

FAGACEAE OAK FAMILY

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Trees and shrubs; monoecious in ours; hairs unbranched or stellate. LEAVES usually alternate, simple, deciduous in autumn or persisting nearly 1-3 years, often lobed, pinnately veined; stipules deciduous. FLOWERS mostly wind-pollinated, unisexual, the perianth much reduced or absent; staminate flowers in heads or aments, the perianth greenish, the stamens 4-9 in ours; pistillate flowers usually tricarpetate, solitary or in clusters of about 3 or more, subtended individually or in groups by an involucre that develops into a woody cupule enclosing or subtending the mature fruit(s). FRUIT a nut. --8 genera, ca. 900 spp., widespread but absent from large portions of tropical S. Amer., tropical and southern Afr., and Australia.

Quercus L. Oak

Trees and shrubs, the wood hard, close-grained or porous; hairs of two types, both usually present, the stellate ones whitish or yellowish, non-glandular, suberect to spreading, the unbranched ones orangeish to golden, glandular, more or less appressed; young growth usually densely woolly, the older growth glabrescent or remaining woolly; buds 1-4(-5) mm long in ours. LEAVES alternate, subcoriaceous to coriaceous, entire, toothed, or lobed. INFLORESCENCES: staminate flowers in aments; pistillate flowers solitary or in groups on spikes, these sometimes abbreviated, each pistillate flower with a separate involucre. FRUIT an ovoid to subcylindric nut, each subtended by a cup- or bowl-shaped cap (together called an acorn), maturing after one summer in all our species except *Q. hypoleucoides*; caps (cupules) woody, covered with many imbricate, shortly woolly scales, variously pubescent within, the scales with thickened bases and thin tips or the entire scale thin. --ca. 450 spp. in N. Amer., n S. Amer., temperate and subtropical Eurasia, and n Afr. (Classical name for oak). Tucker, J. M. 1961. Amer. J. Bot. 48:202-208; 1963. Amer. J. Bot. 50:699-708; 1970. Amer. J. Bot. 57:71-84. Tucker, J. M. & Haskell, H. S. 1960. Brittonia 12:196-219. Tucker, J. M. *et al.* 1961. Amer. J. Bot. 48:329-339.

Quercus is commonly divided into three subgenera in the Western Hemisphere: the white oaks (*Quercus*), red oaks (*Erythrobalanus*) and intermediate oaks (*Protobalanus*). In AZ, species can be assigned to the three subgenera as follows: *Quercus*: *Q. gambelii*, *Q. grisea*, *Q. havardii*, *Q. oblongifolia*, *Q. pungens*, *Q. rugosa*, *Q. toumeyi*, and *Q. turbinella*; *Erythrobalanus*: *Q. emoryi* and *Q. hypoleucoides*; and *Protobalanus*: *Q. chrysolepis* and *Q. palmeri*. Hybridization between subgenera is not known, but hybridization between species of the same subgenus has been reported for all three groups in Arizona.

1. Leaf margins 3-6 lobed on each side, the sinuses between lobes reaching 25-90% of the way to the midvein.
2. Some leaves usually 8 or more cm long, the lobes rounded (rarely acute) never spinescent, the sinuses between lobes mostly reaching about 50% or more of the way to the midvein; margins nearly flat; stellate hairs of lower leaf surface sparse to moderately dense, with 2-4(-5) arms; common, widespread species, often attaining tree size *Q. gambelii*
- 2' Leaves rarely 8 or more cm long, the lobes acute, commonly spinescent, the sinuses between lobes mostly reaching less than 50% of the way to the midvein; margins often undulate; stellate hairs of lower leaf surface dense, usually with 8 or more arms; restricted to n or se AZ, usually forming dense clones of shrubs 0.5-2 m high.
3. Leaves 1.5-5 cm long, lustrous above; acorns 1-1.5 cm long; commonly on limestone hillsides in Cochise and Pima cos. *Q. pungens*

- 3' Leaves 2.5-7.5 cm long, usually dull above; acorns 1.5-3 cm long; typically in sandy, dune-forming soils in n Coconino and n Navajo cos. *Q. havardii*
- 1' Leaf margins entire or toothed, the sinuses between teeth usually reaching less than 25% of the way to the midvein.
4. Lower leaf surface whitish woolly; upper leaf surface dark green when fresh, gray-green when dry, glabrous; leaves lanceolate to elliptic, 3-5 times as long as wide; acorns maturing after second summer (young acorns present at anytime of year); trunk bark dark blackish-gray
..... *Q. hypoleucooides*
- 4' Lower leaf surface various, rarely densely white woolly in *Q. grisea*; upper leaf surface dark or light green, glabrous or hairy; leaves variously shaped, often less than 3 times as long as wide; acorns maturing after one summer (young acorns present only during summer months); trunk bark often light gray.
5. Leaves shiny green on both surfaces, nearly glabrous at maturity except for usually having a tuft of tomentum at base below; margin entire or more commonly with 2-4 (rarely more) teeth widely separated by broadly and shallowly concave sinuses; trunk bark blackish-gray; inner surface of nut-shell woolly *Q. emoryi*
- 5' Leaves dull and/or hairy on at least lower surface, without a distinct tuft of tomentum at base below; margin various; trunk bark usually light gray; inner surface of nut-shell glabrous to subglabrous or more or less woolly in *Q. chrysolepis* and *Q. palmeri*.
6. Mature leaves nearly concolorous, glaucous blue-green, glabrous or essentially so, the margin usually entire, never spiny.
7. Leaves oblong to oval, the apex broadly obtuse to slightly emarginate; petiole usually with flakes of wax; trees of open oak woodlands to grasslands
..... *Q. oblongifolia*
- 7' Leaves mainly ovate, lanceolate or elliptic, the apex acute or acuminate, often mucronate; petiole without flakes of wax; trees or shrubs of closed oak and conifer forests *Q. chrysolepis*
- 6' Mature leaves usually discoloured (at least before drying), not glaucous blue-green on both surfaces, or if so then the leaves hairy or the margin toothed or spiny.
8. Mature leaves with a layer of white wax below, smooth, lustrous dark green above when fresh, drying gray-green above; acorn caps and galls often densely covered with bright yellow-orange glandular hairs (but sometimes with few or none); inner surface of nut-shell more or less woolly.
9. Leaves mostly entire or leaves on rapidly growing shoots sometimes with serrate margins, the teeth apically directed; acorn cap usually saucer-shaped, the margins not flared; inner surface of acorn nut-shell with patches of tomentum; usually trees at about 1800 m (6000 ft) or above
..... *Q. chrysolepis*
- 9' Leaves with spinosely toothed margins, the teeth seeming to radiate from the approximate center of the leaf; acorn cap variable, often nearly plate-shaped, with flared margins; inner surface of acorn nut-shell uniformly densely woolly; usually shrubs below 1800 m (6000 ft) *Q. palmeri*
- 8' Mature leaves without a noticeable layer of white wax below, often rugose and/or lighter green above; acorn caps and galls with few or no yellow-orange glandular hairs; inner surface of nut-shell glabrous to sparsely pubescent or the tip pubescent.

