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THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

A TAXONOMIC STUDY OF THE SUBGENUS PTEROGONUM IN THE GENUS ERIOGONUM (POLYGONACEAE)

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

WILLIAM JOHN HESS

Norman, Oklahoma

1967

A TAXONOMIC STUDY OF THE SUBGENUS PTEROGONUM IN THE GENUS ERIOGONUM

(POLYGONACEAE)

APPROVED BY

DISSERTATION COMMITTEE

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Appreciation is extended to the curators of herbaria from which specimens of Eriogonum were borrowed. The abbreviations of the following herbaria are as indicated by Lanjouw and Stafleu (1964).

Gray Herbarium	GH
Missouri Botanical Garden	MBG
New York Botanical Garden	NY
University of Oklahoma	OKL
Pomona College	POM
Rancho Santa Ana Botanic Garden	RSA
Southern Methodist University	SMU

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A TAXONOMIC STUDY OF THE SUBGENUS PTEROGONUM IN THE GENUS ERIOGONUM (POLYGONACEAE)

CHAPTER I

INTRODUCTION

Michaux (1803) in "Flora Boreali-Americana" described the genus Eriogonum based on a specimen which he named E. tomentosum. Bentham (1837) was the first to monograph the genus and included 28 species in 6 sections. The genus was expanded by Bentham (1856) to include 9 divisions with 81 species. The next revision was by Torrey and Gray (1870) in which they listed 14 major groups with 81 species. A short time later, Watson (1877) monographed the genus again, explaining that much more collecting had been done and many new species described. He described 3 sections with a total of 95 species. Stokes (1936), the last to revise the genus, had 4 major sections with 25 groups and 155 species and periodically added new species to her list. Recently, Reveal (in ms. a) has proposed what he considered a natural system in Eriogonum above the species level. He recognizes 7 subgenera and tentatively 35 sections.

The object of this research was a critical evaluation of the first 8 species in section 1A of Stokes' monograph, now considered

by Reveal (l.c.) as the subgenus Pterogonum. Field studies of the species common to southwestern United States were utilized as were analyses of herbarium material of all the species from the United States and Mexico. The general morphology of all the species was studied and chromosome counts for certain species were made.

CHAPTER II

SECTION HISTORY AND INTERPRETATION

Originally, Bentham (1856) placed the winged achene members, E.alatum, E. hieracifolium, and E. atrorubens in section Alata. Watson (l.c.) excluded E. atrorubens from the Alata group and placed it in his section Ganysma near E. ciliatum and E. greggii. Gross (1913) interpreted the Alata group (sensu Bentham) as generically distinct from Eriogonum and described the genus Pterogonum to include them. Stokes believed that the Alata group belonged in the genus Eriogonum and included the above 5 species along with E. rupestre, E. hemipterum, E. nealleyi and E. inflatum as section 1A of her treatment. Reveal (l.c.) considered the species in section 1A of Stokes' monograph closely related, except for E. inflatum. He therefore included all but E. inflatum in the subgenus Pterogonum in line with his efforts to re-evaluate the genus Eriogonum.

Gross's interpretation of the winged achene members of Eriogonum has recently been endorsed by Roberty and Vautier (1964). This treatment made no mention of the other species related to Pterogonum, except for E. ciliatum which was placed in the genus Eriogonum and not in Pterogonum. They commented that E. ciliatum was closely related to Pterogonum. There is little doubt that

E. ciliatum, E. greggii, E. hemipterum, and E. nealleyi belong in this group, and, as pointed out by Reveal (l.c.), the relationship of E. rupestre to E. atrorubens is quite close. Reveal believed that Roberty and Vautier did not take into consideration the close relationship between the genera Eriogonum and Pterogonum. Possibly, if they had examined the other members of Pterogonum (sensu Reveal), they might have reached different conclusions.

Reveal (l.c.) indicated that the 8 species making up the subgenus Pterogonum "may be grouped into 2 sections." Precise delimitation of these sections will not be easy. The taxa E. alatum, E. hieracifolium, E. hemipterum, and E. nealleyi are closely related and could make up one of the sections. They show similar characteristics such as winged achenes, basal and alternate cauline leaves, and alternately branched inflorescences in the axils of all or some of the cauline leaves. The remaining species would be placed in the other section and show the following relationships. Eriogonum ciliatum and E. greggii appear related to one another and have certain characteristics in common such as wingless achenes, basal or basal with whorled cauline leaves in the axils of ternate bracts, and unilaterally branched inflorescences in the axils of ternate bracts. The relationship of E. atrorubens to E. rupestre is close, sharing characteristics such as slightly winged to wingless achenes, basal leaves, and di- or trichotomously branched inflorescences in the axils of ternate bracts. Many authorities have placed E. atrorubens with the other members of the Alata group (sensu Bentham) because of the winged fruits, but,

judged on the structure of the inflorescences it would form a more natural arrangement in association with E. ciliatum and E. greggii.

CHAPTER III

CYTOLOGY

Cytological material was obtained from buds collected in the field during the summers of 1965 and 1966. The buds were fixed in freshly prepared 3 parts 95% ethanol to 1 part glacial acetic acid and stored in a refrigerator not later than 20 days after collection. The anthers were squashed in aceto-carmine and temporary mounts made. Microsporocytes that showed the desired meiotic figures were drawn with the aid of a camera lucida attached to a Bausch and Lomb microscope (15x ocular X 98x oil immersion objective lens). The temporary mounts were made permanent by the alcohol vapor exchange-euparal method of Bradley (1948).

The species examined, E. alatum, E. hieracifolium, E. nealleyi, and E. hemipterum, had normal meiotic division of the microsporocytes with 2n = 40. Voucher specimens of these species are deposited in the Bebb Herbarium at the University of Oklahoma. The counts were difficult since the excised buds were small (ca. 0.5-1 mm) and possibly because meiosis was rapid or reached a maximum at an unknown time of day. Interpretation of the chromosome number was difficult with the resulting conclusion that because of polyploidy,

many chromosome pairs were closely associated with other chromosome pairs. The camera lucida drawings are shown in Figure 1.

Stokes and Stebbins (1955) examined 16 taxa and reported the first chromosome numbers in Eriogonum. All other reported counts have been made by Reveal (1965, 1966) with the exception of one by Raven et al (1965) and one by Hitchcock et al (1964). Listed in Table 1 are chromosome counts for 37 species which include some by Reveal as recorded on voucher specimens in the Bebb Herbarium at the University of Oklahoma.

Stokes and Stebbins (l.c.) suggested the base chromosome number to be X = 10, and the more recent counts have indicated the same. It is evident that to date the base number of 10 has not been realized, but the many polyploids with multiples of 10 imply this base number. It is readily seen that aneuploidy, which resulted in n = 9 or 11, may have occurred, and in conjunction with other kinds of polyploidy, various diploid chromosome numbers were formed. Stokes and Stebbins indicated that if this interpretation were correct, then hybridization has played an important role in the evolution of the present day Eriogonum.

Figure 1. Camera lucida drawings of chromosomes from microsporocytes of Eriogonum.

A. Eriogonum alatum Torr. var. alatum, Hess 353. Metaphase I.

B. Eriogonum alatum var. mogollense St. ex Jones, Hess 761. Metaphase I.

C. Eriogonum alatum var. glabriusculum Torr., Hess 506. Metaphase I.

D. Eriogonum nealleyi Coult., Hess 876. Metaphase I.

E. Eriogonum hieracifolium Benth., Hess 886. Metaphase I.

F. Eriogonum hemipterum (Torr. and Gray) St., Hess 799. Metaphase I.



Figure 1.

TABLE 1. REPORTED CHROMOSOME NUMBERS FOR ERIOGONUM

TAXA	2n	AUTHORITY
E. virgatum Benth.	18	Stokes and Stebbins (1955)
E. adsurgens St. ex Jepson	22	"
E. gracile Benth.	22	"
E. dasyanthemum Torr.	24	"
E. vimineum Dougl. ex Benth.	24	"
E. inflatum Torr. & Frem.	32	Reveal (1965)
E. marifolium Torr. & Gray	32	Stokes and Stebbins (1955)
E. pusillum Torr. & Gray	32	Reveal (1965)
E. reniforme Torr. & Frem.	32	"
E. trichopes Torr.	32	"
E. elatum Dougl. ex Benth.	34	Hitchcock et al (1964)
E. elongatum Benth.	34	Stokes and Stebbins (1955)
E. wrightii Torr. ex Benth.	34	"
E. collinum St. ex Jones	36	Reveal (1966)
E. demissum St. var. romanum St.	36	Reveal (herbarium label)
E. alatum Torr. var. alatum	40	Hess 353
var. glabriusculum Torr.	40	Hess 506
var. mogollense St. ex Jones	40	Hess 761
E. crocatum Davidson	40	Stokes and Stebbins (1955)
E. deflexum Torr. var. deflexum	40	Reveal (herbarium label)
E. hemipterum (T. & G.) St. var. hemipterum	40	Hess 799
E. hieracifolium Benth.	40	Hess 886
E. hookeri Wats.	40	Reveal (herbarium label)
E. insigne Wats.	40	"
E. latifolium Smith	40	Stokes and Stebbins (1955)
E. maculatum Heller	40	Reveal (1965)
E. nealleyi Coult.	40	Hess 876
E. nudum Dougl. ex Benth.	40, 80	Stokes and Stebbins (1955)
var. pubiflorum Benth.	40	Reveal (1965)
E. ovalifolium Nutt.	40	Stokes and Stebbins (1955)
var. nivale (Canby) Jones	40	Reveal (1965)
var. ochroleucum (Small) Peck	40	"
var. orthocaulon (Small) Hitchc.	40	"
E. parishii Wats.	40	Stokes and Stebbins (1955)
E. parvifolium Sm.	40	"
E. sphaerocephalum Dougl. ex Benth. var. halimioides (Gand.) St.	40	Reveal (1965)
E. thomasii Torr.	40	Raven et al (1965)
E. watsonii Torr. & Gray	40	Reveal (herbarium label)
E. fasciculatum	40, 80	Stokes and Stebbins (1955)
E. indictum Jepson	80	"
E. nutans T. & G. ex Wats. var. nutans	80	Reveal (1966)
var. glabratum Reveal	80	"
E. umbellatum Torr. ssp. polyanthum (Benth.) St.	80	Reveal (1965)

CHAPTER IV

TAXONOMY AND DISCUSSION

Subgenus Pterogonum (H. Gross) Reveal

Pterogonum (H. Gross) Reveal, stat. nov. in press, 1967.

Pterogonum H. Gross, Bot. Jahrb. Engler 49: 239. 1913.

Tall erect perennials, mostly with a single stem, arising from a deep rootstock or branched caudices, (0.3-) 0.5-2 m tall, glabrous or glabrate to silky-pubescent, or glandular-pubescent; leaves basal or basal and alternate or whorled, spathulate to oblanceolate or linear-lanceolate, glabrous to densely pubescent or glandular-pubescent, leaf margins ciliate; bracts on the main stem or inflorescence branches, ternate, connate at the bases; inflorescence an elongate, open paniculate cyme or a di- or trichotomously branched cyme or a cyme sometimes suppressed on one side; peduncles often stout; involucres turbinate to campanulate, rarely angled, the 4-5 (-8) lobes acute to obtuse to truncate; bractlets linear-lanceolate to lanceolate, glabrous, often ciliate, occasionally glandular; pedicels glabrous, occasionally glandular; calyx astipitate, connate lower 1/4 to 1/3, glabrous or pubescent, yellow to red or purple; stamen filaments glabrous or pilose at base, anthers yellow

or red; achenes winged or slightly ridged, glabrous or pilose, long exserted; embryo straight, endosperm copious.

DISTRIBUTION: Southern Texas and northern Mexico into the Sierra Madre Occidental of Durango, north through northeastern Utah, southern Wyoming, and southwestern Nebraska.

TYPE: E. atrorubens Engelm. in Wisliz., Mem. Tour No. Mex. p. 108. 1849. Lectotype selected by Roberty and Vautier, Boiss. 10: 107. 1964.

Key to the taxa of the subgenus Pterogonum

1. Inflorescence an open paniculate cyme, occurring in the axils of alternate cauline leaves; ternate bracts restricted to secondary branches of the inflorescence; fruits distinctly 3-winged.

2. Perennial from a deep taproot; fruits, winged the entire achene length, 5-9 mm long, 3-6 mm wide. 1. E. alatum

3. Plants strigose throughout or occasionally sparsely strigose on peduncles with glabrous involucres; inflorescence mostly developed from the basal nodes through the upper nodes; 10-17 dm tall; common in the Rocky Mountains.

4. Basal leaves 0.3-1.5 cm wide, linear-lanceolate to lanceolate to oblanceolate; petiole bases strigose. 1a. var. alatum

4. Basal leaves 1-2 cm wide, spathulate, petiole bases wooly; common in the Juniper-Pinyon Pine and Ponderosa Pine woodlands around Flagstaff, Arizona. 1b. var. mogollense

3. Plants glabrous or slightly strigose in the inflorescence and rarely with strigose peduncles; inflorescence mainly developed in the upper nodes; 10-21 dm tall, leaves linear-lanceolate; common in the Great Plains of north central Texas and Oklahoma. 1c. var. glabriusculum

2. Perennial from branched caudices; fruits, winged the upper half, 4-6 mm long, 2-3.5 mm wide.

5. Axis of inflorescence glabrous; perianth glabrous or remotely strigose; 7 or more nodes on the stems; locally common in central Texas. 2. E. nealleyi

5. Axis of inflorescence pubescent, perianth densely strigose; less than 7 nodes on the stems.

6. Perianth yellow, sometimes maturing with a reddish tinge. 3. E. hieracifolium

6. Perianth maroon or reddish purple. 4. E. hemipterum

7. Leaves strigose on both surfaces; involucres slightly strigose; bractlets glabrous; peduncles 1-7 cm long. 4a. var. hemipterum

7. Leaves strigose above, tomentose below; involucres densly strigose; bractlets ciliate, peduncles 1-12 cm long. 4b. var. griseum

1. Inflorescence a di- or trichotomously branched cyme or a continuous cyme mostly suppressed on one side, occurring in the axils of ternate bracts; a distinct pedunculate involucre from the axis of the main branch; achenes slightly 3-winged or ridged the entire length.

