THREE NEW SPECIES OF *STYLOCLINE* (ASTERACEAE: INULEAE) FROM CALIFORNIA AND THE MOJAVE DESERT

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ABSTRACT

Three new species of *Stylocline* are described and illustrated, bringing the number of species in this previously unrevised genus to seven. A key to the genus is provided. **Stylocline masonii** and **S. citroleum** are closely related to *S. psilocarphoides* and *S. gnaphaloides,* respectively, and are rare taxa of west-central California that were last collected in 1971 and 1935, respectively. *Stylocline citroleum* appears nearly restricted to oil-producing areas now highly disturbed; it may be extinct. Its character states suggest an origin via hybridization involving *S. gnaphaloides* and a *Filago* species. *Stylocline masonii* was previously identified as *S. gnaphaloides* by collectors, but appears instead to be a parapatric derivative of *S. psilocarphoides.* **Stylocline intertexta** combines character states, and may be a hybrid derivative, of *S. psilocarphoides* and *S. micropoides,* and has been the source of previous taxonomic confusion. It is found almost throughout the Mojave Desert, where the putative parents are sympatric. Both putative hybrid derivatives appear morphologically uniform and independently reproducing, and are thus treated as species. *Stylocline* species probably are almost obligately geitonogamous, insuring that any viable products of rare hybrid events would immediately be both isolated from their parents and capable of reproducing independently.

Ongoing systematic studies of *Stylocline* Nutt. (1840 p. 338) are generating new data regarding its distribution (Morefield 1988; Morefield and Taylor 1988), circumscription, and relationships and have revealed several previously undescribed taxa. So that treatments of *Stylocline* may be completed for the California Jepson Manual, Flora North America, Arizona Flora, and other projects, and so that rare and possibly endangered taxa may become better known, three new species are here formally described. Unfortunately, it was impossible to locate living material of two of the new taxa during the poor growing seasons of 1988–1990; the descriptions are thus based primarily on extensive analyses of herbarium material.

The previous literature on *Stylocline* consists solely of new species descriptions and floristic treatments. *Stylocline* has been placed in subtribe Filagininae Benth. in Benth. & Hook. (1873 p. 166; as "Filagineae") of Inuleae Cassini (Merxmuller et al. 1977) or Gnapha-

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lieae Benth. emend. A. Anderberg (1989, 1991). Its closest living relatives appear to be in *Filago* L. subgenus *Oglifa* (Cass.) Gren., which in turn appears derived from *Gnaphalium* L. and its relatives (Morefield unpublished cladistic data).

The type species of *Stylocline* is *S. gnaphaloides* Nutt. (the spelling has widely been changed to "*gnaphalioides*", based on the assumption that Nuttall derived the name from *Gnaphalium*). I consider *Stylocline* to exclude *S. filaginea* (A. Gray) A. Gray (=*Ancistrocarphus filagineus* A. Gray), *S. griffithii* A. Gray (=*Cymbolaena griffithii* (A. Gray) Wagenitz 1972), and *S. amphibola* (A. Gray) J. Howell (=*Micropus amphibolus* A. Gray; status uncertain and under investigation). The following characteristics are shared by all species remaining in *Stylocline,* justify placement of the genus in Filagininae, and collectively separate *Stylocline* from all other genera in the subtribe:

Diminutive gray arachnoid-tomentose annuals. Leaves simple, entire, alternate or seeming whorled below heads, lax, 1-nerved, evenly tomentose, sessile or with petiole short, broad, indistinct; uppermost leaves subtending the heads. Heads disciform, sessile in dense groups. Receptacle glabrous, 2.8–8 times longer than wide, with paleae subtending all the florets. Phyllaries none or few, grading into the paleae. Paleae in spiral ranks, deciduous with the mature florets or achenes; body parallel-veined, greenish to brownish, curved evenly inward, dorsally rounded, often partly sclerified; tips free, entire, acute to obtuse, erect at maturity; margin abruptly differentiated into a scarious wing with divergent striations, entire, glabrous, ± flat to concave. Middle (and usually outermost) paleae each subtending and tightly enclosing a pistillate floret; body dorsally woolly, the mass of wool dorsiventrally compressed; tips oriented inward over central florets during anthesis; wing reflexed from the line of closure, forming a complete or terminal ligule. Innermost paleae reduced, subtending central florets, concave or loosely folded; tips erect. Outermost and middle florets pistillate, arising in 3–6 series from the side of the receptacle; corolla narrowly tubular to filiform, barely exserted from the closed palea, whitish; style exserted, pressed against and exceeded by the palea wing, offset slightly inward from the geometric tip of the ovary, branches linear; achenes obovoid, curved inward, brown, glabrous, smooth, shiny, epappose. Central florets functionally staminate, in 1 series at tip of receptacle, surpassed and concealed by outer paleae; corolla narrowly funnelform, actinomorphic, lobes equal, triangular; style included; ovary vestigial or partially developed, abortive; pappus of (0–)1–12(–13) bristles.

In *Stylocline* the paleae subtending the pistillate florets provide many diagnostic characters for separating species. Cronquist (1950)

suggested that the scarious wings of *Psilocarphus* paleae function in pollination, forcing the styles of the outer pistillate florets over the few central, functionally staminate florets of the same head during anthesis. My own observations of *Stylocline* specimens at many different developmental stages suggest that their palea wings perform the same function. Because the wings of *Stylocline* paleae usually cover the staminate florets throughout development, pollination *between* heads on the same or different plants is likely rare. Preliminary isozyme evidence in *Stylocline* confirms the very low allelic polymorphism expected of diploid selfers (Morefield unpublished data). As discussed further below, a prevalence of structurally enforced geitonogamy in *Stylocline* could have helped mediate two apparent cases of hybrid speciation.

As here conceived, *Stylocline* comprises seven species restricted to southwestern North America and distinguished by the key below. Descriptions of three new species follow the key. The terms *dorsal* and *ventral* are used synonymously with *abaxial* and *adaxial,* respectively. All descriptions are based on fully mature specimens:

Key to the Species of *Stylocline*

a. Longest palea scarious-winged for its full length, wing widest near or below middle of palea; phyllaries 2–4, slightly smaller than adjacent paleae, scarious throughout, persistent.
   b. Wing of largest palea broadly ovate, base round or cordate; ovaries of central florets vestigial, 0–0.2 mm long, pappus usually of 1–5 bristles; receptacle cylindric; heads shiny, appearing nearly glabrous, wool mostly concealed by the palea wings. ..... *S. gnaphaloides* Nutt.
   b′. Wing of largest palea elliptic to slightly obovate, base acute; ovaries of central florets partially developed, abortive, (0.2–)0.3–0.6 mm long, pappus usually of 6–12 bristles; receptacle slightly clavate; heads evidently and copiously woolly. ..... *S. citroleum* Morefield
a′. Longest palea scarious-winged only toward tip, wing widest well above middle of palea; phyllaries none, or 1–3, deciduous, either vestigial or partly sclerified.
   b. Receptacle strongly clavate, 2.8–3.5 times longer than wide; ovaries of central florets partially developed, abortive, 0.3–0.6 mm long; achenes 0.6–0.8 mm long; heads ± spheric, 3–4 mm wide; longest palea < 3.4 mm long; lowest leaves obtuse. ..... *S. sonorensis* Wiggins
   b′. Receptacle ± cylindric in outline, >3.5 times longer than wide; ovaries of central florets vestigial, 0–0.3(–0.4) mm long; either achenes > 0.8 mm long *or* heads ovoid to ellipsoid *or* heads 5–9 mm wide *or* longest palea 3.4–4.5 mm long *or* lower leaves acute.
      c. Heads spheric, largest 5–9 mm wide; longest palea 3.4–4.5 mm long, body sclerified or membranous; outermost paleae closed, copiously woolly; achenes variously compressed.
         d. Body of longest palea (except midvein) membranous, tearing easily and irregularly as wool is pulled or scraped; achenes laterally compressed; longest leaves subtending the heads mostly 11–17 mm long, awl-like to lanceolate. ..... *S. micropoides* A. Gray
         d′. Body of longest palea thickened and sclerified, splitting lengthwise if forced, wool easily scraped off; achenes dorsiventrally compressed; longest leaves subtending the heads mostly 4–10 mm long, elliptic to oblanceolate or obovate. ..... *S. intertexta* Morefield

c'. Heads ovoid to ellipsoid, 1.5–4 mm wide; longest palea < 3.4 mm long, body thickened, sclerified; outermost paleae open, glabrous or thinly woolly; achenes dorsiventrally compressed.
  d. Heads 2.5–4 mm wide; longest palea 2.8–3.3 mm long; achenes 1.1–1.6 mm long; central corollas 1.1–1.7 mm long, 5-lobed; leaves mostly acute. ..... *S. psilocarphoides* M. E. Peck
  d'. Heads 1.5–2.5 mm wide; longest palea 2.0–2.7 mm long; achenes 0.7–1.0 mm long; central corollas 0.8–1.1 mm long, mostly 4-lobed; leaves mostly narrowly obtuse. ..... *S. masonii* Morefield

Stylocline masonii Morefield, sp. nov. (Fig. 1).—TYPE: USA, California, Kern Co., plains W of Bakersfield, 30 Mar 1935, *H. L. Mason 8241* (holotype, UC 581167, in particular the upper-right-most mounted plant just below the fragment packet on the sheet; isotypes, DS, GH).

Styloclinae psilocarphoidi M. E. Peck (1945) similis, sed capitulis 1.5–2.5(non 2.5–4) mm latis; bracteis longissimis receptaculi 2.0–2.7(non 2.8–3.3) mm longis; acheniis exterioribus maturitate 0.7–1.0(non 1.1–1.7) mm longis; corollis centralibus 0.8–1.1(non 1.1–1.7) mm longis, plerumque quadrilobatis (non quinquelobatis); foliis plus minusve anguste obtusis (non acutis); ramis inferioribus foliosis (non efoliosis) inter furcas; et habitatione ad California centrali-occidentali (non deserta interiora orientaliora).

Stems to 10 cm long, branching above and usually at base; branches ± sympodial throughout or shortly monopodial at base, usually proliferating pseudo-dichotomously under the heads, ± evenly leafy below, usually ± leafless between the upper forks. Leaves mostly narrowly obtuse, tip herbaceous. Lowest leaves 2–3 mm long, ±0.5 mm wide, 1.5–3× as long as the internodes, ± imbricate, elliptic to oblanceolate. Middle leaves 5–9 mm long, ±1 mm wide, 1.5–2× as long as the internodes, linear to narrowly oblong or narrowly elliptic. Uppermost leaves 2–5 mm long, ±1 mm wide, shorter to barely longer than heads, linear-oblong to narrowly elliptic. Heads 2–5 per group, restricted to forks and tips of branches, 2–5 mm long, 1.5–2.5 mm wide, ovoid to ellipsoid, ± woolly. Receptacle 2–3 mm long, 0.3–0.4 mm wide, ± cylindric in outline, scars of paleae and florets elongate, peg-like, concentrated toward the base and tip of the receptacle. Phyllaries none, or 1–3, vestigial, unequal, scarious, deciduous, or a few of the outermost paleae sometimes not subtending florets and thus resembling phyllaries. Paleae in 4–5 series; body thickened and sclerified between the veins (splitting lengthwise if forced, any pubescence easily scraped off); wing terminal, narrowed and vestigial toward base, whitish to silvery. Outermost paleae each usually subtending a pistillate floret (sometimes empty), 1–2 mm long, open, concave, ± obovate; body dorsally glabrous or thinly woolly. Middle paleae 2.0–2.7 mm long; body lanceolate, its mass of wool broadly ± elliptic in outline; wing oblanceolate to obovate,

