

A NEW SPECIES OF FLAVERIA (COMPOSITAE:  
FLAVERIINAE) FROM GRAND CANYON, ARIZONA<sup>1</sup>

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Recent collections from remote areas of the Grand Canyon National Park, Coconino and Mohave Counties, Arizona, include a hitherto undescribed endemic species of *Flaveria* Juss. *Flaveria* is a widespread genus of mostly American distribution. Our new species, *Flaveria mcdougallii*, is the second member of the genus known from Arizona and extends the range of the genus into the Mohave Desert region.

We are naming the new species in honor of Dr. Walter B. McDougall, Curator of Botany at the Museum of Northern Arizona since 1955 and a long-time student of the flora of the National Parks System and northern Arizona. His many contributions are summarized by Hamann (1974).

***Flaveria mcdougallii*** Theroux, Pinkava & Keil, sp. nov. (Fig. 1) Suffrutex robustus usque ad 1 m diametro, basi crassa rhizomata lignea 1–3 cm diametro, caulibus numerosis erectis vel ascendentibus, usque ad 1 m altis, glabris, fragilibus, in dimidio superiore herbaceis virentibus, porcis decurrentibus leviter angulosis, in dimidio inferiore aetate lignescentibus et tephro-brunnescentibus. Folia opposita, carnosa, basi connata, linearia vel anguste lineari-lanceolata saepe falcata, 5–14 cm longa, 2–8 mm lata, apice acuta, basi cuneata, margine integra, 1–5-nervata, glabra. Capitula discoidea, sessilia vel brevipedunculata (1–2 mm), in fasciculis oligocephalis in cymis corymbiformibus 4–5 cm diametro aggregatis; ramuli capitulaque a bracteolis subtenti; bracteolae infimae foliaceae, supernae reductae et squamiformes, 1–2 mm longae. Involucrum turbinatum; phyllaria 3–6, oblongo-lanceolata, 2.0–3.5 mm longa, 0.6–0.8 mm lata, dorsaliter 3–5 nervata, apicibus acutis erectis vel vix patentibus, basibus truncatis, in marginibus et adaxiale prope apicem trichomatibus multicellularibus 0.02–0.04 mm longis puberulenta vel glabrescentia. Flosculi ligulati nulli. Flosculi tubuliflori 3–6; corollae flavae, 3.5–4.0 mm longae, glabrae, tubis 1–2 mm longis, faucibus 1.0–1.5 mm longis, lobis 1 mm longis ad maturitatem reflexis; antherae exsertae thecis 1.0–1.5 mm longis, basaliter rotundatae vel truncatae, appendicibus terminalibus oblongis, 0.3 mm longis et 0.1 mm latis, subacutis; pollenis granum circa 23  $\mu$ m diametro; styli basaliter bulboso-incrassati, glabri, altitudine fere antheras aequantes, ramulis exilibus recurvatis apice peni-

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cillatis, extus papillosis. Achenia 1.5–2.5 mm longa, brunnescentia vel nigrescentia, cylindrica, circa 0.4 mm diametro, 10-costata, trichomatibus duplicibus 0.05–0.08 mm longis puberulenta vel glabra, carpodio eburneo obliquo 0.1 mm longo et 0.3 mm lata; pappus coroniformis, squamellis fimbriatis 0.2–0.4 mm longis, plus minusve connatis. Chromosome numerus:  $2n = 18_{IT}$ .