8. Inflorescence di- or trichotomously branched, main stem glabrous and glaucous; mature achenes 4-5.5 mm long; bractlets glabrous or slightly ciliate and remotely glandular.

9. Perianth glabrous or remotely strigose in plants from Nuevo Leon and Coahuila; achenes slightly 3-winged. 5. E. atrorubens

10. Leaves strigose to glabrous with ciliate lower midveins and margins.

11. Leaves strigose on both surfaces often more so below than above. 5a. var. atrorubens

11. Leaves glabrous or slightly strigose above and rarely below except for ciliate midveins and margins. 5b. var. pseudociliatum

10. Leaves strigose above and densely white tomentose below. 5c. var. intonsum

9. Perianth densely strigose; achenes ridged; common in the hills around Chihuahua in the state of Chihuahua, Mexico. 6. E. rupestre

8. Inflorescence a continuous cyme, mostly suppressed on one side; glandular-pubescent or glabrous except for short stipitate glands around the nodes; mature achenes 3-4.5 mm long; bractlets densely white ciliate or ciliate and glandular.

12. Cauline leaves absent except rarely at the first node; basal leaves glabrous except for ciliate margins; bractlets densely white ciliate; pedicels glabrous and eglandular. 7. E. ciliatum

12. Cauline leaves in the axils of ternate bracts; basal leaves strigose to hispid, rarely glabrous; bractlets slightly ciliate and glandular; pedicels glandular. 8. E. greggii

1. Eriogonum alatum Torr., in Sitgreaves Report, p. 168. 1854.

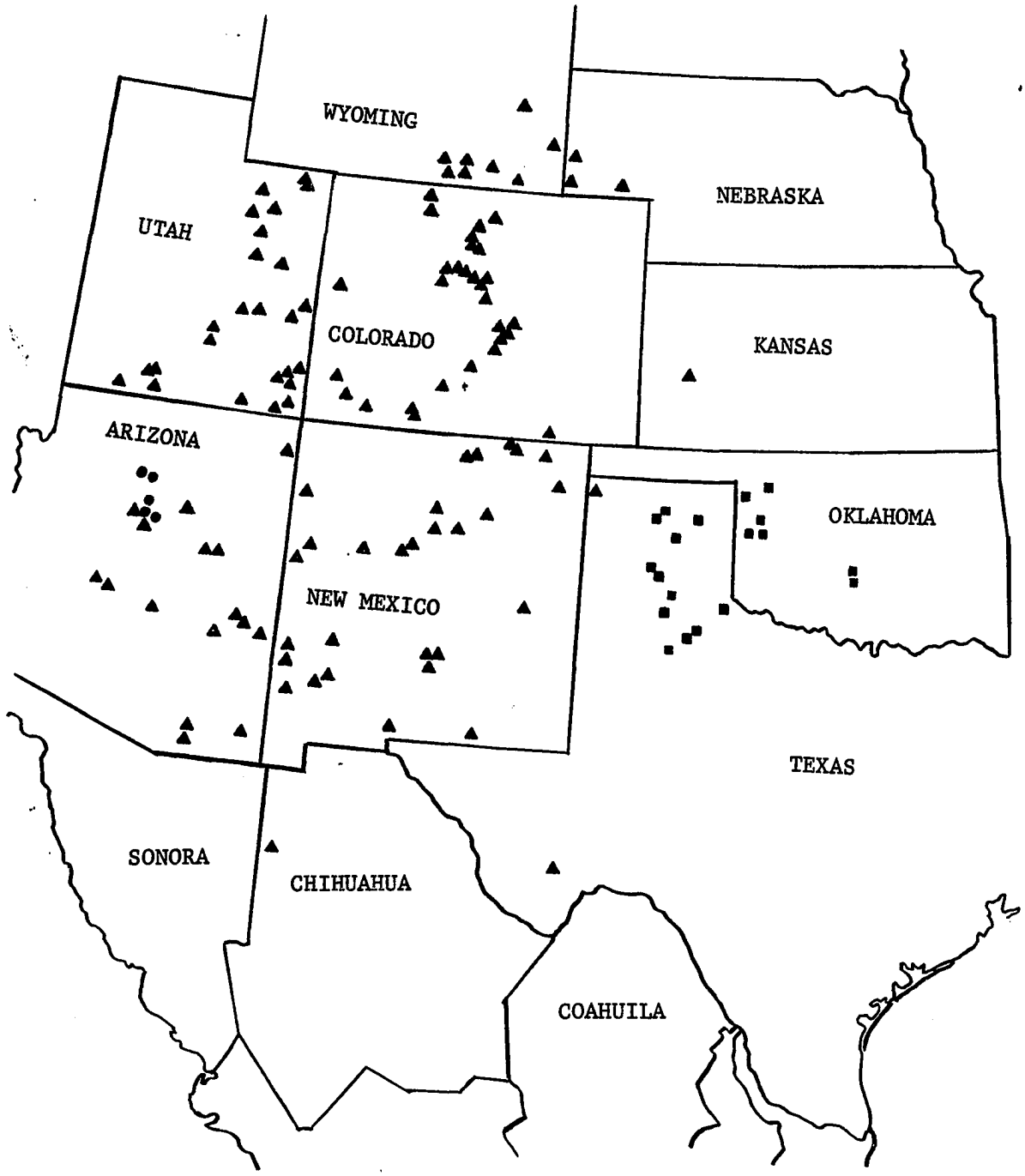
Erect perennial herbs, mostly single stalked, 5-20 dm tall from a deep taproot, densely to slightly strigose at the base becoming scattered strigose to glabrous in the inflorescence; basal leaves 3-20 cm long, 0.3-2 cm wide, lanceolate to linear-lanceolate or spathulate, strigose to glabrous above, glabrous to slightly strigose below with ciliate midvein, margins ciliate, apices obtuse or acute, bases long cuneate to winged petioles 2-6 cm long, petiole base scattered strigose to woolly; cauline leaves alternate, 1-9 cm long, lanceolate to linear-lanceolate, strigose to glabrous above, glabrous to slightly strigose below with ciliate midvein and margins, apices acute to slightly obtuse, bases tapering to short narrow winged petioles; bracts 2-7 (-9) mm long, awl-shaped to linear, strigose or glabrous, ciliate, ternate, connate at the bases; inflorescence an open paniculate cyme, branching from the base or restricted to the upper nodes; peduncles 0.5-3.5 cm long, ascending to erect, straight or curved; involucres 2-3.5 (-4.5) mm long and wide, turbinate to campanulate, strigose to glabrous, the 5

lobes 1/4 to 1/3 the length of the tube, often ciliate, slightly acute to obtuse or truncate; bractlets 2-3 mm long, linear-lanceolate, glabrous or slightly ciliate; pedicels green maturing red, 2-6 mm long, glabrous; flowers 10-25; perianth yellow or yellow-green often maturing red, 2-4 mm long, calyx-segments similar, rounded at the apex, entire, glabrous; stamens yellow, 1.5-2.5 mm long, sometimes reduced and sterile, anthers oblong, occasionally maturing red; ovary short stipitate, glabrous, mature achenes 5-9 mm long, 3-6 mm wide, ovate to elliptic or elliptic-obovate, distinctly 3-winged the entire achene length, yellow or yellow-green maturing reddish-brown, exserted; embryo straight, yellow-green, 4-6.5 mm long, 2-3 mm broad.

DISTRIBUTION: Common in grasslands of the Great Plains and Juniper-Pinyon Pine and Ponderosa Pine woodlands of the Rocky Mountains at an elevation of 1000-9000 feet from southwestern Texas and northern Mexico through Chihuahua, north through south central Oklahoma, New Mexico, and Arizona to southwestern Nebraska, southern Wyoming, and northeastern Utah. Flowers and fruits July through October.

Figure 2.

DISCUSSION: This polymorphic species has a wide range of distribution which resulted in the description of several taxa. In this treatment, these taxa are included in var. alatum, var. mogollense, or var. glabriusculum. The populations of E. alatum which are morphologically uniform and have a restricted distribution, were accorded varietal status along with the highly variable and widely distributed var. alatum.



▲ E. alatum var. alatum
● E. alatum var. mogollense
▪ E. alatum var. glabriusculum

Figure 2. Species Distribution Map for Eriogonum alatum.

In the subgenus Pterogonum, E. alatum best illustrates the winged condition of the fruit. This species differs from the other members of the subgenus Pterogonum by remaining in a vegetative condition for an undetermined number of years before producing an inflorescence shoot. After flowering and fruiting, the plant dies. An investigation undertaken in New Mexico during the summers of 1965 and 1966 established the monocarpic habit of this taxon. Plants of E. alatum in a 30 square foot area were plotted to scale. Comparison of the graphs showed that the plants of E. alatum that flowered in the summer of 1965 were dead the following summer and the plants that were vegetative in 1965 were either in flower or still vegetative in 1966. This indicated that some plants do not flower for at least three years and that death follows flowering.

1a. Eriogonum alatum var. alatum

E. alatum var. β , elatum Geyer, ms. (name only) in Hooker, Jour. of Bot., p. 263. 1853.

E. alatum β , elatum Benth., DC. Prodromus 14: 7. 1856.

E. triste Wats., Proc. Am. Acad. Sci. 10: 347. 1875.

E. alatum ssp. triste (Wats.) St., Stokes, Gen. Eriogonum p. 20. 1936.

E. alatum var. brevifolium Gdgr., Bull. Soc. Bot. Belg. 17: 145. 1906.

E. alatum var. typicum St., Stokes, Gen. Eriogonum p. 20. 1936.

Pterogonum alatum (Torr.) H. Gross, Bot. Jahrb. Engler 49: 239. 1913.

Figure 6, A-C.

Erect plants 5-13 (-17) dm tall, densely strigose at the base becoming strigose to very slightly strigose in the inflorescence; basal leaves (3-) 5-12 (-15) cm long, 0.3-1.5 cm wide, linear-lanceolate to lanceolate to oblanceolate, bases long tapering to narrowly winged petioles, petiole base strigose; cauline leaves 1-6 cm long; peduncles strigose to slightly strigose; inflorescence branching from the lower through the upper nodes; involucres strigose or rarely glabrous, the 5 lobes acute or obtuse; mature achenes (5-) 5.5-8 mm long, 3-5.4 (-6) mm wide, ovate to elliptic; embryo 4-6 mm long, 2-3 mm broad.

DISTRIBUTION: Common in open areas and grasslands of the Juniper-Pinyon Pine and Ponderosa Pine woodlands of the Rocky Mountains at an elevation of 5000-9000 feet from southwestern Texas, through northern Mexico into Chihuahua, north to northwestern Nebraska, southern Wyoming, and northeastern Utah.

Figure 2.

TYPE: United States of America: New Mexico: On the Zuni River, September 25, 1851, Woodhouse s.n. (NY!).

SPECIMENS EXAMINED:

Mexico.

Chihuahua: Jones, M. E. s.n. Sept. 24, 1903 (NY).

United States of America.

State unknown: Rocky Mountains, Beckwith, E. G. s.n. (NY).

Arizona: County unknown: Sierra Madre, Anderson, A. L. s.n. July 2, 1864 (MBG); near Cooley's, Coville, F. V. 1106 (US); Rucker Valley, Hermmon, J. G. 474 (GH); Nagles' Ranch, Jones, M.E. 6054aa

(US), MacDougal, D. T. 409 (US). Apache Co.: Fisher, G. L. 36166 (US); Goodding, L. N. 629, 675 (NY); Goodman, G. J. and L. B. Payson 2860 (NY), 3189 (MBG, NY); Griffiths, D. 5331 (US); Rusby, H. H. s.n. Sept. 1, 1909 (NY); Standley, P. C. 7408 (US). Cochise Co.: Blumer, J. C. 2161 (GH, NY); Pringle, C. G. s.n. June 28, 1884 (GH, NY, OKL, US); Shreve, F. 5082 (NY). Coconino Co.: Allen, F. F. s.n. Aug. 1897 (NY); Anderson, A. L. s.n. July 23, 1864 (MBG); Clute, W. N. 31 (GH, MBG, NY, US); Collom, R. E. 210 (GH), 253 (US); Kearney, T. H. and R. H. Peebles 13656 (US); Pearson, G. A. 259 (NY); Riordan, M. J. 6 (NY); Schallert, P. s.n. July 5, 1943 (NY); s.n. Aug. 23, 1943 (OKL); Ward, L. F. s.n. May 30, 1901 (NY, US). Gila Co.: Collom, R. E. 416 (MBG); Goodman, G. J. and C. L. Hitchcock 1290 (OKL); Gould, F. W. 3649 (US); Hess, W. J. 353 (OKL); Maguire, B. 13064 (NY, OKL). Graham Co.: Kearney, T. H. and R. H. Peebles 12264 (NY). Navajo Co.: Ferris, R. S. 10105 (GH); Hess, W. J. 371 (OKL); Hough, W. 15, 75, 101 (US); Kruckeberg, A. R. 3887 (NY); Luck, M. s.n. Aug. 18, 1896 (MBG, NY, US). Yavapai Co.: Coues, E. and E. Palmer s.n. 1865, 278 (MBG); Griffiths, D. 4899 (MBG, US); Hitchcock, A. S. s.n. Aug. 6, 1915 (US).

