

TAXONOMIC OVERVIEW OF THE *HETEROTHECA FULCRATA* COMPLEX (ASTERACEAE: ASTEREAEE)

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ABSTRACT

Heterotheca fulcrata (Greene) Shinnars has recently been treated as comprising four broadly sympatric varieties. These plants are viewed here as four species, corresponding in part to the varietal taxa: (1) *Heterotheca fulcrata* (including *H. fulcrata* var. *senilis* and *H. fulcrata* vars. *fulcrata* and *amplifolia* in part, sensu Semple), (2) *Heterotheca foliosa* (Nutt.) Shinnars (including *H. fulcrata* vars. *fulcrata* and *amplifolia* in part, sensu Semple), (3) ***Heterotheca arizonica*** (Semple) Nesom, comb. et stat. nov. (= *H. fulcrata* var. *arizonica*), and (4) ***Heterotheca nitidula*** (Woot. & Standl.) Nesom, comb. nov., endemic to the Mogollon Mountains of southwestern New Mexico and White Mountains of immediately adjacent Arizona, previously treated as a synonym primarily of *H. fulcrata* var. *amplifolia*. County-level distribution maps for these taxa are provided (based on collections examined in the current study). *Heterotheca viscida* (Gray) Harms is included in the consideration because it is similar in geographic range to *H. arizonica* and occasionally confused with that taxon and expressions of *H. fulcrata*. *Heterotheca zionensis* Semple is recognized as a distinct species essentially as previously treated by Semple, but it is here observed to occur more widely in New Mexico and to extend into trans-Pecos Texas.

RESUMEN

Heterotheca fulcrata (Greene) Shinnars ha sido recientemente tratada como poseedora de cuatro variedades ampliamente simpátricas. Estas plantas son consideradas aquí como cuatro especies, correspondientes en parte a los taxa varietales: (1) *Heterotheca fulcrata* (incluyendo *H. fulcrata* var. *senilis* y *H. fulcrata* vars. *fulcrata* y *amplifolia* en parte, sensu Semple), (2) *Heterotheca foliosa* (Nutt.) Shinnars (incluyendo *H. fulcrata* vars. *fulcrata* y *amplifolia* en parte, sensu Semple), (3) ***Heterotheca arizonica*** (Semple) Nesom, comb. et stat. nov. (= *H. fulcrata* var. *arizonica*), y (4) ***Heterotheca nitidula*** (Woot. & Standl.) Nesom, comb. nov., endémica de las Mogollon Mountains del suroeste de Nuevo México y White Mountains en la adyacente Arizona, previamente tratada como sinónimo de *H. fulcrata* var. *amplifolia*. Se aportan mapas de distribución a nivel de condado de estos taxa (basados en las colecciones examinadas en el presente estudio). *Heterotheca viscida* (Gray) Harms está incluida en las consideraciones porque es similar en rango geográfico a *H. arizonica* y ocasionalmente confundida con ella y ejemplares de *H. fulcrata*. *Heterotheca zionensis* Semple se reconoce como una especie distinta tal como fue tratada previamente por Semple, pero aquí se ha observado que aparece ampliamente en Nuevo México y se extiende por los trans-Pecos en Texas.

Heterotheca fulcrata (Greene) Shinnars has been treated by Semple (1996, 2006) as comprising four strongly sympatric varieties. My approach to the taxonomy of *Heterotheca* (Nesom 1997, 2006) is different from that of Semple and the current study documents a different taxonomic interpretation of the *H. fulcrata* group. *Heterotheca fulcrata* sensu Semple is treated here as four separate species; *H. viscida* (A. Gray) Harms is included in the consideration because it is similar in geographic range and occasionally confused with expressions of *H. fulcrata*. *Heterotheca zionensis* Semple also is included, though not closely related to *H. fulcrata*, to document an increased understanding of its identity.

The current study is based primarily on study of collections from ASU, BRIT-SMU, NMC, MO, SJNM, SRSC, and TEX-LL. Distribution maps are based on specimens examined.

KEY TO THE SPECIES OF THE *HETEROTHECA FULCRATA* GROUP AND *H. VISCIDA*

1. Leaves 5–15(–20) mm long, 2–5(–7) mm wide, with a thick-indurate, sharp-pointed, often recurving terminal mucro _____ ***Heterotheca arizonica***
1. Leaves 15–40 mm long, 3–20(–25) mm wide, without a thick-indurate terminal mucro.
 2. Heads not immediately subtended by foliar bracts; glands usually stipitate _____ ***Heterotheca viscida***
 2. Heads immediately subtended by foliar bracts; glands present or absent, usually sessile if present.
 3. Plants eglandular; nonglandular hairs very thin, with all cells equal in width, appressed, stem hairs appressed to closely ascending _____ ***Heterotheca nitidula***

3. Plants usually glandular; sometimes sparsely so; nonglandular hairs relatively thicker, with expanded basal cells, spreading or arching erect, stem hairs spreading or often deflexed.
4. Midstem cauline leaves (10–)15–30 mm long, 3–7(–10) mm wide, mostly oblong to oblanceolate-oblong or lanceolate-oblong _____ ***Heterotheca fulcrata***
4. Midstem cauline leaves 25–60 mm long, (5–)10–18 mm wide, mostly oblanceolate-obovate _____ ***Heterotheca foliosa***

***Heterotheca fulcrata* sensu stricto**

Heterotheca fulcrata (Greene) Shinnars, as treated here, is recognized by its heads immediately subtended by foliar bracts, the bracts prominently ciliate with coarse, spreading hairs. Stems are densely hirsute-villous. The range of the species extends from north-central Mexico into Texas, southern New Mexico, Arizona, and Utah (Fig. 1), exclusive of the population system in Colorado and Wyoming mapped by Semple as *H. fulcrata*. The latter are treated here as *H. foliosa* (Nutt.) Shinnars (see below).