10. Shrubs or small trees of chaparral or low scrub forests; leaves mainly under 4 cm long; secondary veins not clearly visible below without a lens; acorns maturing from Jul to Sep.
11. Leaves usually dull bluish green above, 1.3-2 times as long as wide; leaf margin usually toothed, rarely entire; bark of twigs 1-2 years old more or less smooth; widespread
..... *Q. turbinella*
- 11' Leaves usually lustrous, dark green above, 1.9-3.3 times as long as wide; leaf margins entire or toothed; bark of twigs 1-2 years old rough; se AZ *Q. toumeyii*
- 10' Trees of forests; leaves often over 4 cm long; secondary veins clearly visible below without a lens; acorns maturing from Sep to Nov.
12. Lateral veins and sometimes secondary veins impressed above; mature leaves often golden yellow below; peduncles mostly over 2 cm long; growing mainly from 1800-3000 m (6000-10000 ft); Cochise, Pima, Santa Cruz and s Greenlee cos. *Q. rugosa*
- 12' Lateral veins and secondary veins nearly flat above; mature leaves usually not golden yellow below; peduncles mostly less than 2 cm long; growing mainly below 2100 m (7000 ft) from Cochise, Pima and Santa Cruz cos. n to c Yavapai, s Coconino, s Navajo, and s Apache cos.
..... *Q. grisea*

Quercus chrysolepis Liebm. (with golden scales). Canyon Oak. --In AZ a shrub or tree to ca. 10 m high, the bark smooth or rough, dark gray, the young growth often covered with orangeish glandular hairs; young twigs densely to sparsely woolly, smooth reddish-brown beneath tomentum, the older twigs glabrescent, gray, often blackened, the bark exfoliating in thin filaments or scales. LEAVES unlobed (sometimes deeply serrate), ovate, elliptic, lanceolate, or suborbicular, 1-4.3 cm long, 0.7-3.1 cm wide, 1.2-3 times as long as wide, often covered with orangeish glandular hairs below when young, the mature leaves glabrous to subglabrous with few or no glandular hairs, covered with whitish wax below, lustrous dark green above, drying light gray above, persisting about 3 years; stellate hairs of lower leaf surface few, with 4-8 arms; apex acute or acuminate, often mucronate; base rounded to obtuse; petiole 3-10 mm long; midvein flat to slightly raised above, prominent below; lateral veins 10-15 pairs, ascending, indistinct or faint above, faint to moderately strong below; secondary venation indistinct; blade coriaceous; margin slightly revolute, usually entire but sometimes with 1 to several attenuate, spinose, mostly ascending teeth. STAMENS ca. 7-9. ACORNS 2-2.5 cm long; cap usually saucer-shaped, slightly thickened and woody, 5-7 mm long, 14-18 mm wide, often with yellow glandular hairs without, densely covered with stiff, straight hairs within; scales with thickened bases; nut-shell subglabrous except for patches of tomentum within. [*Q. wilcoxii* Rydb.]. --In riparian and conifer forests, and in exposed rocky areas: Cochise, Coconino, Gila, Graham, Greenlee, Mohave, Pima, and Yavapai cos.; 1050-2350 m (3500-7800 ft); May (fr. Aug-Sep); CA, OR, to nw Mex.

Quercus emoryi Torr. (for W. H. Emory). Emory Oak. --In AZ a tree to ca. 10 m high, the bark dark blackish-gray; young twigs usually densely woolly during first year, dark reddish-brown beneath hairs, the older twigs glabrescent, gray, remaining smooth. LEAVES unlobed, lanceolate, elliptic, oblanceolate, or oblong-lanceolate, 2-6 cm long, 1-2.3 cm wide, 1.8-3 times as long as wide, woolly when young, subglabrous at maturity except for a tuft of tomentum at the base of the blade below, persisting about 1 year, deciduous in spring; apex acute; base cordate to rounded, oblique, or subtruncate; petiole 3-7 mm long, woolly; midvein straight to sinuate, longitudinally striate, nearly flat to raised above, prominent below; lateral veins ca. 6-9 pairs, faint to moderately prominent; secondary veins very weak to indistinct; blade coriaceous, shiny green on both surfaces; margin entire or more commonly sinuate with 1-3(-7) small, spinosely tipped teeth. STAMENS ca. 4. ACORNS 1.5-1.8 cm long; cap 5-6 mm long, 7-8 mm wide, woolly within; scales of cap papery, not much thickened basally; nut-shell woolly within. --Chaparral, pinyon-juniper, oak-woodlands: Cochise, Coconino, Gila, Graham, Greenlee, Pima, Pinal, Santa Cruz, and Yavapai cos.; 1000-2100 m (3400-7000 ft); Apr-May (fr. Aug-Oct); NM, TX; n Mex.

