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DESCRIPTION OF NEW SPECIES OF *MILODERES CASEY*, WITH COMMENTS ON OTHER SPECIES OF THE GENUS (COLEOPTERA: CURCULIONIDAE)

Vasco M. Tanner¹

Abstract.— *Miloderes allredi*, from Utah, and *M. tingi*, from California, are described as new to science.

*Miloderes allredi*, n. sp.
Figs. 1-5

Derm black, clothed with bluish-green, iridescent, densely placed scales; side of prothorax and elytra with long brownish setae, disc of prothorax and elytra with sparse shorter setae. *Rostrum* continuous, with no transverse impression; apex one-half width base of head. Origin of scrobes near apex of rostrum, well developed and extending to lower base of eye. Antenna brown, with setae and scales; scape reaching to middle of eye; segments 1 and 2 of funicle elongate, as long as segments 3-6 combined. Segment 7 asymmetrical, cuplike widest on outer margin, clavate at apex. Mentum large, flat, wider than long, filling entire gular cavity. Eyes small, vertical; row of scales between eye and vibrissae of prothorax. *Prothorax* widest at anterior third, sides arcuate, strongly convergent toward base; base well separated from elytra; postocular lobes small, with developed vibrissae; sides and disc punctate, scales compact, setae short and sparse on disc; apex slightly constricted. *Scutellum* obscure. *Elytra* widest at basal fourth; sides feebly arcuate, rounded behind, posterior declivity perpendicular; disc punctate, with sparse short brown setae, a mixture of compact blue, green, and iridescent scales. *Abdomen*, ventrites and legs clothed with scales and setae similar to those on dorsal areas of body; ventrite 1 at midline as long as 2 and 3 combined. Metathoracic tibia with corbel open, margin with amber-colored row of short spines. Prothoracic tibia corbel open and with an outward projection of the distal portion of tibia. Male spermatheca and female genitalia distinctive; related to *setosus* Ting, 1940.

Length.— 5.0-5.8 mm; breadth: 2.5-3.0 mm.

Type locality.— Cotton Bench, Glen Canyon City, Kane County, Utah.

Type specimens.— Male holotype and female allotype in the entomological type collection at Brigham Young University; one paratype in the entomological collection, U.S. Natural Museum.

Specimens of this species were collected by Dr. Dorald M. Allred and assistants in May and June 1973, while collecting plant and animal species of the Lake Powell area in connection with the En-

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environmental Monitoring Project in relationship to Navajo Power Plant Project. Specimens dealt with above were collected on the sand dunes, in an association of Ephedra viridis Coville and Yucca baileyi Woot. Standl.

I am pleased to name this striking species in honor of Dr. Dorald M. Allred, Professor of Zoology at Brigham Young University. Dr. Allred is a capable field worker who has devised many means of collecting arthropods and is a leader in environmental studies.

Figs. 1-5. Miloderes allredi: 1, dorsal view of adult female; 2-3, ♀ and ♂ genitalia; 4, spermatheca; 5, front and hind tibia.
In making this study, the genitalia of several of the species of Miloderes have been compared. Drawings of tibia, male, female genitalia, and spermatheca of five species are included in this study.

*Miloderes tingi*, n. sp.

Fig. 6-9

Derm dark chestnut brown to black, with small, irregular-shaped, rather compact, ash-grey scales that clothe legs, head, prothorax, and dorsal and ventral parts of body, each scale with central puncture; long grey setae on sides of prothorax, sides and posterior dorsal sides of elytra. *Rostrum* continuous with head, with slight transverse impression, apex one-half width base of head. Scrobes shallow, extending to well below base of eye. *Antennae* reddish brown, scape slender, first segment of funicle enlarged, as long as segments 2 and 3 combined, club large and setiferous; prementum wider than long, with few short setae; eye ovate. *Prothorax* slightly wider than long; widest at middle, sides arcuate, weakly convergent toward base, moderately convex; sides covered with dense whitish scales and long setae; dorsally tuberculate, punctate, with few scales. *Scutellum* and postocular well developed; postocular lobes small, with well-developed vibrissae, apex slightly constricted. *Elytra* widest at anterior fourth, sides feebly arcuate, rounded behind, posterior declivity perpendicular; disc punctate, scales covering surface, with scattered long setae on posterior half of disc, scales with a center puncture. Ventrites covered with scales and setae; ventrite 1 as long as 2 and 3 combined, 2 as long as 3 and 4 combined. Metathoracic tibia open, with a row of eleven amber-colored spines. Size, shape, and number of tibial spines and tibia distinctive. Prothoracic tibia with distal portion spicate, 10 spines (Fig. 7). Spermatheca and genitalia distinctive (Fig. 8-9).