From typical *Heterotheca fulcrata*, Semple differentiated *H. fulcrata* var. *senilis* (Woot. & Standl.) Semple by “distal margins of uppermost leaves with numerous long hispid-strigose hairs” [var. *senilis*] vs. “leaf margins of upper leaves lacking long hairs or [with] only a few basally” [var. *fulcrata*] (1996, p. 28, key couplet 17). The types of both taxa were collected in the Organ Mountains of Dona Ana Co., New Mexico, and variability within the species accounts for the difference in vestiture. ‘Senilis’-like plants are the common form in Arizona, New Mexico, Texas, and Mexico; bract and leaf margins become less coarsely and densely ciliate northward, but there does not appear to be a discontinuity. Some plants of *H. fulcrata* from this area show reduced nonglandular vestiture on the leaf faces (e.g., the type of *Chrysopsis cryptocephala*, below), while others produce denser nonglandular vestiture. Analogous variation in density of nonglandular vestiture occurs in Colorado and Wyoming populations of *H. foliosa* (comments below). Plants identified as *H. fulcrata* from northern Utah (i.e., Cache, Duchesne, Salt Lake, Summit, Utah, Wasatch counties) perhaps represent a distinct, separately evolved population system; compared to typical, southern populations of *H. fulcrata*, these plants occur at significantly higher elevations and consistently are more glandular with reduced nonglandular vestiture.

Heterotheca fulcrata (Greene) Shinnars, Field & Lab. 29:71. 1951. *Chrysopsis fulcrata* Greene, Bull. Torrey Bot. Club 25:119. 1898. TYPE: U.S.A. NEW MEXICO. LINCOLN CO.: White Mts., near Cherokee Bill’s Spring, 6300 ft, 21 Aug 1897, E.O. Wooton 511 (LECTOTYPE, Shinnars 1951: ND-G; ISOLECTOTYPES: NY, NY [internet image!], US [internet image!]).

From among ND-G syntypes Wooton 510, 511, and 512, Shinnars (1951) selected 511 as the lectotype. Harms (1968a, p. 17) entered a caveat, noting that “This choice causes some confusion since Wooton and Standley (1913, 1915) obviously considered the first cited specimen, Wooton 510 from the Organ Mountains, as the true type of *C. fulcrata*, and their subsequent descriptions of *C. cryptocephala* and *C. senilis* seem based upon this understanding.” Wooton 512 was cited as a paratype in the protologue of *C. cryptocephala*, but there was never an explicit or formal statement by Wooton and Standley regarding lectotypification of *C. fulcrata*. Semple (1987) stated that “I consider all three Wooton syntype collections to be members of [*Heterotheca fulcrata*] var. *fulcrata* and accept Shinnars’ lectotype designation, Wooton 511 (ND-G).” Semple’s 1987 position is affirmed here and Shinnars’ choice appears to remain valid, notwithstanding Semple’s later citation (1996, pp. 68, 70) and 1995 and 1997 annotations (e.g., NY, US) of 510 as lectotype, in which he apparently accepted Harms’ implication that the original lectotypification was made implicitly by Wooton and Standley.

Chrysopsis senilis Woot. & Standl., Contr. U.S. Natl. Herb. 16:179. 1913. *Heterotheca fulcrata* (Greene) Shinnars var. *senilis* (Woot. & Standl.) Semple, Brittonia 39:380. 1987. TYPE: U.S.A. NEW MEXICO. Dona Ana Co.: Organ Mts., 4800 ft, 1 Sep 1897, E.O. Wooton 509 (HOLOTYPE: US [internet image!]; ISOTYPES: MIN, MO!, NDG, NY [internet image!]).

Chrysopsis cryptocephala Woot. & Standl., Contr. U.S. Natl. Herb. 16:179. 1913. TYPE: U.S.A. NEW MEXICO. [Lincoln Co.]: White Mts., V Pasture, sect. 23, 23 Jul 1905, E.O. Wooton s.n. (HOLOTYPE: US [internet image!]; ISOTYPE: US).

Status of *Chrysopsis nitidula*

Populations recently identified mostly as *Heterotheca fulcrata* in the Mogollon Mountains of southwestern New Mexico and White Mountains of immediately adjacent Arizona (Fig. 1) are recognized here as a separate species, originally described as *Chrysopsis nitidula* Woot. & Standl. The protologue noted that the leaf surfaces are “finely sericeous, the leaf as a whole appearing green and remarkably soft and smooth; ... This is very unlike any of our other species, being strongly marked by its peculiar pubescence and long rays [10–12 mm long].” Compared to *H. fulcrata*, the leaves of *H. nitidula* also tend to be narrow and elongate with acute apices.