Quercus gambelii Nutt. (for W. Gambel). Gambel Oak. --In AZ a tree to ca. 12 m high, the bark light gray, with longitudinal fissures between plates; young twigs thinly grayish pubescent, dark reddish

brown, the older twigs glabrescent, light brown or gray. LEAVES lobed, elliptic in outline, 4-17 cm long, 3-12 cm wide, 1.2-1.9 times as long as wide, thinly pubescent below (especially along the veins), thinly pubescent to subglabrous above, deciduous at end of first summer, the lobes 2-4(-6) per side (sometimes lobed themselves), the sinuses between lobes reaching about 30 to 90% of the way to the midvein; stellate hairs of lower leaf surface with 2-4(-5) arms; apex obtuse to rounded; base cuneate to attenuate; petiole 0.3-2 cm long, pubescent to subglabrous; midvein nearly flat or raised above, prominent below; lateral veins up to ca. 8 pairs, nearly flat above, raised below; secondary veins clearly visible and flat above, somewhat raised below; blade subcoriaceous, lustrous or dull above, drying dark yellow-green or olive green, somewhat darker above than below; margin aside from lobes entire, flat. STAMENS 5-7. ACORNS 1.8-2.7 cm long, solitary or clustered in 2's and 3's; cap nearly hemispheric, 8-12 mm long, 15-18 mm wide, the inner surface densely appressed pubescent, the hairs about straight; scales with thickened bases; nut-shell thinly pubescent (more densely so apically) to subglabrous within. [*Q. submollis* Rydb.]. --In forests, usually associated with ponderosa pine: Apache, Cochise, Coconino, Gila, Graham, Greenlee, Mohave, Navajo, Pima, and Yavapai cos.; 1200-2900 m (3900-9700 ft); Apr-Jun (fr. Aug-Oct); CO, NM, s NV, w TX, UT, s WY; n Mex. *Quercus gambelii* hybridizes with *Q. grisea*, *Q. turbinella*, and perhaps with *Q. havardii*. These hybrid populations comprise a complex for which Tucker (1961, 1963, 1970) and Tucker *et al.* (1963) used a single name, "*Q. undulata*." Some hybrids have been described as species [*Q. fendleri* Liebm., *Q. pauciloba* Rydb., *Q. subobtusifolia* Camus, *Q. undulata* Torr.]. Hybrids of *Q. gambelii* and *Q. grisea* or *Q. turbinella* can be very similar to *Q. havardii* or *Q. pungens*, their identity being ascertained with certainty only with population samples.

***Quercus grisea* Liebm. (gray).** Gray or Arizona Oak. --In AZ a tree to 8 m high, the bark light grayish, furrowed; young twigs densely yellowish woolly, the older twigs losing most hairs within a year, becoming gray, remaining more or less smooth. LEAVES unlobed, oblong, elliptic-oblong, oblanceolate, or lanceolate, or less often ovate, mostly widest centrally or above, 2.4-10.4 cm long, 1-4 cm wide, 2-3.4 times as long as wide, densely to sparsely covered with stellate and sometimes glandular hairs below, sparsely pubescent to glabrous above, persisting about one year, deciduous in spring or summer; stellate hairs of lower leaf surface with 4-9(-11) spreading, somewhat curled arms; apex obtuse to acute; base cordate to obtuse; petiole 3-10 mm long, woolly; midvein slightly raised to nearly flat above, prominent below; lateral veins prominent below, scarcely distinguishable from secondary veins above; secondary veins forming a reticulate pattern, somewhat raised below; blade coriaceous, dull or slightly lustrous above; margin entire or shallowly toothed, often slightly revolute, the teeth asymmetrical, apically directed. STAMENS 4-6. ACORNS to ca. 2 cm long, solitary or in clusters of 2 or 3 on peduncles 0-2 cm long; cap nearly hemispheric, 6-11 mm long, 10-16 mm wide, shortly woolly within; scales with thickened bases; nut-shell subglabrous within except for pubescent tip. [*Q. arizonica* Sarg.]. --In riparian and pine forests: Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Navajo, Pima, Pinal, Santa Cruz and Yavapai cos.; 1050-2200 m (3500-7200 ft); Apr-Jun (fr. Sep-Nov); NM, TX; n Mex. *Quercus grisea* hybridizes with *Q. gambelii*, *Q. turbinella* and *Q. toumeyi*. Traditionally the complex here recognized as *Q. grisea* has been divided into two species: *Q. grisea* with smaller, elliptic to ovate leaves, with the veins less prominent below, tending to grow in drier habitats; and *Q. arizonica* with larger, oblong to oblanceolate leaves, with the veins more prominent below, tending to grow in wetter habitats. In AZ the intermediates between these extremes are as common as the extremes themselves. *Q. grisea* appears to be a genetically variable complex, local conditions determining what leaf forms are present in a population.

***Quercus havardii* Rydb. (for V. Havard).** Shin Oak. --In AZ typically a cloning shrub (rarely a tree) 0.5-2(-5) m high, forming patches of a few to numerous stems in sandy soils, the bark light gray, fissured; young twigs densely to moderately tawny woolly, the older twigs glabrescent within about 2 years, light chalky gray or less often reddish-brown. LEAVES lobed, elliptic to obovate, 2.5-7.5 cm long, 1.2-5.5 cm wide, 1.3-2.8 times as long as wide, densely woolly below, moderately woolly above, persisting from spring to autumn, the lobes 3-6 per side, the sinuses reaching to ca. 50% of the way to the midvein; stellate hairs of lower leaf surface with 8-13 arms; apex acute, obtuse, or truncate; base acute to subcordate, sometimes

oblique; petiole 2-10 mm long, densely woolly; midvein raised to nearly flat above, prominent below; lateral veins nearly flat above, raised below; secondary veins forming a reticulate pattern, obscured by hairs below; blade leathery, usually dull above; margin aside from lobes entire or coarsely toothed, nearly flat to strongly undulate, the apices of the lobes and teeth often weakly spinescent. STAMENS ca. 8. ACORNS 1.5-3 cm long, solitary or in pairs; cap hemispheric to plate-like, 5-15 mm long, 12-25 mm wide, the inner surface densely woolly; scales with thickened bases; nut-shell glabrous to subglabrous within. --Pinyon-juniper or blackbrush scrub in light, sandy soils that tend to form dunes around the bases of clones of this species. The dunes become as high as 2 m and the shrubs protrude another 0.5 or 2 m above them: ne Coconino, and n Navajo cos.; 1600-2050 m (5200-6800 ft); (fr. Jul-Aug); sw NM, w TX, se UT. In habit, and in leaf undulation, *Q. havardii* is very similar to *Q. pungens*. Tucker (1970) hypothesizes that populations of *Q. havardii* in AZ and UT are introgressed with *Q. gambelii*, and includes them in the *Q. undulata* complex of hybrids.