Colorado: County unknown: Sand Creek Pass, Baker, C. F. s.n. Aug. 3, 1896 (MBG, NY); La Plata Mountains, Baker, C. F., F. S. Earle, and S. M. Tracy 806 (MBG, NY, US); Canby, W. M. s.n. Aug. 1871 (NY); Trail Glen, Clements, F. E. and E. S. Clements 53 (GH, NY, US); Cowen, J. H. 439 (US); Table Rock, Crandall, C. S. s.n. June 27, 1891 (NY); Source of the Platte, Fremont, J. C. s.n. 1843, Bahia Salada, 288 (NY); S. Cheyenne Canyon, Glatfelter, N. M. s.n. Sept. 11, 1905 (MBG); Hall,

E. and J. P. Harbour 500 (GH, MBG, NY); South Park, Hayden, F. V. s.n. 1868 (NY); Hoss s.n. (NY); Newberry, J. S. s.n. July 29, 1859 (US); Parry, C. C. 975 (US); Upper Arkansas River, Porter, T. C. s.n. July 26, 1872 (US); Arkansas Cañon, Redfield, J. H. 557 (NY), 6771 (MBG); Sangre de Christo Creek, Rydberg, P. A. and F. K. Vreeland 6323 (NY); Platte Cañon, Snow, F. H. s.n. Aug. 1879 (MBG); Bear Creek, Vasey, G. 508 (GH, MBG, NY); Fossil Creek, Ward, L. F. s.n. Aug. 10, 1881 (US); Arkansas and South Platte Divide, Woodward, R. W. s.n. July 29, 1883 (GH). Archuleta Co.: Baker, C. F. 283 (GH, MBG, NY, US); Goodman, G. J. 7565 (OKL); Hess, W. J. 476 (OKL); Waterfall, U. T. 15143 (OKL). Boulder Co.: Hanson, H. c460 (MBG); Jacobson, Y. s.n. Aug. 12, 1932 (OKL); Mericle, L. W. 724 (OKL); Sheer, C. L. 4735 (NY); Tweedy, F. 4994 (NY). Clear Creek Co.: Degener, O. and L. Peiler 16855 (NY); Engelmann, G. s.n. Aug. 26, 1874 (MBG); Jones, M. E. 682 (NY); Parry, C. C. 319 (GH, MBG, NY). Denver Co.: Marquand, A. D12A (NY). Douglas Co.: Goodman, G. J. 1997 (GH, MBG, NY, OKL). El Paso Co.: Benke, H. C. 4262 (US); Bessey, E. s.n. July 17, 1896 (NY); Eastwood, A. s.n. July 1887 (OKL); Letterman, G. W. s.n. July 25, 1884 (MBG); McCosh, A. J. and C. G. Greene s.n. July 7, 1877 (NY); Sheldon, C. S. s.n. Aug. 1892 (NY), 568 (US); Torrey, J. s.n. Aug. and Sept. 1872 (NY); Ward, W. W. 10673 (NY); Waterfall, U. T. 12039 (OKL); Young, M. S. s.n. Sept. 1923 (GH). Jefferson Co.: Clokey, I. W. 3758 (GH, MBG, NY, US); Constance, L. and R. C. Rollins 1920 (GH); Stokes, S. 205 (GH, MBG, NY), 205A (GH, NY, US); Woitchek, F. D. s.n. Aug. 1957 (OKL); Waterfall, U. T. 3225 (GH, OKL). Lake Co.: Trelease, W. s.n. July 1886 (MBG).

La Plata Co.: Hess, W. J. 469 (OKL); Tweedy, F. 506 (US); Waterfall, U. T. 11711 (OKL). Larimer Co.: Crandall, C. S. s.n. July 8, 1897, 3904 (NY, US); Lappin, A. F. 15 (OKL); von Schrenck, H. 123 (MBG). Las Animas Co.: Rogers, C. M. 5415 (US). Mesa Co.: Langenheim, J. H. 4099 (OKL). Rio Grande Co.: Goodman, G. J. 7257 (OKL). San Miguel Co.: Tweedy, F. 278 (US); Walker, E. P. 506 (GH, MBG, US). Washington Co.: Piemeisel, R. L. 1583 (US). Yuma Co.: Piemeisel, R. L. 1561 (US); Rossbach, G. B. 774 (OKL).

Kansas: County unknown: Carleton, M. A. 397 (US). Scott Co.: Rydberg, P. A. and R. Imler 1088 (NY).

Nebraska: County unknown: Engelmann, H. s.n. 1856 (GH, MBG, NY). Banner Co.: Rydberg, P. A. 330 (NY), s.n. Aug. 8, 1891 (US). Deuel Co.: Rydberg, P. A. 330 (NY). Kimball Co.: Tolstead, W. L. 41399 (MBG).

New Mexico: County unknown: Bigelow, J. M. s.n. 1853-54 (NY), San Antonita, s.n. 1853 (US); Pecos River T. R., Coghill, G. E. 149 (MBG); Sandia Mountains, Ellis, C. C. 30 (MBG, NY, US); Pleasant Valley, Mulford, I. 495 (NY); Albuquerque, Rusby, H. H. s.n. Sept. 6, 1905 (NY); Wright, C. 1773 (GH, MBG, US). Catron Co.: Eggleston, W. W. 20246 (NY, US), 2047 (US); Hess, W. J. 311, 879 (OKL); Rusby, H. H. 361 (NY). Colfax Co.: Abert, J. W. s.n. 1847 (NY); Engleman, J. s.n. Aug. 17, 1934 (OKL); Ewan, J. 18711 (OKL); Griffiths, D. 5473 (US); Hess, W. J. 495 (OKL); Mathias, M. 506 (MBG); Rose, J. N. and W. R. Fitch 17539 (US); Standley, P. C. 6352 (US), 14396 (GH, NY); Waterfall, U. T. 12276 (OKL). DeBaca Co.: Waterfall, U. T. 7730 (GH). Dona Ana

Co.: Parry, C. C., J. M. Bigelow, C. Wright, and A. Schott 1142 (NY, US). Eddy Co.: Barneby, R. C. 2585 (NY). Grant Co.: Blumer, J. C. 50 (GH, NY, US); Hess, W. J. 874 (OKL); Holzinger, J. M. s.n. Aug. 27 to Sept. 12, 1911 (US); Jones, M. E. 28758 (MBG); Maguire, B., B. L. Richards, Jr., and T. Moeller 13003 (GH, NY, OKL); Mearns, E. A. 440 (US); Meyer, F. G. and L. E. Meyer 2197 (MBG); Rusby, H. H. 361 (NY, OKL, US); Thurber, G. 225 (GH, NY). Lincoln Co.: Earle, F. S. and E. S. Earle 486 (NY, US); Eggleston, W. W. 18937 (US); Hess, W. J. 294 (OKL); Skehan, J. 111 (NY, US); Wooton, E. O. 308 (GH, MBG, NY, US), 7356 (NY), s.n. Aug. 1, 1897, s.n. July 25, 1901 (US); Wooton, E. O. and P. C. Standley 3684 (US). McKinley Co.: Babcock, O. G. 14332 (GH); Eggleston, W. W. 18754 (NY, US); Matthews, W. s.n. 1883 (GH). Otero Co.: Hess, W. J. 302 (OKL); Waterfall, U. T. 12458 (OKL); Wolf, C. B. 2819 (GH); Wooton, E. O. s.n. Aug. 9, 1899 (US). Rio Arriba Co.: Standley, P. C. 6789, 8235 (US). San Miguel Co.: Dewey, L. H. s.n. June 23, 1891 (US); Fendler, A. 763 (GH, MBG); Standley, P. 4567 (GH, MBG, NY, US), 7123, 7746 (US). Santa Fe Co.: Heller, A. A. and E. G. Heller 3730 (MBG, NY, US); Vasey, G. s.n. June 1881 (MBG, NY, US). Socorro Co.: Herrick, C. L. 660 (US); Metcalfe, O. B. 331 (GH, MBG, NY, OKL); Wooton, E. O. s.n. Aug. 4, 1900 (US). Taos Co.: Eggleston, W. W. 19321 (US). Union Co.: Hess, W. J. 976 (OKL); Waterfall, U. T. 11484 (OKL).

Texas: County unknown: Havard, V. s.n. (US). Brewster Co.: Warnock, B. H. 5 (GH), W5 (MBG). Dallam Co.: Griffiths, D. 5631 (US).

Utah: County unknown: Bishop, F. M. 34 (US), s.n. 1873 (NY); Johnson, s.n. 1875 (US); Head of Salina Canyon, Jones, M. E.

5441ak, Asa's, 6030u (US). Carbon Co.: Graham, E. H. 9516 (GH, MBG, OKL); Jones, M. E. 5483 (NY, US). Daggett Co.: Maguire, B., G. Piranian, and B. L. Richards, Jr. 12655 (GH). Duchesne Co.: Harrison, B. and E. Larsen 7588 (MBG). Emery Co.: Cronquist, A. 9104 (NY); Maguire, B. 18428 (OKL). Garfield Co.: Hess, W. J. 409, 419 (OKL). Grand Co.: Graham, E. H. 9843 (MBG, OKL); Jones, M. E. 5312a, 5667 (US); Rydberg, P. A. and A. O. Garrett 8567 (NY). Kane Co.: Gierisch, R. K. 433 (GH, OKL); Harrison, B. F. 11083 (US); Maguire, B. 19663 (NY, OKL); Siler, A. 147 (MBG, NY, US). San Juan Co.: Cutler, H. C. 2252 (GH, NY), 3055 (MBG, NY, OKL); Goodman, G. J. and C. L. Hitchcock 1350 (MBG, NY, OKL); Hess, W. J. 462 (OKL); Holmgren, A. H. 3226 (GH, NY); Holmgren, A. H. and S. Hansen 3339 (NY), 3414 (GH, NY, US); Maguire, B. and J. D. Redd 1745 (MBG), 2118 (GH, MBG); Rydberg, P. A. and A. O. Garrett 9228 (NY, US), 9325 (NY); Waterfall, U. T. 11057 (OKL). Sevier Co.: Cronquist, A. and N. Holmgren 9325 (NY). Uintah Co.: Graham, E. H. 6368 (OKL); Harrison, B. and E. Larsen 7813 (MBG). Washington Co.: Maguire, B. 12299 (GH, NY, US). Wayne Co.: Harrison, B. 7536 (MBG).

Wyoming: County unknown: Near Laramie, Continental Divide, Bartley, F. and L. L. Pontius 667 (NY); Upper Platte, Hayden, F. V. s.n. (GH). Albany Co.: Brenckle, J. F. and L. H. Shinners 41-321 (NY, OKL); Goodding, L. N. 2108 (GH, NY, US); Goodman, G. J. 649, 5118 (OKL); Nelson, A. 416 (GH, US), 7328 (GH, MBG, NY, US); Porter, C. L. 3760 (GH). Carbon Co.: Nelson, A. 416 (NY). Goshen Co.: Collector unknown, vicinity of Ft. Laramie, (MBG); Cory, M. 378 (US). Laramie Co.: Nelson, A. 18 (GH); Wiegard, K. M., H. Castle, W. R. Dann, and G. E. Douglas 2897 (MBG). Platte Co.: Porter, C. L. 4011 (GH).

DISCUSSION: Torrey's description of E. alatum was based on an 1851 collection by Woodhouse from the Sitgreaves exploration of the Zuni and Colorado Rivers. Torrey cited three previous collections; one in 1843 by Fremont "in the upland prairies at the source of the Plata", the second by Fremont in 1844 at "Bahia Salada" (South Park, Colorado) in the Rocky Mountains, and the third by Lt. Abert in 1846 "at Raton Pass" in the Rocky Mountains.

In the subgenus Pterogonum, the distribution of var. alatum is the most extensive. Included are two short-leaved taxa, probably northern and high altitudinal extremes. Geyer (l.c.) suggested, in name only, and later Bentham (l.c.) described one of these short-leaved taxa as E. alatum var. elatum, and Gandoger (l.c.) described the other one as E. alatum var. brevifolium. A Siler collection from Utah in 1874 was originally described by Watson (l.c.) as E. triste and later reduced by Stokes (l.c.) to a subspecies of E. alatum. The distinguishing characteristic cited for this Utah taxon was a tendency toward a glabrous condition. Studies of this characteristic in populations and herbarium specimens showed some variation. The distribution of E. triste, although primarily found in southern Utah and northern Arizona, is scattered in the Rocky Mountains throughout the range of the pubescent E. alatum. A conservative treatment of these more glabrous plants as var. alatum is suggested by the morphological variation, disjunct distributions, and ecological observations.

The center of distribution for var. alatum would seem to be southwestern United States, perhaps in the Mogollon Mountains of New Mexico. Here, the populations mostly occur in relatively undisturbed

areas, whereas further north, the populations are more common along disturbed sites such as roadcuts, erosional cuts, and canyon breaks. Its migration would seem to be northward in the mountains and into the Great Plains via waterways. Plants intermediate between var. alatum and var. glabriusculum were found in Union County, northeastern New Mexico, on the canyon breaks above Tramperos Creek (Hess 976). This indicated a possible pathway of movement for certain members of this species onto the Great Plains. If isolation and selection occur, then a polymorphic taxon could result.

1b. Eriogonum alatum var. mogollense St. ex Jones, Contr. West. Bot. 11: 15. 1903.

E. alatum β macdougalii Gdgr., Bull. Soc. Bot. Belg. 42: 186. 1906.

E. alatum ssp. mogollense (St.) St., Stokes, Gen. Eriogonum p. 20. 1936.

Figure 6, D.

