, ellipsoid, 17–30 mm; scales persistent, (2–)3 pairs, oblong and basifixed, thin and woody; proximal pair reduced, sterile, often reflexed or lacking; median pair fertile; distal pair connate, sterile. Seeds 2 per scale, lenticular, unequally 2-winged; cotyledons 2. $x = 11$.

Species 3 (1 in the flora): North America, Asia with 1 in Taiwan and 1 in s China and Burma.

1. **Calocedrus decurrens** (Torrey) Florin, Taxon 5: 192. 1956 · Incense-cedar, cedro incienso

Libocedrus decurrens Torrey, Smithsonian Contr. Knowl. 5(1) [6(2)]: 7, plate 3. 1853

Trees to 57 m; trunk to 3.6 m diam. Bark cinnamon brown, fibrous, furrowed and ridged. Branchlet segments mostly 2 or more times longer than wide, broadening distally. Leaves 3–14 mm, including long-decurrent base, rounded abaxially, apex acute (often abruptly), usually mucronate. Pollen cones red-brown to light brown. Seed cones oblong-ovate when closed, red-brown to golden brown, proximal scales often reflexed at cone maturity, median scales then widely spreading to recurved, distal scales erect. Seeds 4 or fewer in cone, 14–25 mm (including wings), light brown. $2n = 22$.

Montane forests; 300–2800 m; Calif., Nev., Oreg.; Mexico in Baja California.

Incense-cedar is an important commercial softwood species. Its wood, exceptionally resistant to decay and highly durable when exposed to weather, is manufactured into many products, including lumber, pencil stock (for which it is the major United States source), fence posts, shakes, and landscape timbers, which are attractive because of punky spots resulting from fungus. The tree is widely grown as a handsome ornamental.

8. JUNIPERUS Linnaeus, Sp. Pl. 2: 1038. 1753; Gen. Pl. ed. 5, 461. 1754 · Juniper, cedar, redcedar, cedro, sabino [Latin *juniperus,* name for juniper]

Robert P. Adams

Shrubs or trees evergreen. Branchlets terete, 3–6 angled, variously oriented, but not in flattened sprays. Leaves opposite in 4 ranks or in whorls of 3. Adult leaves closely appressed to divergent, scalelike to subulate, free portion to ca. 10 mm (to ca. 15 mm in *Juniperus communis*); abaxial gland visible or not, elongate to hemispheric *(J. ashei),* sometimes exuding white crystalline deposit. Pollen cones with 3–7 pairs or trios of sporophylls, each sporophyll with 2–8 pollen sacs. Seed cones maturing in 1 or 2 years, globose to ovoid and berrylike, 3–20 mm, remaining closed, usually glaucous; scales persistent, 1–3 pairs, peltate, tightly coalesced, thick and fleshy or fibrous to obscurely woody. Seeds 1–3 per scale, round to faceted, wingless; cotyledons 2–6. $x = 11$.

Species ca. 60 (13 in the flora): primarily Northern Hemisphere, 1 in e Africa.

Juniperus is the only dioecious (sometimes monoecious) genus of Cupressaceae in the flora. Cones, generally terminal, are axillary in *J. communis.*

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Numerous cultivars of *Juniperus* species are widely used for landscaping. Mutants, or "sports," affecting plant habit and foliage are present in all species and are likely related to single-gene mutations. Many have been given formal names or incorrectly ascribed to hybridization. Gymnocarpy (bare seeds protruding from the cone), caused by insect larvae (T. A. Zanoni 1978), is occasionally found in most junipers, particularly in the southwestern United States. Specimens with such aberrations may be almost impossible to identify without chemical data.

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1. Leaves of 1 kind, subulate, with basal abscission zone, spreading; cones axillary (*Juniperus* sect. *Juniperus*). . . . . 1. *Juniperus communis*
1. Leaves of 2 kinds, whip (subulate, without basal abscission zone) and scalelike; cones terminal (*Juniperus* sect. *Sabina* Spach).
   2. Margins of leaves entire (at 20×) or, if with irregular teeth (at 40×), then scalelike leaves acuminate at apex.
      3. Margins of leaves with irregular teeth (at 40×), scalelike leaves acuminate at apex; seed cones with 4–13 seeds, tan-brown to brownish purple when mature; branches as well as branchlets flaccid. . . . . 2a. *Juniperus flaccida* var. *flaccida*
      3. Margins of leaves entire (at 20× and 40×), scalelike leaves obtuse to acute or apiculate at apex; seed cones with 1–3 seeds, blue-black to brownish blue when mature; branches not drooping, but branchlets often flaccid.
         4. Prostrate to decumbent shrubs; scalelike leaves apiculate at apex; peduncles generally curved. . . . . 3. *Juniperus horizontalis*
         4. Upright trees; scalelike leaves obtuse to acute at apex; peduncles generally straight.
            5. Scalelike leaves not overlapping, or, if so, by not more than 1/5 their length, apex obtuse to acute; bark of larger branchlets exfoliating in plates; seed cones maturing in 2 years, of 2 distinct sizes. . . . . 4. *Juniperus scopulorum*
            5. Scalelike leaves overlapping by more than 1/4 their length, apex acute (to bluntly obtuse in var. *silicicola,* se United States); bark of larger branchlets usually exfoliating in strips; seed cones maturing in 1 year, of 1 size. . . 5. *Juniperus virginiana*
   2. Margins of leaves denticulate (at 20×), scalelike leaves usually obtuse to acute at apex (sometimes mucronate in *Juniperus deppeana* or acuminate in *J. monosperma*).
      6. Seed cones with 3–6 seeds, fibrous to obscurely woody; bark exfoliating in rectangular plates, branchlets erect (rarely bark exfoliating in thin strips, branchlets then flaccid). . . . . 6a. *Juniperus deppeana* var. *deppeana*
      6. Seed cones with 1–3 seeds, fleshy or resinous to fibrous; bark exfoliating in thin strips, branchlets erect.
         7. Leaves with raised hemispheric glands (particularly obvious on whip leaves). . . 7. *Juniperus ashei*
         7. Leaves with ovate, elliptic, elongate, or inconspicuous glands (or glands round on scalelike leaves only).
            8. Seed cones blue to blue-black, with 2(–3) seeds, maturing in 2 years; bark of branchlets greater than 10 mm diam. exfoliating in scales or flakes; single-stemmed trees to 20(–30) m. . . . . 8. *Juniperus occidentalis*