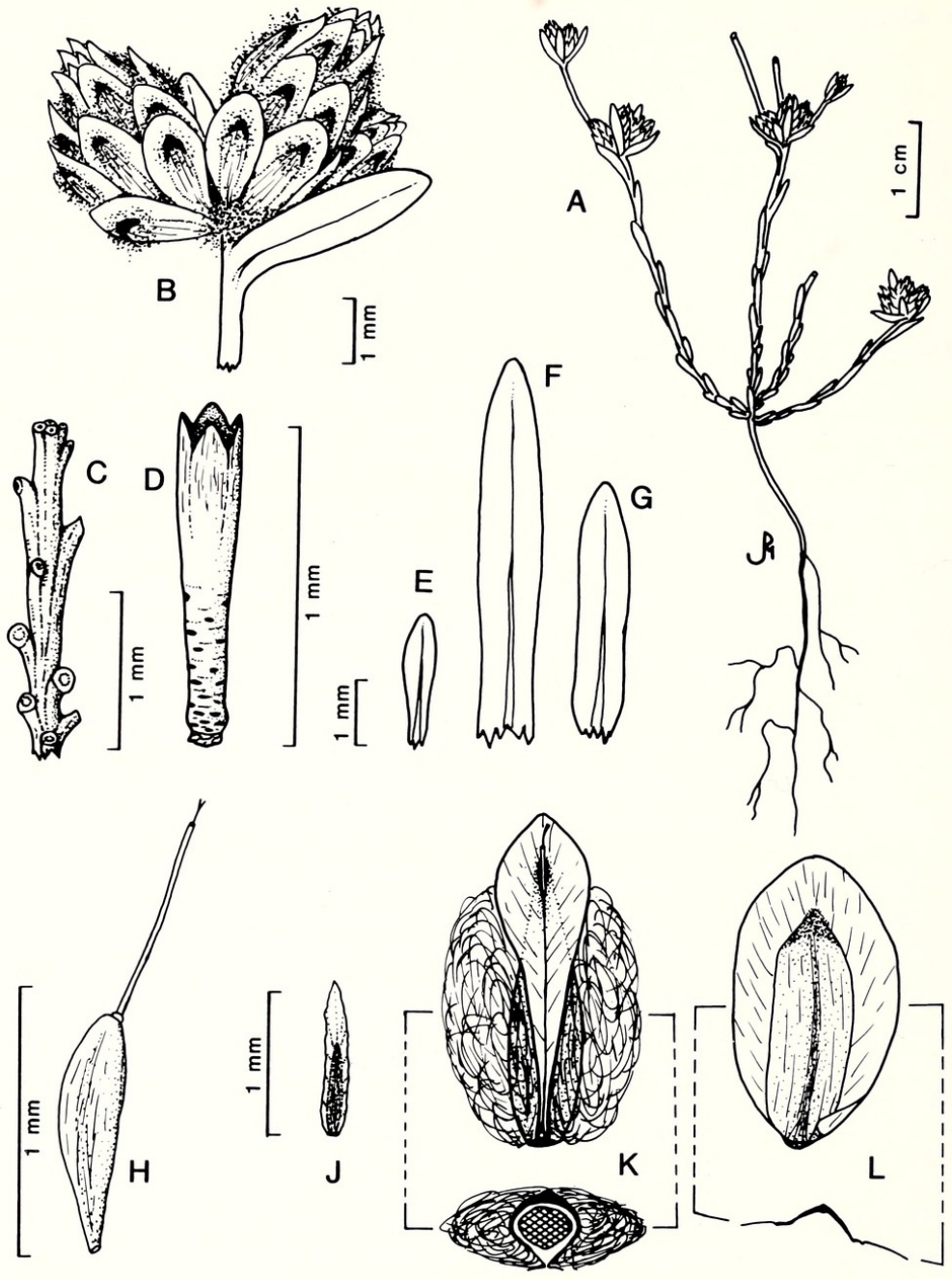

FIG. 1. *Stylocline masonii* (pubescence of stems and leaves not shown). A. Habit. B. Capitulescence. C. Receptacle. D. Central floret. E–G. Lower, middle, upperleaves. H. Lateral view of mature pistillate floret. J. Ventral view of innermost palea. K. Ventral view of middle palea with cross-section. L. Ventral view of outermost palea with cross-section.

obtuse, base acuminate. Innermost paleae 0.8–1.5 mm long, linear-lanceolate; body dorsally glabrous; wing acute. Pistillate florets in 3–4 series; corolla 3–4-denticulate; style branches 0.4–0.6 mm long; achenes 0.7–1.0 mm long, dorsiventrally compressed. Central florets 2–4; corolla 0.8–1.1 mm long, lobes mostly 4, yellowish to reddish-brown, throat whitish, tube maculate; style branches ±0.1 mm long, ± ovate; ovary vestigial, 0–0.1 mm long; pappus none, or of 1 smooth bristle 0.7–1.0 mm long.

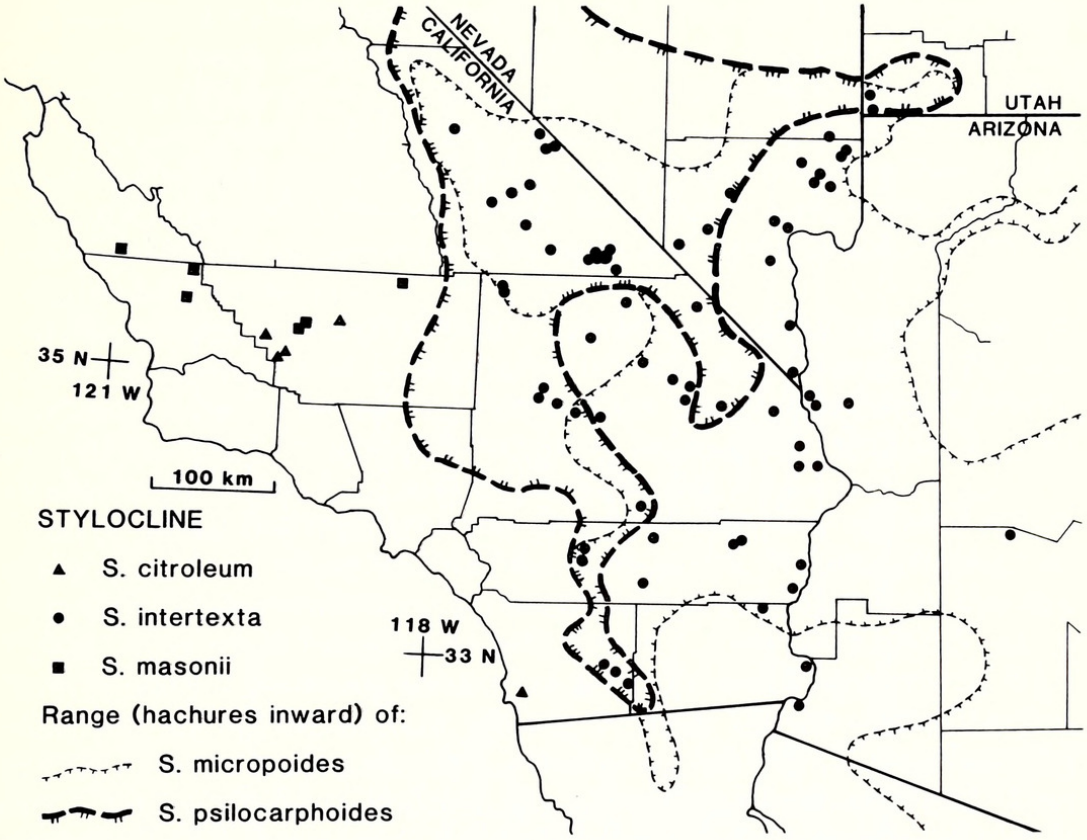

FIG. 2. Distributions of *Stylocline citroleum, S. intertexta,* and *S. masonii*; partial range outlines of *S. micropoides* and *S. psilocarphoides.*

PARATYPES: USA, California, Kern Co., plains W of Bakersfield, 30 Mar 1935, *Mason 8240* (UC); 5 mi W of Rosedale, 11 Apr 1937, *Hoover 1841* (JEPS); Sierra Nevada, Cyrus Canyon, scarce and scattered in light sandy soil in arid canyon bottom, California juniper association, 3900 ft, 26 Apr 1971, *Twisselmann 17572* (CAS). Monterey Co., Santa Lucia Mountains, sandy flat along San Antonio [River] near Pleyto, 29 Apr 1958, *Hardham 3092* (RSA). San Luis Obispo Co., Cholame Valley, 30 Mar 1935, *Mason 8252* (DS, UC); Commatti Canyon 11 mi S of Shandon, 16 May 1955, *Bacigalupi et al. 5126* (JEPS).

