An Autogamous Rainforest Species of *Schiedea* (Caryophyllaceae) from East Maui, Hawaiian Islands

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ABSTRACT. A new autogamous species of *Schiedea* is described and illustrated. It is known only from cliff habitat in rainforest on a single ridge in the Natural Area Reserve, Hanawi, East Maui. With the addition of this species there are 28 species in this endemic Hawaiian genus. The new species appears to be most closely related to *Schiedea nuttallii*, a species of mesic habitats on O'ahu, Moloka'i, and Maui.

In June 1992 James Jacobi and Arthur Medeiros were collecting in the wet forests of Hanawi, East Maui, when they discovered a species of *Schiedea* Chamisso & Schlechtendal they considered to be probably new to science. It appeared similar to *S. nuttallii* Hooker, but close study of the herbarium specimens showed that it was a closely related new species from a much wetter habitat than *S. nuttallii*. In June 1995 Ken Wood and Steve Perlman revisited the population with Medeiros, W. Evanson, and R. Hobdy. They obtained seeds for greenhouse propagation at the University of California, Irvine. Studies of plants grown in the greenhouse confirmed that they represented a new species, here named *Schiedea jacobii*. With the addition of this species there are 28 species in this endemic Hawaiian genus. Observations in the greenhouse also showed that the new species is autogamous and that it shares several characteristics with another rainforest species in the genus, *S. diffusa* A. Gray. These shared characters, related to the breeding system and to seed dispersal, include anthers shedding pollen while the styles are elongated and receptive, and seeds persistent on the placenta after capsule dehiscence. The latter feature may be associated with germination of seeds in the capsule, followed by dispersal of small seedlings, as noted for *S. diffusa* (Wagner, unpublished obs.).

Schiedea jacobii W. L. Wagner, Weller & Medeiros, sp. nov. TYPE: Cultivated from seeds at University of California, Irvine greenhouse in 1997. Source: Hawaiian Islands. Maui: East Maui, Hanawi, Kuhiwa unit, E of Hanawi Stream, between Hanawai Stream and Kuhiwa drainage [20°45′N, 156°7′40″W], 6340 ft., E-facing slope, ca. 20 ft. below ridge top, in *Metrosideros* montane wet forest, 22 June 1995, *S. Perlman, K. Wood, A. Medeiros, R. Hobdy & B. Evanson 14807* (holotype, US-3351775; isotypes, BISH, CANB, CHR, K, MO, NY, PTBG). Figure 1A–H.

Haec species *S. nuttallii* similis, sed ab ea caulibus quadrangularibus, floribus autogamis, sepalis sub angulo ca. 100–135 e pedicello abeuntibus, tubo apicali 1.4–1.8

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Figure 1. *Schiedea jacobii* W. L. Wagner, Weller & Medeiros. —A. Flowering stem. —B. Stem cross section. —C. Portion of inflorescence branch. —D. Flower, showing stamens ready to dehisce and styles elongated and receptive. —E. Adaxial view of sepal with nectary and stamen. —F. Dehisced capsule surrounded by the sepals exposing the mass of persistent seeds. —G. Seed, lateral view. —H. Seed, marginal view. Drawn from live greenhouse material of the type.


3mm
B
5mm
D
1cm
C
3mm
E
0.5mm
G
H
3mm
F
1cm
A
A. R. Tangerini
1998

mm longo nectarii omnis, stylibus plerumque 4, seminibus cohaerentibus et persistentibus differt.

Perennial herbs or subshrubs, pale yellowish green throughout; stems 4.0–7.6 dm long, ascending to sprawling when longer, conspicuously quadrangular, the angles weakly winged, glabrous throughout. Leaves opposite; blade coriaceous, 4.5–10.5 cm long, 1.4–2.6 cm wide, lanceolate to oblong-elliptic, only the midvein evident and slightly eccentric, margin slightly thickened and weakly revolute, apex acute to attenuate, base acute to obtuse; petiole 0.4–0.8 cm long, the base often flared at juncture with stem and the leaf pair slightly connate by petioles. Flowers perfect, facultatively autogamous, in diachasia on the main and upper lateral branches, these forming an open, panicle-like inflorescence 40–50 cm long, the lateral branches 11–18 cm long, ascending, each with 25–35 flowers; bracts yellowish green, foliaceous, nearly as large as the leaves in lower portions of central axis and the lateral branches, those in upper part of inflorescence and subtending flowers narrowly lanceolate to subulate, 3–11 mm long; pedicels 3–8 mm long at anthesis, elongating slightly in fruit, but none over 9 mm long, conspicuously asymmetrically flattened. Sepals 3.9–4.2 mm long, lanceolate, dull yellowish green, greener toward the midrib, sometimes with purple toward apex, thick and opaque, ascending, concave to shallowly navicular toward apex, oriented at ca. 100° to 135° angle to the pedicel, abaxially smooth and rounded, glabrous, the margins weakly scarious, sparsely ciliate, the apex attenuate. Nectary base 0.4–0.5 mm long, somewhat broadened and flattened at base, dark yellow, the nectary shaft 1.4–1.8 mm long, the apex deeply bifid. Stamens 10, the filaments weakly dimorphic, the antisepalous whorl 3.2–3.5 mm long, the alternate set 2.8–3.0 mm long, the anthers attached near the middle, subequal, 0.3–0.4 mm long, yellow, dehiscing after flower opens. Styles (3)4–5, the stigmas receptive when flower opens. Capsule ovoid, 3.7–4.2 mm long. Seeds ca. 16–22 per capsule, 0.7–0.8 mm long, suborbicular, asymmetrical, compressed, brown, rugose, remaining coherent as a unit and persistent on placenta after dehiscence, seeds eventually dispersing (or perhaps germinating *in situ* in the wild).