8. Seed cones variously colored, but with brownish or reddish hue, even when some blue is present, with 1(–2) seeds, usually maturing in 1 year; bark of branchlets greater than 10 mm diam. usually exfoliating in strips or smooth; usually multistemmed shrubs or trees to 12 m.
   9. Abaxial glands inconspicuous because embedded in leaf; monoecious. . . . . 9. *Juniperus osteosperma*
   9. Abaxial glands conspicuous; dioecious (very rarely monoecious).
      10. Seed cones mostly 9–10 mm diam., bluish brown, glaucous; branchlets about as wide as length of scalelike leaves; scalelike leaves closely appressed, abaxial surface generally flattened; branchlets terete. . . . . 10. *Juniperus californica*
      10. Seed cones mostly 6–8 mm diam., reddish blue to brownish blue, rose to pinkish, or copper to copper-red, glaucous or not; branchlets ca. 2/3 as wide as length of scalelike leaves; scalelike leaves with apex spreading, abaxial surface raised; branchlets generally 3–4(–6)-sided.
         11. Seed cones reddish blue to brownish blue; fewer than 1/5 of whip-leaf glands with evident white exudate. . . . . 11. *Juniperus monosperma*
         11. Seed cones rose to pinkish or copper to copper-red; 1/4 or more of whip-leaf glands with evident white exudate.
            12. Seed cones rose to pinkish, glaucous; adaxial surface of leaves glaucous. . . . . 12. *Juniperus coahuilensis*
            12. Seed cones copper to copper-red, not glaucous; adaxial surface of leaves not glaucous. . . . . 13. *Juniperus pinchotii*

8a. JUNIPERUS Linnaeus sect. JUNIPERUS

Juniperus Linnaeus sect. *Oxycedrus* Spach

Shrubs or small trees, if shrubs, decumbent or rarely upright. Adult leaves in whorls of 3, of 1 kind, subulate, spreading, with basal abscission zone. Cones axillary.

1. Juniperus communis Linnaeus, Sp. Pl. 2: 1040. 1753 · Common juniper, genévrier comun

Shrubs or small trees dioecious, to 4 m (if trees, to 10 m), multistemmed, decumbent or rarely upright; crown generally depressed. Bark brown, fibrous, exfoliating in thin strips, that of small branchlets (5–10 mm diam.) smooth, that of larger branchlets exfoliating in strips and plates. Branches spreading or ascending; branchlets erect, terete. Leaves green but sometimes appearing silver when glaucous, spreading, abaxial glands very elongate; adaxial surface with glaucous stomatal band; apex acute to obtuse, mucronate. Seed cones maturing in 2 years, of 2 distinct sizes, with straight peduncles, globose to ovoid, 6–13 mm, bluish black, glaucous, resinous to obscurely woody, with 2–3 seeds. Seeds 4–5 mm. $2n = 22$.

Varieties 5 (3 in the flora): North America, Eurasia.

Juniperus communis is the most widespread juniper species, and many subspecies and varieties have been described. A major study, including chemical characters, is needed to clarify the taxonomy. J. D. A. Franco (1962) recognized four subspecies (here considered varieties); two of these—var. *communis* and var. *hemisphaerica* (J. Presl & C. Presl) Parlatore—do not occur in the flora and a fifth, recognized here, was not treated by Franco.

The seed cones of *Juniperus communis* are used to flavor gin.