Erect plants 8-13 dm tall, densely strigose becoming scattered strigose in the inflorescence; basal leaves 4-11 cm long, 1-2 cm wide, spathulate, strigose above, glabrous below, bases short tapering to long narrowly winged petioles, petiole bases with brown woolly pubescence; inflorescence branching from the lower through the upper nodes; peduncles and involucres strigose; bractlets slightly ciliate; mature achenes 5-8 mm long, (4-) 4.5-6 mm wide, ovate; embryo 4-6 mm long, 2.5-3 mm broad.

DISTRIBUTION: Common in the Juniper-Pinyon Pine and Ponderosa Pine woodlands at an elevation of 6000-8000 feet in north central Arizona.

Figure 2.

TYPE: United States of America: Arizona: Flagstaff, August 7, 1884, M. E. Jones 3975 (POM). Isotypes (GH!, NY!, US!).

SPECIMENS EXAMINED:

United States of America.

Arizona: County unknown: Palmer, E. 6 (GH, US). Coconino Co.: Degener, O. and K. K. Park 4438 (NY); Heiser, C. 834 (MBG); Hess, W. J. 961, 966 (OKL); Kearney, T. H. and R. H. Peebles 12093 (GH); Knowlton, F. H. 58 (US); Kuntz, O. 23220 (NY); Leibig, J. B. 5703 (US); Lemmon, J. G. and wife s.n. July 1884 (OKL, US); MacDougal, D. T. 259 (NY, US), 246 (US); Schallert, P. s.n. July 3, 1943 (NY), s.n. Sept. 5, 1943 (OKL); Toumey, J. 340a (MBG, US), 340b, 340c, 340d, (US), 340j (MBG), s.n. Sept. 5, 1894 (GH, NY); Tracy, S. M. s.n. June 26, 1887 (NY); Ward, L. F. s.n. June 11, 1901 (NY, US).

DISCUSSION: The plants of var. mogollense are restricted in distribution to the mountains around the Flagstaff area. This taxon may be characterized by spathulate basal leaves and woolly haired petiole bases. Otherwise, they are quite similar to var. alatum. Populational analysis of plants in the Flagstaff area predominately shows the spathulate leaf character. It would seem that no or little movement of genes controlling leaf shape has occurred in this area. It is evident that the spathulate leaf character has been maintained. However, it is difficult to determine if there is a populational change in the frequency of plants with spathulate leaves as opposed to those with lanceolate leaves. Nevertheless, recognition of these plants as var. mogollense seems reasonable.

1c. Eriogonum alatum var. glabriusculum Torr., Pacif. RR. Reports 4: 131. 1857.

Figure 6, E-G.

Erect plants 10-20 dm tall, strigose at the base becoming glabrous or sparsely strigose above; basal leaves 8-20 cm long, 0.6-1.5 cm wide, linear-lanceolate to lanceolate, slightly strigose or glabrous above, glabrous below except for ciliate midvein, bases long tapering to winged petioles, petiole base slightly strigose; cauline leaves 1-9 cm long, 0.3-0.9 cm wide; inflorescence branching restricted to the upper nodes; peduncles glabrous or occasionally slightly strigose; involucres glabrous, the 5 lobes obtuse or truncate, slightly ciliate; bractlets glabrous; mature achenes 5.5-9 mm long, 3-5.5 mm wide, ovate to elliptic or elliptic-obovate; embryo 5-6.5 mm long, 2-3 mm broad.

DISTRIBUTION: Common along canyon breaks in the grasslands of the Great Plains at an elevation of 1000-4500 feet from the north central Texas and Panhandle east to central Oklahoma.

Figure 2.

TYPE: United States of America: Oklahoma (?): High places near the Canadian, September 3 (?), 1853, J. M. Bigelow (NY!). Isotype (US!).

SPECIMENS EXAMINED:

United States of America.

New Mexico ?: Locality unknown, probably from Texas: Leroy, P. V. s.n. (NY).

Oklahoma: Beckham Co.: Stratton, R. 364 (MBG). Ellis Co.: Hess, W. J. 497 (OKL); Stevens, G. W. 2938 (GH, MBG, NY, OKL, US); Waterfall, U. T. 8713 (OKL). Garvin Co.: Hess, W. J. and T. Harrison 984 (OKL); Pearce, R. 1381, 1420 (OKL). Roger Mills Co.: Goodman, G. J. and R. W. Kelting 5404 (NY, OKL); Hess, W. J. and W. Seibert 506, 507 (OKL); Waterfall, U. T. 8276 (OKL). Stephens Co.: Hess, W. J. and T. Harrison 985 (OKL). Woodward Co.: Goodman, G. J. 2180 (MBG, OKL).

Texas: County unknown: Bigelow, J. M. s.n. (NY). Armstrong Co.: Muller, C. H. 8622 (NY). Briscoe Co.: Hess, W. J. 770 (OKL). Childress Co.: Biology Class s.n. Oct. 1, 1932 (NY). Crosby Co.: Correll, D. S. 15119 (US); Hess, W. J. 771 (OKL). Floyd Co.: Ferris, R. S. and C. D. Duncan 3366A (MBG, NY). Gray Co.: Hess, W. J. 761 (OKL). Hemphill Co.: Eggert, H. s.n. Aug. 10, 1900 (GH, MBG); Tharp, B. C. 4345 (US). Hutchinson Co.: Cory, V. L. 16286 (GH); Hess, W. J. 977 (OKL). Lubbock Co.: Reed, E. L. 3106 (US). Motley Co.: Cory, V. L. 15977 (GH); Waterfall, U. T. 7838 (GH, NY). Randall Co.: Ball, C. R. 1216 (NY); Cory, V. L. 50446 (NY); Eggert, H. s.n. Aug. 13, 1900 (MBG, NY); Hess, W. J. 769 (OKL); Palmer, E. J. 14587 (MBG, US); Reverchon, J. 2946 (MBG), 3680 (GH, NY, US); Young, M. S. s.n. Sept. 5, 1917, s.n. Sept. 7, 1917 (US).

DISCUSSION: Bigelow collected var. glabriusculum in September of 1853 while with the Whipple expedition of 1853 and 1854. A herbarium specimen from this collection (NY) of Bigelow included drawings of parts of the plant, and on one drawing was the date "Sept. 3, 1853". If we

assume that this was the date when the plant was collected, then according to Foreman (1941) the expedition would have been in central Roger Mills County around Strong City, Oklahoma. Until 1965, this area would have been the easternmost known limits of var. glabriusculum, but more recent collections have extended the range further east to central Oklahoma. If the date on the drawing is incorrect, then the collection could have been made in Texas along the hills bordering the Canadian River within the present known range of var. glabriusculum.

In Oklahoma and Texas, var. glabriusculum is most often found on slightly disturbed ground at the edges of canyons and gullies. The occurrence of this taxon on the breaks suggests a pathway of distribution from the Rocky Mountains onto the Great Plains as mentioned above. Incipient speciation may occur with the present isolation if the morphological differences of var. glabriusculum and var. alatum are genetically controlled. This would be speculation, and since var. alatum is quite variable including some intraspecific characteristics common to var. glabriusculum, consideration of the Oklahoma and Texas taxon as a variety seems to be the most reasonable.

The trends in var. glabriusculum are easily distinguished when populations are examined. Many plants are over 5 feet tall and heights of 7 feet have been measured. The basal leaves are generally long and narrow, with less pubescence than those of the other varieties in this species. The inflorescence branching is restricted to the upper nodes of the stem and is not developed from the bottom nodes

as is common in var. alatum and var. mogollense. For the most part, the involucres and peduncles are quite glabrous and the remaining branches of the inflorescence are glabrous to scattered pubescent. The involucre lobes are not sharply pointed but are often irregular or truncate. These trends in populations of var. glabriusculum tend to place it apart from the other varieties.

2. Eriogonum nealleyi Coult., Contr. U. S. Nat. Herb. 1: 48. 1890.

Figure 7, A-D.

Erect perennial herbs, 5-12 dm tall from branched caudices or from spreading rhizomes, glabrous nearly throughout; basal leaves 4-8 cm long, 0.8-1.6 cm wide, oblanceolate to spathulate, strigose on both surfaces with entire ciliate margins, apices acute or obtuse, bases long tapering to slightly winged petioles 1-2.5 cm long; cauline leaves 1-4 cm long, 3-8 mm wide, oblanceolate, sparsely strigose on both surfaces with ciliate margins, petioles short; bracts 0.5-2 mm long, scale-like, ternate, connate at the bases; inflorescence an open paniculate cyme, branching mostly restricted to the upper half; peduncles 1-8 cm long, ascending to erect, straight or curved; involucres 2-3 mm long and wide, turbinate or campanulate, the 5 shallow lobes obtuse or occasionally acute; bractlets 1.5-2.5 mm long, linear-oblanceolate, glandular; pedicels light green, 2-4 (-6) mm long; flowers 10-20; perianth white with a green or red midrib, becoming pink or reddish at maturity, 2.5-3 mm long, calyx-segments similar, apices rounded, glabrous or sparsely strigose without; stamens 2-2.5 mm

long, sometimes reduced and sterile, filaments yellow and densely pilose at the bases, anthers red, oblong; ovary short stipitate, pilose, mature achenes green turning reddish-brown at maturity, 4-6 mm long, 2-3 mm wide, pandurate, upper third winged, slightly pilose along the winged margins, exserted; embryo straight, bright yellow, 3-4 mm long, ca. 2 mm broad.

DISTRIBUTION: Uncommon, in dry, open grassland areas and roadsides of central Texas. Flowers and fruits August through September.

Figure 3.

TYPE: United States of America: Texas: Near Pecos City (Pecos County), G. C. Nealley (US!).

SPECIMENS EXAMINED:

United States of America.

Texas: County unknown: Headwaters of the middle Concho River, Réverchon, J. s.n. (MBG). Coke Co.: Palmer, E. J. 10351 (US). Howard Co.: Eggert, H. s.n. June 11, 1900 (MBG). Irion Co.: Hess, W. J. 786 (OKL). Sterling Co.: Tharp, B. C. 3373 (US).

DISCUSSION: This species has a very limited distribution and the two populations seen by me were small, consisting of about 80-100 plants covering a half mile. The rareness of this species was evident by its absence from collections in various herbaria. No collections from Pecos County are known by me except for the type as cited by Coulter (l.c.).

Coulter (l.c.) stated that E. nealleyi belonged in the subgenus Ganysma and suggested that it was closely related to E.

ciliatum and E. atrorubens. However, it seems more closely related to the members of the Alata group (sensu Watson) since the inflorescence branching developes in the axils of the upper leaves and not in the axils of the bracts as in the Ganysma group. Certain characteristics of E. nealleyi, such as glabrous peduncles and involucres, similar leaf pubescence and 7 or more cauline leaves, are shared with E. alatum var. glabriusculum. It resembles E. hieracifolium in possessing a branched caudex system, pilose filaments of the stamens, and a pandurate ovary with scattered pubescence. The nearly glabrous condition throughout the stem of E. nealleyi quickly distinguishes it from the other two taxa which have some stem pubescence. The similarity of habit, flowers, and fruits tends to suggest that E. nealleyi and E. hieracifolium are more closely related to one another than to E. alatum var. glabriusculum.

3. Eriogonum hieracifolium Benth., DC. Prodromus 14: 6. 1856.

E. pannosum Woot. and Standl., Contr. U. S. Nat. Herb. 16: 118. 1913.

E. leucophyllum Woot. and Standl. ssp. pannosum (Woot. and Standl.) St., Stokes, Gen. Eriogonum p. 97. 1936.

Pterogonum hieracifolium (Benth.) H. Gross, Bot. Jahrb. Engler 49: 239. 1913.

Figure 7, E-G.

Erect perennial herbs, 4-7 dm tall spreading from branched caudices, strigose or woolly nearly throughout; basal leaves 5-15 cm long, 0.6-2 cm wide, oblanceolate to spathulate, strigose to woolly

on upper surface, woolly underneath, margins ciliate, apices obtuse or occasionally acute, bases tapering to slightly winged petioles 0.5-5 cm long, petiole bases strigose to woolly; cauline leaves 0.7-5 cm long, 0.3-1.1 cm wide, oblanceolate, strigose on upper surface, strigose to woolly below, tapering into short petioles; bracts 0.3-1.5 cm long, linear-lanceolate, strigose, ternate, connate at the bases; inflorescence an open paniculate cyme, branching restricted to upper nodes; peduncles 1-3 cm long, ascending to erect, straight or curved; involucres 2.5-4 mm long and wide, turbinate, hirsute to strigose, the 5 lobes 1/3 the length of the tube and mostly acute but occasionally obtuse; bractlets 2-2.5 mm long, linear-lanceolate, glabrous, glandular; pedicels yellow, 2-5 mm long, glabrous; flowers 20-35; perianth yellow, sometimes turing red at maturity, 2.5-4.5 mm long, connate at base, calyx-segments similar, rounded at apex, entire, strigose along base and midrib; stamens yellow, 2-3 mm long, sometimes reduced and sterile, base of filaments pilose, anthers oblong; ovary short stipitate, pilose, mature achenes yellow-green, 4.5-6 mm long, 2.5-3.5 mm wide, pandurate, upper half winged, exserted; embryo straight, green, 3-4 mm long, ca. 1 mm wide.

DISTRIBUTION: Common in open areas of grasslands, Juniper-Pinyon Pine and Ponderosa Pine woodlands at an elevation of 3000-8500 feet in the foothills and mountains of western Texas to north central New Mexico, and west to east central Arizona. Flowers and fruits July through October.

Figure 3.