Etymology. We are pleased to name this species in honor of its discoverer, James D. Jacobi, Biological Resources Division, Pacific Islands Science Center, who has made significant contributions to vegetation ecology and alien plant management in Hawaii.

Distribution and ecology. Known only from wet cliffs, between Hanawai Stream and Kuhiwa drainage, East Maui, at 1930 m. This area is within a protected Hawaii State Natural Area Reserve. The habitat is a *Metrosideros* Banks ex Gaertner montane wet forest with *Cheirodendron trigynum* (Gaudichaud) A. Heller, *Coprosma ochracea* W. R. B. Oliver, *Dubautia dolosa* O. Degener & Sherff, *D. plantaginea* Gaudichaud, *Melicope* sp., *Sadleria cyatheoides* Kaulfuss, *Broussaisia arguta* Gaudichaud, *Elaphoglossum* sp., *Uncinia uncinata* (L.f.) Kükenthal, *Deschampsia nubigena* Hillebrand, *Myrsine lessertiana* A. de Candolle, *Dryopteris subbipinnata* W. H. Wagner & Hobdy, *D. wallichiana* (Sprengel) Hylander, *Labordia* sp., *Peperomia* sp., *Pipturus forbesii* Krajina, *Astelia menziesiana* Small, *Carex alligata* Boott, *Rubus hawaiiensis* A. Gray, and *Vaccinium* sp. The only known population consisted of nine plants when first discovered in 1992, although time for exploration was limited. In 1995 shoots representing only two to four plants could be located with several hours of searching the area. Two recently dead plants were located near the living ones and eight cotyledon-stage individuals, which may be this species, were found growing among bryophytes. All of the living plants in 1995 were contained within a 2-m^2 area. A separate small population located downhill in 1992 was not relocated because of a small landslide/tree fall. Other populations may occur in this rugged, largely inaccessible region of East Maui, especially on wet cliffs. Degradation of forests in the Hanawi area by alien animals appears to be the major threat to *Schiedea jacobii*. The only known population is currently without any evidence of pigs because of Natural Area Reserve System staff efforts.

Paratypes. HAWAIIAN ISLANDS. **Maui:** East Maui, Hanawi, Kuhiwa unit, E of Hanawi Stream, between Hanawai Stream and Kuhiwa drainage [20°45′N, 156°7′40″W], E-facing slope, ca. 6 m below ridge top, 22 June 1995, *Perlman et al. 14807* (US); on rock face with *Deschampsia*, 7 Apr. 1992, *Medeiros & Jacobi 798* (BISH, US).

Relationships. *Schiedea jacobii*, with its fleshy stems, large leaves with one principal vein, open inflorescence, and attenuate sepal apex, is clearly a member of the *S. nuttallii* clade as defined by Wagner et al. (1995) and Weller et al. (1995), which consists of nine hermaproditic species of mesic to wet forest. *Schiedea jacobii* appears to be most closely related to *S. nuttallii* of mesic forests on O'ahu, Moloka'i, and West Maui. This relationship is suggested by the shape and size of the leaves, similar shrubby habit, sepal size, and rugose seeds. It differs from *S. nuttallii* most conspicuously in characters related to the breeding system, espe-

cially those associated with autogamy. The most significant are the shift in timing of receptivity of the stigmas and the shorter staminal filaments. Several characters of *S. jacobii* are also found in *S. diffusa*, but appear to have been independently derived based on the evolution of autogamy in a wet forest environment. Re-analysis of the phylogeny of *Schiedea* following inclusion of *S. jacobii* in the data matrix may resolve the extent of convergence between this species and *S. diffusa* (Wagner et al., unpublished).

Breeding system. Experimental crosses in the greenhouse and observations of pollen tube growth in styles indicate that *S. jacobii* is autogamous. Emasculated flowers failed to produce capsules. In unmanipulated flowers numerous pollen tubes were observed in the styles (Weller, Sakai, Thai & Dieu, unpublished data). These results, and the production of hybrids following interspecific crosses, indicate that the abundant capsule production of this species in the absence of cross-pollination is likely to result from self-fertilization rather than apomixis. Autogamy is facilitated by the synchrony of pollen dispersal and stigma receptivity, a feature not found in most other species of *Schiedea*, which are strongly protandrous (Sakai et al., 1997). *Schiedea diffusa*, which occurs in very wet forests on Moloka'i, Maui, and Hawai'i, is also autogamous. Our observations suggest that in very wet habitats, autogamy may limit exposure of pollen to rain, which may either wash pollen from flowers or cause pollen to burst. Additionally, visitation by insects capable of pollination may be rare in very wet habitats.

Seed dispersal. Among species of *Schiedea*, retention of mature seeds on the placenta within dehisced capsules is found only in *S. jacobii*. A related species, *S. diffusa*, retains seeds within closed capsules. Seedlings of *S. diffusa* have been observed germinating within disintegrating capsules still attached to the plant. This trait may provide an advantage during establishment in wet habitats. Whether precocious germination occurs in *S. jacobii* is unknown, although seeds eventually disperse from capsules under greenhouse conditions.

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