Quercus hypoleucoides A. Camus (similar to *hypoleuca*, which means white below). Silverleaf Oak. --In AZ a tree to 10 m high, the bark dark blackish-gray; young twigs woolly, dark reddish-brown beneath hairs, becoming glabrous with age, the older twigs gray, more or less smooth. LEAVES unlobed, lanceolate to elliptic, 4-11 cm long, 0.8-3 cm wide, 3-5 times as long as wide, densely whitish woolly with stellate hairs beneath, glabrous or subglabrous above, persisting more than 1 year; stellate hairs of lower leaf surface with 10 or more arms; apex acute to acuminate, often mucronate; base acute to obtuse, sometimes oblique; petiole 3-11 mm long, woolly, later glabrescent; midvein raised above, prominent below; lateral veins ca. 9-15, impressed slightly above, prominent below; secondary venation impressed, often obscured by hairs below; blade coriaceous, dark green above, whitish (because of hairs) below; margin entire or less often serrate-dentate. STAMENS 4-6. ACORNS 1.5-2 cm long, maturing after second summer; cap ca. 8 mm long, ca. 12 mm wide, woolly within and without; scales not much thickened basally; nut-shell woolly within. [*Q. hypoleuca* Engelm.]. --In oak and conifer forests: Cochise, Graham, Greenlee, Pima, and Santa Cruz cos.; 1100-2700 m (3600-9000 ft); Apr-Jun (young fruits present at any time, mature fruits Aug-Nov); s NM, w Tex; n Mex.

Quercus oblongifolia Torr. (with oblong leaf). Mexican Blue Oak. --In AZ a tree to 4-8 m high, the bark light gray, deeply furrowed; young twigs subglabrous to glabrous, gray to reddish brown, the epidermis sometimes falling in thin flakes, the older twigs usually becoming slightly roughened, lightish gray but sometimes blackened. LEAVES unlobed, oval to oblong, 2-10 cm long, 1-2.7 cm wide, 1.5-4 times as long as wide, woolly when very young, glabrescent at maturity, persisting about 1 year, deciduous in spring; apex broadly obtuse to slightly emarginate; base rounded to cordate, often oblique; petiole ca. 2-4 mm long, often waxy, often reddish; midvein nearly flat or raised above, prominent below; lateral veins ca. 7-10 pairs, flat to slightly raised above, weak to moderately prominent below; secondary veins forming a reticulate pattern, visible above and below; blade coriaceous, blue-green to gray-green, nearly concolorous; margin usually entire, less often slightly sinuate. STAMENS ca. 3-5. ACORNS 1-1.5 cm long; cap ca. 7 mm long, 10-15 mm across, woolly within; scales with thickened bases; nut-shell glabrous to thinly pubescent apically within. --In oak woodlands or scattered in grasslands: Cochise, Graham, Pima, and Santa Cruz cos.; 850-1800 m (2800-6000 ft); Apr-May (fr. Oct-Nov); s NM, w TX; n Mex.

Quercus palmeri Engelm. (for E. Palmer). Palmer or Dunn Oak. --In AZ a shrub 1-3 m high, the bark dark gray, with many scaly, narrow plates between fissures, the young growth often covered with orangeish glandular hairs; young twigs woolly to sparsely pubescent, the older twigs glabrescent, gray, often blackened, remaining more or less smooth. LEAVES unlobed, ovate to suborbicular, 1.5-4.5(-6.5) cm long, 1-4.4 cm wide, 0.9-1.8 times as long as wide, often covered with orangeish glandular hairs at first, later glabrescent, strongly glaucous below, lustrous dark green above, drying light gray-green above, persisting to 3 years; stellate hairs on lower leaf surface essentially none; apex acute to rounded, sharply mucronate; base truncate, subcordate to rounded; petiole 2-5 mm long, pubescent to glabrous; midvein prominent below, nearly flat or raised and faint above; lateral veins prominent below, faint to obscure above, about 3-6(-8)

pairs ascending to nearly perpendicular to midvein; secondary veins usually visible below, usually indistinct above; blade stiffly coriaceous, contorted to nearly flat; margin revolute or not, each side armed with about 3-9 sharply spinescent, radiating teeth. STAMENS 7-9. ACORNS subconical, 3-3.5 cm long; cap bowl to nearly plate shaped, 1-13 mm long, 15-30 mm wide, covered with orangeish glandular hairs without, densely woolly within, the hairs curly and matted, the margins of the cap usually flared, often irregular; scales on mature cap not clearly overlapping, the base blending in with cap; nut-shell densely woolly within. [*Q. dunnii* Kell.]. --Chaparral to pinyon-juniper: Coconino, Gila, Graham, Maricopa, Mohave, and Yavapai cos.; 750-1800 m (2500-6000 ft); Apr-Jul (fr. Aug-Oct); CA; Baja C., Mex.

***Quercus pungens* Liebm.** (sharply pointed). In AZ a shrub 1-2 m high, the bark light gray, somewhat flaky when older; young twigs densely woolly (rarely subglabrous), the older twigs glabrescent within about 2 years, purplish-gray to gray, more or less smooth. LEAVES lobed, elliptic to oblong, 1.5-5 cm long, 0.8-4 cm wide, 1.2-2.4 times as long as wide, densely woolly below, moderately covered with hairs above (rarely subglabrous), persisting about 1 year, the lobes 2-5 per side, the sinuses reaching 25-60% of the way to the midvein; stellate hairs of lower leaf surface with 8-20 arms; apex acute, obtuse, or truncate; base acute to subcordate; petiole 1-6 mm long, sparsely to densely woolly; midvein raised to nearly flat above, prominent below; lateral veins nearly flat above, raised below; secondary veins forming a reticulate pattern, usually obscured by hairs below; blade coriaceous, lustrous above (at least beneath hairs); margin undulate, with ca. 1 undulation per lobe and adjacent sinus, the lobe-apex shortly spinescent. STAMENS 3-4. ACORNS 1-1.5 cm long, solitary or in pairs; cap about hemispheric, ca. 5-8 mm long, 8-12 mm wide, inner surface densely appressed pubescent, the hairs about straight; scales with thickened bases; nut-shell subglabrous within. Chaparral, typically on limestone hills: Cochise and Pima Cos.; 1050-1650 m (3400-5500 ft); Apr (fr. Sep-Oct); NM, TX; n Mex.