1. Seed cones 9–13 mm, longer than leaves. . . . . 1a. *Juniperus communis* var. *megistocarpa*
1. Seed cones 6–9 mm, shorter than leaves.
   2. Glaucous stomatal band on adaxial leaf surface 2 or more times as wide as each green marginal band; spreading to matlike shrubs; leaves linear-lanceolate, to 2 mm wide, apex acute to obtuse and mucronate. . . . . 1b. *Juniperus communis* var. *montana*
   2. Glaucous stomatal band on adaxial leaf surface about as wide as each green marginal band; prostrate, low shrubs with ascending

branchlet tips (occasionally spreading shrubs, rarely small trees); leaves linear, to 1.6 mm wide, apex acute and mucronate to acuminate. . . . . 1c. *Juniperus communis* var. *depressa*

1a. **Juniperus communis** Linnaeus var. **megistocarpa** Fernald & H. St. John, Proc. Boston Soc. Nat. Hist. 36: 58. 1921

Shrubs prostrate. Leaves upturned, lanceolate, apex acute and mucronate, to 12 × 1.6 mm, glaucous stomatal band about 1.5 times width of each green marginal band. Seed cones 9–13 mm, longer than leaves.

Sand dunes, serpentine, and limestone barrens; 0–500 m; Nfld., N.S., Que.

In Nova Scotia this variety is known from Sable Island. Magdalen Island, Quebec, is the type locality.

Although this taxon appears to be distinct, it might be more appropriately treated at the rank of *forma*.

1b. **Juniperus communis** Linnaeus var. **montana** Aiton, Hort. Kew. 3: 414. 1789

Juniperus communis subsp. *alpina* (Smith) Čelakovsky; *J. communis* subsp. *nana* (Willdenow) Syme; *J. communis* var. *jackii* Rehder; *J. communis* var. *saxatilis* Pallas; *J. sibirica* Burgsdorff

Shrubs spreading to matlike, 0.5–1 m. Leaves upturned or upcurled, to 15 × 2 mm, linear-lanceolate, sometimes almost overlapping, glaucous stomatal band on adaxial leaf surface 2 or more times width of each green marginal band, apex acute to obtuse and mucronate. Seed cones 6–9 mm, shorter than leaves. $2n = 22$.

Dry rocky soil and rock crevices on slopes and summits; 0–2500 m; Greenland; B.C.; Calif., Oreg., Wash.

Juniperus communis var. *montana* is widespread throughout the Northern Hemisphere. Although the proposed var. *jackii* is quite distinct in the field (prostrate shrub with sparsely branched, whiplike, trailing branches), transplants indicate that the unusual growth form is environmentally induced (Steve Edwards, pers. comm.).

1c. **Juniperus communis** Linnaeus var. **depressa** Pursh, Fl. Amer. Sept. 2: 646. 1814

Juniperus communis subsp. *depressa* (Pursh) Franco

Shrubs prostrate or low with ascending branchlet tips (occasionally spreading shrubs to 3 m, rarely small trees to 10 m). Leaves upturned, to 15 × 1.6 mm, rarely spreading, linear, glaucous stomatal band about as wide as each green marginal band, apex acute and mucronate to acuminate. Seed cones 6–9 mm, shorter than leaves. $2n = 22$.

Rocky soil, slopes, and summits; 0–2800 m; Alta., B.C., Man., N.B., Nfld., N.W.T., N.S., Ont., P.E.I., Que., Sask., Yukon; Alaska, Ariz., Calif., Colo., Conn., Ga., Idaho, Ill., Ind., Maine, Mass., Mich., Minn., Mont., Nev., N.H., N.Mex., N.Y., N.C., N.Dak., Ohio, Oreg., Pa., R.I., S.C., S.Dak., Utah, Vt., Va., Wash., Wis., Wyo.

In the flora, larger individuals of this variety (to 10 m) have been misidentified as var. *communis*.

8b. JUNIPERUS Linnaeus sect. SABINA Spach, Ann. Sci. Nat., Bot., sér. 2, 16: 291. 1841.

Trees or shrubs, if shrubs, prostrate to decumbent or upright. Adult leaves opposite in 4 ranks or in whorls of 3, of 2 kinds on same branchlet, whip leaves (subulate, spreading) and scalelike (appressed or with spreading apex), both without basal abscission zone. Cones terminal.

2. **Juniperus flaccida** Schlechtendal, Linnaea 12: 495. 1838 · Drooping juniper, tascate

Varieties 3 (1 in the flora): North America, Mexico.

2a. Juniperus flaccida Schlechtendal var. **flaccida**

Trees dioecious, to 12 m, single-stemmed to 1–2 m; crown globose. Bark cinnamon to reddish brown or gray to reddish brown, exfoliating in broad interlaced fibrous strips, that of small branchlets (5–10 mm diam.) smooth, that of larger branchlets exfoliating in wide strips or plates. Branches drooping; branchlets flaccid, 3–4-sided in cross section, ca. 2/3 or less as wide as length of scalelike leaves. Leaves green, abaxial gland variable, elongate, conspicuous, exudate absent, margins appearing entire at 20× but with irregular teeth at 40×; whip leaves 4–6 mm, not glaucous adaxially; scalelike leaves 1.5–2 mm, overlapping by 1/4–1/5 their length, apex rounded to acuminate, spreading. Seed cones maturing in 1 year, of 1 size, with straight to curved peduncles, globose, 9–20 mm, tan-brown to brownish purple when mature, glaucous, obscurely woody, with (4–)6–10 (–13) seeds. Seeds 5–6 mm.