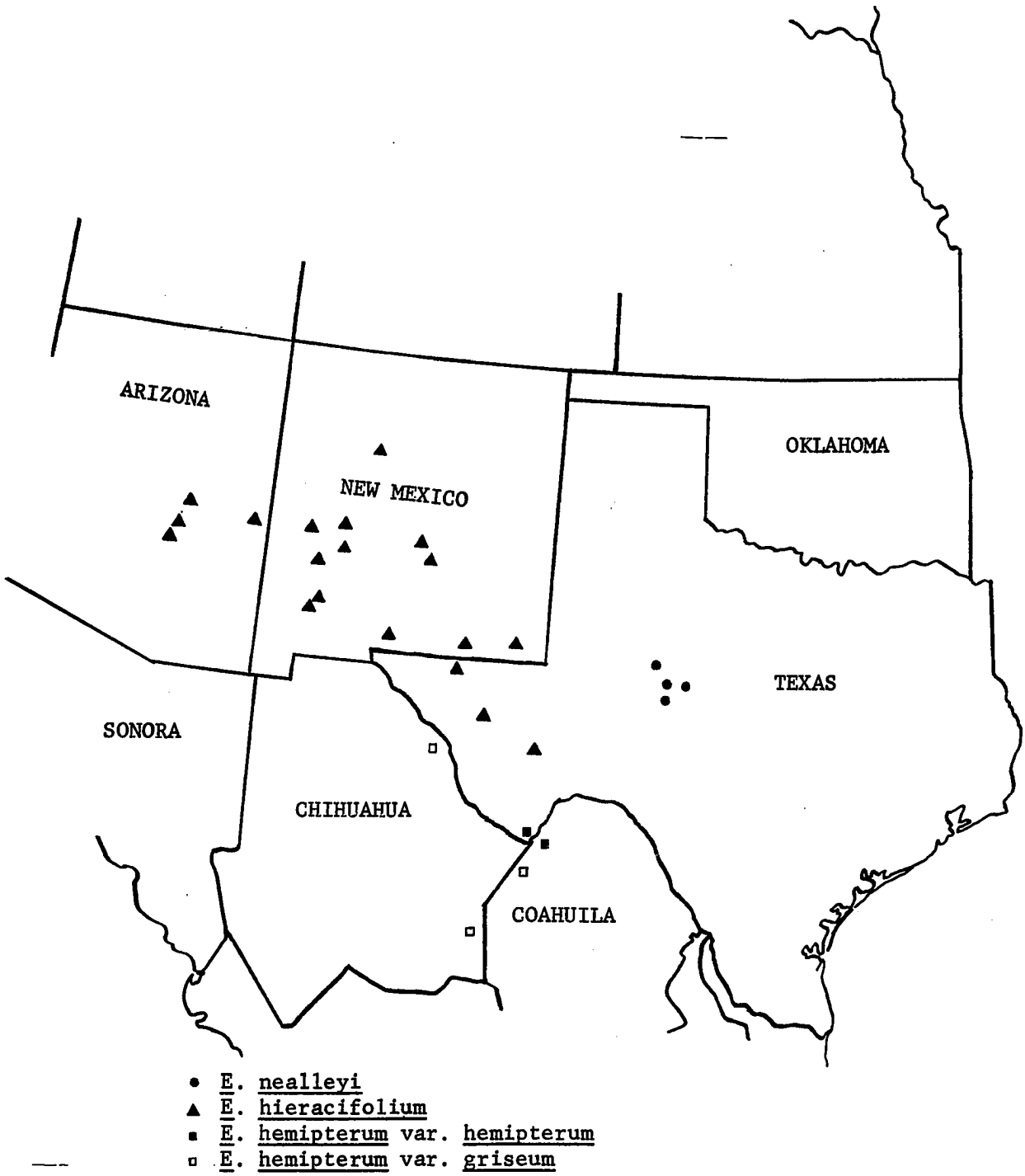


Figure 3. Species Distribution Map for Eriogonum nealleyi, Eriogonum hieracifolium, and Eriogonum hemipterum.

TYPE: United States of America: Texas: Guadalupe Mountains, east of El Paso, 1849, Wright 616 (GH). Isotype (NY!, US!).

SPECIMENS EXAMINED:

United States of America.

Arizona: County unknown: Willow Spring, Rothrock, J. T. 260 (GH, US). Fort Apache: Goodding, L. N. 683 (GH, NY, US); Hough, W. 93 (US); Hoyt, R. W. s.n. 1893 (NY); Palmer, E. 597 (GH, NY, US). Apache Co.: Griffiths, D. 5384 (US); Schroeder, W. L. s.n. 1938 (NY). Gila Co.: Allen, R. P. 908 (OKL); Darrow, R. A. s.n. June 6, 1940 (NY); Goodman, G. J. and C. L. Hitchcock 1288 (GH, NY, OKL); Hess, W. J. 352 (OKL); Pultz, L. M. 1006 (MBG, NY).

New Mexico: County unknown: Continental Divide, Wooton, E. O. s.n. July 15, 1906 (US). Bernalillo Co.: Barneby, R. C. 2415 (NY). Catron Co.: Eggleston, W. W. 20380 (US); Hess, W. J. 312, 886, (OKL); Smith, C. E., Jr. 80 (US); Weber, W. A. and P. Salamun 12791 (OKL). Dona Ana Co.: Parker, K. F. 3028 (RSA); Vasey, G. R. s.n. Aug. 1881 (NY, US). Eddy Co.: Degener, O. 5029 (NY); Hess, W. J. 853 (OKL); Payson, L. B. 28 (OKL); Standley, P. C. 40403 (US); Steiger, T. L. 498 (NY); Wooton, E. O. s.n. Aug. 1, 1909, s.n. Aug. 4, 1909 (US). Grant Co.: Holzinger, J. M. s.n. Aug. 27 to Sept. 12, 1911 (US). Lea Co.: Cory, V. L. s.n. Sept. 9, 1939 (GH). Lincoln Co.: Earle, F. S. and E. S. Earle 187 (MBG, NY, POM); Hitchcock, C. L., R. V. Rethke, and R. van Raadshooven 4204 (GH, NY, OKL, RSA); Skehan, J. 96 (GH, NY, POM, US); Wooton, E. O. s.n. Aug. 5, 1901 (POM, US), s.n. July 26, 1905 (US). Sierra Co.: Hess, W. J. 310 (OKL). Socorro Co.: Wooton, E. O. s.n. Aug. 15, 1900, s.n. Aug. 20, 1900 (US).

Texas: Culberson Co.: Hinckley, L. C. 2591 (GH, NY); McKechnie, B. E. 552 (MBG); Moore, J. A. and J. A. Steyermark 3617 (GH, NY, US); Shreve, F. 10248 (GH); Strandtmann, R. W. s.n. Aug. 22, 1941 (GH); Waterfall, U. T. 4509 (GH), 5243 (GH, NY), 5760 (GH, MBG, NY). Pecos Co.: Cory, V. L. 6858 (GH).

DISCUSSION: The locality of Wright's collection in Texas would probably be within 100 miles of the Organ Mountains of New Mexico. The Organ Mountains is the type locality of a collection by Vasey which was later described by Wooton and Standley (l.c.) as E. pannosum. They stated that E. pannosum "is nearest E. hieracifolium" and that it differed in the kind of pubescence and smaller size of the leaves, involucres, and perianth parts. However, the variation among the various populations and herbarium specimens examined of E. hieracifolium indicated that recognition of E. pannosum as a distinct species or even a variety is impractical. Stokes (l.c.) included E. pannosum as a variety of Wooton and Standley's E. leucophyllum. She stated that it "is on the border line between the lachnogynum group and the alatum group of Section I and geographically it is related to both." Stokes chose to relate it more closely to the lachnogynum group. I disagree with this treatment of E. pannosum on the basis of certain characteristics shared with E. hieracifolium and not with E. leucophyllum, namely, the presence of cauline leaves from which axillary inflorescences develop, winged fruits, and larger involucres and perianth parts.

The relationship of E. hieracifolium to other species is probably greatest with E. hemipterum and E. nealleyi. The basis for

this assumption would be the pandurate shape of the fruit, common to all three species. Other characteristics shared by E. hieracifolium with either one of these species are mentioned in their species discussion. The relationship of E. hieracifolium to E. alatum can be seen by the presence of the winged fruits, cauline leaves, and a similar mode of inflorescence branching. These characteristics strongly support the positioning of these taxa in a close relationship with one another.

4. Eriogonum hemīpterum (Torr. and Gray) St., Stokes, Gen. Eriogonum p. 21. 1936.

Erect perennial herbs, 2-6 dm tall from branched caudices, strigose throughout; basal leaves 4-8 cm long, 0.5-1.5 cm wide, mostly spathulate or oblanceolate, strigose on both surfaces or tomentose below, margins ciliate, apices obtuse or occasionally acute, bases long tapering to slightly winged petioles 0.5-3 cm long; cauline leaves 1-5.5 cm long, 0.2-0.9 cm wide, spathulate to oblanceolate, strigose on both surfaces or tomentose below, margins ciliate, petioles short, slightly winged; bracts 3-8 mm long, oblanceolate or sometimes scale-like, strigose with ciliate margins, connate at the bases; inflorescence an open paniculate cyme, branching mostly restricted to upper 3 or 4 nodes; peduncles 1-12 cm long, ascending to erect, straight or curved; involucres 3-4 mm long, 2.5-4 mm wide, campanulate or turbinate, slightly strigose to densely strigose, the 5 lobes 1/3 the length of the tube, acute or sometimes obtuse; bractlets 2-2.5 mm long, linear or linear-lanceolate, glabrous or ciliate and glandular; pedicels

red, 2-3 mm long, glabrous; flowers 20-35; perianth maroon, 2-3.5 mm long, lower third connate, calyx-segments similar, rounded at apex, strigose without, particularly around the base and on the midrib, glabrous within; stamens maroon, 2-2.5 mm long, filaments pilose at the bases, anthers oblong; ovary short stipitate, distinctly pilose, mature achenes reddish-brown, 4-5 mm long, 2-3.5 mm wide, pandurate, upper third winged, exserted; embryo straight, yellow-green, 3-4 mm long, 2-2.5 mm broad.

DISTRIBUTION: Locally common in the mountains of northern Coahuila and northeastern Chihuahua, Mexico and the Chisos Mountains of southwestern Texas, United States, from an elevation of 4000-7500 feet.

Figure 3.

DISCUSSION: This species was collected by Parry on the "hillsides, along the cañons of Rio Grande, above the mouth of the Pecos" and first cited by Torrey (1858) as E. hieracifolium. Later, Torrey and Gray (1870) described Parry's collection as E. hieracifolium var. hemipterum and included "E. hemipterum Torr. in herbariis" after the varietal epithet. This herbarium name caused some author-citation confusion after Stokes (l.c.) cited it as "Eriogonum hemipterum Torr. in T. & G., Pr. 154" in her description of this taxon. Johnston (1944) cited this species as E. hemipterum Torr. ex Stokes. Goodman (1945) explained that he believed Stokes intended to raise var. hemipterum of Torrey and Gray to the species level, with which I concur. Consequently, the proper author-citation should read E. hemipterum (Torr. and Gray) Stokes.

The close relationship of E. hemipterum to E. hieracifolium is obvious. They share similarly shaped, pubescent fruits with the upper third distinctly winged, distinctly pubescent perianths, up to 4 or 5 cauline leaves, similar inflorescences and similar habits of branched caudices. Smaller maroon perianths, less pubescence, and a less robust nature but longer inflorescence branches are the most distinguishing characteristics of E. hemipterum from E. hieracifolium.

4a. Eriogonum hemipterum var. hemipterum

E. hieracifolium Benth. var. β hemipterum Torr. and Gray, Proc. Am. Acad. Sci. 8: 154. 1870.

E. hieracifolium Benth. forma atropurpureum Standl., Field Mus. Pub. Bot. 11: 149. 1936.

Figure 7, H-J.

Basal and cauline leaves strigose on both surfaces; peduncles 1-7 cm long, involucres slightly strigose; bractlets 2 mm long, linear, glabrous; perianth-segments 2-3 mm long; embryo 3.5-4 mm long, 2-2.5 mm broad.

DISTRIBUTION: Locally common in the canyons and mountain sides at an elevation of 4000-7500 feet in the Chisos Mountains of southwestern Texas, United States, to northeastern Coahuila, Mexico. Flowers and fruits July through November.

Figure 3.

TYPE: United States of America: Texas: Hillsides of the Rio Grande, above the mouth of the Pecos, November 8, 1852, C. C. Parry (NY!).

SPECIMENS EXAMINED:

Mexico.

Coahuila: Marsh, E. G. Jr. 660 (GH).

United States of America.

Texas: Brewster Co.: Cook, R. R. 29 (GH); Cory, V. L. 26546, 44702 (GH); Fletcher, H. P. 11990 (GH); Goodman, G. J. 5430 (OKL); Hess, W. J. 799 (OKL); Hinckley, L. C. 835 (GH, NY); Muller, C. H. 7977 (GH, NY, US), s.n. July 28, 1932 (GH, MBG, NY, US); Sperry, O. E. 216 (US); Steiger, T. L. 617, 1213, 1421 (NY); Warnock, B. H. s.n. July 2, 1937 (GH); Warnock, B. H. and L. C. Hinckley 4061 (US); Young, M. S. s.n. Sept. 10, 1915 (GH).

DISCUSSION: Standley (l.c.) described a Muller collection (no. 7977) in 1931 from the Chisos Mountains as E. hieracifolium forma atropurpureum. Johnston (l.c.) placed Standley's name in synonymy under E. hemipterum but this change went mostly unnoticed. Nearly all the plants of this taxon from the Chisos Mountains have been called forma atropurpureum. A factor which probably prompted Standley to consider the red-flowered plants a forma of E. hieracifolium was another collection by Muller (no. 7978) from the same locality which fits the description of the typical form of E. hieracifolium. It seems doubtful that the typical E. hieracifolium occurs in the Chisos Mountains since my field work and the herbarium specimens examined have not shown it to be present there. However, no explanation is available for Muller's collection (no. 7978).