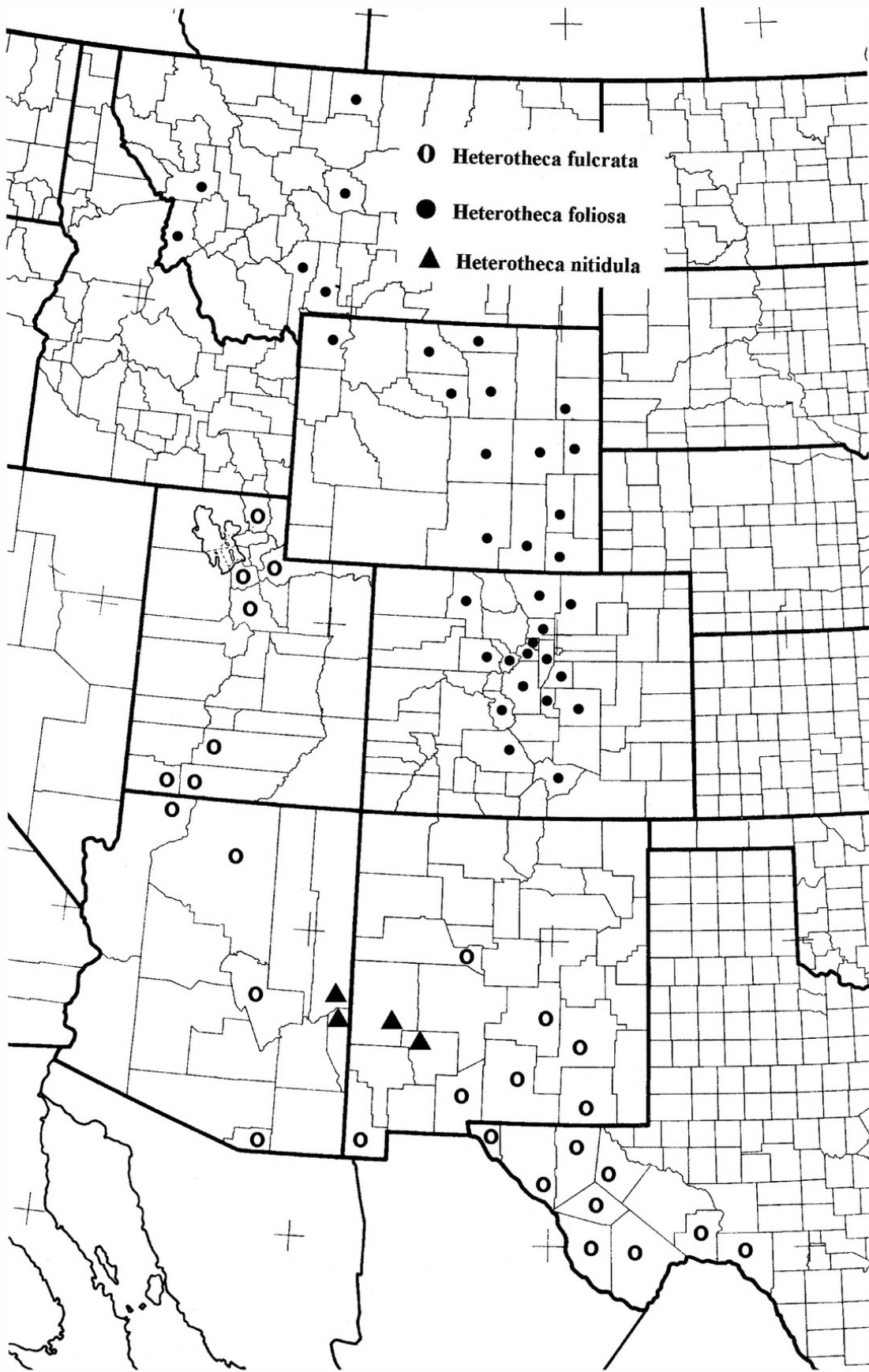


FIG. 1. Geographic range of *Heterotheca fulcrata*, *H. foliosa*, and *H. nitidula*. See text for specimen citations for *H. nitidula*.

Heterotheca nitidula (Woot. & Standl.) Nesom, comb. nov. *Chrysopsis nitidula* Woot. & Standl., Contr. U.S. Natl. Herb. 16:179. 1913. TYPE. NEW MEXICO. "SOCORRO Co.:" Mogollon Mts., on or near the West Fork of the Gila River, 7500 ft, 20 Aug 1903, O.B. Metcalfe 552 (HOLOTYPE: US [internet image!]; ISOTYPES: GH, MO!, NMC!, RM). Redefined county boundaries now place the type locality in Catron County.

Diagnostic description of *Heterotheca nitidula*: Stems 10–35 cm tall, arching upward from the base, antrorsely strigillose. Cauline leaves mostly narrowly oblanceolate, 3–5.5 cm long, 3–8 mm wide, attenuate to the base, apices acute. Heads solitary or usually in clusters of 2–6, usually immediately subtended by lanceolate foliar bracts. Stems, leaves, bracts, and phyllaries eglandular, sparsely to moderate strigillose with nonglandular vestiture of extremely thin, slightly flexuous, closely appressed hairs 0.5–1.5 mm long, without enlarged basal cells; leaves eciliate or with a few weak, spreading cilia along the proximal margins; foliar bracts eciliate to ciliate. Heads on some plants of the type collection are pedunculate, lacking foliar bracts, but bracteate heads are the normal condition for the species, hence the association with *H. fulcrata*.

Numerous collections of *Heterotheca nitidula* have been made since its original description—all are consistent in morphology and all occur within a radius of 35–40 miles. Its geographic range apparently lies within that of *H. fulcrata* (Fig. 1), but no collections of typical *H. fulcrata* have been examined from within the range boundary of *H. nitidula*. *Heterotheca nitidula* occurs at elevations of (7000–)7400–9200 feet; *H. fulcrata* occurs at 4600–6900(–8000) feet in Texas, 2100–7200 feet in New Mexico, and 4900–7100(–8700) feet in Arizona. Plants of *H. nitidula* grow on open rocky slopes and flower Aug–Sep(–Oct). A diploid chromosome number ($2n = 18$) has been documented for *H. nitidula* by Semple (see citation for Semple & Heard 8021, below) and Turner (Turner 5700).

The holotype of *Chrysopsis nitidula* was annotated by Semple in 1985 as *Heterotheca villosa* var. *pedunculata*. In 1995, he re-annotated the specimen as *H. fulcrata* var. *amplifolia*, and later (1996, 2006) he cited *C. nitidula* as a synonym of the latter. NMC specimens of *H. nitidula* were annotated by Semple as *H. fulcrata* var. *fulcrata* and as *H. fulcrata* var. *amplifolia*. Similarly, Semple (1996) cited "Rusby 168 (MIN, NY(3), PH)" under three different taxa: *H. fulcrata* aff. var. *fulcrata* (p. 74), *H. fulcrata* var. *amplifolia* (p. 76), and *H. villosa* aff. var. *pedunculata* (p. 126). A duplicate of the same collection (Rusby 168, MO!) is identified here as *H. nitidula* (as cited below).

Additional collections examined: **ARIZONA. Apache Co.:** Apache Natl. Forest, Mount Baldy area, W Fork Little Colorado River, parking area off State Rd 273, locally abundant in dry grassland, 2787 m, 21 Sep 1998, Brant & Stone 4128 (MO, TEX); White Mts., 6–15 Aug 1903, Griffiths 5329 (MO); along Forest Rd 275 in Stone Creek drainage, above stream in gravelly soil, 8000 ft, 11 Aug 1998, Hammond 11478 (TEX); White Mts., dry road shoulders, 8500 ft, 15 Aug 1973, Moldenke 27846 (LL); near Greer, 8300 ft, 19 Aug 1935, Peebles 12555 (LL); E edge of Alpine on US 180, road embankment, red shale substrate, limber pine forest, 8030 ft, 19 Sep 1985, Semple & Heard 8021 [voucher $2n = 18$] (BRIT); 12 mi N of Alpine, common in roadside cuts, 13 Aug 1967, Turner 5700 [voucher $2n = 18$] (TEX); Sitgreaves Natl. Forest, 5.4 mi S of jct US 666 and US 180 on 666, E of road in meadow, 15 Aug 1978, Warnock 1677 (TEX). **Greenlee Co.:** Apache Natl. Forest, 10 mi E of Big Lake on Forest Rd 249 and 8 mi from Alpine, near turnoff to Sierra Blanca and on hillside above lake in rocky soil, open areas in spruce forest, 8900 ft, 16 Aug 1972, Hess 2937 (SMU). **NEW MEXICO. Catron Co.:** Mogollon Mts., Gila Natl. Forest, Indian Creek drainage and Bear Wallow Mt., common perennial on E-facing slope and drier areas, 1 ft tall, 9200 ft, 4 Sep 1968, Hess 2394 (NMC, SMU); Mogollon Mts., 1.4 road mi N of Gilita Campground, ponderosa pine, ca. 8100 ft, 7 Sep 1978, Moir & Fitzhugh s.n. (NMC); Mogollon Mts., high rocky summits, 7 Sep 1881, Rusby 168 (MO); Gila Natl. Forest, 13 mi straight line NNE of Beaverhead Ranger Station, near NM 163 and FS 150, montane grassland and pinon-juniper woodland, SW-facing slope, sandy, rocky ashflow, 7500 ft, 3 Oct 1995, Williams 2600 (NMC). **"Socorro Co.:"** Middle Fork of Gila, 7500 ft, 5 Aug 1900, Wooton s.n. (NMC). **Sierra Co.:** Taylor Creek, ca. 14 air mi E of Beaverhead, rocky S-facing slope with ponderosa pine, 7400 ft, 14 Aug 1982, Spellenberg et al. 6598 (NMC).

