

POTAMOGETONACEAE PONDWEED FAMILY

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Aquatic submerged and floating perennials, rarely annual herbs, caulescent, rhizomatous or not, the stems terete or flattened; turions (vegetative propagules) present or absent. LEAVES alternate or rarely opposite, submerged or submerged and floating, rarely erect, sessile or petiolate; sheathing stipules free or adnate to the petioles. INFLORESCENCES terminal or axillary, spikes or panicles of spikes, pedunculate, the peduncle not elongating or spiraling after fertilization [as in Ruppiaceae]. FLOWERS bisexual, sessile; floral bracts absent; tepals 4 in 1 series, free, claw-like, the apex rounded; stamens (2–)4, in 1 series, epipetalous; anthers sessile, distinct, 2-loculed; pollen spherical; pistils (1–)4, sessile, distinct, rarely short stipulate, 1-locular; ovule 1; style sessile or short, erect or curved, persistent. FRUITS drupaceous, sessile, 1-seeded, indehiscent, embryo curved. —3 genera, ca. 90 spp.; nearly worldwide. Reveal, J. 1977. *Intermountain Flora* 6: 24–42; Haynes, R. R. and C. B. Hellquist. 2000. *Flora of North America*. 22: 47–74.

Many of the species of both *Potamogeton* and *Stuckenia* are known to be highly polymorphic and difficult to distinguish. The known species in Arizona are among the most common and polymorphic of these genera. Under ideal conditions, these species can easily be identified and the keys provided are meant to aid in identifying our material under these conditions. Sterile and less-than-ideal collections can be extremely difficult to determine and are often left to individual interpretation. Aquatic habitats provide their own unique issues, both in the physical collection and the quality of material needed for identification. Under the best conditions, early in the season, the plant material may be green and healthy and show all the characteristics described below. However, as the season wears on, such things as grazing, water level, and desiccation significantly affect the quality of the plants. The combination of collecting representative vegetative material and mature fruits, especially in broad leafy species, can be challenging. At higher elevations, fruits generally mature mid-to-late summer or early fall, often after vegetative material has weathered.

The similar and closely allied families Ruppiaceae (Ricketson 2018a) and Zannichelliaceae (Ricketson 2018b) should be consulted when identifying aquatic plants of Arizona.

Species of Potamogetonaceae are known to hybridize freely, and hybrids are generally sterile, making it nearly impossible to identify them positively. If sterile collections are made that are suspected of being hybrids, special care should be taken to collect both the parent material and the suspect hybrid material from the location. It should be noted that no known hybrids have been collected from Arizona.

Virtually all these populations of Potamogetonaceae and other aquatic plants are established by migrating waterfowl. They may appear or disappear depending on weather conditions, especially the frequency and length of dry conditions. Long-term monitoring of aquatic habitats, such as those reported below under each taxon, should prove interesting.

All illustrations (Figs. 1–4) are original and prepared by the author.

1. Submerged leaves with stipules free from the rest of the leaf, or adnate for less than $\frac{1}{2}$ the length of the stipule; leaf blade or petiole directly attached to the node of the stem; leaves all submerged or both submerged and floating; blades of submerged leaves translucent, not channeled, flattened *Potamogeton*

1' Submerged leaves with stipules adnate to the base of the leaf and forming a sheath around the stem for $\frac{2}{3}$ or more of the length of stipule; leaf blade or petiole not directly attached at the node of the stem; leaves all submerged; blades opaque, channeled, inflated..... *Stuckenia*

Potamogeton L. Pondweed

STEMS terete or compressed, with rhizomes present or absent, with turions present or absent. LEAVES submerged or both submerged and floating, alternate or rarely appearing opposite; submerged leaves sessile or petiolate, translucent, linear to orbiculate, 1–35-veined, not channeled, flattened; apex subulate to obtuse; base sessile or acute; margins entire to serrate, rarely crispate; stipules usually tubular and connate, if not, then rolled, free from the leaf base or adnate to the base for less than $\frac{1}{2}$ the length of the stipule and freely ligulate to the apex; floating leaves petiolate, rarely sessile. INFLORESCENCES submerged or emergent, spikes or panicles of spikes, capitate or cylindrical; peduncles usually erect, inflorescence extended above the water surface. FLOWERS with 1 to 4 pistils. FRUITS dorsally keeled or rounded, beaked, compressed to inflated; embryo coiled 1 or more times. $x = 13$ or 14 . —ca. 100 spp., nearly worldwide. (Greek: *potamos* = river + *geiton* = neighbor). Reveal, J. 1977. Intermountain Flora vol. 6: 24–42; Haynes, R. R. and C. B. Hellquist. 2000. Flora of North America. 22: 48–70.

1. Leaves all of the same basic shape and form, all or nearly all submerged.
 2. Submerged leaf margins finely serrulate; fruit with curved beak 2–3 mm long *P. crispus*
 - 2' Submerged leaf margins entire (or nearly so); fruit with erect to slightly recurved beak less than 2 mm long.
 3. Submerged leaves narrowly linear or nearly so, less than 5 mm wide.
 4. Peduncles stout, usually recurved, 0.3–3.7 cm long; spikes congested, 1.5–7 mm long; leaves without basal glands; fruits with dorsal keel undulate, winglike, the beak 0.2–0.6 mm long *P. foliosus*
 - 4' Peduncles slender, erect, rarely recurved 0.5–6.6 cm long, spikes more open, capitate to cylindric, 1.5–10.1 cm long; leaves often with 2 basal glands at the nodes; fruit with a smooth dorsal keel, the beak 0.3–0.8 mm long *P. pusillus*
 - 3' Submerged leaves more broadly linear to greatly elongated or ovate, over 5 mm wide.
 5. Submerged leaves sessile, clasping the stem *P. richardsonii*
 - 5' Submerged leaves petiolate or tapering to a sessile base, not strongly clasping the stem *P. montezumawellensis*
- 1' Leaves dimorphic, the floating leaves usually broad, the submerged leaves narrower and usually elongated.
 6. Floating leaf blades obovate to elliptic, 0.8–1.6 cm long, 3–8.5 mm wide; submerged leaves narrowly linear, 1–1.3 cm long, 0.1–1.5 mm wide; fruits 1–1.5 mm long *P. diversifolius*
 - 6' Floating leaf blades lenticular to linear-lanceolate to ovate to broadly elliptic to ovate, longer than 3 cm; submerged leaves linear to ovate, 3.1–20 cm long, 0.7–35 mm wide; fruits 1.9–5 mm long.
 7. Submerged leaves sessile, ridged, 0.7–2.5 mm wide, narrowly linear; floating leaves ovate to broadly elliptic, 1.5–6 cm wide; fruits 3.5–5 mm long *P. natans*
 - 7' Submerged leaves petiolate, rarely sessile, lax, 3–35 mm wide, linear-lanceolate to lanceolate-elliptic to elliptic; floating leaves ovate to lanceolate to elliptic, 1.5–4.5 cm wide; fruits 1.9–4.3 mm long.
 8. Submerged leaves on petioles 2–10(–13) cm long; floating leaves lenticular to elliptic, 3–11 cm long, 1.5–4.5 cm wide, petioles 3.5–26 cm long; fruits 2.7–4.3 mm long, reddish..... *P. nodosus*
 - 8' Submerged leaves sessile or on petioles up to 3 cm long; floating leaves narrowly to broadly elliptic or oblong-elliptic, 3.5–4 cm long, 1.6–2 cm wide, petioles 3–4.5 cm long; fruits 1.9–2.3 mm long, greenish..... *P. gramineus*