Distribution and habitat (Fig. 2). Known only from the above collections in west-central California; 100–400 (rarely to 1200) m. Dry, open sandy places (see further under *S. intertexta*). Last collected in 1971.

On average *Stylocline masonii* is the smallest and most inconspicuous species of *Stylocline,* and it is unclear whether the small number of specimens results from that fact or from genuine rarity of the species. To give it benefit of the doubt, rarity should be assumed until it can be disproven. Endangerment should also be assumed; visits to most of the known sites in 1989 revealed no plants (perhaps because of poor rains) but showed ample evidence of development or disturbance.

TABLE 1. COMPARISON OF *STYLOCLINE INTERTEXTA* WITH ITS PUTATIVE PARENTS, AND OF *S. MASONII* WITH *S. PSILOCARPHOIDES*. "Longest" = longest structure(s) found on each mature plant.

Character	*S. micropoides*	*S. intertexta*	*S. psilocarphoides*	*S. masonii*
Interforks of lower branches	leafy	leafy	± leafless	leafy
Tips of leaves	acute	acute	acute	obtuse
Shape of uppermost leaves	lanceolate	elliptic–obovate	elliptic–obovate	elliptic
Longest uppermost leaves (mm)	11–17	5–11	4–9	3–7
Shape of head	spheric	spheric	ovoid	ovoid
Width of largest head (mm)	5–9	5–6	2.5–4	1.5–2.5
Scars of receptacle	low	low	elongate	elongate
Longest palea (mm)	3.4–4.5	3.4–4.5	2.8–3.3	2.0–2.7
Outermost palea closure	complete	complete	none	none
Outermost palea texture	membranous	sclerified	sclerified	sclerified
Length of achene (mm)	1.0–1.3	1.0–1.4	1.1–1.7	0.7–1.0
Compression of achene	lateral	dorsiventral	dorsiventral	dorsiventral
Length of central corolla (mm)	1.2–1.9	1.1–2.3	1.1–1.7	0.8–1.1
Lobes of central corolla	5	5	5	4
Pappus bristles/central flower	(2)3–5(10)	0–4(8)	0–3	0–1
Distribution	Mojave/Sonoran/ Chihuahuan deserts	Mojave Desert	Mojave/Great Basin deserts	west-central California

Relationships. Although specimens of *S. masonii* were previously determined as *S. gnaphaloides,* with which it is wholly sympatric, its closest relative appears instead to be *S. psilocarphoides.* It resembles the latter, and is separated from the former, by its heads ovoid; outermost paleae open, concave, obovate; each middle palea thickened and sclerified between veins, its winged margin vestigial or much narrowed and acuminate at base; and achenes dorsiventrally compressed (Table 1).

Stylocline masonii differs from *S. psilocarphoides* primarily in the smaller dimensions of its reproductive structures given in the diagnosis and in Table 1. The two species are allopatric and nearly parapatric, with *S. masonii* occurring in habitats similar to, but wholly to the west of, *S. psilocarphoides* (Fig. 2).

Given its strong similarities to *S. psilocarphoides,* varietal status might have been more justified for *S. masonii.* No morphologic or geographic connection could be found between the two taxa, though. Unlike most other Filagininae (see under *S. intertexta* and *S. citroleum* below), *S. masonii* specimens are only rarely intermixed with other species on herbarium sheets. Among the 10 sheets (representing 7 collections) examined, one was mixed with *S. gnaphaloides* and *Filago californica* Nuttall; the remainder were unmixed. This suggests that *S. masonii* is relatively distinct morphologically and/or ecologically in the field.

The epithet honors Dr. Herbert L. Mason (1896–), whose discerning collections of North American Filagininae provide the majority of the material on which *S. masonii* is based and contribute substantially to our understanding of many other taxa as well.

Stylocline intertexta Morefield, sp. nov. (Fig. 3).—TYPE: USA, California, Inyo Co., north end of Ibex Hills, along N side of California Highway 178, 0.3 mile W of Salsberry Pass, T21N R5E sect. 15, 990 m, 7 May 1991, *J. D. Morefield 5445* (holotype, RSA; isotypes to be distributed, ASU, BRY, MO, NSMC, NY, UC, UNLV).

Styloclinae micropoidi A. Gray (1853) similis, sed bracteis longissimis receptaculi dorsaliter incrassateae et firmae (non membranaceae); acheniis dorsiventraliter (non lateraliter) compressis; et foliis supremis longissimis plerumque 4–10(non 11–17) mm longis, ellipticis oblanceolatisve obovatisve (nec lanceolatis nec lesiniformibus).

Stems to 11 cm long, branching above and usually at base; branches essentially sympodial but often very unequal and appearing monopodial, usually not proliferating pseudo-dichotomously under the heads, ± evenly leafy throughout or less so above. Leaves acute, tip mucronate. Lowest leaves 4–12 mm long, 1.5–2 mm wide, 2–3× as