Identity of *Heterotheca foliosa*

Harrington (1954) divided Colorado *Heterotheca* with prominent foliar bracts subtending the heads between *H. fulcrata* ("involucres sparingly to definitely glandular") and *H. foliosa* (Nutt.) Shinners in part ("involucres pubescent but the glands obscure or none"). Wyoming plants were similarly identified in Dorn's key (2001). Weber and Wittmann (1990) identified these plants primarily as *H. fulcrata* but later (1996) called them *H. foliosa*, noting that the name *H. fulcrata* would be incorrectly applied.

Semple (1996, 2006) treated most of the same plants within *Heterotheca fulcrata*—some as var. *fulcrata* ("sparsely to moderately glandular") and some as var. *amplifolia* ("glandless or nearly so"). Regarding distinc-

tive features of *H. foliosa* (treated by him as *H. villosa* var. *foliosa*), he noted (1996, p. 117–118) that its “upper stem leaves ... are oblong ... and its heads ... are often subtended by narrow oblanceolate bracts.” His key couplet 15 (1996, pp. 28–29) separated *H. fulcrata* from *H. villosa* with foliar-bracteate heads by the shape of the bracts—*H. fulcrata* with ovate-lanceolate bracts, *H. villosa* var. *foliosa* with oblanceolate to linear-oblanceolate bracts. Even as identified and annotated by Semple, however, variation in bract shape exists in plants that otherwise are clearly referable to the *H. fulcrata* var. *fulcrata-amplifolia* forms.

Among the plants in Colorado and southern Wyoming with bracteate heads, there is a tendency for sessile glands to be abundantly developed on all parts and for nonglandular hairs to be reduced in density. Such green-glandular plants are typified by *Chrysopsis resinolens* A. Nels. (see below). At the other extreme, leaves and stems are eglandular or nearly so and distinctly grayish-strigose with denser nonglandular vestiture (e.g., *Chrysopsis amplifolia* Rydb.). Intermediates in vestiture are common (as noted also by Semple 2006); glands may be absent on the leaves but present on the foliar bracts. If two taxa are distinguished on the basis of vestiture, the resulting two are similar in variability of leaf shape and size and in variability of size and shape of foliar bracts. Further, they are ecologically similar and their geographic ranges are congruous (see Semple 1996, Fig. 28, A and B) and disjunct from other taxa of the *Heterotheca fulcrata* complex (Figs. 1, 2). Their treatment here as a single taxon, *Heterotheca foliosa*, emphasizes the (1) geographic and ecological coherence of the extended population system and its disjunction from related ones, and (2) intergradation in vestiture and apparent impossibility of identifying more than a single entity without relying on a typological concept.

The geographical coherence of *Heterotheca foliosa* in Colorado and Wyoming, also as recognized by Semple (1996) in his identification of *H. fulcrata* in that region, substantiates its evolutionary coherence. As identified here, the range of *H. foliosa* extends into southwestern Montana (Fig. 1), slightly further north and west than mapped by Semple for *H. fulcrata* in the Rocky Mountains. Semple indicated the geographic range of *H. villosa* var. *foliosa* to continue southward (into New Mexico) and much further north and west (into Idaho, Oregon, Washington, and Canada), but as in my previous study (Nesom 2006), most plants identified and mapped by Semple as *H. villosa* var. *foliosa* are regarded here as variants within *H. villosa* var. *villosa*.

The morphological distinction of *Heterotheca foliosa* from *H. fulcrata* sensu stricto is not great, but they differ conspicuously in leaf size, as noted in the key above. Further, as treated here, the two are geographically disjunct and appear to have different ecological tendencies. Closely similar but allopatric population systems are often treated as conspecific, but recognition of both taxa at specific rank also is justified, here emphasizing the differentiation and disjunction.

Heterotheca foliosa (Nutt.) Shinn. & Wieg. 1951. *Heterotheca villosa* var. *foliosa* (Nutt.) Harms, Wrightia 4:15. 1968. *Chrysopsis villosa* var. *foliosa* (Nutt.) Cronq., Bull. Torrey Bot. Club 74:150. 1947. *Chrysopsis foliosa* Nutt., Trans. Amer. Philos. Soc. 2, 7:316. 1841. TYPE: U.S.A. [Wyoming.] “In the Rocky Mountain plains, near the banks of the Platte. Flowering in August” [protologue], [Jun 1834], T. Nuttall s.n. (HOLOTYPE: K; ISOTYPES: GH 2 sheets). Nuttall, with Wyeth’s expedition, crossed the North Platte River in southern Wyoming in June 1834, probably in Carbon County. If the collection of *Chrysopsis foliosa* were made in June, the nature of his reference to “Flowering in August” is not clear, but perhaps he observed that full flowering would be reached by that month. Nuttall’s description of *C. foliosa*, especially features of the leaves, clearly aligns it with the present concept of the taxon: “About foot high, sending up many hairy stems from the same root. Nearly allied to *C. villosa* but far more pubescent and hoary, with the leaves widest at the base. ... sericeously villous, and more or less canescent ... flowers fastigate, corymbose; leaves entire, oblong or oblong-ovate, subamplexicaule”

Chrysopsis resinolens A. Nels., Bull. Torrey Bot. Club 28:232. 1901. TYPE: U.S.A. WYOMING. Albany Co.: Moist mountain valleys, Laramie Peak, 13 Jul 1900, A. Nelson 7583 (HOLOTYPE: RM; ISOTYPES: GH, MIN, MO!, NY 2 sheets [internet images!], RM, US [internet image!]). The protologue notes for the habitat and locality: “open slopes in the foothills of Laramie Peak.” A handwritten label (NY 163187) notes “Open, grassy slopes, Laramie Peak,” while printed labels (NY 163216, RM, US) note “Moist mountain valleys, Laramie Peak.” Nelson’s collection book has “In the open valleys.” Other label information is identical among the specimens. The plants are similar in morphology and plausibly from the same gathering.