**Length.**—7 mm; breadth: 3.6 mm.

**Holotype.**—Female, deposited in type collection, Brigham Young University.


*M. tingi* is uniformly a dark brownish species, clothed with small dense greyish scales; head and prothorax tuberculate, no traces of striation on elytra, and devoid of setae on the central areas of prothorax and elytra. The female genitalia and spermatheca differ from similar structures of other species of this genus. This species is closely related to *M. setosa* Csy; however, it is more robust with smaller scale punctuation on prothorax, and the female genitalia and spermatheca are different (Figs. 8-9).

I am pleased to name this species in honor of Peter T. Ting who contributed much to our knowledge of this group of Brachyrhininae weevils (1940). Edwin C. Van Dyke and David G. Kissinger have done much to bring about an orderly arrangement and understanding of this interesting western-American weevil fauna.
The keys to the genera and species of this group as contained in Ting's paper (1940) will be useful, in combination with the description and illustrations of this paper, in separating the species of

Figs. 6-9. *Miloderes tingi*: 6, dorsal view adult female; 7, front and hind tibia; 8, ♀ genitalia; 9, spermatheca.
Fig. 10: Miloderes nelsoni Kissinger, front and hind tibia. Fig. 11: M. setosus Casey. Fig. 12: M. nelsoni. ♂ genitalia. Fig. 13: M. mercuryensis Tanner, ♂ genitalia. Fig. 14: M. setosus Csy., ♀ genitalia. Fig. 15: mercuryensis Tanner, front and hind tibia. Fig. 16: M. setosus Csy. ♂ genitalia.
Miloderes. I have had the privilege of examining specimens of all six of the species now included in Miloderes. Unfortunately, I did not make drawings of the tibia of M. viridis Pierce.

Dr. Elbert L. Sleeper has made a study of some species of Miloderes, but I do not have access to his writings dealing with the species of this genus. He kindly contributed specimens of M. nelsoni Kissinger which I have reported on.

I wish to express my thanks to Dr. Rose Ella Warner for her aid in this study and for loan of specimens of M. viridis and M. setosus from the U.S. National Museum and courtesies extended while I studied at the museum.

Literature Cited


REVISION OF THE PLANT GENUS *GERANIUM* IN UTAH

Glen T. Nebeker

**Abstract.**—Within the state of Utah are seven species of *Geranium*, two of which are annual. The nature of the caudex and the growth habit have been used to separate the perennial species. These characters are inadequate for separating the species. Better morphological characters, keys, and descriptions are presented.

Two characters used to separate various species of *Geranium* are not effective. One of these characters is "plants somewhat caespitose." Use of this character in keys would lead to plants which are sometimes three feet tall and with the same growth habit of plants considered not caespitose. The other character is the branching or simple nature of the caudex. In herbarium specimens it is usually impossible to see the caudex. In addition, authors vary in the description of the caudex; for example, *G. richardsonii* is described as: "caudex often slightly branched" (Hanks and Small, 1907), "the usually simple caudex" (Jones and Jones, 1943), "plants . . . erect from a simple caudex" (Harrington, 1959). The caudex actually varies from simple to very branched. (VanCott, 1969). These characters illustrate a need for a revision of the genus.

Hanks and Small (1907) treated the known species of North America *Geranium*. In Knuth’s (1912) worldwide monograph of the genus the treatment of the North American species was more or less copied from Hanks and Small’s work. Jones and Jones (1943) treated the perennial species north of Mexico, and Moore (1943) included one Utah species in his coverage of the Mexican species.