Potamogeton crispus L. (crisped, irregularly waved and twisted, kinky, curled). Curled Pondweed. —STEMS rhizomes absent; turions present; primary portion of stems flattened, to 100 cm tall, stout, and freely branching above. LEAVES all submerged; blades linear-oblong to linear-oblongate, 1.2–9 cm long, 4–10 mm wide, the veins 3 to 5, the apex rounded to rounded-acute, the base sessile, obtuse to rounded, rarely appearing nearly auriculate, the margins serrate, usually undulate, not crispate; stipules persistent, fraying early, to 5 mm long, not ligulate. INFLORESCENCES unbranched, emergent, terminal, rarely axillary; spikes, cylindric, 1–1.5 cm long, with few flowers in 3 to 5 whorls; peduncle 2.5–4 cm long. FLOWERS sessile or nearly so; perianth lobes orbicular, 1.2–2 mm wide. FRUITS sessile, ovate to obovoid, 5–6 mm long, 2–2.5 mm wide, inflated to slightly concave, the dorsal keel prominent, entire or slightly denticulate, the two lateral keels low and rounded to somewhat obscure, the beak stout, erect to slightly recurved, 2–3 mm long; embryo with 1 full coil. $2n = 52$. —Lakes, ponds, creeks, and rivers: Cochise, Coconino, Santa Cruz, Yavapai, Yuma cos.; 50–1,600 m (200–5,300 ft.); spring to summer; throughout most of N. Amer., C. Amer., S. Amer., Eurasia and Australia. Figs. 1A–C, 5A.

An easy species to recognize, with serrate leaf margins and fruits with an erect beak much longer than any of our other species. Introduced in the Americas. In Arizona, *P. crispus* has continued to spread and should be expected in other counties.

Potamogeton diversifolius Raf. (with leaves of different shapes on the same individual). Water-thread Pondweed. —STEMS rhizomes present; turions absent; primary portion of stems compressed, 10–35 cm tall, slender and freely branched. LEAVES dimorphic, submerged, and floating; submerged leaves sessile, lax; submerged leaf blades narrowly-linear, 1–1.3 cm long, 0.1–1.5 mm wide, 1-veined, the apex acute, the base slightly tapering, not clasping, the margins entire; floating leaves, when present, petiolate, the petioles 7–8 mm long; floating leaf blades obovate to elliptic, 0.8–1.6 cm long, 3–8.5 mm wide, the veins 3 to 7, the apex rounded to acute, the base acute, the margins entire; stipules persistent, fraying early, inconspicuous, 1.5–2.3 cm long, ligulate. INFLORESCENCES unbranched, submerged, and emergent; submerged inflorescences axillary, with peduncles 3–5 mm long; spikes capitate, 2–3 mm long, 1 to 6 flowers in 1 to 3 whorls; emergent inflorescences axillary or terminal, erect to slightly recurved above surface of water, with peduncles 6–15 mm long; spikes cylindric, 5–9.7 mm long, 4–8-flowered, 2–4-whorled. FLOWERS sessile; perianth lobes suborbicular to broadly rhombic, 0.7–1 mm wide. FRUITS sessile, orbicular, 1–1.5 mm long, 0.9–2 mm wide, compressed, the prominent dorsal keel sharp and undulate-dentate, the two lateral keels low and rounded, mostly entire, the beak erect, minute to 0.1 mm long; embryo with more than 1 coil. Chromosome number unknown. [*P. capillaceus* Poir.]—Lakes, ponds, tanks, and springs; Coconino, Navajo, Yavapai cos.; 700–2,450 m (2,200–8,000 ft.); summer-fall; throughout most of N. Amer. and Mex. Figs. 2A–C, 5B.

In Arizona, *Potamogeton diversifolius* is best recognized by its dimorphic leaves, smaller floating leaves (compared to other species with floating leaves), and narrowly linear submerged leaves (similar to those of *P. foliosus* and *P. pusillus*); fruit usually has a prominent dorsal keel that is sharp and undulate-dentate (similar to *P. foliosus*).

Potamogeton foliosus Raf. (leafy). Leafy Pondweed. —STEMS rhizomes absent; turions uncommon; primary portion of stems terete to slightly compressed, 4–75 cm tall, filiform, mostly unbranched below, freely branched above. LEAVES all submerged; without basal glands at the nodes; blades narrowly linear, 1.3–8.2 cm long, 0.3–2.3 mm wide, the veins 1 to

5, the apex acute to apiculate, rarely with a bristle, the base sessile, tapering, not clasping, the margins entire; stipules persistent, fraying early, to 2–22 mm long, not ligulate. INFLORESCENCES unbranched, emergent, axillary; spikes congested, capitate to cylindrical, 1.5–7 mm long; flowers few in 3 to 5 whorls; peduncles stout, usually recurved, 0.3–3.7 cm long. FLOWERS sessile, perianth lobes flabellate, 0.6–1 mm wide. FRUITS sessile, obovate to nearly orbicular, 1.4–2.7 mm long, 1.1–2.2 mm wide, inflated to concave, the dorsal keel prominent, undulate-dentate, winglike, the two lateral keels obscure, the beak erect, 0.2–0.6 mm long; embryo with 1 coil. —2 subsp., N. Amer. and C. Amer.

Subsp. *foliosus*. —LEAVES with stipules greenish to brown, delicate, tending to disintegrate. INFLORESCENCES with spikes continuous, rarely interrupted. FRUITS olive-green to green-brown, 1.5–2.7 mm long, 1.2–2.2 mm wide, the dorsal keel 0.2 mm long or more, the beak 0.2–0.6 mm long. $2n = 28$. —Lakes, ponds, tanks, ditches, springs, creeks, and rivers; Apache, Cochise, Coconino, Gila, Graham, Greenlee, Mohave, Navajo, Pima, Santa Cruz, Yavapai cos.; 350–2,600 m (1,100–8,500 ft.); summer-fall; throughout most of N. Amer. and C. Amer. Figs. 2D–F, 5C.

In Arizona, *Potamogeton foliosus* subsp. *foliosus* is most easily confused with either of the subspecies of *P. pusillus* because they only have narrowly linear submerged leaves. This taxon is recognized by its capitate inflorescence on a short peduncle and the fruit with a dorsal keel that is prominently undulate-dentate. Although, *P. diversifolius* also has an undulate-dentate dorsal keeled fruit, the dimorphic leaves and shorter submerged leaves (1–1.3 cm long) easily separate it from *P. foliosus* subsp. *foliosus*.

Potamogeton gramineus L. (grass-like). —STEMS rhizomes present; turions absent; primary portion of stems terete to flattened, to 150 cm tall, slender, and freely branched, especially near the top. LEAVES dimorphic, submerged, and floating; submerged leaves lax, sessile, or rarely petiolate, the petioles to 3 cm long, the blades elliptic, 3.1–9.1 cm long, 3–27 mm wide, the veins 3 to 9, with apex acuminate, with base attenuate, not clasping, with margins entire, rarely crispate; floating leaves, when present, petiolate, the petioles 3–4.5 cm long, with leaf blades ovate to elliptic, 3.5–4 cm long, 1.6–2 cm wide, the veins 11 to 13, the apex acuminate, the base rounded, the margins entire; stipules persistent, fraying early, inconspicuous, 1.3–1.6 cm long, not ligulate. INFLORESCENCES unbranched, emergent, axillary and terminal, erect to ascending; spikes cylindric, 15–35 mm long, multi-flowered in 3 to 5 whorls; peduncle 3.2–7.7 cm long. FLOWERS sessile; perianth lobes orbicular, 2–3 mm wide. FRUITS sessile, greenish, ovoid, 1.9–2.3 mm long, 1.8–2 mm wide, laterally compressed, the dorsal keel sharp and prominent, the two lateral keels rounded and obscure, the beak erect, 0.3–0.5 mm long; embryo with less than 1 coil. $2n = 52$. [*P. gramineus* L. var. *maximus* Bennett]. —Lakes, ponds, tanks, and rivers; Apache, Coconino, Gila, Navajo, Yavapai cos.; 1,400–2,700 m (4,600–8,800 ft.); summer-fall; throughout N. Amer., Eurasia. Figs. 3A–B, 5D.