***Quercus rugosa* Née** (wrinkled). Net-leaf Oak. --In AZ a tree to 10 m high, the bark light gray, relatively thin, with many longitudinal fissures between narrow plates; young twigs densely yellowish woolly to scarcely pubescent, reddish-brown with lighter lenticels beneath the hairs, the older twigs glabrescent within about 2 years, becoming grayish, remaining more or less smooth. LEAVES unlobed, obovate, oblanceolate, or less often elliptic, 2-10 cm long, 1.5-7 cm wide, 1.3-2.5 times as long as wide, densely to scarcely covered with stellate and glandular hairs beneath, persisting about 1 year; stellate hairs of lower leaf surface with 6-11 arms; apex rounded to acute; base cordate to obtuse; petiole 2-5 mm long, usually densely woolly, less often subglabrous; midvein impressed (although often convex) above, prominent below; lateral veins 6-10 pairs, impressed and distinct above, prominent below; secondary veins impressed slightly or flat above, raised below; blade coriaceous, slightly lustrous or dull above, often golden yellow below because of glandular hairs, often concave beneath; margin slightly to strongly revolute, with 3-9, somewhat mucronate teeth. STAMENS 3-6. ACORNS 1.5-2 cm long, usually 2-4 on peduncles 1.5-6.3 cm long; cap hemispheric to deep-bowl shaped, 4-10 mm long, 10-16 mm wide, finely appressed yellowish or reddish pubescent to woolly within; scales with thickened bases; nut-shell subglabrous within or with pubescent apex and base. [*Q. diversicolor* Trel., *Q. reticulata* Humb. & Bonpl.]. --In oak and conifer forests: Cochise, Graham, Greenlee, Pima, and Santa Cruz cos.; 1500-2700 m (5000-9000 ft); Apr-Jun (fr. Sep); NM to c Mex.

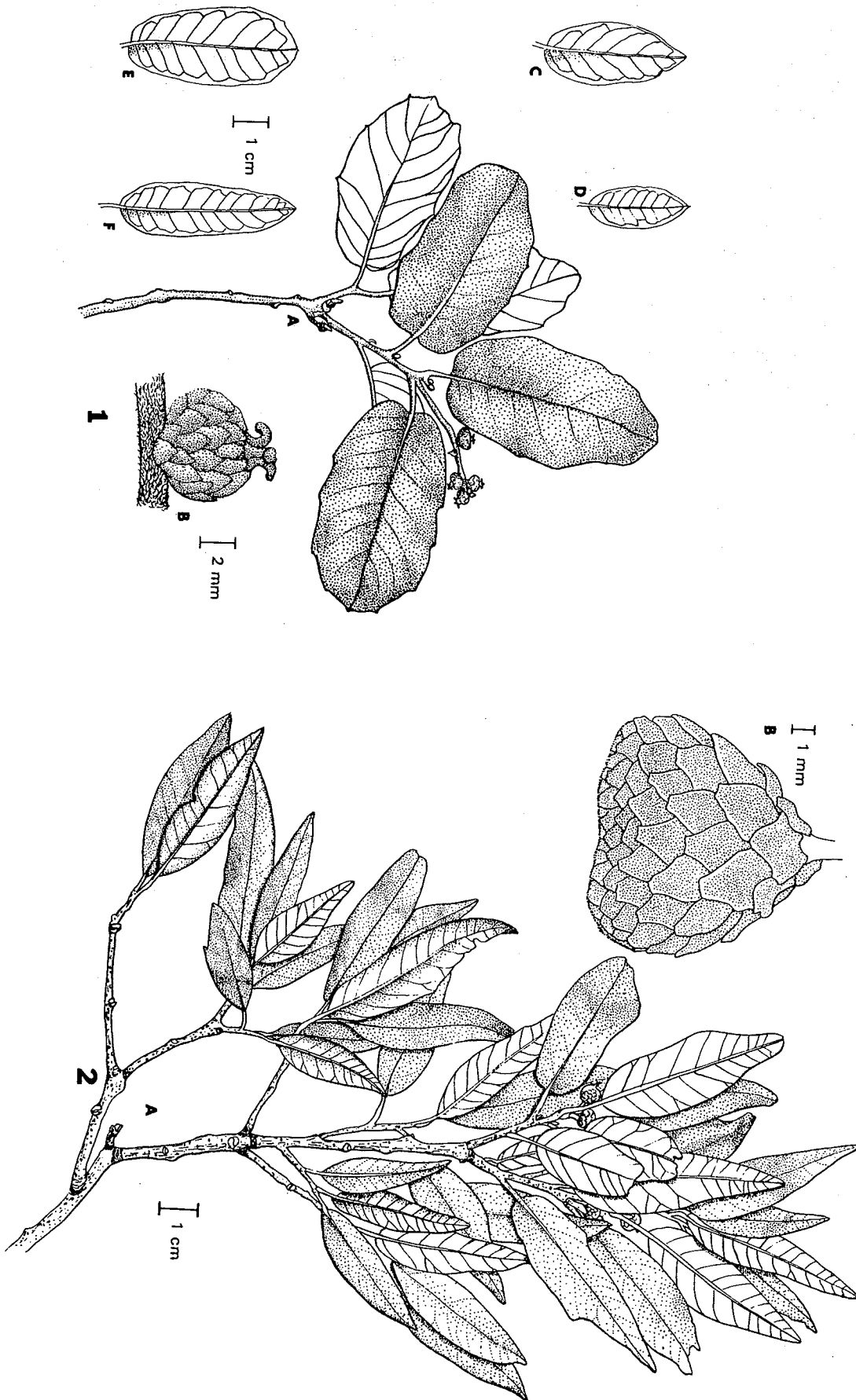
***Quercus toumeyii* Sarg.** (for J. T. Toumey). Toumey Oak. --In AZ a shrub or small tree to ca. 3 m high, the bark rough, furrowed, light gray; young twigs densely to moderately covered with hairs, soon losing some or all pubescence, smooth reddish-brown beneath pubescence, the older twigs gray, becoming rough and sometimes blackened. LEAVES unlobed, oblong-lanceolate, oblong-oblanceolate, or elliptic, 1-4 cm long, 0.4-1.4 cm wide, 1.9-3.3 times as long as wide, glabrous above, sparsely to densely covered with glandular hairs below, usually sparsely covered with stellate hairs below, persisting about 1 year, deciduous in spring or summer; stellate hairs of lower leaf surface with 4-14 arms; apex acute, obtuse, or acuminate, the tip generally mucronate; base truncate, cordate, rounded, or acute; petiole 1-3 mm long, moderately to densely woolly, often reddish; midvein nearly flat above, prominent below; lateral veins 4-7 pairs, scarcely

distinguishable from secondary venation above, faint below; secondary veins forming a reticulate pattern with laterals above and below; blade stiffly coriaceous, lustrous above, dull below; margin entire or with 1 to a few shortly spinose teeth. STAMENS 4-6. ACORNS 1-1.5 cm long; cap ca. 5-7 mm long, woolly within; scales with thickened bases; nut-shell glabrous within except for a puberulent apex. --In chaparral and oak forests, often with *Q. grisea*: Cochise and Santa Cruz cos.; 1200-2000 m (3900-6600 ft); Apr-May (fr. Aug); NM; n Mex. Hybridizes sometimes with *Q. grisea*.