Chrysopsis resinolens var. *ciliata* A. Nels., Bull. Torrey Bot. Club 28:233. 1901. *Chrysopsis viscida* var. *ciliata* (A. Nels.) Blake in Tidestrom, Contr. U.S. Natl. Herb. 25:537. 1925. TYPE: U.S.A. WYOMING. Albany Co.: sandy river bottoms, Dunn’s Ranch, 16 Jul 1900, A. Nelson

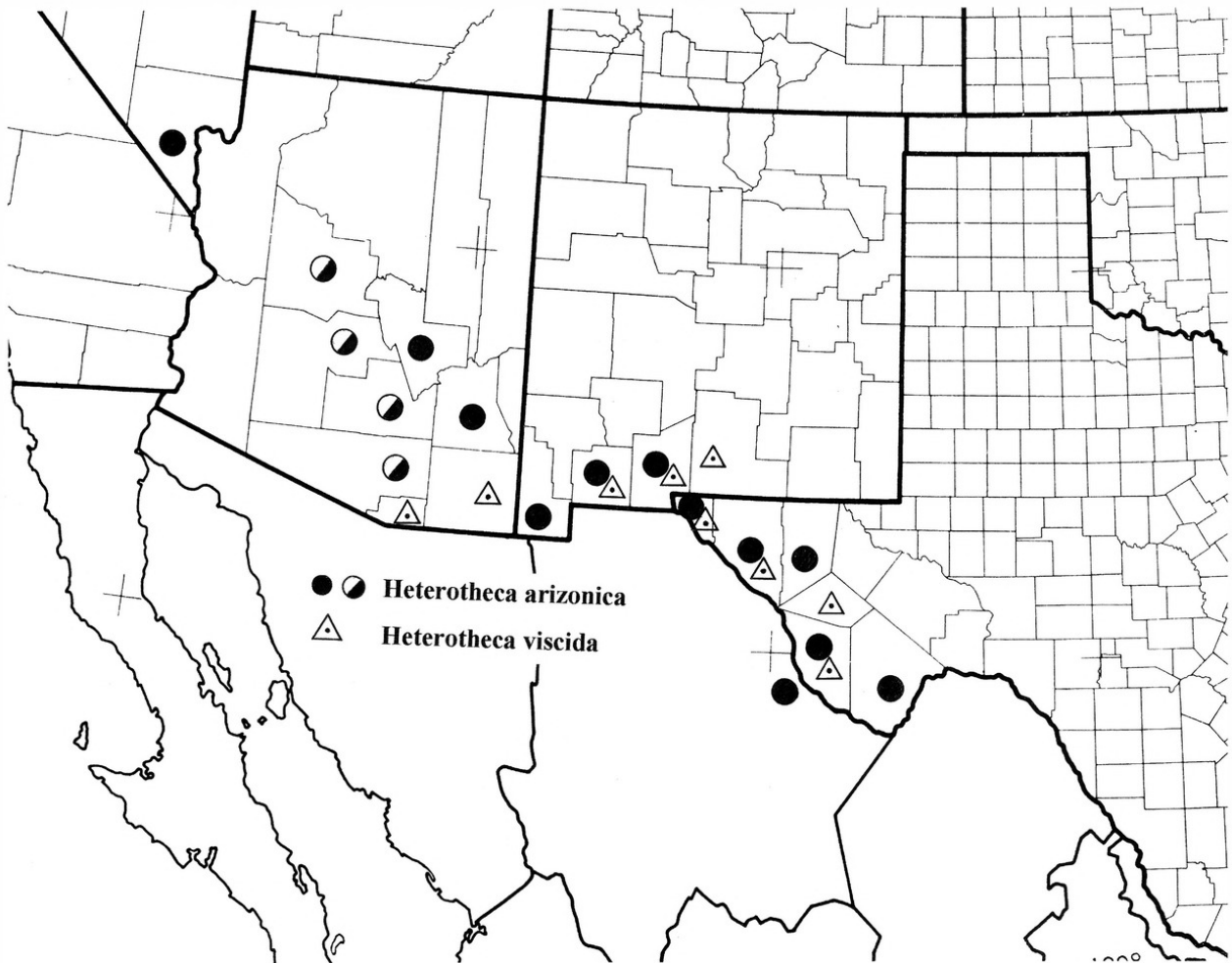


Fig. 2. Geographic range of *Heterotheca arizonica* and *Heterotheca viscida*. Half-filled circles are added from Semple (1996).

7566 (HOLOTYPE: RM; ISOTYPE: NY [internet image!]). “Nelson 7560” is the collection number cited in the protologue, and the NY isotype is labeled as “7560 n. var.” on a label (ex Rocky Mountain Herbarium) apparently handwritten by Nelson. The RM specimen, however, is labeled 7566 and Nelson’s original notes state that 7566 = *Chrysopsis resinolens* var. *ciliata*; Nelson 7560 is listed as a moss (*Mnium serratum*). Thus the collection number in the protologue as well as the label on the NY collection are interpreted as resulting from errors in transcription.

Chrysopsis amplifolia Rydb., Bull. Torrey Bot. Club 31:648. 1904. *Chrysopsis foliosa* var. *amplifolia* (Rydb.) A. Nels. in Coult. & Nels., Man. Bot. Rocky Mts. 5493. 1909. *Heterotheca fulcrata* var. *amplifolia* (Rydb.) Semple, Univ. Waterloo Biol. Ser. 37:74. 1996. TYPE: U.S.A. COLORADO. [Boulder Co.:] Plains and foothills near Boulder, Longmont, Jul 1902, F. Tweedy 4898 (HOLOTYPE: NY [internet image!]; ISOTYPE: RM).

Chrysopsis caudata Rydb., Bull. Torrey Bot. Club 31:648. 1904. TYPE: U.S.A. COLORADO. [El Paso Co.: Pike’s Peak,] Ruxton Dell, 2950 m, 2 Aug 1901, F.E. & E.S. Clements 143 (HOLOTYPE: NY [internet image!]; ISOTYPES: DH, GH, MIN, MO!, RM, US [internet image!]).

Chrysopsis imbricata A. Nels., Bot. Gaz. 37:263. 1904. *Chrysopsis foliosa* var. *imbricata* (A. Nels.) A. Nels. in Coult. & Nels., Man. Bot. Rocky Mts. 493. 1909. TYPE: U.S.A. COLORADO. El Paso or Teller Co.: Pike’s Peak, open slopes, 1 Sep 1901, A. Nelson 8616 (HOLOTYPE: RM).