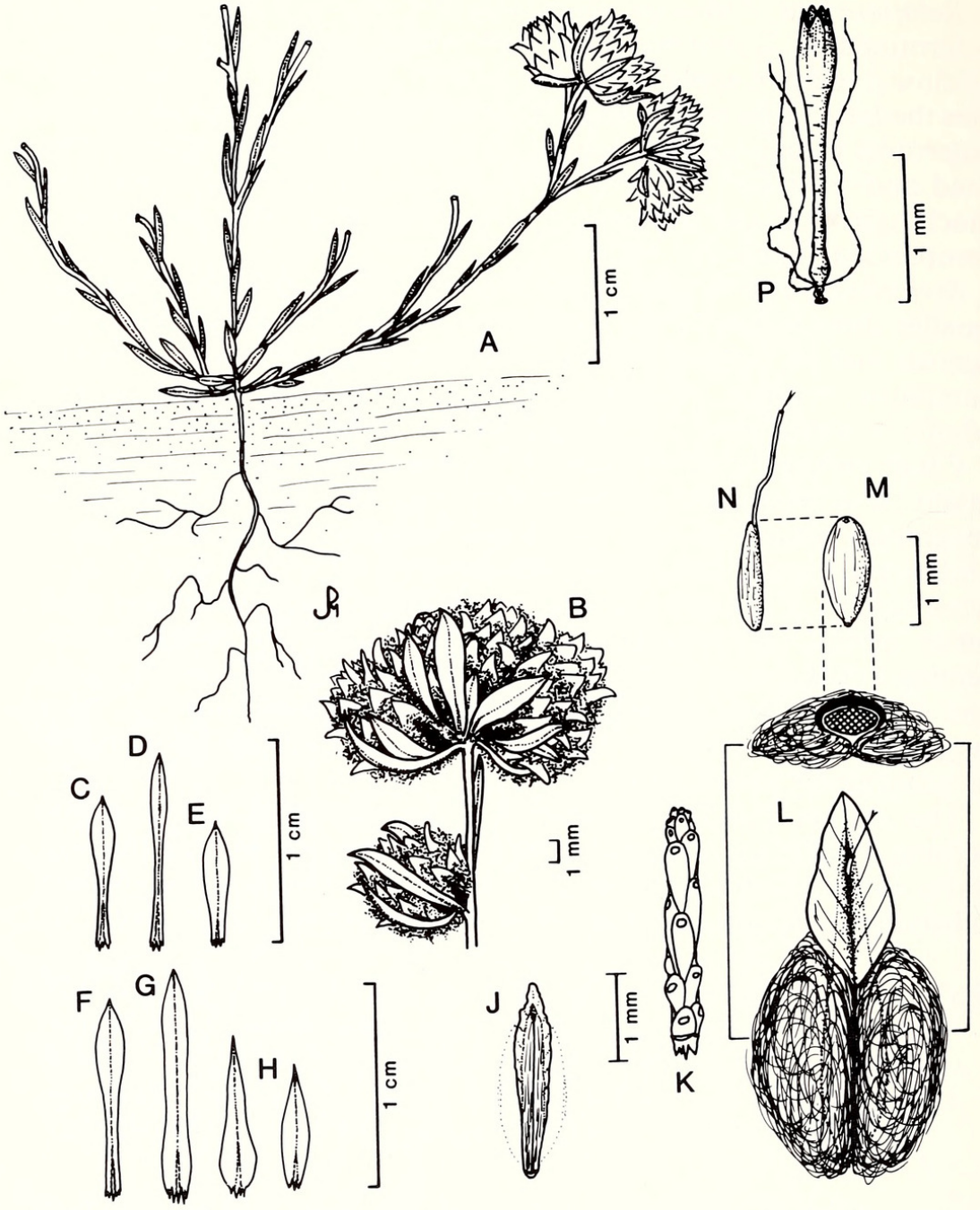

FIG. 3. *Stylocline intertexta* (except where stated otherwise; pubescence of stems and leaves not shown). A. Habit. B. Capitulescence. C–H. Lower, middle, upper leaves of *Stylocline intertexta* (C–E) and *Stylocline micropoides* (F–H). J. Ventral view of innermost palea. K. Receptacle. L. Ventral view of outer palea with cross-section. M. Ventral view of achene. N. Lateral view of achene. P. Central floret.

long as the internodes, ± imbricate, oblanceolate. Middle leaves 6–15 mm long, 1–1.5 mm wide, 1–2× as long as the internodes, narrowly oblanceolate. Uppermost leaves 4–11 mm long, 1–2.5 mm wide, shorter to barely longer than heads, elliptic to oblanceolate or obovate. Heads (1–)2–6 per group, mostly restricted to tips of branches, ± spheric, copiously woolly, the largest 5–6 mm in di-

ameter. Receptacle 1.4–2.7 mm long, 0.3–0.5 mm wide, ± cylindric in outline, scars of paleae and florets low, rounded, ± evenly distributed. Phyllaries none, or 1–3, vestigial, unequal, scarious, deciduous. Paleae in 5–7 series; body thickened and sclerified between the veins (splitting lengthwise if forced, pubescence easily scraped off), copiously woolly; wing terminal, narrowed and vestigial toward base, yellowish to silvery, broadly acute. Outermost and middle paleae similar, the longest 3.4–4.5 mm long; body lanceolate to ovate, the mass of dorsal wool ovate in outline; wing elliptic to ovate, base acute. Innermost paleae 1.5–2.5 mm long, linear to lanceolate or oblanceolate; body lanceolate, the mass of dorsal wool elliptic in outline or none. Pistillate florets in 4–6 series; corolla 4–5-denticulate; style branches 0.4–0.6 mm long; achenes 1.0–1.4 mm long, dorsiventrally compressed. Central florets 3–6; corolla 1.1–2.3 mm long, lobes 5, yellowish to reddish, throat and tube whitish; style branches ±0.1 mm long, ± ovate; ovary vestigial, 0–0.3 mm long; pappus of 0–4(–8) bristles 1.1–2.0 mm long, smooth to minutely and antrorsely barbellate.

PARATYPE: USA, Nevada, Clark County, along the Virgin River, 3.5 mi SW from Riverside Bridge, 12 airline mi SW of Mesquite, T14S R69E sect. 26, 457 m, 5 May 1975, *Holmgren and Holmgren 7873* (ASU, BRY, MONTU, NY, UTC, WTU).

Distribution and habitat (Fig. 2). Northern and eastern Mojave Desert, northern and western Sonoran Desert; 40–1400 m (averaging 590 m). In open, often barren places on stable, sandy or gravelly, frequently calcareous soils, intolerant of recent disturbance but often on older, stabilized disturbance, often near bases of rocks, in small drainages or depressions, or under drip-lines of shrubs. With minor variations, this habitat description applies to all other *Stylocline* species I have observed in the field.

Relationships. This previously undetected taxon may have obscured the presence of *S. psilocarphoides* in California (Morefield and Taylor 1988) by seeming to link the latter with *S. micropoides.* It appears to share the most character states with *S. micropoides* and the remainder with *S. psilocarphoides* (Table 1). This suggests that *S. intertexta* was derived either from a hybrid between the other two or from their common ancestor. The epithet *intertexta* suggests this recombination of traits, as well as its intermediate geographic distribution.

Stylocline intertexta is outwardly so similar to *S. micropoides* that at first I planned to treat both as varieties of a single species. The differences described above, though, are constant for all specimens examined. The two species will at first have to be separated carefully and with magnification, but this does not alter the fact that they are entirely separate. After some experience, the shorter, elliptic to ob-

lanceolate or obovate upper leaves of *S. intertexta* are easily separated in the field and herbarium from the larger, lanceolate to awl-shaped upper leaves of *S. micropoides* (Fig. 3).

Although *S. intertexta* occurs largely in the region of sympatry between its two putative parents (Fig. 2), it is clear from its abundance, broad range, frequent occurrence with neither or only one congener, and normally developed fruits and pollen, that it is now an independently reproducing species, whatever its origin may have been. Its present distribution may reflect retention of physiologic tolerances recombined from its parents.