In Arizona, *Potamogeton gramineus* is a difficult species to separate. Superficially, it is similar to both *P. natans* and *P. nodosus* in having elliptic floating leaves. It tends to be a brighter green; the floating leaves are generally narrower with an acuminate apex, and the fruits are usually smaller than the other two species.

Potamogeton montezumawellensis Ricketson, G. Ricketson & Greenawalt, (from Montezuma Well). Montezuma Well Pondweed. —STEMS rhizomes present; turions absent; primary portion of stems terete, to 8 m tall (making this one of the tallest aquatic plants in the

world), stout, 3–6 mm in diam., simple below, with 1–5 branches above near apex; nodal glands absent. LEAVES all submerged, no true floating leaves present; submerged leaf blades bright translucent green to dark green, narrow-lanceolate to narrowly elliptic, 2.5–18 cm long, 4–19 mm wide, the veins 11 to 13, the apex long acuminate, the acumen 10–22 mm long, the base acute to decurrent on the petiole, the margins entire, but appearing crispate or denticulate with age; petioles 0.3–1.8 cm long; stipules green, persistent, conspicuous, convolute, free from the blade, 1.1–4 cm long, fibrous or shredding at the tip, the apex acute, the margins entire, not ligulate. INFLORESCENCES unbranched emergent, axillary and terminal, erect to ascending, 6–17.5 cm long; spikes cylindrical, 2.5–3.7 cm long, multi-flowered in 15 to 30 whorls; peduncle terete, 2.3–15 cm long. FLOWERS sessile or on short pedicels to 0.5 mm long, the perianth lobes green to reddish with age, claw-like to orbicular, 3-lobed, 2.7–3 mm long, 1.8–2 mm wide, the lobes rounded, the margins entire; stamens sessile, adnate to the perianth, 1.5–1.7 mm long, 1.2–1.8 mm wide, anthers yellowish-green, ovate, 1.3–1.5 mm long, 0.3–0.6 mm wide; pistil sessile, laterally compressed, 1.5–2 mm long, 0.8–1 mm wide, with hump on dorsal ridge, with stigma and style sessile, lateral. FRUITS (fully formed, but appearing sterile) sessile or on short pedicels, obovoid, 4–4.2 mm long, 2.8–3 mm wide, laterally compressed. 2–2.2 mm wide, the dorsal keel obscure with few projecting knobs, the two lateral keels absent to obscure, the beak erect to slightly recurved, 0.2–0.3 mm long; embryo $\frac{1}{2}$ to $\frac{3}{4}$ coiled. Chromosome number unknown. —Geothermal limnocrone spring; Yavapai Co.; 1,103 m (3,618 ft.), flowering and fruiting summer-fall; endemic to Montezuma Well. Figs. 1D–E, 6A (dot), 8E.

***Potamogeton natans* L.** (swimming, floating on or under the surface of water). Floating-leaf Pondweed. —STEMS rhizomes present; turions absent; primary portion of stems terete, 30–90 cm tall, slender, simple, or rarely branched. LEAVES dimorphic, submerged, and floating; submerged leaves sessile, rigid, with leaf blades narrowly linear, 9–20 cm long, 0.7–2.5 mm wide, the veins 1 to 5, the apex obtuse, the base tapering, not clasping, the margins entire, often crispate; floating leaves petiolate, the petioles 5.5–29 cm long; floating leaf blades ovate to broadly elliptic, 3.5–11 cm long, 1.5–6 cm wide, the veins 17 to 37, obscure, the apex acute to round, the base cordate, the margins entire; stipules persistent, fraying early, conspicuous, 4.5–1 mm long, not ligulate. INFLORESCENCES unbranched, emergent, terminal, erect to ascending; spikes cylindric, 25–50 mm long, with 8–15 multi-flowered whorls; peduncle 4.5–9.5 cm long. FLOWERS sessile or on short pedicels to 0.5 mm long; perianth lobes orbicular, 1.5–3 mm wide. FRUITS sessile, obovoid, 3.5–5 mm long, 2–3 mm wide, inflated, the dorsal keel prominently rounded, the two lateral keels less prominent, rounded; the beak erect to apically recurved, 0.4–0.8 mm long; embryo with 1 coil. $2n = 52$. —Lakes, ponds, pools, tanks, marshes, springs, and streams; Apache, Coconino, Greenlee, Navajo, Santa Cruz, Yavapai cos.; 1,700–2,750 m (5,600–9,100 ft.); summer-fall; throughout N. Amer., Eurasia. Figs. 3C–D, 6B.

In Arizona, *Potamogeton natans* is a difficult species to separate. Superficially, it is similar to both *P. gramineus* and *P. nodosus* in having elliptic floating leaves. In *P. natans*, the submerged leaves are usually sessile, rigid narrowly linear, 0.7–2.5 mm wide; the floating leaves usually turn reddish-brown earlier, and the bases are usually more cordate.

***Potamogeton nodosus* Poir.** (knotted, knobby). Long-leaf Pondweed. —STEMS rhizomes present; turions absent; primary portion of stem terete, to 100 cm tall, stout, and simple or branched at the top. LEAVES dimorphic, submerged and or floating; submerged

leaves petiolate, lax, the petioles 2–10(–13) cm long; submerged leaf blades linear-lanceolate to lanceolate-elliptic, 9–20 cm long, 10–35 mm wide, the veins 7 to 15, the apex acute, not sharply mucronate, the base acute, not clasping, the margins entire often crispate; floating leaves, when present, petiolate, the petioles 3.5–26 cm long, the blades lenticular to elliptic, 3–11 cm long, 1.5–4.5 cm wide, the veins 9 to 21, the apex acute to round, the base cuneate to rounded, the margins entire; stipules persistent, fraying early, conspicuous, not ligulate 3–9 cm long. INFLORESCENCES unbranched, emergent, terminal, erect to ascending; spikes cylindrical, 20–70 mm long, multi-flowered, in 10 to 17 whorls; peduncle 3–15 cm long. FLOWERS sessile; perianth lobes orbicular to elliptical, 1.4–2.6 mm wide. FRUITS sessile, reddish, obovoid, 2.7–4.3 mm long, 2.5–3 mm wide, the dorsal keel sharp and prominent, the two lateral keels rounded and less prominent, the beak erect to 1 mm long; embryo with 1 coil. $2n = 52$. —Lakes, ponds, tanks, springs, creeks, and rivers; Coconino, Gila, Graham, Maricopa, Santa Cruz, Yavapai cos.; 400–2,350 m (1,300–2,300 ft.); summer-fall; throughout N. Amer., Mex., C. Amer., W. Ind., S. Amer., Eurasia. Figs. 3E–F, 6C, 8A–B.

In Arizona, *Potamogeton nodosus* is a difficult species to separate. Superficially, it is similar to both *P. gramineus* and *P. natans* in having elliptic floating leaves. In *P. nodosus*, the submerged leaves are typically petiolate; the floating leaves usually turn reddish-brown early. The bases are cuneate to rounded, compared to cordate in *P. natans* and rounded in *P. gramineus*.