Rocky soils and slopes, 900–2900 m; Tex.; Mexico.

This variety is found in Big Bend National Park, Texas. It is abundant in Mexico, where two additional varieties occur: var. *poblana* Martínez and var. *martinezii* (Pérez de la Rosa) Silba.

3. Juniperus horizontalis Moench, Methodus, 699. 1794 · Creeping juniper, savinier

Juniperus horizontalis var. *douglasii* hort.; *J. horizontalis* var. *variegata* Beissner

Shrubs dioecious, prostrate to decumbent; crown depressed. Bark brown, exfoliating in thin strips, that of small branchlets (5–10 mm diam.) smooth, that of larger branchlets exfoliating in wide strips or plates. Branches creeping; branchlets erect, 3–4-sided in cross section, ca. 2/3 or less as wide as length of scalelike leaves. Leaves green but turning reddish purple in winter, abaxial gland elliptic, conspicuous, exudate absent, margins entire (at 20× and 40×); whip leaves 4–8 mm, not glaucous adaxially; scalelike leaves 1.5–2 mm, mostly overlapping to 1/3 their length, apex rounded or obtuse to acute and apiculate, spreading. Seed cones mostly maturing in 2 years, of 2 distinct sizes, generally with curved peduncles, globose to ovoid, 5–7 mm, blue-black to brownish blue when mature, lightly glaucous, soft and resinous, with 1–2(–3) seeds. Seeds 4–5 mm. $2n = 22$.

Sand dunes, sandy and gravelly soils, prairies, slopes, rock outcrops, and stream banks; 0–1000 m; St. Pierre and Miquelon; Alta., B.C., Man., N.B., Nfld., N.W.T., N.S., Ont., P.E.I., Que., Sask., Yukon; Alaska, Ill., Iowa, Maine, Mass., Mich., Minn., Mont., Nebr., N.Y., N.Dak., S.Dak., Vt., Wis., Wyo.

Juniperus horizontalis, a prostrate species, hybridizes with the trees *J. virginiana* and *J. scopulorum* (R. P. Adams 1983; N. C. Fassett 1945; M. Palma-Otal et al. 1983) and is closely related to both. The hybrid between *J. horizontalis* and *J. scopulorum* has been named *J.* ×*fassettii* Boivin.

4. Juniperus scopulorum Sargent, Gard. & Forest 10: 420, fig. 54. 1897 · Rocky Mountain juniper, Rocky Mountain redcedar

Sabina scopulorum (Sargent) Rydberg

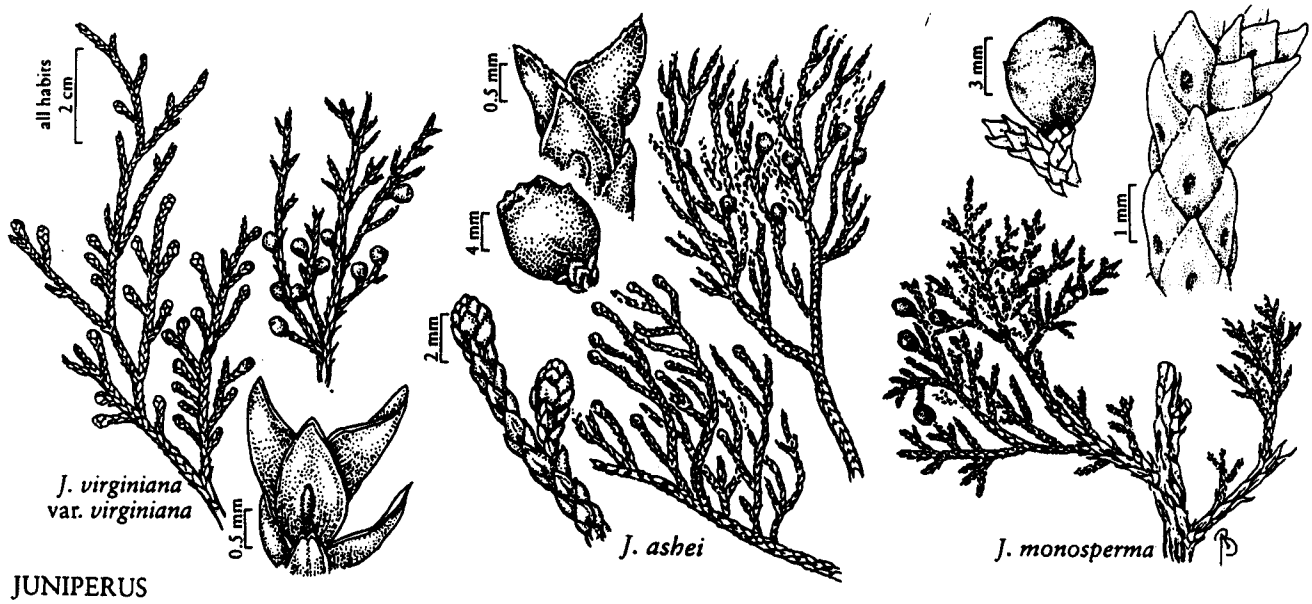
Trees dioecious, to 20 m, single-stemmed (rarely multistemmed); crown conic to occasionally rounded. Bark brown, exfoliating in thin strips, that of small branchlets (5–10 mm diam.) smooth, that of larger branchlets exfoliating in plates. Branches spreading to ascending; branchlets erect to flaccid, 3–4-sided in cross section, ca. 2/3 or less as wide as length of scalelike leaves. Leaves light to dark green but often glaucous blue or blue-gray, abaxial gland elliptic, conspicuous, exudate absent, margins entire (at 20× and 40×); whip leaves 3–6 mm, not glaucous adaxially; scalelike leaves 1–3 mm, not overlapping to overlapping by not more than 1/5 their length, keeled to rounded, apex obtuse to acute, appressed or spreading. Seed cones maturing in 2 years, of 2 distinct sizes, generally with straight peduncles, globose to 2-lobed, 6–9 mm, appearing light blue when heavily glaucous, but dark blue-black beneath glaucous coating when mature (or tan beneath glaucous coating when immature), resinous to fibrous, with (1–)2(–3) seeds. Seeds 4–5 mm. $2n = 22$.