Insufficient collections of var. hemipterum and var. griseum in Mexico probably depict an incompleted distribution. Although var.

hemipterum is mostly found in the Chisos Mountains of Texas, it is interesting that it occurs mainly on the western slopes. Ecological studies could probably explain this phenomenon.

4b. Eriogonum hemipterum var. griseum Johnst., Jour. Arn. Arb. 25: 138. 1944.

Basal and cauline leaves strigose above and tomentose below; peduncles 1-12 cm long; involucres densely strigose; bractlets 2-2.5 mm long, linear-lanceolate, ciliate, glandular; perianth 2-3.5 mm long; embryo 3-3.5 mm long, ca. 2 mm broad.

DISTRIBUTION: Scattered in the mountains of northern Coahuila and northeastern Chihuahua, Mexico. Flowers and fruits May through December.

Figure 3.

TYPE: Mexico: Coahuila: Central parts of the Sierra del Piño, 1940, Johnston and Muller 547 (GH).

SPECIMENS EXAMINED:

Mexico.

Chihuahua: LeSueur, H. D. 1533 (GH); Stewart, R. M. 968 (GH).

Coahuila: Stewart, R. M. 1249 (GH).

DISCUSSION: This taxon is set apart from var. hemipterum because the undersides of the leaves are tomentose and the involucres are densely pubescent. Although the branching pattern of the two varieties is similar, var. griseum is more robust. Additional distributional data would aid in the interpretation of these taxa.

5. Eriogonum atrorubens Engelm., in Wisliz. Mem. Tour No. Mex. p. 108. 1848.

Erect perennial herbs, 5-8 (-10) dm tall from branched caudices; stems glabrous and glaucous; leaves basal, 7-20 cm long, (0.5-) 1-3 cm wide, lanceolate to oblanceolate or oblong, sparsely strigose on both surfaces, often more so below than above, or glabrous except for ciliate margins and midveins or densely white tomentose below and strigose above, apices obtuse or occasionally acute, bases tapering to winged petioles 3-8 (-12) cm long; bracts 1-4 (-10) mm long, scale-like or linear-lanceolate, glabrous to sparsely pilose without and within, ciliate along the margins, ternate, connate at the bases; stems usually solitary, 1-4 dm long, sometimes inflated below the first node, rarely inflated below the second node, di- or trichotomously divided above, branches erect and spreading with an involucre-bearing peduncle in the forks of each node; peduncles (1-) 2-6 (-12) cm long, ascending to erect, straight or curved; involucres 1.5-4 (-4.5) mm long, 1-3 mm wide, turbinate to campanulate, glabrous, the 5 lobes 1/3 the length of the tube, often ciliate, acute to truncate; bractlets 2-3.5 mm long, linear-lanceolate to lanceolate, glabrous or ciliate, glandular; pedicels reddish, 2-5 (-6) mm long, glabrous; flowers 20-40; perianth purple to maroon often with a dark greenish midrib, 2-6 mm long, inner calyx-segments broader and longer than outer segments, connate at the bases, rounded at the apices, glabrous or occasionally pilose without, glabrous within, minutely glandular; stamens maroon, 2-2.5 mm long, glabrous, anthers oblong; ovary short stipitate, glabrous, mature achenes 4-5.5 mm long, 2-3.5 mm wide,

light greenish-brown to brown, ovate, slightly 3-winged the entire achene length, exserted; embryo straight, green, 2.5-3.5 mm long, ca. 1.5 mm broad.

DISTRIBUTION: Infrequent in exposed meadows and slopes or within Juniper-Pinyon Pine and Pine-Oak woodlands at an elevation of 6000-9000 feet, from Zacatecas and Durango northeast to Nuevo Leon and Coahuila, and north through the Sierra Madre Occidental of Chihuahua, Mexico, and to southern New Mexico, United States.

Figure 4.

DISCUSSION: The type was collected in Chihuahua, Mexico, in 1846 by Wislizenus during his forced internment by the Mexicans at the time of the Mexican War. Only recently has a critical evaluation of the available specimens been undertaken, that by Reveal (in ms. b). He has described var. atrorubens, var. pseudociliatum, and var. intonsum based on this investigation. I have followed his treatment, however, comments about vars. atrorubens and pseudociliatum follow in the discussions below.

5a. Eriogonum atrorubens var. atrorubens

Pterogonum atrorubens H. Gross, Bot. Jahrb. Engler 49: 239. 1913.

Figure 8, A-D, H.

Plants erect; leaves strigose on both surfaces, often more so below than above; the lobes of the involucres acute; bractlets often ciliate, glandular; perianth maroon often with a greenish midrib, the calyx-segments glabrous or sometimes remotely strigose, often clasping the mature achenes; beaks of the achenes unexposed or exposed.

DISTRIBUTION: Locally common in low foothills and mountains at an elevation of 6000-8000 feet, from Zacatecas northeast to Nuevo Leon and Coahuila, and northwest into Chihuahua. Found in exposed areas such as meadows and slopes or in Juniper-Pinyon Pine and Pine-Oak woodlands. Flowers and fruits May through October.

Figure 4.

TYPE: Mexico: Chihuahua: On the banks of streamlets at Cosihuiriachi (present spelling, Cusihuiriachic), September, 1846, A. Wislizenus (MBG!). Isotype (NY!).

SPECIMENS EXAMINED:

Mexico.

Chihuahua: Dobie, B. M. 77 (OKL); Gentry, H. S. 2709 (GH, MBG, US); Hartman, C. V. 780 (GH); Hewitt, H. R. 44 (GH); Jones, M. E. s.n. Sept. 16, 1903 (NY, POM, US); LeSueur, H. 75 (GH); Muller, C. H. 3382 (GH, MBG); Nelson, E. W. 6017 (GH, MBG, US); Pennell, F. W. 18763, 18828 (US); Pringle, C. G. 1357 (GH, NY, RSA, US); Straw, R. M. and M. Foreman 1850 (RSA); White, S. S. s.n. (GH).

Coahuila: Kenoyer and Crum 2994 (GH); Palmer, E. 1175 (GH, NY, US); Pennell, F. W. 17324 (US); Stanford, L. R., K. L. Retherford, and R. D. Northcraft 359 (NY).

Nuevo Leon: Muller, C. H. 2184 (GH, MBG, NY); Muller, C. H. and M. T. Muller 466, 492, 1045 (GH); Pennell, F. W. 17008 (US); Schneider, R. 973 (US); Taylor, M. 85 (MBG, NY, OKL); University of Illinois 973 (GH, MBG, NY).

Zacatecas: Gentry, H. S. 8484 (GH, US).

DISCUSSION: The plants of E. atrorubens in the Mexican state of Chihuahua are quite variable with all three varieties present. The variation within two of the varieties, atrorubens and pseudociliatum, is pronounced. Reveal (l.c.) has stated that he is fully aware of the variation and that additional collection in "the intermediate mountain ranges" might help clarify the situation.

The type specimen of var. atrorubens has swollen nodes, leaves 20 cm long which are densely strigose beneath and sparsely so above, flowers with perianths 5-6 mm long at maturity which clasp the fruit, and is quite robust. A specimen of Muller's (no. 2184), collected almost 100 years later and from near the type locality, shows the same characteristics. A collection by Pringle (no. 1357) is also similar to the type except for the clasping perianth parts which are not as obvious. The exact location in Chihuahua of the Pringle collection is unknown. Several specimens collected from Majalca, Chihuahua, approximately 60 miles north of the type locality, appear similar to the type. However, they differ from the type in the occurrence of less leaf pubescence, finer peduncles, smaller involucres and obscurely clasping perianth parts with the beak of the achene slightly exposed. Still other Chihuahuan specimens are less robust, smaller leaved, and have smaller involucres and a smaller perianth which exposes the beak of the achene. I am uncertain that these specimens make up a natural group — and some may be more closely related to var. pseudociliatum. However, until field work and some experimentation is done, and since there is such an overlap in morphological variation, it seems better to treat these plants as a single variety.



▲ E. atrorubens var. atrorubens
▪ E. atrorubens var. pseudociliatum
• E. atrorubens var. intonsum

Figure 4. Species Distribution Map for Eriogonum atrorubens.

The specimens of var. atrorubens from Nuevo Leon and neighboring Coahuila seem to be morphologically similar and can be distinguished from most of the Chihuahuan specimens of the same variety. They appear to make a natural group and with their similar distribution are most tempting to recognize as distinct from the Chihuahuan plants. However, some Chihuahuan specimens approach morphologically those of Nuevo Leon and Coahuila to the extent that further details are needed. Until field work and more collecting is done in these areas, these eastern plants are considered as a portion of the var. atrorubens complex.

5b. Eriogonum atrorubens var. pseudociliatum Reveal (in ms. b).

Figure 8, E-G.

Plants erect; leaves glabrous on both surfaces or sparsely strigose above, or rarely sparsely strigose on both surfaces; the lobes of the involucres obtuse or truncate or rarely acute; bractlets glabrous, glandular; perianth maroon, the calyx-segments glabrous, beaks of the achenes exposed.

DISTRIBUTION: Locally common in the foothills and mountains of the Sierra Madre Occidental at an elevation of 6000-9000 feet, in open meadows and slopes or within Juniper-Pinyon Pine and Pine-Oak woodlands of Durango through Chihuahua, Mexico and possibly extreme southern New Mexico, United States. Flowers and fruits June through September.

Figure 4.

TYPE: Mexico: Durango: Otinapa, July 25-August 5, 1906, E. Palmer 382 (US). Isotypes (MBG!, NY!).

SPECIMENS EXAMINED:

Mexico.

Chihuahua: Collector unknown s.n. July 11, 1899 (NY); LeSueur, H. 77 (GH); Mearns, E. A. 568 (US), 2123 (NY, US), 2463 (GH, NY, US); Palmer, E. 280 (GH, MBG, NY, US); Pennell, F. W. 19008 (NY, US), 19107, 19123 (US); Shreve, F. 7950 (US); Townsend, C. H. T. and C. M. Barber 72 (GH, MBG, NY, POM, US).

Durango: Maysilles, J. H. 7184 (NY, US), 8463 (NY); Nelson, E. W. 4552 (GH, US); Pennell, F. W. 18554 (NY, US); Waterfall, U. T. 12649 (GH, OKL, US), 12653 (OKL).

DISCUSSION: The collections of var. pseudociliatum from Durango are morphologically similar and seem to form a natural group. A collection from Chihuahua (Palmer 280) is also similar to those from Durango. Other specimens from Chihuahua are similar to those from Durango in leaf character except that they are predominately more strigose above. The northern plants have smaller involucres with distinctly acute lobes as opposed to the larger involucres and obtuse or truncate lobes of the Durango specimens. It is evident that var. pseudociliatum in Chihuahua is more variable than that in Durango and its relationship to the Durango plants is uncertain. Some specimens of var. pseudociliatum from Chihuahua and New Mexico may be more closely related to some of the specimens considered to be var. atrorubens from Chihuahua.

An example of the problem in interpretation may be illustrated by specimens from the Gray Herbarium and Missour Botanical Garden of a Chihuahuan collection (Nelson 6017). Reveal annotated the specimen

from the Gray Herbarium as var. atrorubens and, to my knowledge, did not see the specimen from the Missouri Botanical Garden. According to Reveal's description of var. atrorubens and var. psuedociliatum, I would consider the Gray specimen as var. pseudociliatum and the other one as var. atrorubens. The Gray specimen compares quite favorably, morphologically, with some other specimens from Chihuahua considered by Reveal to be var. pseudociliatum. Nevertheless, this minor disagreement only illustrates the need for additional botanizing in this area of Mexico. Until this is done, it would be more prudent to maintain this taxon as Reveal interprets it.

5c. Eriogonum atrorubens var. intonsum Reveal (in ms. b).

Plants erect; leaves strigose above and densely white tomentose below; lobes of the involucres acute; bractlets glabrous, glandular; perianth maroon, calyx-segments glabrous, beaks of the achenes exposed.

DISTRIBUTION: Habitat unknown, occurs in the northern part of Durango and southern Chihuahua, Mexico. Flowers and fruits August through November.

Figure 4.

TYPE: Mexico: Durango: Inde, August, 1927, B. P. Reko 5239 (US).

SPECIMENS EXAMINED:

Mexico.

Chihuahua; Lumholtz, C. 1043 (GH, US); Palmer, E. s.n. Nov. 1885 (GH).

DISCUSSION: Upon close examination, the underside of the leaves is distinctly white tomentose which separates this taxon quickly from var. pseudociliatum and var. atrorubens. Further collections of this variety would aid in the treatment of this taxon in relationship to the other varieties of E. atrorubens.

6. Eriogonum rupestre St., Stokes, Gen. Eriogonum p. 21. 1936.

Figure 8, I-K.

Erect perennial herbs, 4-9 dm tall from branched caudices; stems glabrous and glaucous nearly throughout; leaves basal, 4-13 cm long, 1-2.5 cm wide, oblong to oblanceolate, densely strigose on both surfaces generally more so below than above, margins ciliate, apices acute or slightly obtuse, bases tapering to narrowly winged petioles 1-4 cm long; bracts up to 5 (-10) mm long, scale-like, slightly ciliate, ternate, connate at the bases; stems usually solitary, 1-4.5 cm long, di- or trichotomously divided above, branches erect and spreading, often with an involucre-bearing peduncle in the forks of each node; peduncles 1.5-5 cm long, ascending to erect, straight or curved; involucres 1.5-2 mm long and wide, turbinate, glabrous, the 4 or 5 lobes acute and 1/2 the length of the tube, margins of the lobes with minute glands; bractlets 1.5 mm long, linear-lanceolate, slightly ciliate, glandular; pedicels maroon, 1.5-3 mm long, glabrous; flowers 10-25; perianth maroon, 2-4 mm long, connate at base, calyx-segments unequal, rounded at apex, densely strigose without, glabrous within; stamens maroon, 1.5-2.5 mm long, glabrous, anthers oblong; ovary short stipitate, glabrous, mature achenes light brown, 4-5 mm long, 2-3 mm

wide, ovate, ridged the entire achene length, exserted; embryo straight, light green, 2-3 mm long, ca. 1.5 mm broad.