Mixed collections of sympatric Filagininae seem the rule rather than the exception (Morefield 1988 and unpublished; Morefield and Taylor 1988). Of the 89 collections (represented by 122 sheets) of *S. intertexta* examined, 44 collections (49%) included sheets mixed with one or more additional taxa, including *S. micropoides* (found in 33 collections), *Filago depressa* A. Gray (15), *S. psilocarphoides* (8), *S. gnaphaloides* (2), *Filago californica* (1), and *S. sonorensis* (1). These numbers no doubt reflect some combination of the relative resemblance, and frequency of occurrence, of *S. intertexta* with each of the other taxa.

With *S. masonii* and *S. intertexta* recognized, *S. psilocarphoides* becomes a more clearly defined species centering in the western Mojave and Great Basin deserts (Fig. 2), extending northward to SE Oregon and SW Idaho. In California *S. psilocarphoides* has been misidentified most often as *S. micropoides* (Morefield and Taylor 1988) but has also been responsible for reports of *S. gnaphaloides* and *Filago arizonica* A. Gray from the northern and eastern Mojave Desert. *Stylocline gnaphaloides* is centered in the California Floristic Province (Hickman 1989), barely edges onto the California and Baja California deserts along the east slopes of the Tehachapi, Transverse and Peninsular ranges, and thence is disjunct to south-central Arizona and northern Sonora. *Filago arizonica* is similarly distributed, but is not known in California north of Riverside County.

Exsiccata (all collections early March to early May). USA, Arizona, Maricopa Co., *Palmer 603* (GH). Mohave County, *Jones s.n.*, 13 May 1884 (GH, POM); *Jones 3905* (ARIZ, NY, ORE, POM, UC); *Lemmon and Lemmon s.n.*, Apr 1884 (UC [2], US); *Mason 14240* (UC). Yuma Co., *Jones s.n.*, 25 Apr 1906 (POM).

California, county unknown, *Brandegee s.n.*, Apr 1905 (UC). Imperial Co., *McLaughlin and Bowers 2887, 2974* (ARIZ). Inyo Co., *Annable 566* (ARIZ, UNLV); *Boyd and Boyd 2007* (RSA, UCR); *Charlton and Pitzer 1678* (RSA); *Coville and Funston 673* (US); *Ferris et al. 4058* (DS); *Fosberg 5413* (PENN); *Gilman 1498* (US); *Gustafson and Herbst 2521a* (RSA); *Hall and Chandler 7049* (RM, UC); *Howell 3629* (CAS, JEPS); *Howell and True 49121* (CAS); *Jones s.n.*, 3 May 1897, 10 Apr 1907 (POM); *Keck and Ferris 5806*

(DS); *Neese and Welsh 12828* (BRY); *Parish 10091* (DS); *Peirson 7792* (DS); *Pinkava et al. 12554* (ASU); *Pinzl and Pinzl 4983* (NSMC); *Pitzer and Charlton 772* (UCR); *Raven 12113* (CAS, JEPS); *Stein 827* (MO); *Thorne et al. 42562* (RSA); *Tilforth and Dourley 747* (RSA); *Wright 1558a* (ORE, OSC). Riverside Co., *Boyd et al. 1316* (RSA), *2107* (RSA, UCR); *Boyd and Mistretta 1446* (RSA); *Hall 5917* (UC); *Ferris and Bacigalupi 13237* (JEPS), *13324* (DS, JEPS); *Mason 14208* (UC); *Munz 15688* (UTC); *Spencer 1629* (GH). San Bernardino Co., *Baldwin 112* (RSA); *Eastwood and Howell 8836* (CAS); *Ferris 12623* (DS); *Fosberg 5427* (PENN); *Gustafson and Keeley 2614* (RSA); *Hall 6150* (UC); *Hoffmann s.n.*, 16 May 1930 (SBBG); *Howell 3589* (CAS); *Jepson 17264* (JEPS); *Jones s.n.*, 2 May 1906 (POM); *Kellogg and Alexander 935* (K); *Liston and Zona 645-4* (RSA); *Mason 8233* (DS, GH, UC), *12248* (UC), *14236* (DS, UC), *14252* (SD); *Meebold 15517* (M); *Newlon 501* (JEPS); *Parish 9310, 10120* (DS); *Ripley and Barneby 3293* (CAS); *Sanders and Twitchell 166* (UCR); *Smith and Hansen 24* (FSC); *Wolf 3201* (RSA), *10215* (NY, RSA). San Diego Co., *Gander 176.44, 7117* (SD); *Jepson 8569* (JEPS).

Nevada, Clark Co., *Ackerman 3099* (UNLV); *Atwood and Thorne 11890* (BRY); *Bailey et al. 1914* (US); *Clokey 5961* (CM, DS, LL, NY, UC, WTU), *8610* (LL, NY, UC, US); *Kass and Neese 1549* (UNLV); *Kennedy 1120* (NESH); *Pinzl and Holland 2164, Pinzl 2557, 5051* (NSMC); *Pinzl and Knight 8189* (NSMC, RSA); *Swearingen 1025* (UNLV), *1409* (RSA); *Train 1425* (RENO). Lincoln Co., *Kennedy and Goodding s.n.*, 1906 (NESH).

Utah, Washington Co., *Neese 13026* (BRY); *Thorne et al. 4251A* (NY).

Stylocline citroleum Morefield, sp. nov. (Fig. 4).—TYPE: USA, California, Kern Co., flats at Taft, 2 Apr 1935, *P. A. Munz 13641* (holotype, POM 213346, in particular the upper-left-most mounted plant on the sheet; isotypes, DS, UC, UTC; all type sheets have *Filago californica* Nutt. intermixed).

Styloclinae gnaphaloidi Nutt. (1840) similis, sed bracteis receptaculi maturitate densius et copiosius lanatis, ambitu marginis scariosi elliptico vel parum obovato (non late ovato) et fundo acuto (nec cordato nec subcordato); ovariis flosculorum centralium evolutis ex parte, abortivis (non vestigialis), (0.2–)0.3–0.6(non 0–0.2) mm longis, setis pappi plerumque 6–12(non 1–5); receptaculo plus minusve clavato (non cylindrico); et foliis plerumque late acutis (non plerumque obtusis).

Stems to 13 cm long, branching above and at base; branches ± sympodial, often proliferating pseudo-dichotomously under the heads, ± evenly leafy below, mostly leafless between the upper forks.