Rocky soils, slopes, and eroded hillsides; 1200–2700 m (0 m at Vancouver Island and Puget Sound); Alta., B.C.; Ariz., Colo., Idaho, Mont., Nebr., Nev., N.Mex., N.Dak., Oreg., S.Dak., Tex., Utah, Wash., Wyo.; n Mexico.

Juniperus scopulorum hybridizes with its eastern relative *J. virginiana* in zones of contact in the Missouri River basin (C. W. Comer et al. 1982) and with *J. horizontalis* (*J.* ×*fassettii* Boivin; N. C. Fassett 1945). Relictual hybridization with *J. virginiana* is known in the Texas panhandle (R. P. Adams 1983).

5. Juniperus virginiana Linnaeus, Sp. Pl. 2: 1039. 1753 · Eastern redcedar

Trees dioecious, to 30 m, single-stemmed; crown narrowly erect to conical, round, or flattened. Bark brown, exfoliating in thin strips, that of small branchlets (5–



JUNIPERUS

10 mm diam.) smooth, that of larger branchlets usually not exfoliating in plates. Branches pendulous to ascending; branchlets generally erect, sometimes lax to flaccid, 3–4-sided in cross section, ca. 2/3 or less as wide as length of scalelike leaves. Leaves green but sometimes turning reddish brown in winter, abaxial gland elliptic or elongate, conspicuous, exudate absent, margins entire (at 20× and 40×); whip leaves 3–6 mm, not glaucous adaxially; scalelike leaves 1–3 mm, overlapping by more than 1/4 their length, keeled, apex obtuse to acute, spreading. Seed cones maturing in 1 year, of 1 size, generally with straight peduncles, globose to ovoid, 3–6(–7) mm, blue-black to brownish blue when mature, glaucous, soft and resinous, with 1–2(–3) seeds. Seeds 1.5–4 mm.

Varieties 2: only in the flora.

1. Seed cones 4–6(–7) mm; crown narrowly erect to conic or round; bark reddish brown; scalelike leaves acute at apex; pollen cones 3–4 mm. . . . . 5a. *Juniperus virginiana* var. *virginiana*
1. Seed cones 3–4 mm; crown flattened; bark cinnamon reddish; scalelike leaves bluntly obtuse to acute at apex; pollen cones 4–5 mm. . . . . 5b. *Juniperus virginiana* var. *silicicola*

5a. Juniperus virginiana Linnaeus var. **virginiana**

· Eastern red-cedar, cèdre rouge

Juniperus virginiana var. *crebra* Fernald & Griscom; *Sabina virginiana* (Linnaeus) Antoine

Trees to 30 m; crown narrowly erect (in young, fast-growing trees) to conic or occasionally round. Bark reddish brown. Branches erect, spreading, or pendulous. Scalelike leaves acute at apex. Pollen cones 3–4 mm. Seed cones globose to ovoid, 4–6(–7) mm. Seeds 2–4 mm. $2n = 22, 33$.

Upland to low woods, old fields, glades, fencerows, and river swamps; 0–1400 m; Ont., Que.; Ala., Ark., Conn., Del., D.C., Fla., Ga., Ill., Ind., Iowa, Kans., Ky., La., Maine, Md., Mass., Mich., Minn., Miss., Mo., Nebr., N.H., N.J., N.Y., N.C., N.Dak., Ohio, Okla., Pa., R.I., S.C., S.Dak., Tenn., Tex., Vt., Va., Wis.

Eastern redcedar hybridizes with the related species *Juniperus horizontalis* (M. Palma-Otal et al. 1983) and *J. scopulorum* (C. W. Comer et al. 1982). Reported hybridization with *J. ashei* has been refuted in subsequent studies (R. P. Adams 1977).