DISTRIBUTION: In low hills to an elevation of at least 7000 feet in the east central part of Chihuahua, Mexico. Flowers and fruits July through September.

Figure 5.

TYPE: Mexico: Chihuahua: Cool slopes and rocky hills near Chihuahua, August 1885, C. G. Pringle 285 (UC). Isotypes (MBG!, NY!, RSA!, US!).

SPECIMENS EXAMINED:

Mexico.

Chihuahua: Hewitt, W. P. 288 (GH); Lopez, A. 67 (GH); Pennell, F. W. 18673 (NY, US); Stewart, R. M. 760 (GH).

DISCUSSION: This species is closely related to E. atrorubens as suggested by Johnston (l.c.) and Reveal (in press, 1967). The most striking differences between the two species are that E. rupestre has a pubescent perianth, a general trend of fewer flowers in the involucres, finer peduncles, smaller involucres and very acute involucre lobes. Johnston states, and Reveal agrees, that further studies may relegate E. rupestre to varietal rank in E. atrorubens. Because of the above morphological differences and its apparent restricted distribution, recognition of this taxon as a species is advocated until more detailed field study is carried out. Some plants of E. atrorubens from Nuevo Leon have been collected that have a few strigose hairs on the perianth. The bractlets within the involucres of the plants from Nuevo Leon are similar to those of E. rupestre. This evidence presents an argument in

favor of reducing E. rupestre to varietal status within E. atrorubens even though their distributions are disjunct.

7. Eriogonum ciliatum Torr., DC. Prodromus 14: 20. 1856.

Figure 9, A-C.

Erect perennial herbs, up to 6 dm tall from branched caudices; stems glabrous nearly throughout with some stipitate glands at the bases of the involucres and above and below the nodes; basal leaves 3-9 cm long, 1-2.5 cm wide, spathulate, glabrous except for some strigose hairs on midvein below and margins, apices obtuse and mostly apiculate, bases abruptly tapering to long narrowly winged petioles 1-4 cm long; rarely with cauline leaves, in axils of bracts, up to 2 cm long, spathulate, glabrous with a few strigose hairs on midvein below and margins, apices obtuse or apiculate, bases abruptly tapering to short winged petioles; bracts up to 5 mm long, scale-like, slightly ciliate and glandular, ternate, connate at the bases; inflorencence cymose and mostly suppressed on one side; involucre-bearing peduncle in the fork of each node, peduncles 2-15 cm long, ascending to erect, straight or curved; involucres 3-5 mm long and wide, cup-shaped, the 5 shallow lobes mostly obtuse; bractlets 1.5-2.5 mm long, linear-lanceolate, densely ciliate; pedicels red or straw colored, 2-3 mm long, glabrous; flowers 20-40; perianth maroon, 2-4 mm long, lower 1/3 connate, calyx-segments similar, rounded at apex, glabrous; stamens red, 2 mm long, glabrous, anthers oblong; ovary short stipitate, glabrous, mature achenes 3-4.5 mm long, 2-3 mm wide, ovate, slightly ridged the entire achene length, exserted; embryo straight, light green, 2-2.5 mm long, ca. 1 mm broad.

DISTRIBUTION: Locally common in the low hills and high plains at an elevation of 4000-7500 feet from western Nuevo Leon and southeastern Coahuila south through central Tamaulipas to north central San Luis Potosi, Mexico. Flowers and fruits July through September.

Figure 5.

TYPE: Mexico: Coahuila (?): Camp at Buena Vista, July 28, 1848, Edwards (NY!). Selected by James Reveal 1965.

SPECIMENS EXAMINED:

Mexico.

Coahuila: Johnston, I. M. 7287 (GH, US); Palmer, E. 385 (GH, NY, US), 2088 (GH); Pringle, C. G. 2379 (GH, NY, RSA, US); Stanford, L. R., K. L. Retherford, and R. D. Northcraft 359 (GH).

Nuevo Leon: Gregg, J. s.n. 1848-1849 (NY); Vierech, H. W. 524 (US).

San Luis Potosi: Lundell, C. L. 5127 (GH, US), 5463 (US).

Tamaulipas: Stanford, L. R., K. L. Retherford, and R. D. Northcraft 748 (GH, NY); Stanford, Lauber, and Taylor 2460 (US).

DISCUSSION: This species is mostly restricted in distribution to northeastern Mexico and has little morphological variation. Most closely related to E. ciliatum would be E. greggii, originally described as its variety. Although these taxa share many characteristics, E. ciliatum is easily distinguished from E. greggii on the basis of a nearly glabrous condition except for a few glands, conspicuous ciliate bractlets, and no cauline leaves except occasionally at the first node.



• E. rupestre
▪ E. ciliatum
▲ E. greggii

Figure 5. Species Distribution Map for Eriogonum rupestre, Eriogonum ciliatum, and Eriogonum greggii.

8. Eriogonum greggii Torr. and Gray, Proc. Am. Acad. Sci. 8: 187. 1870.

E. ciliatum var. foliosum Torr., in Emory, Rep. U. S. & Mex. Bound. Surv. (Bot.): 175. 1859.

Figure 9, D-E.

Erect perennial herbs, 1-4 dm tall from branched caudices, glandular-pubescent nearly throughout; basal leaves 2-6 cm long, 0.5-1.5 (-2.5) cm wide, broadly spathulate, glabrous except for ciliate midveins and margins or slightly strigose near the apices, or uniformly hispid, stipitate glandular, apices obtuse to apiculate, bases long tapering to winged petioles 0.5-2 cm long; cauline leaves, in axils of bracts, 0.5-3 (-4) cm long, 0.2-1.2 (-2) cm wide, lanceolate to mostly spathulate to obovate, glabrous except for slightly ciliate midvein and margins, or hispid on both surfaces often more so above than below, obscurely to distinctly stipitate glandular on both surfaces, apices acute to mostly obtuse, bases cuneate, sessile; bracts up to 1.5 cm long, mostly lanceolate or occasionally obovate, glabrous except for slightly ciliate margins, or hispid with distinct ciliate margins, stipitate glandular, ternate, connate at the bases; inflorescence a continuous cyme often with one side mostly suppressed, branching 3-7 (-10) times; peduncles 1-6 (-7) cm long, ascending to erect, straight or curved; involucres 1.5-3 mm long, 3-5 mm wide, mostly cup-shaped or turbinate, slightly strigose to densely strigose, stipitate glandular, the 5 ciliate lobes 1/3 the length of the tube; bractlets 1.5-2 mm long, linear-lanceolate, slightly ciliate, glandular; pedicels

green or red, 2-3 mm long, hispid and glandular; flowers (15-) 20-40; perianth red or red with green midrib, 2-3.5 mm long, lower 1/3 connate, calyx-segments similar, rounded at apex, strigose without, glabrous within; stamens green or red, 1.5 mm long, glabrous, anthers oblong; ovary short stipitate, glabrous, mature achenes red, 3-4 mm long, 2-3 mm wide, ovate, slightly ridged the entire achene length, exserted; embryo straight, light green, 2-2.5 mm long, ca. 1 mm broad.

DISTRIBUTION: Locally common in the high plains, grasslands, and dry hillsides, at an elevation of 200-7500 feet, from northern Nuevo Leon and Coahuila, to central Coahuila, Mexico, east into southern Texas, United States, near the Rio Grande River. Flowers and fruits March through October.

Figure 5.

TYPE: Mexico: Coahuila: High Plains, San Juan de la Vaquería, May 20, 1847, J. Gregg (NY!). Isotype (MBG!).

SPECIMENS EXAMINED:

Mexico.

State unknown: From San Luis Potosi to San Antonio, Texas, Parry, C. C. 797 (GH, NY, US).

Coahuila: Fisher, G. L. 215 (US); Frye, T. C. and E. M. Frye 2512 (GH, NY, RSA, US); Hinton, G. B. 16674 (GH); Kenoyer and Crum 4114 (GH); Muller, C. H. 3073 (GH); Palmer, E. 166, 1176 (GH, NY, POM, US); Pennell, F. W. 17289 (US); Purpus, A. 1151 (GH); Warnock, B. H. and F. A. Barkley 14731 (GH); Wynd, F. L. and C. H. Muller 181 (GH, NY).

Nuevo Leon: Canedo, Jr, F., F. Garza, N. Gonzales III, and

W. I. McCart 9061 (SMU); Johnston, M. C. 2800A (SMU); Ripley, H. D. and R. C. Barneby 13265 (NY).

United States of America.

Texas: Hildago Co.: Walker, E. J. 47 (GH).

DISCUSSION: In a report about Gregg's activities during the war with Mexico in the 1840's, Fulton (1944) indicates that "San Juan de la Vaquería" is in the state of Coahuila. Verification of the state in Mexico from which Gregg's type was collected can be made by a comparison of the date and locality on the herbarium label of the type with a list of dated barometric readings at various localities in Mexico as recorded by Gregg and cited by Fulton (l.c.).

The range of E. greggii coincides closely with that of E. ciliatum. These taxa are easily distinguishable from one another as mentioned in the discussion of E. ciliatum. The variation within E. greggii appears to be greater than that of E. ciliatum but there is no mistaking members of E. greggii. The cauline leaves in the axils of the bracts and glandular pubescence set it apart from all the other species herein studied.

There is a wide amplitude in variation of glandular-pubescence within E. greggii. Gregg's type specimen has the least amount of glandular-pubescence when compared with E. greggii from that same region, and these in turn, have less glandular-pubescence than some collections more to the north and east. There is no clear distinction between the extreme members of this taxon when the intermediates are examined, and since the distribution of these collections is not distinct, it seems best to consider them as members of a highly variable

species. Future investigations, including field work, may necessitate the description of some varieties.

Figure 6. Involucral and floral parts of Eriogonum.

A-C. Eriogonum alatum Torr. var. alatum, Hess 874. Involucre with mature flower, inside part of perianth, and mature achene, respectively.

D. Eriogonum alatum var. mogollense St. ex Jones, Hess 966. Mature achene.

E-G. Eriogonum alatum var. glabriusculum Torr., Hess 507. Involucre with mature flower, inside part of perianth, and mature achene, respectively.

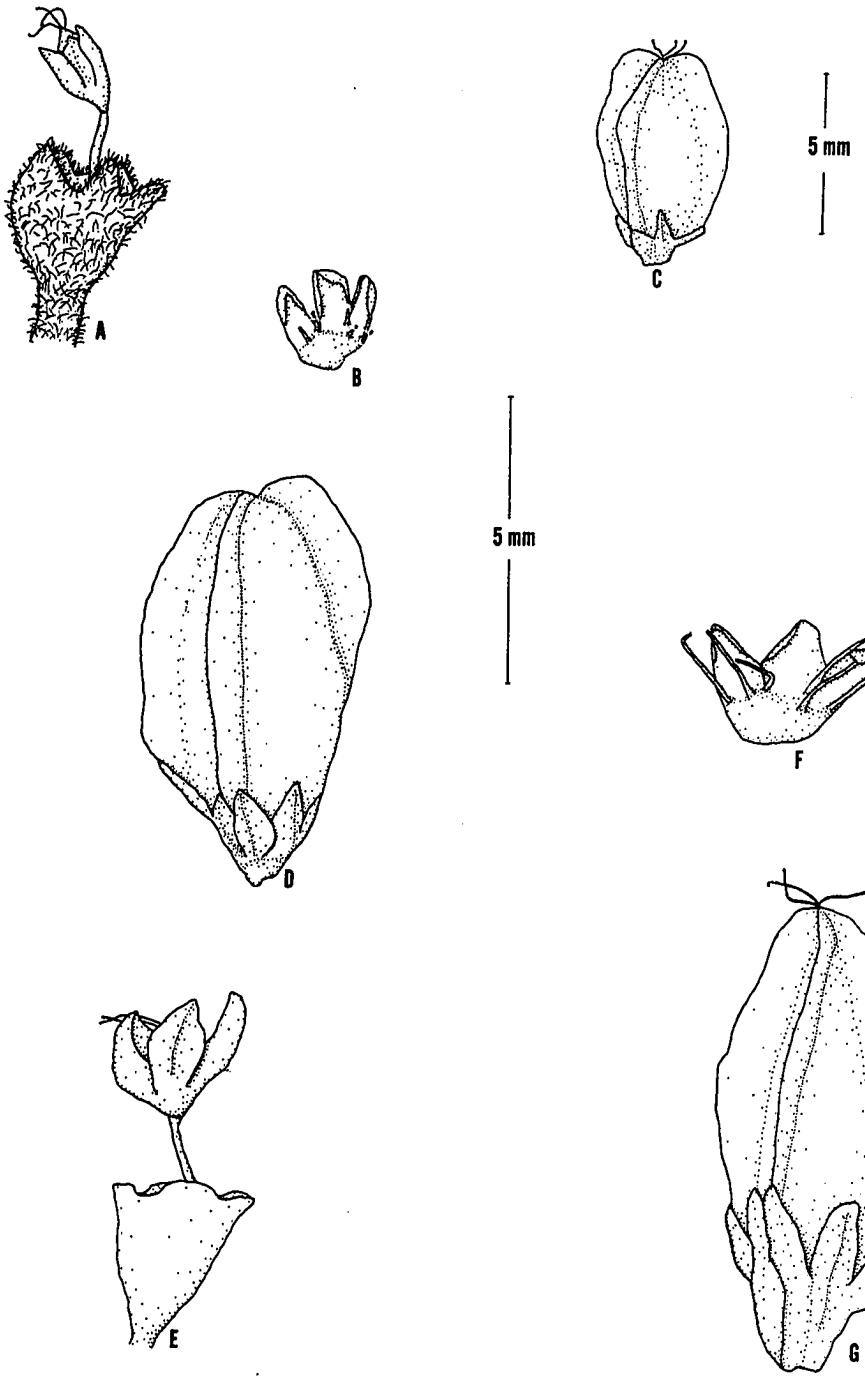


Figure 6.