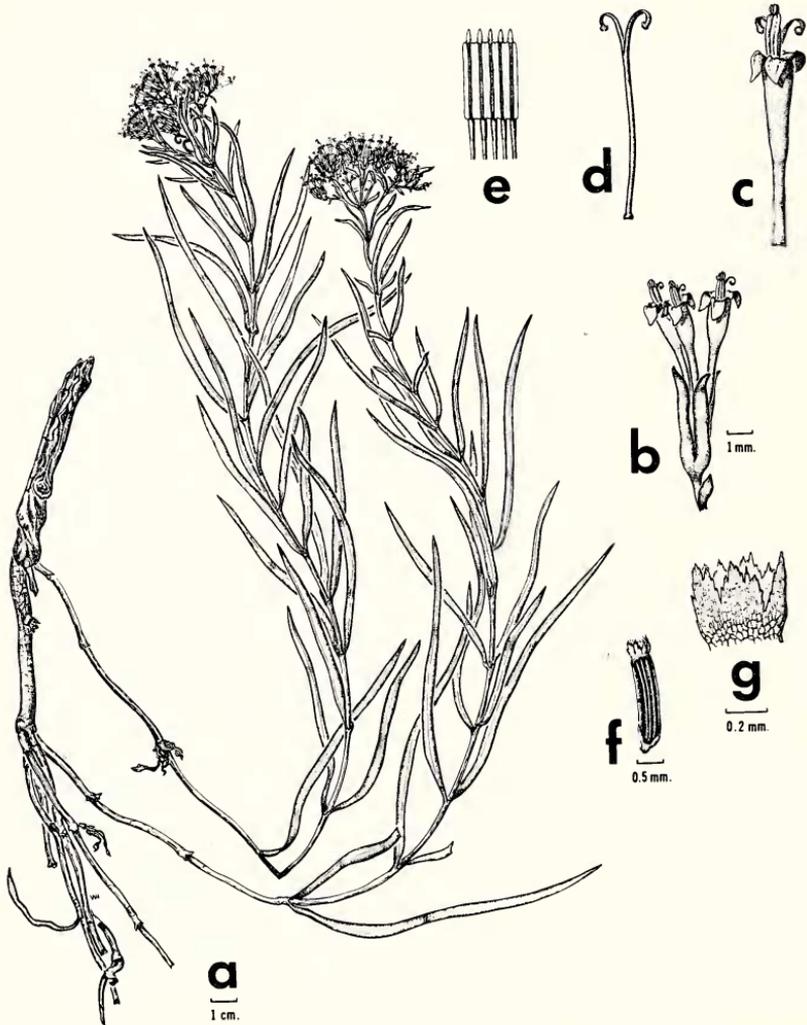


FIG. 1. *Flaveria mcdougallii*. a, Habit; b, Head; c, Corolla; d, Style; e, Stamens; f, Achene; g, Pappus. c, d, e, f, same scale.

TYPE: United States, Arizona, Mohave Co., Grand Canyon National Park, Cove Canyon (174.2 mi below Lee's Ferry), 27 Jan 1976, *M. E. Theroux 1675* (Holotype: US; isotypes: ARIZ, ASC, ASU, DES, GCNP, GH, MNA, NY, RSA, SRSC, TEX, UC).

PARATYPES: United States, Arizona, Coconino Co., Grand Canyon National Park, Matkatamiba Canyon (148.8 mi below Lee's Ferry), 1 Oct 1975, *M. E. Theroux 1519* (MNA); Mohave Co., Grand Canyon National Park, Cove Canyon, 5 Oct 1975, *M. E. Theroux 1567* (MNA).

The type locality of *Flaveria mcdougallii* is a permanent saline spring situated near the mouth of a remote tributary canyon in the Grand Canyon. The spring, located at ca. 550 m on an ESE-facing slope, is fed by seepage from the Muav Limestone at its contact with the underlying Bright Angel Shale. Direct sunlight reaches the site for a period of only a few hours per day because of shading by surrounding canyon walls. The soil where *F. mcdougallii* grows is a saturated, highly organic varying mixture of sand and silt bound together by roots and rhizomes of two grass species, *Muhlenbergia asperifolia* (Nees & My.) Parodi and *Sporobolus airoides* (Torr.) Torr. The A-horizon averages about 30 cm deep and overlies an unstable, shifting aggregation of coarse shale talus. *Flaveria mcdougallii* grows in soils ranging from a loose mud to consolidated travertine oxides. The other site where *F. mcdougallii* has been collected is very similar to the type locality.

Both collection localities for *F. mcdougallii* are situated in the narrow strip of Mohave Desert vegetation that parallels the Colorado River through the western two-thirds of the Grand Canyon. The most common woody species represented in the area are *Acacia greggii* A. Gray, *Lycium pallidum* Miers, and *Zizyphus obtusifolia* (T. & G.) A. Gray. The new species is the dominant shrub at the springy sites. In addition to the grasses and shrubs mentioned above, associated species include *Brickellia longifolia* S. Wats. and *Mentzelia pumila* (Nutt.) T. & G. in wet soil and *Adiantum capillus-veneris* L., *Mimulus cardinalis* Dougl., and *Petrophytum caespitosum* (Nutt.) Rydb. on seepage rock-faces.

Reproduction in the known populations of *Flaveria mcdougallii* is apparently predominately vegetative. Woody horizontal rhizomes 4–5 cm below the soil surface connect adjacent clumps. Seed set is low with many ovaries shrunken and apparently abortive. According to Dr. A. M. Powell (pers. comm.) perennial *Flaveria* taxa are self-sterile. The low seed set of *F. mcdougallii* may indicate a low incidence of cross-pollination. Our success in germinating a few achenes on moistened filter paper indicates that at least some of the seeds that do form are viable.