**Taxonomic Characters**

As mentioned above, the nature of the caudex and the growth habit are poor taxonomic characters. Six taxonomically significant characters are described below. The variations of each of them were measured, assigned numbers, then averaged for each character and plotted on polygonal graphs. (Fig. 1) All observations were made under a dissecting microscope.

*Stylodia:* These are the branches at the tip of the style column which bear the stigmatic surface. These were first soaked with Pohlstoffe then measured with a standard mm ruler. Only mature flowers were measured. For each species the length was averaged.

*Petal pilosity:* This is the pubescence on the upper surface of the petals. Three degrees of pilosity were recognized and assigned numbers for comparison. The degree and corresponding numbers are: $\frac{1}{4}$ of the petal covered $= 1$; $\frac{1}{3}$ of the petal covered $= 2$; and $\frac{1}{2}$ of the petal covered $= 3$.

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Fig. 1: 1, stylodia; 2, petal pilosity; 3, pubescence of pedicels; 4, pubescence of stems; 5, petals recurving or not; 6, petal color; A. G. atropurpureum; B. G. fremontii; C. G. marginale; D. G. parryi; E. G. richardsonii.

Pubescence of the pedicels: The pedicels of some species are glandular pubescent, while others are pubescent but not glandular. The color (purple or not) of the glands was also noted. The numbers given these characters are: glandular = 1; purple glands = 2; and nonglandular = 3.
Pubescence of the stems: Pubescence on the stems varied from very glandular to glabrous. The only significant difference in pubescence was glandular = 1; nonglandular = 2.

Petals recurving or not: The petals of most species extend out flat or curve upward slightly. One species has petals that curve downward abruptly. Numbers assigned to these are: petals not recurving = 1; petals recurving = 2.

Petal color: White petals = 1; varying shades of pink to purple = 2.

The above characters have been applied to the five perennial species that occur in the state. The characteristics used to separate the annual species are the number of fertile stamens and awned or nonawned sepals.

Shaw (1952) has worked out the cytology of four species that occur in Utah. The chromosome numbers that he reported are as follows: G. carolinianum 2n = 52; G. pusillum 2n = 26; G. richardsonii n = 26; G. fremontii (which he called G. nervosum) n = 26. Other cytological work should be done because there are indications of hybridization between G. richardsonii and G. fremontii.

The probable phylogenetic relationships of the perennial species within the state are outlined on Figure 2 and their distributions are plotted on Figure 3.

Taxonomy

Geranium L. Sp. Pl. 676 (1753)

Annual or perennial herbs, often with a woody caudex; stems glabrous to glandular-villous; leaves palmately lobed, cleft or parted, basal leaves generally larger than the cauline ones; inflorescence compact to spreading; flowers complete, actinomorphic; sepals 5 usually awn tipped; petals 5, deciduous, purple to white, usually pubescent toward the base; ovary 5 lobed, 5 loculed with 2 ovules per locule becoming 1 seeded, elastically recoiling at maturity but not twisting.

Key to the Species

1. Plants annual, petals less than 1 cm long ....................... 2
   Plants perennial, petals more than 1 cm long ................... 3

2(1). Sepals awnless, fertile stamens 5 .................... 1. G. pusillum
   Sepals awned, fertile stamens 10 ................ 2. G. carolinianum

3(1). Plants nonglandular (sometimes nonglandular in G.
   richardsonii) ............................................. 4
   Portions of the plant glandular .......................... 5

4(3). Petals reflexing at maturity, pilose on the petals
   1/3-1/2 their length ..................... 3. G. atropurpureum
   Petals not reflexing at maturity, pilose on the petals
   1/4 their length ......................... 4. G. marginale
5(3). Pedicels and lower portions of the plant glandular

5. *G. parryi*

Lower portions of the plant nonglandular, pedicels glandular

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6(5). Petals white, petals pilose $\frac{1}{3}-\frac{1}{2}$ their length

6. *G. richardsonii*

Petals purple, petals pilose $\frac{1}{4}$ their length

7. *G. fremontii*


Annual; stems 10-60 cm long, decumbent or prostrate, puberulent; leaves reniform to orbicular, 1-6 cm broad, 3-7 parted; sepals 2.5-5 mm long, awnless; petals purple to violet; 5 fertile stamens; style column 6-9 mm long, glandular puberulent; carpel bodies 2 mm long; seeds smooth. A weed of fields and waste places. Type locality, England and France. Provo Bench near Pleasantview, Utah Co.,

![Diagram](image)

Fig. 2. The probable phylogenetic relationships of the perennial species of Utah *Geranium*.