The wood of *Juniperus virginiana* is used for production of eastern redcedarwood oil, fenceposts, and cedar chests.

5b. **Juniperus virginiana** Linnaeus var. **silicicola** (Small) E. Murray, Kalmia 13: 8. 1983 · Southern red-cedar, coastal redcedar

Sabina silicicola Small, Mem. New York Bot. Gard. 24: 5. 1923; *Juniperus silicicola* (Small) L. H. Bailey

Trees to 10 m; crown flattened or conic (when young and protected or crowded). Bark cinnamon reddish. Branches spreading to pendulous. Scalelike leaves bluntly obtuse to acute at apex. Pollen cones 4–5 mm. Seed cones 3–4 mm. Seeds 1.5–3 mm.

Coastal foredunes and coastal river sandbanks; 0–15 m; Fla., Ga., N.C., S.C.

This southern variety of *Juniperus virginiana* appears to be restricted to coastal foredunes but differs little in morphology or leaf terpenoids from upland *J. virginiana* and appears to intergrade with that variety in Georgia (R. P. Adams 1986). These taxa are distinct from the Caribbean junipers *J. lucayana* Britton of the Bahamas, Jamaica, and Cuba, and *J. bermudiana* Linnaeus of Bermuda (R. P. Adams et al. 1987). Reports of *J. virginiana* var. *silicicola* from west of Florida are questionable.

6. **Juniperus deppeana** Steudel, Nomencl. Bot. ed. 2, 1: 835. 1841 · Alligator juniper, cedro chino

Varieties 5 (1 in the flora): North America, Mexico.

6a. **Juniperus deppeana** Steudel var. **deppeana**

Trees dioecious, to 10–15(–30) m, single-stemmed; crown rounded. Bark brown, exfoliating in rectangular plates (rarely in thin strips in f. *sperryi*, but then branchlets flaccid), that of small branchlets (5–10 mm diam.) smooth, that of larger branchlets exfoliating in plates. Branches spreading to ascending; branchlets erect, rarely flaccid, 3–4-sided in cross section, ca. 2/3 or less as wide as length of scalelike leaves. Leaves green, but sometimes appearing silvery when glaucous, abaxial gland ovate to elliptic, conspicuous, exudate absent, margins denticulate (at 20×); whip leaves 3–6 mm, not glaucous adaxially; scalelike leaves 1–2 mm, not overlapping, keeled, apex acute to mucronate, appressed. Seed cones maturing in 2 years, of 2 distinct sizes, with straight to curved peduncle, globose, 8–15 mm, reddish tan to dark reddish brown, glaucous, fibrous to obscurely woody, with (3–)4–5(–6) seeds. Seeds 6–9 mm.

Rocky soils, slopes, and mountains; 2000–2900 m; Ariz., N.Mex., Tex.; Mexico.

Although four additional varieties are found in Mexico, the relationships among the *J. deppeana* taxa are poorly understood and need additional study (R. P. Adams et al. 1984). The very rare *J. deppeana* Steudel var. *deppeana* f. *sperryi* (Correll) R. M. Adams (= *J. deppeana* Steudel var. *sperryi* Correll) is endemic to the Davis Mountains, Texas, where only two or three individuals are known to exist. This form is characterized by bark that exfoliates in thin strips and by flaccid branchlets.

7. **Juniperus ashei** J. Buchholz, Bot. Gaz. 90: 329. 1930 · Ashe juniper, mountain-cedar

Trees dioecious, to 15 m, single-stemmed to 1–3 m, occasionally branching at base; crown rounded to irregular and open. Bark brown, exfoliating in thin strips, that of small branchlets (5–10 mm diam.) smooth, that of larger branchlets exfoliating in strips. Branches spreading to ascending; branchlets erect, 3–4-sided in cross section, ca. 2/3 or less as wide as length of scalelike leaves. Leaves dark green, abaxial glands hemispheric, raised (particularly obvious on whip leaves), exudate absent, margins denticulate (at 20×); whip leaves 3–6 mm, not glaucous adaxially; scalelike leaves 1–2 mm, not overlapping or overlapping to 1/4 their length, keeled, apex acute to obtuse, spreading. Seed cones maturing in 1 year, of 1 size, with straight peduncles, ovoid to nearly globose, 6–9 mm, dark blue, glaucous, fleshy and resinous, with 1(–3) seeds. Seeds 4–6 mm. $2n = 22$.

Limestone glades and bluffs; 150–600 m; Ark., Mo., Okla., Tex.; Mexico.

The name *Juniperus mexicana* Sprengel has been misapplied to this species. Reports of hybridization with *J. virginiana* and *J. pinchotii* have been refuted using numerous chemical and morphologic characters (R. P. Adams 1977).

Ashe juniper is a source of Texas-cedarwood oil and fence posts.