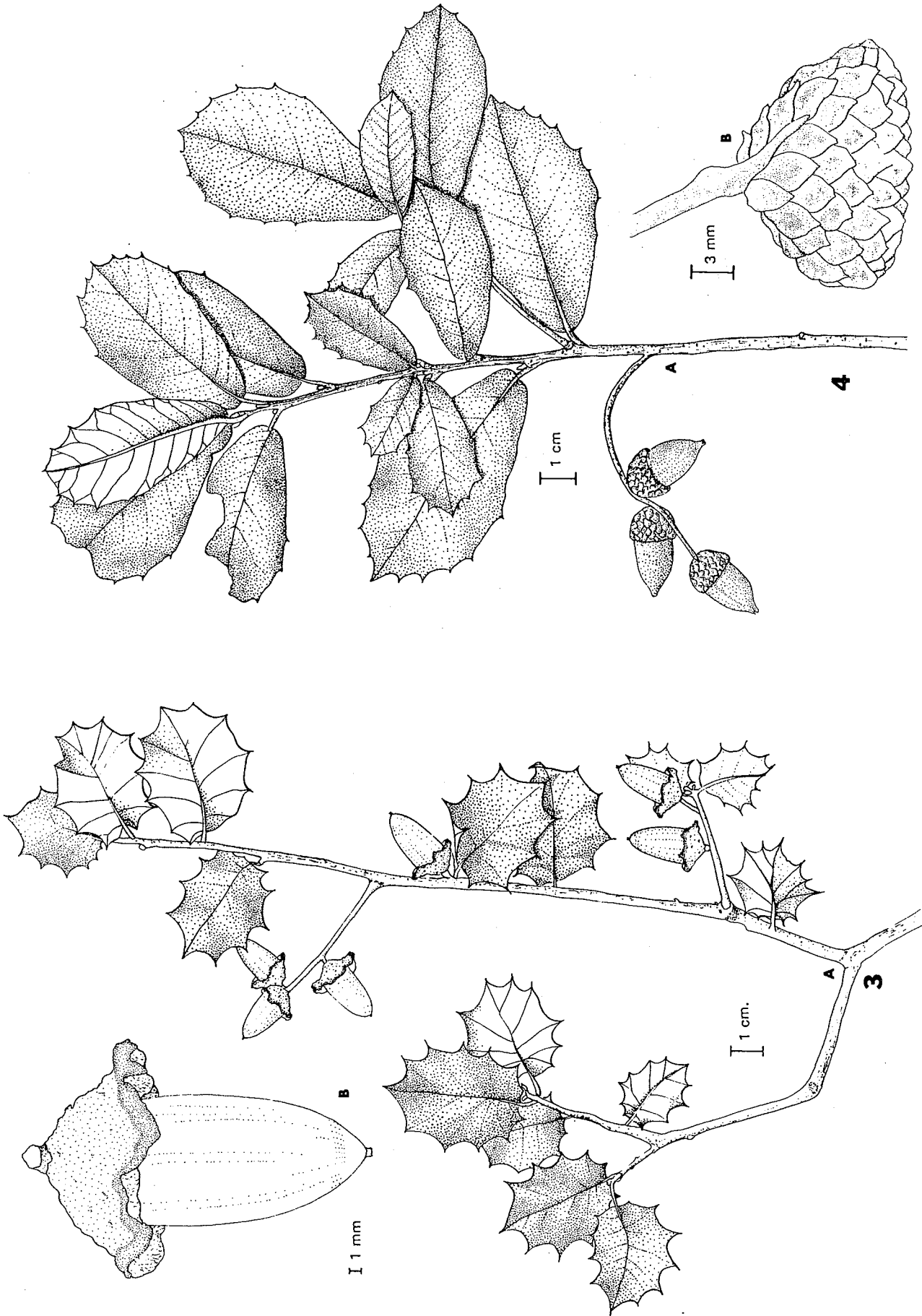
Quercus turbinella Greene (small top-shaped). Scrub Oak. --In AZ a shrub or small contorted tree 1-3(-6) m high, the bark light gray, rough, fissured; young twigs densely woolly (rarely glabrous) when young, smooth reddish-brown beneath hairs, the older twigs glabrescent, gray, sometimes blackened, remaining more or less smooth. LEAVES unlobed, oblong-elliptic, ovate to suborbicular, 1.3-5.5(-6.5) cm long, 0.8-3(-4.5) cm wide, 1.3-2 times as long as wide, densely to sparsely covered with stellate and glandular hairs to glabrous below, moderately to sparsely covered with hairs to glabrous above, glabrescent with age, persisting 1-2 years; stellate hairs of lower leaf surface sometimes nearly scale-like, flattish, most with 7-13 arms; apex acute with sharp mucronate tip; base truncate to rounded; petiole 1-5 mm long, yellowish or reddish, moderately to densely covered with hairs; midvein nearly flat above, prominent below; lateral veins about 4-9 pairs, usually faint above, moderately prominent below; secondary veins forming a reticulate pattern above and below; blade usually bluish-green, coriaceous, more or less flat, dull or slightly lustrous above; margin with 1-8 sharply pointed, spinose teeth per side (rarely entire). STAMENS 4-6(-7). ACORNS 1.2-2.5 cm long, the peduncle 0-4 cm long; cap hemispheric, 5-8 mm long, 10-13 mm across, short woolly within; scales with thickened bases; nut-shell sparsely pilose within. [*Q. ajoensis* C. H. Müll., *Q. subturbinella* Trel.]. --In chaparral, pinyon-juniper, and transitions between these and grasslands or desert: probably in all counties but most abundant in c AZ; 600-2300 m (2000-7600 ft); Mar-Jun (fr. Jul-Sep) s CA, NM, w TX, s UT; n Mex. Hybridizes with *Q. grisea* and *Q. gambelii*. *Quercus turbinella* and *Q. grisea* sometimes intergrade; a useful difference can sometimes be seen in the stellate hairs of the lower leaf surface, starfish-like with radiating arms in *Q. turbinella* and more squid-like with ascending arms in *Q. grisea*.