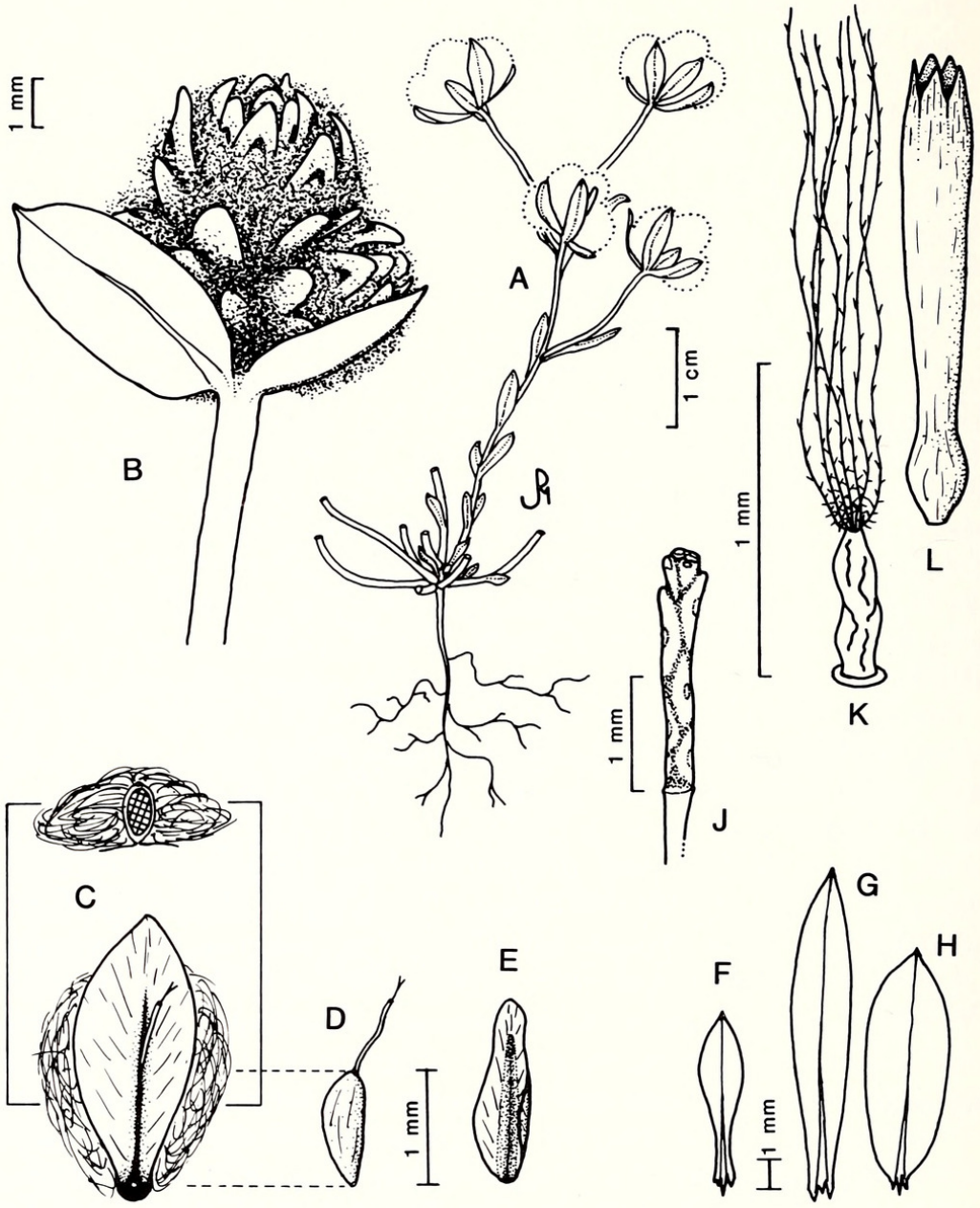

FIG. 4. *Stylocline citroleum* (pubescence of stems and leaves not shown). A. Habit. B. Capitulescence. C. Ventral view of middle palea with cross-section. D. Lateral view of achene. E. Ventral view of innermost palea. F–H. Lower, middle, uppermost leaf. J. Receptacle. K. Central floret with corolla removed. L. Central corolla.

Leaves ±1.5× as long as the internodes, broadly acute, tip mucronate. Lowest leaves 3–10 mm long, 1–2.5 mm wide, obovate. Middle leaves 6–13 mm long, 1–2 mm wide, oblanceolate. Uppermost leaves 4–12 mm long, 2–3.5 mm wide, shorter to barely longer than heads, broadly ± elliptic to oblanceolate. Heads 2–8 per group, mostly restricted to tips and forks of branches, 4–5.5 mm long, 3.5–5 mm wide, nearly spheric, copiously woolly. Receptacle 1.5–2.5 mm long, 0.3–0.5 mm wide, mostly narrowly clavate in outline, scars of paleae

and florets slightly sunken at maturity, ± evenly distributed. Phyllaries 2–4, 1.5–2.5 mm long, elliptic to obovate, narrowly obtuse, slightly unequal, scarious, dorsally woolly, ± persistent, resembling and apparently derived from the paleae (by loss of associated floret, reduction of body, and expansion of the scarious margin). Paleae in 5–7 series; body membranous except at the midvein (tearing easily and irregularly as pubescence is pulled or scraped); wing developed along the full length of the palea, yellowish to silvery, narrowly obtuse. Outermost and middle paleae similar, the longest 2.5–3.5 mm long; body elliptic to lanceolate, the mass of dorsal wool ovate in outline; wing elliptic to slightly obovate, acute at base. Innermost paleae 1–2.5 mm long, lanceolate. Pistillate florets in 4–6 series; corolla 3–5-denticulate; style branches 0.3–0.5 mm long; achenes 0.8–1.0 mm long, laterally compressed. Central florets 3–6; corolla 1.0–1.6 mm long, lobes 5, yellowish to brownish, throat and tube whitish; style branches 0.1–0.2 mm long, ovate to oblong; ovary partially developed, abortive, (0.2–)0.3–0.6 mm long, glabrous; pappus of (5–)6–12(–13) bristles, 1.4–1.8 mm long, densely spreading-hispidulous at base, sparsely antrorse-barbellate above.

PARATYPES: USA, California, Kern Co., Buena Vista Hills [near Taft], 9 Apr 1893, *Eastwood s.n.* (UC); McKittrick, clay soil, brushy country, 4 Apr 1932, *Jepson 16234* (JEPS); 2 mi from Bakersfield, Kern River Canyon Road, 11 Apr 1935, *Esau s.n.* (DAV). San Diego Co., San Diego, Apr 1883, *Cleveland s.n.* (SD).

Distribution and habitat (Fig. 2). Known only from the above collections in southwestern California; 60–320 m. Open sandy flats and clay soils, mostly in areas with high levels of surface petroleum. Last collected in 1935. *Stylocline citroleum* appears nearly restricted to areas of heavy petroleum production and other developments in the southern San Joaquin Valley and is almost certainly endangered, if not already extinct. The epithet is derived from the Latin *citer,* indicating proximity or nearness, and *oleum,* oil.