8. **Juniperus occidentalis** Hooker, Fl. Bor.-Amer. 2: 166. 1838 · Western juniper

Trees monoecious or dioecious, to 20(–30) m, single-stemmed; crown rounded to conical. Bark red-brown to brown, exfoliating in thin strips, that of small branchlets (5–10 mm diam.) smooth, that of larger branchlets exfoliating in scales or flakes. Branches spreading to ascending; branchlets erect, 3–4-sided in cross section, ca. 2/3 or less as wide as length of scalelike leaves. Leaves green, abaxial glands ovate to elliptic, conspicuous, with yellow or white exudate, margins denticulate (at 20×); whip leaves 3–6 mm, not

glaucous adaxially; scalelike leaves 1–3 mm, not overlapping, rounded, apex acute to obtuse, appressed. Seed cones maturing in 2 years, of 2 distinct sizes, with straight peduncle, ovoid, 5–10 mm, blue to blue-black, glaucous, fleshy and resinous, with 2(–3) seeds. Seeds 2–4 mm.

Varieties 2: only in the flora.

1. Bark red-brown; seed cones (5–)7.5(–9) mm; plants often (50%) monoecious. . . . . 8a. *Juniperus occidentalis* var. *occidentalis*
1. Bark brown; seed cones (7–)8.5(–10) mm; plants mostly (90%) dioecious. . . . . 8b. *Juniperus occidentalis* var. *australis*

8a. Juniperus occidentalis Hooker var. **occidentalis**

Sabina occidentalis (Hooker) Antoine

Plants often (50%) monoecious. Bark red-brown. Seed cones (5–)7.5(–9) mm.

Dry rocky foothill and mountain slopes; (0–)1500–3000 m; Calif., Idaho, Oreg., Nev., Wash.

8b. Juniperus occidentalis Hooker var. **australis** (Vasek) A. H. Holmgren & N. H. Holmgren in Cronquist et al., Intermount. Fl. 1: 239. 1972

Juniperus occidentalis Hooker subsp. *australis* Vasek, Brittonia 18: 352. 1966

Plants mostly (90%) dioecious. Bark brown. Seed cones (7–)8.5(–10) mm.

Dry rocky slopes; 1000–3000 m; Calif.

F. C. Vasek (1966) reported hybridization of this variety with *Juniperus osteosperma* in northwestern Nevada.

9. Juniperus osteosperma (Torrey) Little, Leafl. W. Bot. 5: 125. 1948 · Utah juniper, sabina morena

Juniperus tetragona Schlechtendal var. *osteosperma* Torrey, Pacif. Railr. Rep. 4(5): 141. 1857; *J. californica* Carrière var. *utahensis* Engelmann; *Sabina osteosperma* (Torrey) Antoine; *S. utahensis* (Engelmann) Rydberg

Shrubs or trees monoecious, to 6(–12) m, multi- or single-stemmed; crown rounded. Bark exfoliating in thin gray-brown strips, that of smaller and larger branchlets smooth. Branches spreading to ascending; branchlets erect, 3–4-sided in cross section, about as wide as length of scalelike leaves. Leaves light yellow-green, abaxial glands inconspicuous and embedded, exudate absent, margins denticulate (at 20×); whip leaves 3–5 mm, glaucous adaxially; scalelike leaves 1–2 mm, not overlapping, or, if so, by less than 1/10 their length, keeled, apex rounded, acute or occasionally obtuse, appressed. Seed cones maturing in 1–2 years, of 1–2 sizes, with straight peduncles, globose, (6–)8–9(–12) mm, bluish brown, often almost tan beneath glaucous coating, fibrous, with 1(–2) seeds. Seeds 4–5 mm.

Dry, rocky soil and slopes; 1300–2600 m; Ariz., Calif., Colo., Idaho, Mont., Nev., N.Mex., Utah, Wyo.

Juniperus osteosperma is the dominant juniper of Utah. It is reported to hybridize with *J. occidentalis* in northwestern Nevada (F. C. Vasek 1966).

10. Juniperus californica Carrière, Rev. Hort., sér. 4, 3: 352. 1854 · California juniper, huata, cedro

Sabina californica (Carrière) Antoine

Shrubs or trees dioecious (rarely monoecious), to 8 m, multistemmed (seldom single-stemmed); crown rounded. Bark gray, exfoliating in thin strips, that of smaller and larger branchlets smooth. Branches spreading to ascending; branchlets erect, terete, about as wide as length of scalelike leaves. Leaves light green, abaxial glands elliptic to ovate, conspicuous, exudate absent, margins denticulate (at 20×); whip leaves 3–5 mm, not glaucous adaxially; scalelike leaves 1–2 mm, not overlapping, or rarely overlapping by ca. 1/5 their length, generally flattened, apex acute to obtuse, closely appressed. Seed cones maturing in 1 year, of 1 size, with straight peduncles, globose, (7–)9–10(–13) mm, bluish brown, glaucous, fibrous, with 1(–2) seeds. Seeds 5–7 mm.

Dry, rocky slopes and flats; 750–1600 m; Ariz., Calif., Nev.; Mexico in Baja California.

Although two races, differing in volatile leaf oils, were described by F. C. Vasek and R. W. Scora (1967) and confirmed by R. P. Adams et al. (1983), no differences were found in volatile wood oils (R. P. Adams 1987). To date, no morphological characters appear to be correlated with the chemical races. No other Western Hemisphere species of *Juniperus* has been found to have leaf-oil races.