Chrysopsis alpicola var. *glomerata* A. Nels., Bot. Gaz. 40:64. 1905. TYPE: U.S.A. COLORADO. Larimer Co.: Estes Park, 9000 ft, Aug 1904, W.S. Cooper 174 (HOLOTYPE: RM).

Chrysopsis butleri Rydb., Bull. Torrey Bot. Club 37:129. 1910. TYPE: U.S.A. MONTANA. Gallatin Co.: Gateway, 17 Aug 1908, B.T. Butler 620 (HOLOTYPE: NY [internet image!]).

***Heterotheca fulcrata* var. *arizonica* at specific rank**

Semple’s description of *Heterotheca fulcrata* var. *arizonica* Semple was a useful advance in resolving problems of identification in the *H. fulcrata* group. As mapped by Semple (1996), however, and as confirmed here, var. *arizonica* occurs sympatrically with typical *H. fulcrata* (including var. *senilis*) in Texas, New Mexico, and

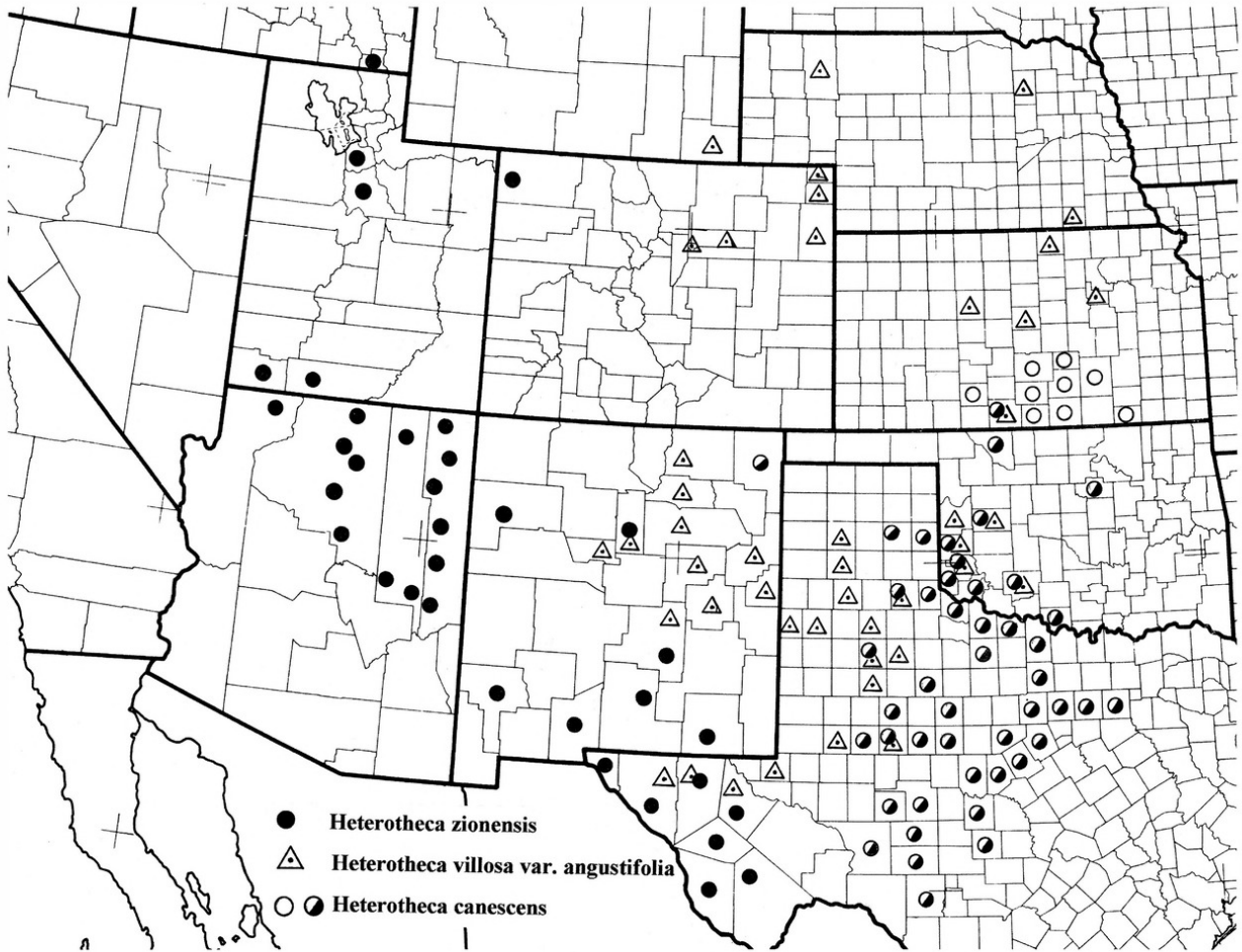


FIG. 3. Geographic range of *Heterotheca zionensis*. Representative localities for *H. villosa* var. *angustifolia* also are shown; the range continues northward to South Dakota. The only collection of *H. canescens* in New Mexico seen in this study is mapped: Union Co., Clayton, 24 Sep 1907, Evans s.n. (NMC); an indication of the total range of *H. canescens* is shown, based on specimens examined, to show the New Mexico locality in context—the range continues to the southeast in Texas. Some of the localities (open circles) for *H. canescens* in Kansas are added from Great Plains Flora Association (1976).

southern Arizona (Fig. 2). Intermediates, if they occur at all, are not common. Biologically, var. *arizonica* fits criteria for recognition of a taxon at specific rank, and it is so treated here.

Heterotheca arizonica (Semple) Nesom, comb. et stat. nov. *Heterotheca fulcrata* (Greene) Shinnars var. *arizonica* Semple, Brittonia 39:380. 1987. TYPE: U.S.A. ARIZONA. Gila Co.: 0.3 km NW of East Verde River, AZ Hwy 87, NW of Payson, 13 Sep 1985, J.C. Semple and S. Heard 7923 (HOLOTYPE: NY; ISOTYPES: ASU, MO, US, WAT). The herbaria cited are from the protologue; specimens apparently have not been deposited at ASU, MO, NY, or US. The concept of the taxon is from annotations by Semple on TEX-LL specimens.