***Potamogeton pusillus* L.** (very small). Small-Leafed Pondweed. —STEMS rhizomes absent; turions present; primary portion of stems terete to slightly compressed, 19–150 cm tall, slender, usually much branched, more so above than below. LEAVES all submerged, often with two basal glands at the nodes; blades linear, 0.9–6.5 cm long, 0.2–2.5 mm wide, the veins 1 to 5, the apex subulate to acute, the base sessile, tapering, not clasping, the margins entire; stipules persistent, inconspicuous, 3.1–9.2 mm long, not ligulate. INFLORESCENCES unbranched, submerged or emergent, axillary or terminal, erect, rarely recurved; spikes capitate or cylindrical, 1.5–10.1 mm long, few-flowered, in 1–5 whorls, interrupted (with spaces between whorls) or not; peduncle slender, 0.5–6.6 cm long. FLOWERS sessile; perianth flabelliform, 1.2–2 mm wide. FRUITS sessile, ovoid to obovoid, 1.5–2.2 mm long, 1.2–1.6 mm wide, inflated, the dorsal keel obscure or lacking, the two lateral keels essentially lacking, the beak erect, 0.1–0.6 mm long; embryo less than 1 full coil. $2n = 26$. —3 subsp., nearly worldwide.

In Arizona, *Potamogeton pusillus* is represented by two subspecies; these are most easily confused with *P. foliosus* subsp. *foliosus* because they have narrowly linear submerged leaves. In general, *P. pusillus* is recognized by its generally longer inflorescence on a slender peduncle and the fruit with a dorsal keel that is essentially smooth. The two subspecies are distinguished in the following key.

1. Leaf blades with 0 to 2 rows of lacunae along midrib; apex acute, rarely apiculate, rarely with a bristle; stipules connate; inflorescences 1 to 3 per plant; spikes cylindric, the whorls interrupted; fruits obovoid, sides concave; beak towards adaxial edge, rarely median. *P. pusillus* subsp. *pusillus*
- 1' Leaf blades with 1 to 5 rows of lacunae along midrib; apex acute to obtuse; stipules convolute; inflorescences more than 3 per plant; spike capitate to cylindrical, the whorls not interrupted; fruits widest at middle or ovoid, sides rounded; beak median, rarely towards adaxial edge. *P. pusillus* subsp. *tenuissimus*

Subsp. *pusillus*. —LEAVES with submerged blades 1.4–6.5 cm long, 0.5–1.9 mm wide, the veins 1 to 3, the apex acute, rarely apiculate, rarely with a bristle, lacunae 0 to 2 rows on

each side of the midrib; stipules connate. INFLORESCENCES 1 to 3 per plant; spikes cylindric, the whorls interrupted. FRUITS obovoid, the sides concave, the beak toward the adaxial edge, rarely in the middle. —Lakes, ponds, tanks, and springs; Apache, Coconino, Graham, Greenlee, Maricopa, Navajo, Pima, Yavapai cos.; 1,050–2,750 m (3,400–9,000 ft.); summer-fall; throughout N. Amer., S. Amer, Eurasia and Afr. Figs. 2G–I, 6D.

Subsp. *tenuissimus* (Mert. & W. D. J. Koch) R. R. Haynes & Hellq. (slender leaved). Slender Leaved Pondweed. —LEAVES with submerged blades 0.9–5.4 cm long, 0.2–2.5 mm wide, the veins 1 to 5, the apex acute to obtuse, lacunae 1 to 5 rows on each side of the midrib; stipules convolute. INFLORESCENCES more than 3 per plant; spikes capitate to cylindrical, the whorls continuous, not interrupted. FRUITS ovoid, the sides rounded, rarely concave, the beak medial, rarely toward the adaxial edge. [*P. pusillus* var. *tenuissimus* Mertens & W. D. J. Koch; *P. berchtoldii* Fieber; *P. berchtoldii* Fieber var. *tenuissimus* (Mertens & W. D. J. Koch) Fern.]. —Lakes, ponds, and tanks; Apache, Coconino, Mohave, Navajo, Santa Cruz cos.; 1,650–2,850 m (5,400–9,350 ft.); summer–fall; throughout N. Amer., Eurasia. Figs. 2J–K, 7A, 8C–D.

Potamogeton richardsonii (A. Benn.) Rydb. (Named for John Richardson, 1787–1865, Artic Explorer). Richardson's Pondweed. —STEMS rhizomes present; turions absent; primary portion of stems terete, to 100 cm tall, stout, and freely branching above. LEAVES all submerged; blades ovate-lanceolate to narrowly lanceolate, 1.6–13 cm long, 5–28 mm wide, the veins 3 to 35, the apex acute to obtuse, the base sessile, rounded, clasping, the margins entire to crispate; stipules persistent, conspicuous, 1.2–1.7 mm long, not ligulate. INFLORESCENCES unbranched, emergent, axillary or terminal, erect to rarely recurved; spikes cylindrical, 1.3–3.7 cm long, multi-flowered, with 3 to 7 whorls; peduncle 1.5–14.8 cm long. FLOWERS sessile; perianth lobes orbicular, 1–2.4 mm wide. FRUITS sessile, obovoid, 2.2–4.2 mm long, 1.7–2.9 mm wide, inflated to slightly concave, the dorsal keel obscure, the two lateral keels obscure, the beak stout, erect, 0.4–0.7 mm long; embryo with 1 full coil. $2n = 52$. —Lakes; Apache Co.; 2,100–2,250 m (6,900–7,300 ft.); summer–fall; throughout n and w N. Amer. Figs. 1F–G, 6A (Xs).

In Arizona, *Potamogeton richardsonii* is easily recognized by only having broadly ovate to lanceolate submerged leaves with entire margins and clasping bases. *P. richardsonii* is only known from 3 historic collections, all from Apache County. Two sterile collections from Wheatfield Lake were gathered on consecutive days in July 1958, and a fruiting collection from Becker Lake was gathered in 1968. Because additional collections have not been made from these well-known locations, it is doubtful that this species is currently a part of our flora.

Stuckenia Börner Pondweed

STEMS terete, subterete, to angled, often compressed; rhizomes present; turions absent. LEAVES all submerged, alternate, sessile, opaque, linear, 1–5-veined, channeled, inflated; apex notched, blunt, or short-apiculate, obtuse to acute; base acute; margins entire; stipules not tubular, adnate for 2/3 or more to the base of the stipules, the upper portion confluent across the top of the sheath forming a short hyaline ligule. INFLORESCENCES submerged spikes, capitate, or cylindrical; peduncles lax, usually on or just below the water surface. FLOWERS with pistils 4. FRUITS dorsally rounded, beaked or not, inflated; embryo with less than 1 full coil. $x = 13$. —ca. 6 species, nearly worldwide. (Named in honor of Wilhelm Adolf Stucken, 1860–1901.) [*Coleogeton* (Reichb.) Les & R. R. Haynes]. Les and

Haynes (1996); Haynes et al. (1998); Haynes and Hellquist (2000).

1. Leaves with apex retuse, obtuse or rounded, rarely apiculate; upper portions of stems sparsely branched; fruit without a distinct beak..... *S. filiformis*
- 1' Leaves with apex acute, apiculate, cuspidate, rarely rounded; upper portions of stems freely branched; fruit with a distinct beak.
2. Leaf blades 5.6–9.2 cm long, 0.2–1 mm wide; peduncles 4.5–11.4 cm long; beak in fruit erect, 0.5–1.1 mm long..... *S. pectinata*
- 2' Leaf blades 5–21 cm long, 0.4–8.5 mm wide; peduncles 1.2–5.2 cm long; beak in fruit erect or rarely recurved, 0.2–0.3 mm long..... *S. striata*

Stuckenia filiformis (Pers.) Börner (thread-like). Threadleaf Pondweed. —STEM freely branching below, sparsely branching above, whitish to greenish, subterete, 10–100 cm long. LEAVES on main stem only slightly larger than those on branches; blades filiform to linear, 1–15 cm long, 0.2–3.7 mm wide, the veins 1 to 3, the apex retuse, obtuse or rounded, rarely apiculate; stipular sheath often inflated, at least on the lower end, 1–9.5 cm long, the ligule 2–20 mm long. INFLORESCENCES terminal, erect, spikes cylindrical or moniliform, 0.5–5.5 cm long, multi-flowered in 2 to 9 whorls, the whorls mostly irregularly arranged; peduncle filiform to slender, 2–15 cm long. FLOWERS sessile; perianth orbicular, 1–2.5 mm wide; styles nearly wanting. FRUITS obovoid, 2–3 mm long, 1.5–2.4 mm wide, the dorsal keel low and rounded, the lateral keels low and obsolete or lacking, the beak wart-like, generally inconspicuous. $2n = 78$. [*Potamogeton filiformis* Pers.]. —5 subsp. Throughout much of N. Amer.; Asia, Eurasia.