I have observed petroleum welling to the surface naturally near two of the known localities. *Stylocline citroleum* could be adapted to or even dependent on these unusual environmental conditions. Other cases of endemism on substrates with high petroleum content have been documented (O'Kane and Anderson 1987). On the other hand, the apparent preference for petroleum-producing areas may be an artifact of the few samples available.

Relationships. Stylocline citroleum shares the most character states with *S. gnaphaloides* (Table 2), as which it was identified in the five known collections. But certain features, especially increased development of the ovaries and pappus of the central florets, suggest hybrid origin involving a member of *Filago* subgenus *Oglifa.* The central florets of the latter have fully developed achenes and pappus.

TABLE 2. COMPARISON OF *STYLOCLINE CITROLEUM* WITH ITS PUTATIVE PARENTAL TAXA AND WITH *S. SONORENSIS*. Measurements are in mm.

Character	*S. gnaphaloides*	*S. citroleum*	*Filago californica*	*S. sonorensis*
Branching pattern	sympodial	sympodial	monopodial	sympodial
Tip of lowest leaves	obtuse	acute	acute	obtuse
Tip of uppermost leaves	obtuse	acute	acute	acute
Shape of uppermost leaves	obovate	elliptic	elliptic	elliptic
Shape of head	spheric	± spheric	ovate	± spheric
Phyllaries	present	present	absent	absent
Outermost palea closure	complete	complete	partial	complete
Outermost palea texture	membranous	membranous	sclerified	membranous
Innermost pistillate paleae	deciduous	deciduous	persistent	deciduous
Paleae of central florets	present	present	absent	present
Palea wing development	complete	complete	terminal	terminal
Palea wing base	± cordate	acute	acute	acute
Receptacle tip	cylindric	± clavate	much expanded	clavate
Receptacle length : width	6–7	5–6	0.7–0.9	2.8–3.5
Compression of achene	lateral	lateral	lateral	none
Central ovary development	none	partial	complete	partial
Central ovary length	0–0.2	0.2–0.6	0.7–0.9	0.3–0.6
Lobes of central corolla	5	5	4	5
Pappus bristles/central flower	1–4(–6)	(5–)6–12(–13)	19–23	(0)1–6(7)

Of the eight sheets of *S. citroleum* examined, five are mixtures with *Filago californica,* and one with *S. gnaphaloides. Filago californica* is thus suggested as the second parent and is also included in Table 2. The spotty, disjunct occurrences of *S. citroleum,* and its apparent restriction to highly disturbed areas, further support a hypothesis of recent and perhaps multiple hybrid origin (Anderson 1948).

The new taxon is treated as a species of *Stylocline* rather than a nothotaxon for the following reasons: 1) hybrid origin is unproven (studies are in progress), 2) a clear majority of its diagnostic character states unite it with *S. gnaphaloides* and the remainder of *Stylocline* (Table 2), 3) mature specimens possess normally-developed achenes that appear to have been once viable, and 4) the known specimens are highly uniform among themselves and occur in multiples on most sheets. These last three observations suggest that, even if *S. citroleum* arose from the products of one or more hybrid events, it has since become a uniform and independently reproducing entity. The disjunct locality in San Diego County could represent an independent hybrid origin of the taxon, or simply a fragmented distribution.

Stylocline sonorensis (Wiggins 1950) was known only from its holotype until recently (Morefield 1988). It is widely distributed in southeast Arizona and northeast Sonora, with one disjunct occurrence near Hayfields Dry Lake in the Sonoran Desert of Riverside County, California. Superficially it is very similar to *S. citroleum,* and shares with it the appearance of hybrid origin involving *Filago* (Table 2). In this case, though, frequencies of mixed collections suggest *S. micropoides* and *F. depressa* as possible parents.

As structurally unlikely as inter-plant pollination seems in most Filagininae, the new taxa recognized above suggest that rare hybridization events could have played a significant role in the origin of new species in *Stylocline.* If viable, the products of such events would be immediately both isolated from their parents and capable of reproducing independently. Studies at the molecular level are under way to test these possibilities.

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Literature Cited

Anderberg, A. A. 1989. Phylogeny and reclassification of the tribe Inuleae (Asteraceae). Canadian Journal of Botany 67:2277–2296.

———. 1991. Taxonomy and phylogeny of the tribe Gnaphalieae (Asteraceae). Opera Botanica 104:1–195.

Anderson, E. 1948. Hybridization of the habitat. Evolution 2:1–9.

Bentham, G. and J. D. Hooker. 1873. Genera plantarum ad exemplaria imprimis in herbariis kewensibus servata definita, Vol. 2, part 1. Lovell Reeve & Co., London.

Cronquist, A. 1950. A review of the genus *Psilocarphus*. Research Studies of the State College of Washington 18:71–89.

Gray, A. 1853. Plantae Wrightianae Texano-Neomexicanae. Part II. Smithsonian Contributions to Knowledge 5(part 6):1–119.

Hickman, J. C. (ed.) 1989. Introduction to the Jepson manual. Jepson Herbarium and Library, Berkeley.

Holmgren, P. K., N. H. Holmgren, and L. C. Barnett (eds.). 1990. Index herbariorum, part I: the herbaria of the world, 8th ed. Regnum Vegetabile 120:1–693.

Merxmuller, H., P. Leins, and H. Roessler. 1977. Inuleae—systematic review. Pp. 577–602 *in* V. H. Heywood, J. B. Harborne, and B. L. Turner (eds.), The biology and chemistry of the Compositae, Vol. I. Academic Press, London.

Morefield, J. D. 1988. Noteworthy collections of *Stylocline sonorensis* (Arizona, California). Madroño 35:278–279.

——— and D. W. Taylor. 1988. Noteworthy collections: California. Madroño 35: 164–166.

Nuttall, T. 1840. Decriptions of new species and genera of plants in the natural order of the Compositae, collected in a tour across the continent to the Pacific, a residence in Oregon, and a visit to the Sandwich Islands and Upper Caliifornia, during the years 1834 and 1835 [first part]. Transactions of the American Philosophical Society, new series 7:283–356.

O'Kane, S. L. and J. L. Anderson. 1987. *Penstemon debilis* (Scrophulariaceae): a new species from Colorado endemic to oil shale. Brittonia 39:412–416.

Peck, M. E. 1945. Some interesting plants of Malheur County, Oregon. Leaflets of Western Botany 4:177–186.

Wagenitz, G. 1972. Zur taxonomischen Stellung und Nomenklatur von *Micropus longifolius* (Compositae—Inuleae). Österreichische Botanische Zeitschrift 119: 399–403 [1971].

Wiggins, I. L. 1950. Taxonomic notes on plants from the Sonoran Desert. Contributions from the Dudley Herbarium 4:15–31.

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