Heterotheca arizonica is characterized as follows: (1) stems and leaves densely and prominently sessile-glandular, essentially green-colored because of the sparsely to moderately hirsutulous nonglandular vestiture; (2) cauline leaves elliptic to elliptic-ob lanceolate or elliptic-lanceolate, 5–15 mm long, usually relatively even-sized, spreading or ascending, often with only the midvein visible and distinctly thickened and raised on abaxial surface, with a thick-indurate, sharp-pointed, often recurving terminal mucro; (3) heads often (sometimes not) immediately subtended by small, linear to oblanceolate foliar bracts; and (4) phyllaries glabrous to sparsely minutely glandular to sparsely strigose.

Status of *Heterotheca viscida*

Heterotheca viscida (A. Gray) Harms (Fig. 3) has been identified with relative consistency. It is included in

the consideration here because of its similarity in geographic range to *H. arizonica* and its occasional confusion with that taxon and expressions of *H. fulcrata*. *Heterotheca viscida* is characterized by its conspicuously glandular (usually stipitate-glandular) vestiture; because of the characteristic lack or paucity of nonglandular hairs, stems and leaves are generally distinctly green. Leaves and stems of some collections from Jeff Davis Co., Texas, are minutely and inconspicuously glandular but prominently villous; *H. viscida* of typical vestiture also is common in the area and intermediates occur. Leaves are oblong-obovate to obovate-oblong, sessile and sometimes subclasping, 15–40 mm long and (7–)10–20(–25) mm wide. Heads are on peduncles without immediately subtending foliar bracts. Plants commonly grow on cliff faces and ledges and in crevices. Semple (1996) mapped *Heterotheca viscida* in Pima Co., Arizona, but did not cite specimens from there.

Heterotheca viscida (A. Gray) Harms, *Rhodora* 70:302. 1968. *Chrysopsis villosa* (Pursh) Nuttall var. *viscida* A. Gray, *Synopt. Fl. N. Amer.* 1(2):123. 1884. *Chrysopsis viscida* (A. Gray) Greene, *Erythea* 2:96. 1894. TYPE: U.S.A. ARIZONA. Santa Cruz Co.: Santa Rita Mts., clefts of dry ledges, 7500 ft, 28 May 1881, C.G. Pringle s.n. (LECTOTYPE, Harms 1968b: GH!; ISOLECTOTYPES: NY 3 sheets [internet images!], PH).

Status of *Heterotheca zionensis*

In an earlier study (Nesom 2006) I noted that *Heterotheca zionensis* Semple was difficult to distinguish from *H. villosa* var. *pedunculata* (Greene) Semple, based on criteria provided by Semple. With further study and perspective, *H. zionensis* is accepted here as a distinct species, essentially as previously described by Semple (1996), but occurring more widely in New Mexico and extending into trans-Pecos Texas (Fig. 4). The apparently disjunct plants in northwestern Colorado (e.g., Moffatt Co.: along Hwy 40, 30 Aug 1930, Baker 4833b, LL; Pat's Hole, near the confluence of Green and Yampa rivers, 8 Jul 1945, Porter 3635, SMU) also were recorded by Semple (1996). A single collection from Idaho has been recorded in this study: Bear Lake Co.: Bear Lake, 6 Aug 1898, Mulford 327 (MO).

Plants of *Heterotheca zionensis* are distinctive in their relatively large stature—stems strictly erect from the base, commonly 4–10 dm tall (grazed or damaged plants may be smaller), up to 2–4 mm thick in the proximal portions, and often 10–20 stems per clump—and in their silvery to silver-gray, sericeous to densely strigose vestiture of thin-based, closely appressed nonglandular hairs. Cauline leaves are oblanceolate-obovate, spreading to ascending, and relatively even-sized up the stem; basal leaves are absent by flowering. Capitula are pedunculate, and often numerous in a subcorymboid arrangement. Cauline vestiture is antrorsely appressed to ascending, rarely spreading. Semple (1987, p. 385) noted that “Non-glandular forms of *H. zionensis* occur in north-central Utah; glandular and non-glandular forms occur in the Utah-Arizona border region.” In New Mexico and Texas they are mostly non-glandular but glandular plants also have been collected, especially near the range of *H. villosa* var. *angustifolia*.

The type of *Heterotheca villosa* var. *pedunculata* (isotypes: MO!, NMC!) was collected in Archeluta Co., Colorado, outside the geographic range of *H. zionensis*. It is similar in habit to many other plants of the regional form of *H. villosa* (var. *minor*, as identified by Semple), but it is at the denser extreme of a variable range in nonglandular vestiture density in the species, which gives it a silvery-gray aspect. The leaves of *H. villosa* usually are basally narrowed to a petiole-like region and gradually diminished in size up the stem.

New Mexico plants treated here as *Heterotheca zionensis* apparently have been identified mostly as *H. villosa* var. *pedunculata* by Semple (1996, and by annotation). Those in trans-Pecos Texas were referred by him to a disjunct population system of *H. canescens* (DC.) Shinners and to *H. villosa* var. *angustifolia*. In 2003 I also identified and annotated these trans-Pecos plants as the “trans-Pecos form” of *H. canescens*, but later (Nesom 2006, as mapped in Fig. 1) I included these as part of the range of *H. villosa* var. *angustifolia*. In the current study, the ranges of *Heterotheca zionensis* and *H. villosa* var. *angustifolia* are recognized to overlap in the trans-Pecos region and in central New Mexico (Fig. 4), where they sometimes are closely similar in habit and aspect and perhaps hybridize. Warnock 6230 from Reeves Co., Texas (cited below), is densely sericeous but like var. *angustifolia*, the plants produce some axillary leaves and are slightly glandular beneath the nonglandular vestiture—they may be of hybrid origin. Some collections from San Miguel Co. and Santa Fe Co., New Mexico, also suggest the occurrence of gene flow.

Some New Mexico collections of *Heterotheca villosa* var. *angustifolia* were identified as *H. canescens* by Semple, some as *H. villosa* var. *pedunculata* (1996, and by NMC annotation).

The following key distinguishes these taxa as they occur in Texas and New Mexico.

1. Heads pedunculate, without closely subtending leaves or bracts; axillary clusters of small leaves usually not produced along stems; leaves usually without sessile glands beneath the nonglandular hairs _____ ***Heterotheca zionensis***
1. Heads on leafy stems, often with immediately subtending, narrowly lanceolate foliar bracts; numerous axillary cluster of small leaves usually produced along stems; leaves with or without sessile glands beneath the nonglandular hairs.
 2. Stems thicker and obscurely lignescent, originating from a thick, woody caudex; leaves narrowly oblanceolate to narrowly obovate, strigose but gray-green, almost always with orange, sessile glands often sparse but evident beneath the nonglandular hairs _____ ***Heterotheca villosa* var. *angustifolia***
 2. Stems thin, distinctly lignescent, originating from relatively thin, adventitiously rooted caudex branches; leaves narrowly oblanceolate, usually silvery-sericeous, without sessile glands beneath the nonglandular hairs _____ ***Heterotheca canescens***

Because *Heterotheca zionensis* has not been previously recognized in Texas, specimens are cited here (below); occurrences in New Mexico also are documented.