Subsp. ***alpina*** (Blytt) R. R. Haynes, Les, & M. Král (alpine). Fineleaf Pondweed. —STEMS 10–30 cm tall. LEAVES with blades to 1 mm wide; stipules persistent, lower portion tightly clasping or slightly enlarged. INFLORESCENCES with whorls less than 2 cm apart. FRUITS numerous. [*Potamogeton marinus* forma *alpinus* Blytt]. —Ponds; Navajo Co.; ca. 1,750 m (5,700 ft.). Widespread in U. S. and Can. Figs. 4A–B, 7B.

In Arizona, *Stuckenia filiformis* subsp. *alpina* is only known from a single location in Navajo Co.

Stuckenia pectinata (L.) Börner (with narrow close-set divisions like a comb). Sago Pondweed. —STEMS freely branched throughout, whitish, terete, 30–100 cm long. LEAVES on main stem only slightly larger than those on the branches; blades linear, 5.6–9.2 cm long, 0.2–1 mm wide, the veins 1 to 3, the apex acute to mucronate or apiculate; stipular sheath not inflated, 0.8–1.1 cm long, the ligule ca. 0.8 mm long. INFLORESCENCES terminal or axillary, erect to ascending; spikes cylindrical or moniliform, 1.4–2.2 cm long, multi-flowered in 3 to 5 whorls, the whorls unequally spaced; peduncle very slender, 4.5–11.4 cm long. FLOWERS sessile or nearly so; perianth orbicular to elliptical, 1–2 mm wide; styles very short. FRUITS oblanceolate, 3.8–4 mm long, 2.5–3.1 mm wide, rounded, the dorsal keel obscure, the lateral keels obscure, the beak erect, 0.5–1.1 mm long. $2n = 78$. [*Potamogeton pectinatus* L.]. —Lakes, ponds, lagoons, tanks, springs, creeks, canals, and rivers; all cos. except Greenlee and Yuma, but should be expected; 350–2,200 m (1,100–7,300 ft.); summer-fall; throughout N. Amer., C. Amer., S. Amer., Eurasia, and Australia. Figs. 4C–E, 7C.

Stuckenia striata (Ruiz & Pav.) Holub (striate, marked with striae). Nevada Pondweed. —STEMS freely branching above, sparsely branching below, whitish to greenish, terete to angled, to 200 cm long. LEAVES on main stem 2 or more times larger than those on the

branches; blades linear, 5–21 cm long, 0.4–5.1 mm wide, the veins 3 to 5, the apex apiculate, cuspidate or rarely rounded; stipular sheath not inflated, 1.2–3.4 cm long, the ligule 2–11 mm long. INFLORESCENCES axillary, rarely terminal, erect to ascending, spikes cylindrical, rarely moniliform, 1.3–4.5 cm long, multi-flowered in 4 to 9 whorls; peduncle slender, 1.2–5.2 cm long. FLOWERS sessile; perianth semi-orbicular, 4–5.4 mm wide; styles very short. FRUITS obovoid to oblanceolate, 3–3.9 mm long, 2.8–3 mm wide, slightly compressed, the dorsal keel obscure, the lateral keels rounded, the beak erect or rarely recurved to apex, 0.2–0.3 mm long. Chromosome number unknown. [*Potamogeton striata* Ruiz & Pav.]. —Slow moving water: Maricopa, Pima, Pinal cos; ca. 400 m (ca. 1,300 ft.); summer-fall; CA, CO, ID, NM, NV, OR, TX, UT; Mex., C. Amer., S. Amer. Figs. 4F–G, 7D.

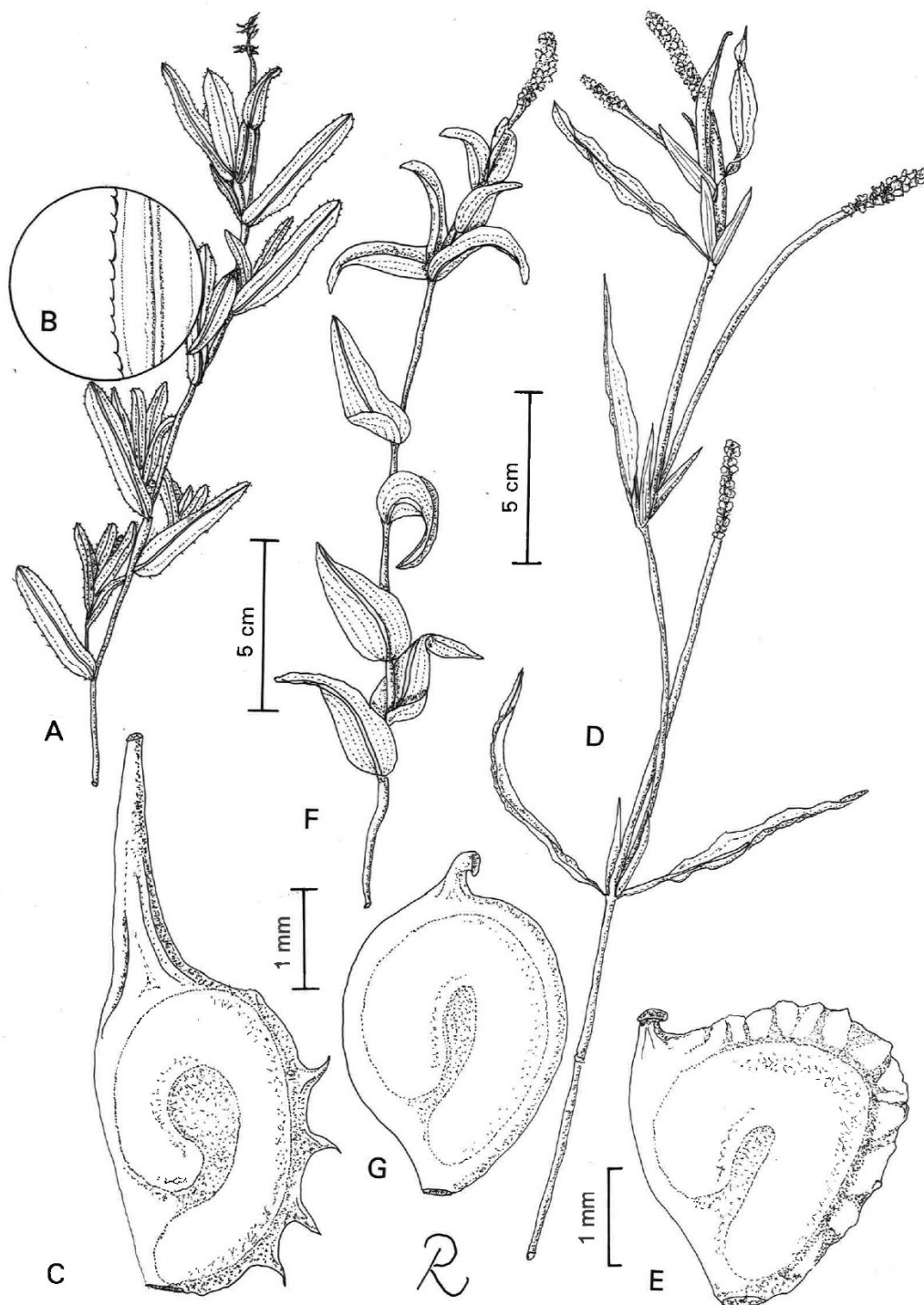
Stuckenia striata is only known in Arizona from three historic collections: Pinal Co., Sacaton, irrigation ditch, 17 April 1928, *R. H. Peebles 5263*; Maricopa Co., Granite Reef Dam, Salt River, 9 October 1938, *R. H. Peebles 14191*; and Pima Co., Santa Cruz Creek, Tucson, 1881, *J. G. Lemmon 579*. This species has not been recollected, and it is doubtful that it is currently a member of our flora.