ACKNOWLEDGMENTS

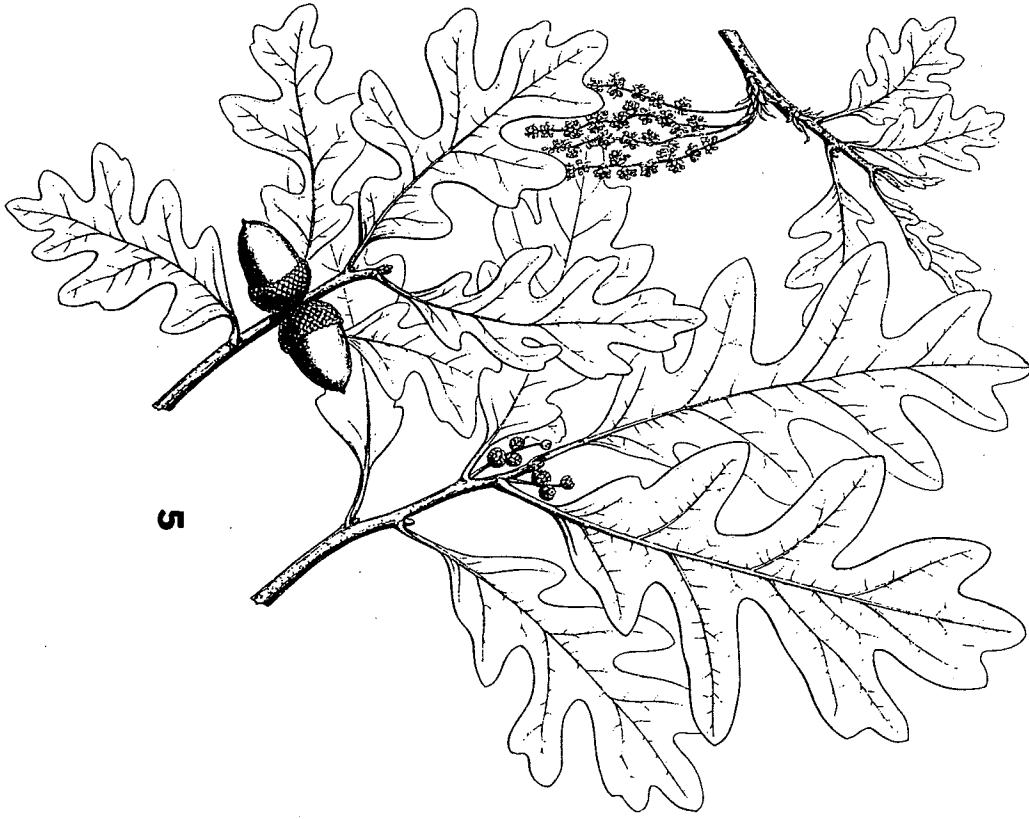
I am very grateful to R. Rubio for drawing the species illustrated in Figures 1 to 4. I thank the curators of the following herbaria for kindly allowing me to utilize their specimens: ARIZ, ASU, ASC, DES, GH, MNA, MO, and NY.



Fagaceae Figure 1. *Quercus grisea*. A, habit; and B, immature acorn (Landrum 610). Leaves: C (Landrum 659); D (Landrum 7168); E (Landrum 7185); F (Landrum 7223). Fagaceae Figure 2. *Quercus hypoleucoides*. A, habit; collected in early May with immature acorns from previous year (Landrum 6018). B, acorn cup (Landrum 7376). Figures 1 and 2 drawn by R. Rubio.



Fagaceae Figure 3. *Quercus palmeri*. A, habit (Landrum 6166 & Mishler 1077). B, acorn (Landrum 6168). Fagaceae Figure 4. *Quercus rugosa*. A, habit (Leithliter 437). B, acorn cup with scales with thickened bases (Wentworth 2636). Figures 3 and 4 drawn by R. Rubio.