TEXAS. Brewster Co.: 2 mi W of Alpine, south side Hwy 90, left of first underpass to Marfa, infrequent, 4300–4500 ft, 4 Oct 1946, Brown B95 (LL, SMU-2 sheets, SRSC); limestone soil at Althida, ca 20 mi E of Alpine, 4000 ft, 24 Sep 1935, Fletcher 487 (SRSC); Glass Mts, arroyo at Altuda Pass, 8 Aug 1940, Warnock 279 (GH, SRSC, TEX); frequent on Alpine Golf Course, Alpine, 13 Aug 1937, Warnock T439 (GH, TEX); Paradise Canyon, 4 mi W of Alpine, infrequent in igneous soil, 4600 ft, 8 Aug 1947, Warnock 6656 (LL, SMU 2 sheets, SRSC, TEX). **Jeff Davis Co.:** Davis Mts, Mitre Peak, 16 Aug 1927, Cory 45386 (LL). **Presidio Co.:** between railroad and Hwy 90, ca. 1/2 mi NW of Paisano Campground, 4900 ft, 3 Aug 1947, Hinckley 3962 (SMU, SRSC). **Reeves Co.:** common along hwy to Carlsbad, limestone soil, 11 mi N of Pecos, 4000 ft, 3 Jul 1947, Warnock 6230 (SRSC, TEX); 3 mi N of Arno on Hwy 285, barren ridge with mesquite-yucca association, 22 Aug 1942, Waterfall 4248 (MO).

NEW MEXICO. Doña Ana Co.: Mesilla Valley, 2 mi NW of San Miguel, sandy wash, 1200 m, 18 Aug 1930, Fosberg S3850 (LL); Mesilla Valley, sand hills, no date, Mead s.n. (NMC); Little Mt., near Las Cruces, 26 Aug 1902, Metcalfe s.n. (NMC); E Las Cruces at University Ave. E of Telshor Drive, 2 km E of IH-25, NE side of Tortugas Mtn., roadside drain in limestone soil, 1360 m, 24 Aug 2001, Spellenberg & Brouillet 13268 (BRIT, NMC); S edge of Las Cruces, roadside of Hwy I-10, abundant roadside weed for many miles along road edges and borrow pits, 3900 ft, 31 Aug 1981, Ward 81-550, voucher for $n = 9$ (NMC); Organ Mountains, Bishop's Cap, 4 Oct 1903, Wootton s.n. (NMC); mesa W of the Organ Mountains, 4000 ft, 1 Oct 1907, Wootton s.n. (MO, NMC); Bishop Cap, 2 air km NNW of the top of Bishop Cap, 1400 m, 24 Sep 1988, Worthington 17524 (TEX); Bishop Cap, 2 air km NNW of the top of Bishop Cap, limestone arroyo, 1400 m, 2 Oct 1988, Worthington 17560 (TEX); Organ Mts., Butterfield Park, soil from igneous substrate, 4600 ft, 22 Sep 1999, Worthington 28700 (TEX). **Eddy Co.:** Queen Quadrangle, Last Chance Canyon, canyon bottom of limestone boulders, 5000 ft, 24 Jun 1999, Baker 13358 (NMC); Guadalupe Mts., 2.6 mi by road NE of Sitting Bull Falls, 24 Jun 1981, Van Devender & Oler s.n. (BRIT); Last Chance Canyon, 1400 m, 29 Aug 1988, Worthington 27964 (TEX). **Grant Co.:** near Silver City, 30 Sep 1880, Greene 12857 (MO); Silver City, bank of Hwy 180 West, near corner of Hill and Mississippi streets, 6000 ft, 20 Oct 1985, Zimmerman 2984 (TEX); NW edge of Silver City, along Hwy 180, 6000 ft, 12 Sep 1987, Zimmerman 3001 (TEX). **Lincoln Co.** [label says "Chaves Co."]: 35 mi W of Roswell, ca. 3800 ft, Aug 1900, Earle 510 (MO). **McKinley Co.:** Zuni Mts., 8 mi E of NM Hwy 32 on road to McGaffey, sandy soil, just inside Cibola National Forest, 16 Aug 1973, Spellenberg 3527 (NMC). **Otero Co.:** Mayhill, low, rocky, open woods, 13 Aug 1969, 6670 ft, Demaree 60793 (SMU). **Santa Fe Co.:** Santa Fe, Old Cemetery, 2120 m, 28 Sep 1935, Arsène 22126 (SMU); Santa Fe, SE part of city near Museum of Internatl. Folk Art, dry open ground, 7200 ft, 3 Aug 1963, Bennett 8296 (TEX); Broken Hill Ranch near Rte 10, 3 mi NE from Los Cerillos, 6000 ft, 13 Aug 1963, Bennett 8298 (TEX); 4 mi N of Madrid, locally abundant on roadsides, 6800 ft, 15 Aug 2001, Neff 01-08-15-01 (TEX); Santa Fe Creek at Santa Fe, 23 Jul 1908, Standley 4503 (NMC).

Status of *Chrysopsis elata*

Chrysopsis elata Osterhout was cited by Semple (1996) as a synonym of *Heterotheca fulcrata* var. *fulcrata* and the isotype (NY) was annotated by him as such in 1997. The NY isotype had been earlier annotated by Semple (in 1993) as *H. villosa* var. *minor*. *Chrysopsis elata* is identified here as *H. villosa* var. *villosa*.

Chrysopsis elata Osterhout, Bull. Torrey Bot. Club 57:560. 1931. TYPE: U.S.A. COLORADO. Eagle Co.: Red Cliff, 16 Aug 1906, G.E. Osterhout 3359 (HOLOTYPE: RM; ISOTYPE: NY [internet image!]). The protologue states that Osterhout "3335" is the type, but the RM and NY sheets both are labeled with the collection number "3359." The original manuscript, in Osterhout's hand, is stapled to the RM holotype and has "3359" as the type number. On Osterhout's unique red type label, C.L. Porter in 1950 noted that publication of the number "3335" was in error.

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