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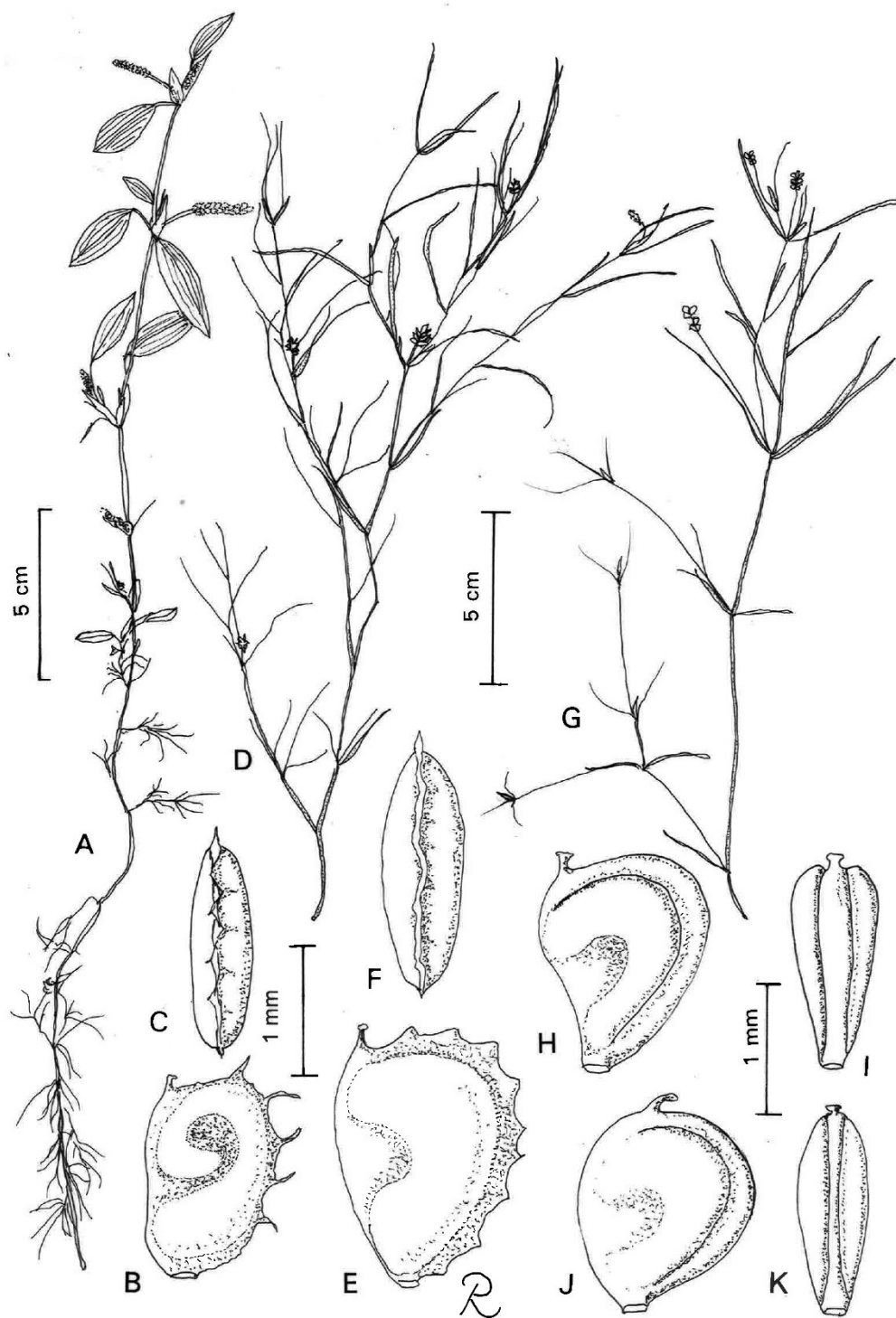
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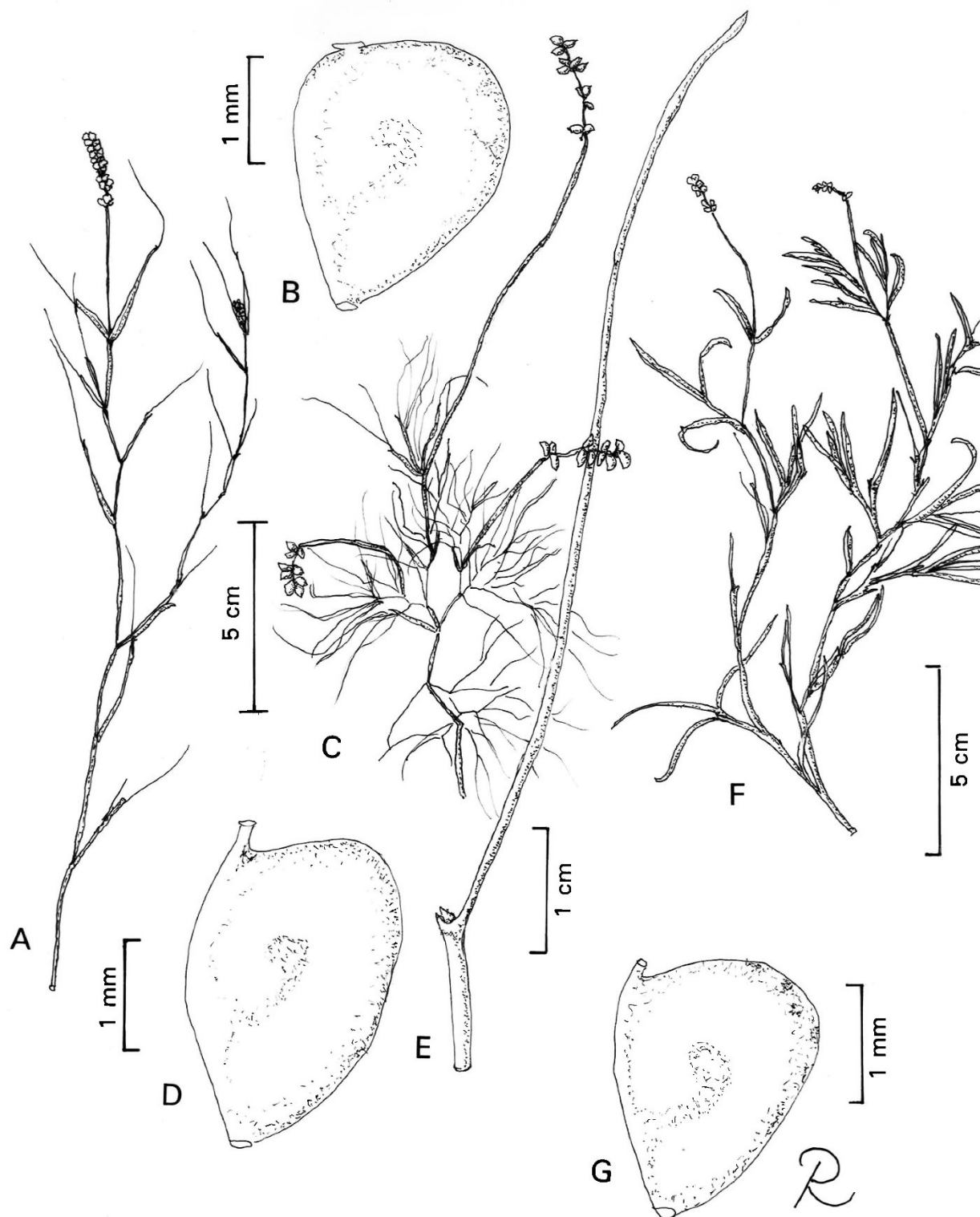
Potamogetonaceae Figure 1. A-C, *Potamogeton crispus*: A) Habit. B) Leaf margin detail. C) Fruit. D-E, *Potamogeton montezumawellensis*: D) Habit. E) Fruit. F-G, *Potamogeton richardsonii*: F) Habit. G) Fruit. Drawings by Jon Ricketson.