*Flaveria* is morphologically similar in many respects to both *Sartwellia* A. Gray and *Haploësthes* A. Gray (Turner, 1971, 1975). All three genera are characterized by opposite, often fleshy, basally connate leaves; yellow-flowered, cymosely-clustered heads with distinct, uniseriate or biseriate involucre bracts; penicillate-tipped, recurved style branches;

TABLE 1. COMPARISON OF CHARACTERISTICS OF MEMBERS OF THE FLAVERIINAE

Character	<i>Flaveria</i>	<i>Flaveria mcdougallii</i>	<i>Sartwellia</i>	<i>Haploësthes</i>
Leaf shape	Linear, linear-lanceolate, or ovate	Linear or linear-lanceolate	Linear	Linear or linear-lanceolate
Phyllary shape	Narrowly oblong to lanceolate	Oblong-lanceolate	Ovate	Ovate
Number of ray florets	0-1	0	2-5	5 or 8
Number of disc florets	1-15	3-6	10-40	20-100
Pappus type	No pappus or separate scales (in one species)	Crown of united scales	Alternating bristles and scales or crown of united scales (in one species)	Many bristles
Corolla pubescence	Multicellular trichomes (or glabrous in some plants from coastal region)	Glabrous	Glabrous	Glabrous
Achene pubescence	Glabrous	Glabrous or double-hairs	Double-hairs	Double-hairs
Photosynthetic pathways	C <sub>3</sub> and C <sub>4</sub> (Smith and Turner, 1975)	C <sub>3</sub> ( <sup>13</sup> C‰ = -30.0)	C <sub>3</sub> (one species reported by Smith and Turner, 1975)	.....
Distribution	Widespread (but not Mohave Desert)	Mohave Desert Region	Chihuahuan Desert Region	Chihuahuan Desert Region
Habitat	Various moist substrates including gypsum	Saline springs	Dry gypseous soils	Dry gypseous soils

and brown to black, cylindrical, 8–10-ribbed achenes. All apparently have the same chromosome base number,  $x = 18$  (Turner, 1975). Recent authors (Turner and Johnston, 1961; Turner, 1971, 1975; Powell, pers. comm.) have maintained the three as separate genera. The principal morphological differences among the three genera are number of flowers per head, pappus structure, and pubescence of florets (Table 1).

The features of *Flaveria mcdougallii* are to some extent intermediate between those of *Flaveria* and *Sartwellia* as traditionally delimited (Table 1). *Flaveria mcdougallii* has slightly broadened leaves and eradiate, few-flowered heads with narrow phyllaries, characteristics that it shares with other *Flaveria* taxa. It also has a coroniform pappus and glabrous corollas, features that have until now been characteristic of *Sartwellia*. Some plants from one population of *F. mcdougallii* have glabrous achenes whereas other members of the same population and representatives of the other population have achenes puberulent with double-hairs (Zwillingshaare). According to Powell (pers. comm.), the double-hairs are characteristic of *Sartwellia* and until now have not been known in *Flaveria*.

If morphology alone were the deciding factor, the continued acceptance of *Flaveria* and *Sartwellia*, and possibly even *Haploësthes* as distinct genera might be questioned. Fortunately, systematists have at their disposal a battery of experimental techniques for gathering information about relationships. Powell (pers. comm.) is currently carrying on an experimental investigation of taxa in the Flaveriinae that hopefully will clarify the biological relationships among the genera. We have made material of *F. mcdougallii* available to Dr. Powell for his study.

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#### LITERATURE CITED

- HAMANN, S. 1974. Ninety-one years of enthusiasms. *Arizona Highways* 50(10):2–4.
- SMITH, B. N. and B. L. TURNER. 1975. Distribution of Kranz syndrome among Asteraceae. *Amer. J. Bot.* 62:541–545.
- TURNER, B. L. 1971. Taxonomy of *Sartwellia* (Compositae-Helenieae). *Sida* 4: 265–273.
- . 1975. Taxonomy of *Haploësthes* (Asteraceae-Senecioneae). *Wrightia* 5: 108–115.
- , and M. C. JOHNSTON. 1961. Chromosome numbers in the Compositae III. Certain Mexican species. *Brittonia* 13:64–69.