Figure 7. Involucral and floral parts of Eriogonum.

A-D. Eriogonum nealleyi Coult., Hess 786. Involucre with mature flower, inside part of perianth, mature achene, and embryo, respectively.

E-G. Eriogonum hieracifolium Benth., Hess 886. Involucre with mature flower, inside part of perianth, and mature achene, respectively.

H-J. Eriogonum hemipterum (Torr. and Gray) St., Hess 799. Involucre with flower, inside part of perianth, and achene, respectively.

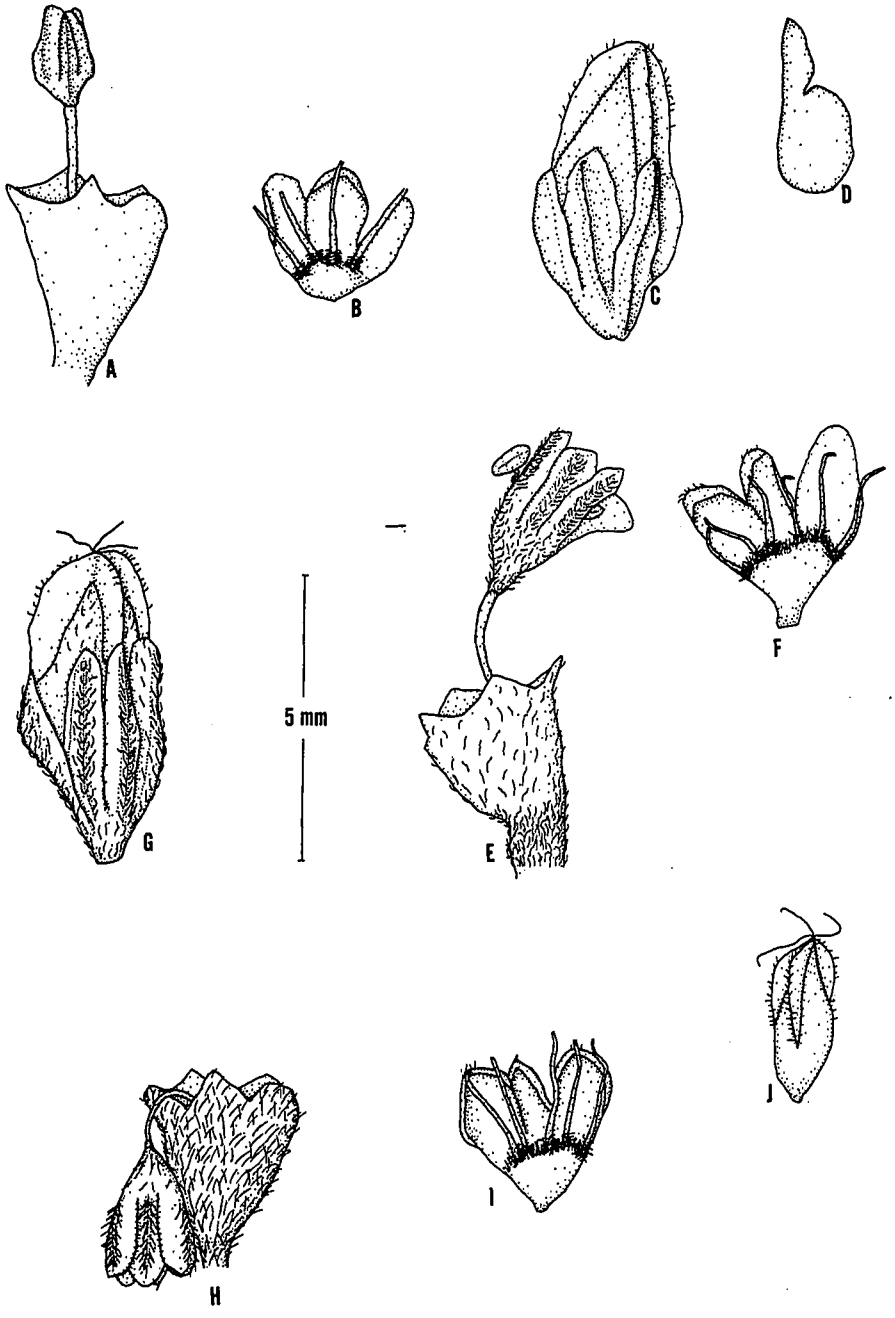


Figure 7.

Figure 8. Involucral and floral parts of Eriogonum.

A. Eriogonum atrorubens Engelm. in Wisliz. var. atrorubens, Wislizenus s.n. Involucre with mature flower.

B-C. Eriogonum atrorubens var. atrorubens, Muller 3382. Mature achene and mature perianth parts with mature fruit completely enclosed.

D. Eriogonum atrorubens var. atrorubens, Gentry 2709. Mature perianth parts with beak of fruit exposed.

E-G. Eriogonum atrorubens var. pseudociliatum Reveal, Waterfall 12653. Mature involucre with flower, inside part of perianth, and mature achene, respectively.

H. Eriogonum atrorubens var. atrorubens, Taylor 85, Involucre and mature flower. Notice the few, scattered, strigose hairs on the perianth.

I-K. Eriogonum rupestre St., Pringle 285. Involucre with flower, inside part of perianth, and mature achene, respectively.

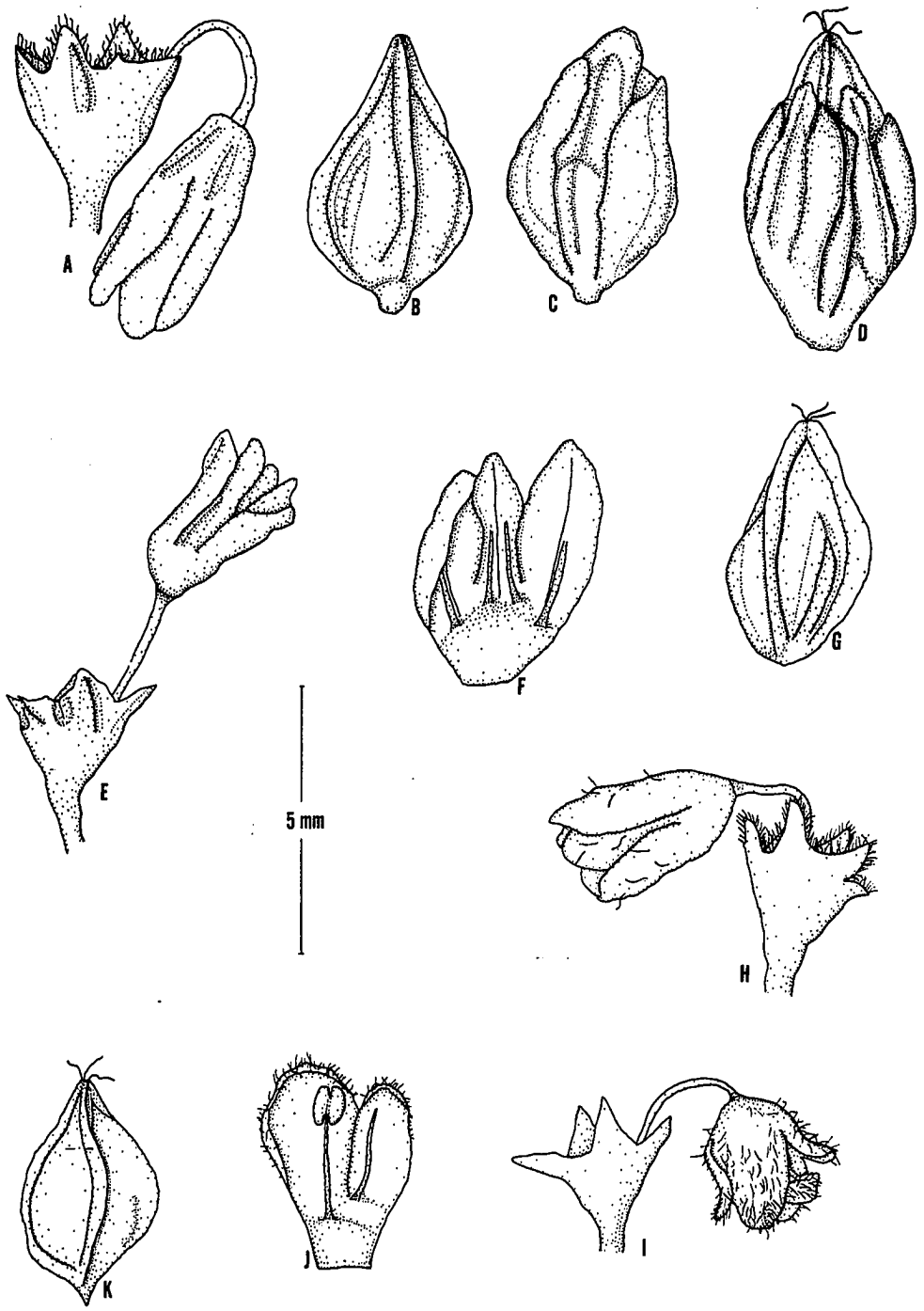


Figure 8.

Figure 9. Involucral and floral parts of Eriogonum.

A-C. Eriogonum ciliatum Torr., Johnston 7287. Involucre, perianth, and mature achene, respectively.

D. Eriogonum greggii Torr. and Gray, Gregg s.n. Involucre with mature flowers.

E. Eriogonum greggii, Warnock and Barkley 14731. Mature achene.

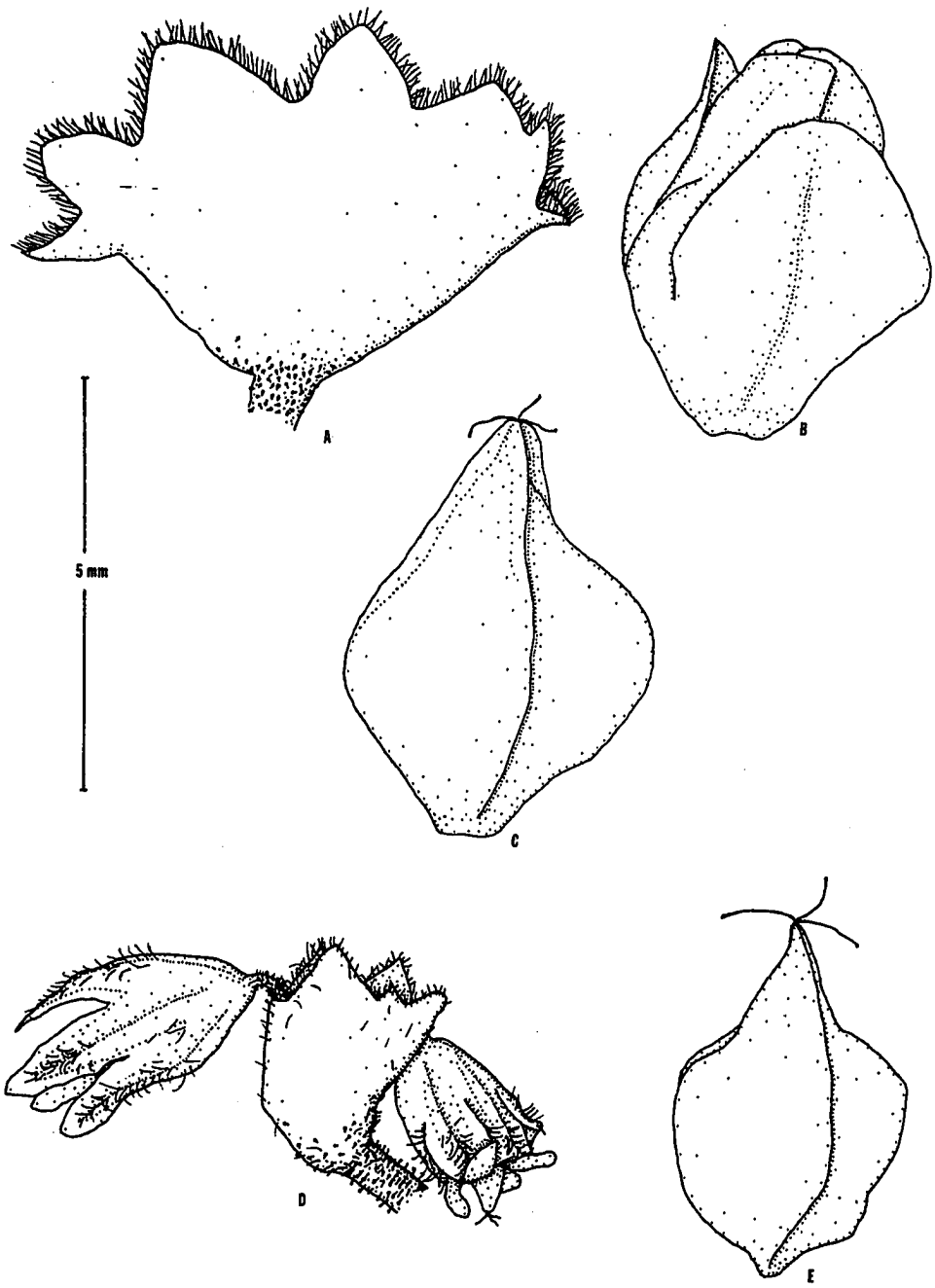


Figure 9.

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