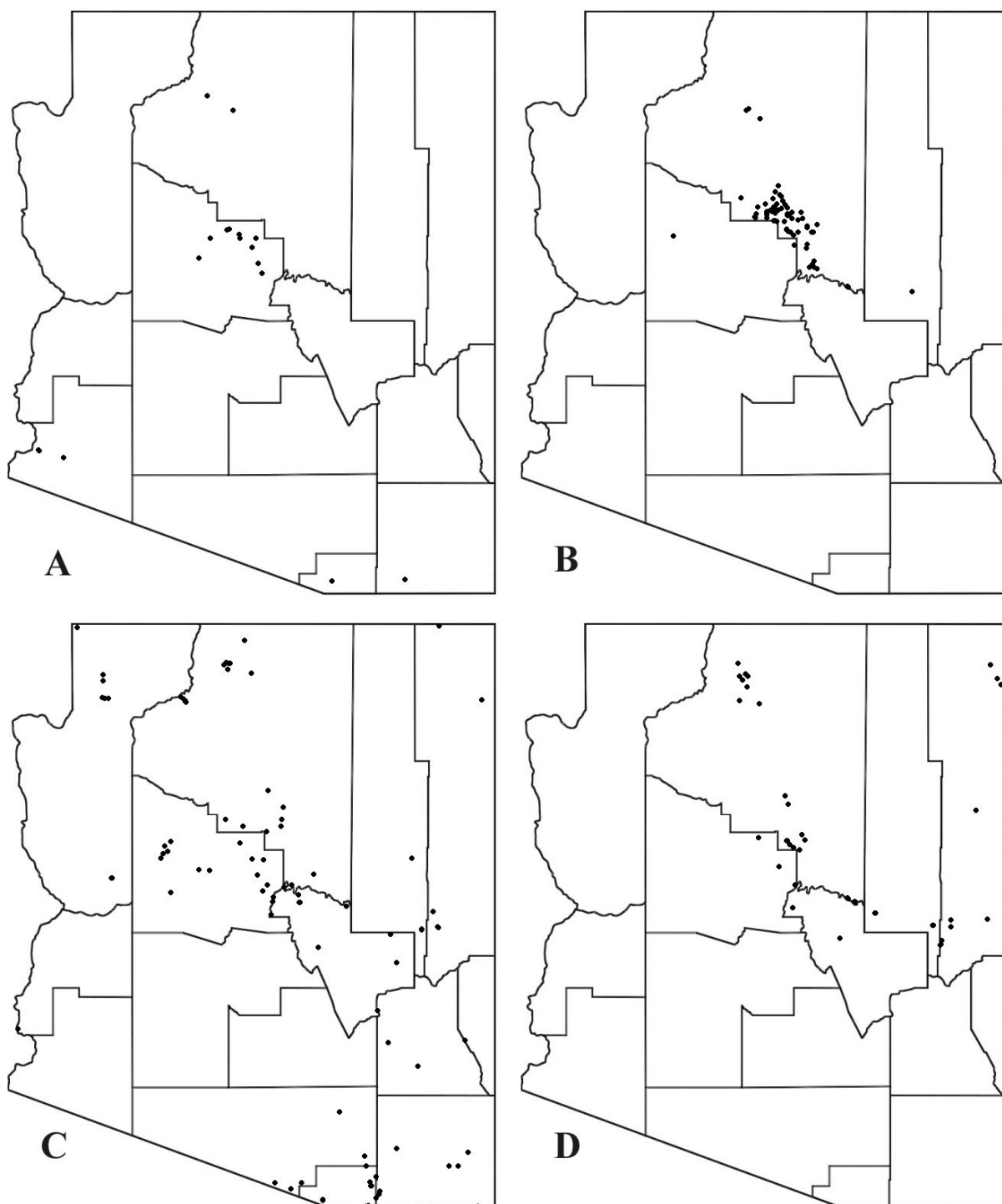
Potamogetonaceae Figure 2. A-C, *Potamogeton diversifolius*: A) Habit. B) Fruit, lateral view. C) Fruit, dorsal view. D-F, *Potamogeton foliosus* subsp. *foliosus*: D) Habit. E) Fruit, lateral view. F) Fruit, dorsal view. G-I, *Potamogeton pusillus* subsp. *pusillus*: G) Habit. H) Fruit, lateral view. I) Fruit, dorsal view. J-K, *Potamogeton pusillus* subsp. *tenuissimus*: J) Fruit, lateral view. K) Fruit, dorsal view. Drawings by Jon Ricketson.