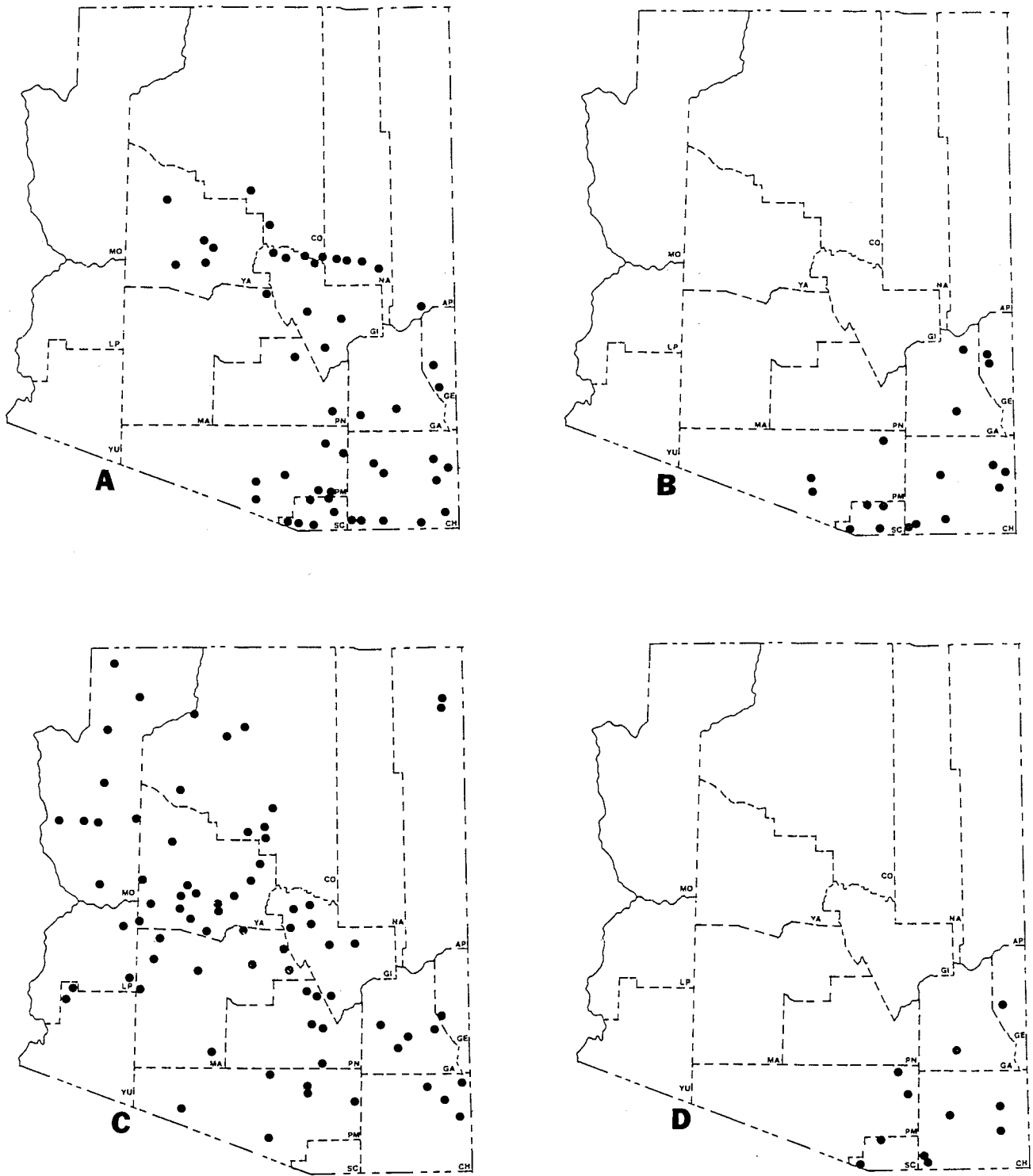


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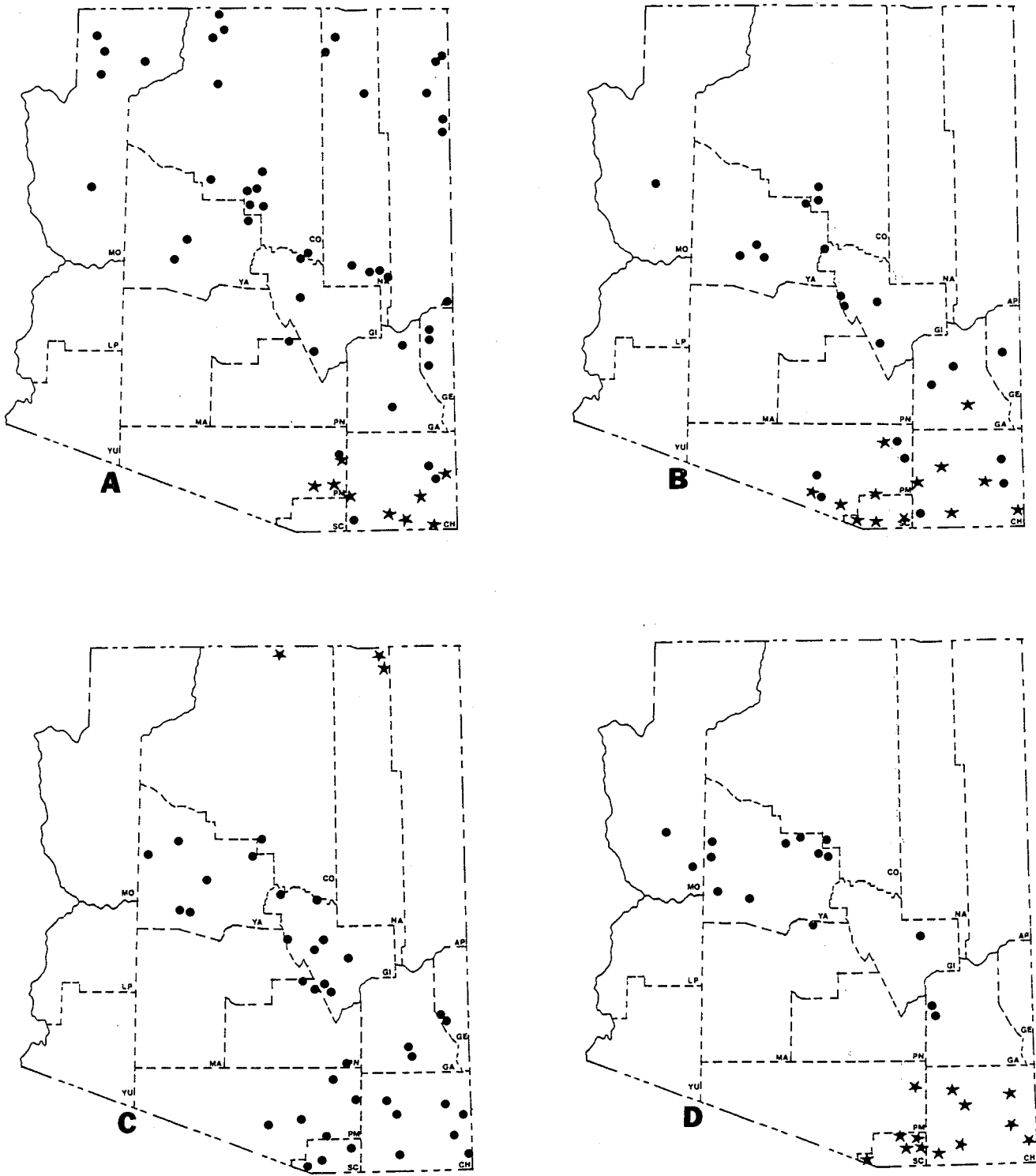


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Fagaceae Figure 5. *Quercus gambelii*. Fagaceae Figure 6. *Quercus oblongifolia*. Figures 5 and 6 reproduced from Sargent (1890-1902), *Silva of North America*.



Fagaceae Figure 7. Distribution of: A, *Quercus grisea*; B, *Q. hypoleucoides*; C, *Q. turbinella* and D, *Q. rugosa*.



Fagaceae Figure 8. Distribution of: A, *Quercus gambelii* (dots) and *Q. pungens* (stars); B, *Q. chrysolepis* (dots) and *Q. oblongifolia* (stars); C, *Q. emoryi* (dots) and *Q. havardii* (stars); D, *Q. palmeri* (dots) and *Q. toumeyii* (stars).