11. Juniperus monosperma (Engelmann) Sargent, Silva 10: 89. 1896 · One-seed juniper, sabina

Juniperus occidentalis Hooker var. *monosperma* Engelmann, Trans. Acad. Sci. St. Louis 3: 590. 1878

Shrubs or trees dioecious, to 7 (–12) m, usually branching near base; crown rounded to flattened-globose. Bark gray to brown, exfoliating in thin strips, that of small branchlets (5–10 mm diam.) smooth, that of larger branchlets exfoliating in either flakes or strips. Branches ascending to erect; branchlets erect, 4–6-sided, ca. 2/3 as wide as length of scalelike leaves. Leaves green to dark green, abaxial glands elongate, fewer than 1/5 of glands (on whip leaves) with an evident white crystalline exudate, margins denticulate (at 20×); whip leaves 4–6 mm, glaucous adaxially; scalelike leaves 1–3 mm, not overlapping, or if so, by less than 1/4 their length, keeled, apex acute to acuminate, spreading. Seed cones maturing in 1 year, of 1 size, with straight peduncles, globose to ovoid, 6–8 mm, reddish blue to brownish blue, glaucous, fleshy and resinous, with 1(–3) seeds. Seeds 4–5 mm.

Dry, rocky soils and slopes; 1000–2300 m; Ariz., Colo., N.Mex., Okla., Tex.

Reports of hybridization with *J. pinchotii* have been refuted by use of numerous chemical and morphologic characters (R. P. Adams 1975); the two species have nonoverlapping pollination seasons.

12. Juniperus coahuilensis (Martinez) Gaussen ex R. P. Adams, Phytologia 74:450. 1993 · Roseberry

Juniperus erythrocarpa Cory var. *coahuilensis* Martinez, Anales Inst. Biol. Univ. Nac. México 17: 115–116. 1946

Shrubs or trees dioecious, to 8 m, single-stemmed to 1 m or branched at base; crown flattened-globose to round or irregular. Bark gray to brown, exfoliating in long ragged strips, that of small branchlets (5–10 mm diam.) smooth, that of larger branchlets exfoliating in strips or occasionally in flakes. Branches spreading to ascending; branchlets erect, 3–4-sided in cross section, ca. 2/3 as wide as length of scalelike leaves. Leaves green to light green, abaxial glands elliptic to ovate, at least 1/4 of glands (on whip leaves) with an evident white crystalline exudate, margins denticulate (at 20×); whip leaves 4–6 mm, glaucous adaxially; scalelike leaves 1–3 mm, not overlapping or if so, by less than 1/4 their length, keeled, apex acute, spreading. Seed cones maturing in 1 year, of 1 size, with straight peduncles, globose to ovoid, 6–7 mm, rose to pinkish but yellow-orange, orange, or dark red beneath glaucous coating, fleshy and somewhat sweet, with 1(–2) seeds. Seeds 4–5 mm.

Bouteloua grasslands and adjacent rocky slopes; 980–1600(–2200) m; Ariz., N.Mex., Tex.; Mexico.

Roseberry juniper is unusual in that it sprouts from the stump after burning or cutting. Hybridization with *Juniperus pinchotii* occurs in Big Bend National Park, Texas (R. P. Adams and J. R. Kistler 1991), and possibly near Saltillo, Mexico. Reports of hybridization with *J. ashei* have been refuted (R. P. Adams 1975).

13. Juniperus pinchotii Sudworth, Forest. Irrig. 10: 204. 1905 · Pinchot juniper, redberry juniper

Juniperus erythrocarpa Cory

Shrubs or shrubby trees dioecious, to 6 m, usually multistemmed; crown flattened-globose to irregular. Bark ashy gray to brown, exfoliating in long strips, that of small branchlets (5–10 mm diam.) smooth, that of larger branchlets exfoliating in strips or sometimes in flakes. Branches spreading to ascending; branchlets erect, 3–4-sided in cross section, ca. 2/3 as wide as length of scalelike leaves. Leaves yellow-green, abaxial glands elliptic to elongate, many with an evident white crystalline exudate, margins denticulate (at 20×); whip leaves 4–6 mm, not glaucous adaxially; scalelike leaves 1–2 mm, not overlapping or overlapping by not more than 1/5 their length, keeled, apex acute, spreading. Seed cones maturing in 1 year, of 1 size, with straight peduncles, globose to ovoid, 6–8 (–10) mm, copper to copper-red, not glaucous, fleshy and sweet, not resinous, with 1(–2) seeds. Seeds 4–5 mm.

Gravelly soils on rolling hills and in ravines, limestone, gypsum; 300–1000(–1700) m; N.Mex., Okla., Tex.; Mexico.

Pinchot juniper hybridizes with *Juniperus coahuilensis* (R. P. Adams and J. R. Kistler 1991) but not with *J. ashei* (R. P. Adams 1977) or *J. monosperma* (R. P. Adams 1975). The type specimen of *J. Erythrocarpa* is merely an individual with brighter red seed cones.