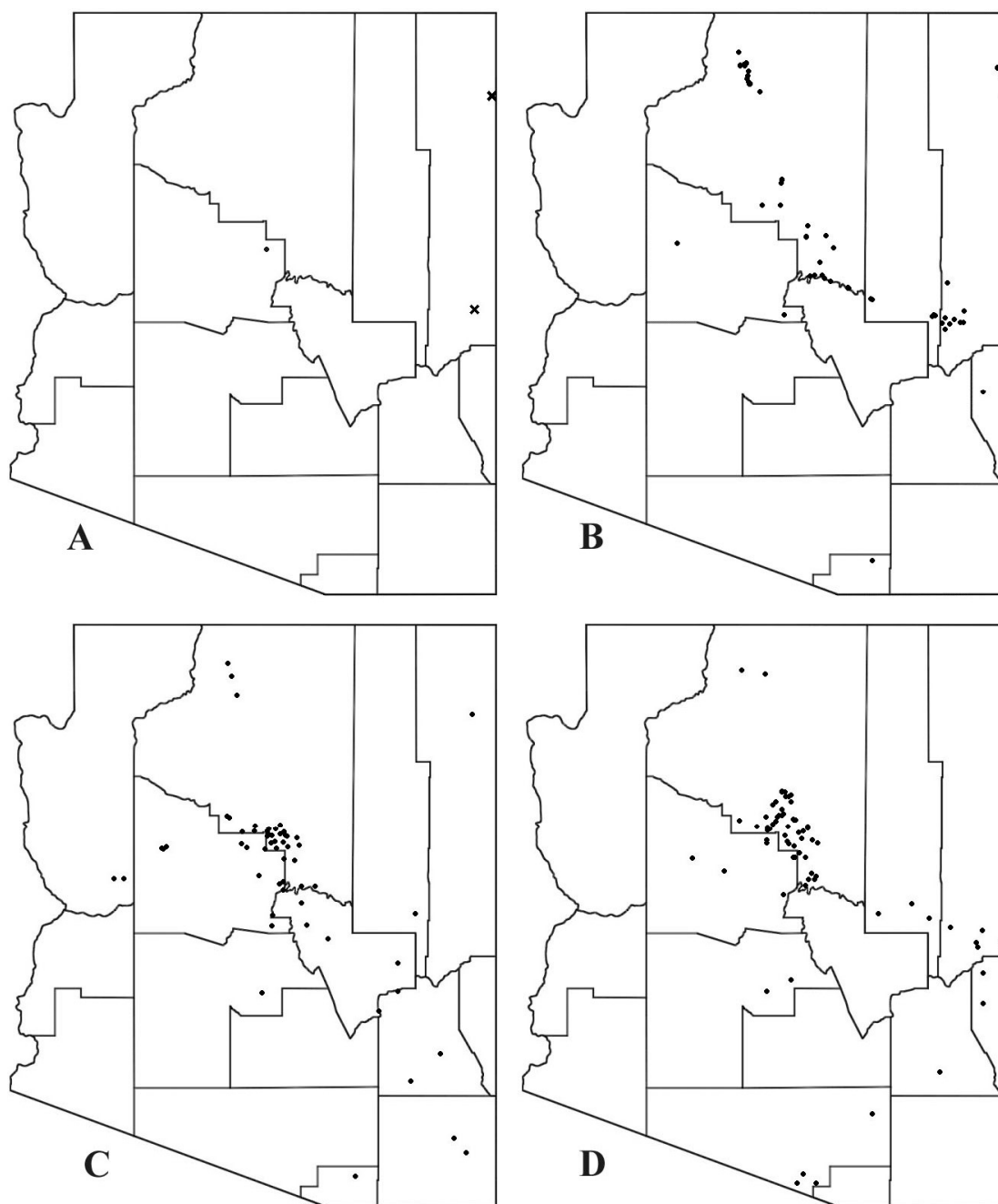
Potamogetonaceae Figure 3. A-B, *Potamogeton gramineus*: A) Habit. B) Fruit. C-D, *Potamogeton natans*: C) Habit. D) Fruit. E-F, *Potamogeton nodosus*: E) Habit. F) Fruit. Drawings by Jon Ricketson.



Potamogetonaceae Figure 4. A-B: *Stuckenia filliformis* subsp. *alpina* A) Habit. B) Fruit. C-E: *Stuckenia pectinata* C) Habit. D) Fruit. E) Stipular sheath and leaf. F-G: *Stuckenia striata* F) Habit. G) Fruit. Drawings by Jon Ricketson.



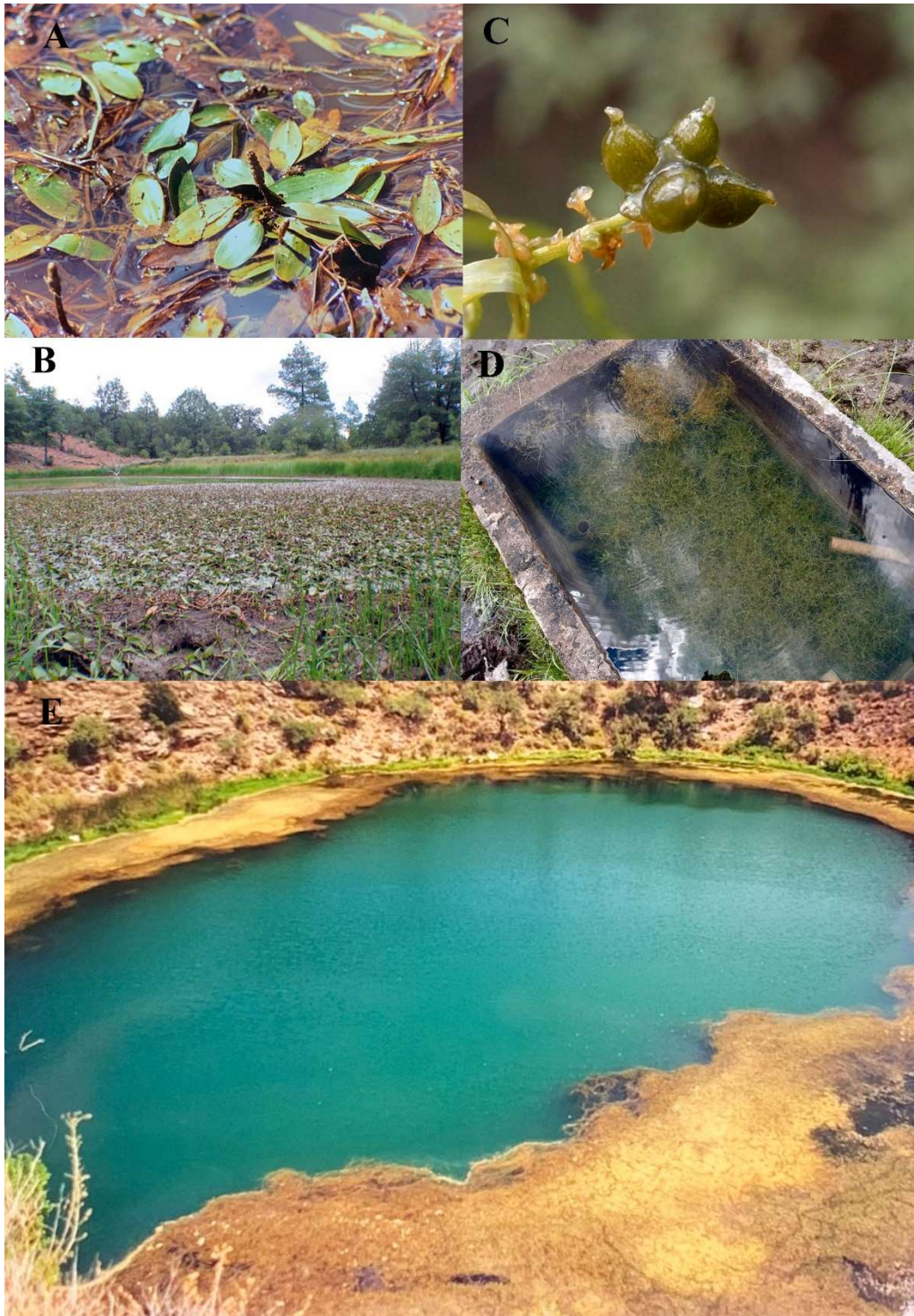
Potamogetonaceae Figure 5. Distribution maps of *Potamogeton*: A) *P. crispus*. B) *P. diversifolius*. C) *P. foliosus* subsp. *foliosus*. D) *P. gramineus*.



Potamogetonaceae Figure 6. Distribution maps of *Potamogeton*: A) *P. montezumawellensis* [dot] and *P. richardsonii* [Xs]; B) *P. natans*; C) *P. nodosus*; D) *P. pusillus* subsp. *pusillus*.



Potamogetonaceae Figure 7. Distribution maps of *Potamogeton* and *Stuckenia*: A) *P. pusillus* subsp. *tenuissimus*; B) *S. filiformis* subsp. *alpina*; C) *S. pectinata*; D) *S. striata*.



Potamogetonaceae Figure 8. Photos of *Potamogeton*: A) *Potamogeton nodosus*. B) *P. nodosus* growing in cattle tank with receding water level in Sierra Ancha mountains, Tonto National Forest, Gila Co. C–D) *P. pusillus* subsp. *tenuissimus* growing near Tejano Spring on Salero Ranch W end of Grosvenor Hills, fruits and habit in concrete water trough in Santa Cruz Co. E) *P. montezumawellensis*, in the fall it is part of the yellowish vegetation around the margin of Montezuma Well, a natural geothermal limnocrone spring in Yavapai Co.