2. *G. carolinianum* L. Sp. Pl. 682 (1753)
   *G. bicknellii* Britt. var. longipes (Wats.) Fern.

Annual; stems 17-40 cm long, erect or branching at the base, short pubescence; leaf blades 2.5-7 cm wide, orbicular to reniform, 5-7
palmately parted; inflorescence very compact; sepals 6-8 mm long, tipped with awn 1-2 mm long; petals about as long as sepals, pink to whitish; 10 fertile stamens; style column 12-18 mm long with glandular hairs; carpel bodies 3-3.5 mm long; seeds reticulate. Open places and fields throughout North America. Type locality, Carolina. Antelope Island, Howard sn. (ut) Fern Hollow near Ogden, Weber Co., Cardon 313 (ut)

"Geranium carolinianum has been confused with G. bicknellii Britt., the latter having been included in the Wasatch region by at least two authors. Inclusion of G. bicknellii in the flora might possibly have been based upon a collection from Logan Canyon in 1910 (C. P. Smith 2164). The stage of the plant's development makes it impossible to determine its true identity." (Shaw, 1952)

G. caespitosum James ex Torr. apud Gray
Perennial; stems 10-90 cm long, erect sometimes becoming decumbent with age, retrorsely pubescent; basal leaves 2-6 cm wide, reniform to orbiculate, divided nearly to the base into 3-5 lobes, generally larger than the cauline leaves; inflorescence open and spreading; pedicels retrorsely pubescent but not glandular; sepals 9-11 mm long, awned; petals 10-15 mm long, pink to purple, pilose on petals 1/3-1/2 the petals’ length, petals recurving; stylodia average 6.55 mm long. Often found growing in association with oak. Type from Santa Fe Creek, New Mexico (Heller 2723). (34 seen) Pine Valley, Wash. Co., Cottam 8905 (ut). Beaver Canyon, Beaver Co., Warnock sn (ut). Devils Canyon Campground, San Juan Co., Cottam 9523 (ut). Long Canyon above Orderville, Kane Co., Cottam 4279 (ut). 4 miles north of Glendale, Kane Co., VanCott 1002 (bry). Sheba mine, Millard Co., Cottam and Biddulph 3200 (bry).

"It was to this species that Gray assigned the name G. caespitosum (Gray 1849) believing it to be the species described by James. Material in the Gray Herbarium shows G. atropurpureum extending northward into the southern and southwestern counties of Colorado but not into the northeastern region where James is supposed to have collected his “caespitose” Geranium as pointed out by Heller (1898). Lacking collections from the general region or actual specimen collected by James, it seems advisable to follow Heller in calling this distinctly southern species G. atropurpureum and to consider G. caespitosum James ex Torr. a women dubium." (Moore, 1943)

4. G. marginale Rydb. ex Hanks and Small. N. Am. Fl. xxv 16 (1907)
Perennial; stems 10-30 cm long, retrorsely pubescent, slightly exceeding the basal leaves; leaves 2-3.5 cm wide, 5 parted; inflorescence not compact; pedicels retrorsely pubescent, not glandular; sepals 7-9 mm long, puberulent to nearly glabrous; petals purple, pilose 1/4 the petal length; style column 1.5-2 cm long, stylodia average 4.33 mm long; carpel bodies 4 mm long; seeds 3 mm long, faintly reticulate. Type locality is the Aquarius Plateau at the head
of Poison Creek, Utah, Rydberg and E. C. Carlton 7401. (Hanks and Small, 1907).


5. G. parryi (Engelm.) Heller. Cat. N. Amer. Pl. ed. 2. 7 (1900)
   G. pattersonii Rydb., G. fremontii var. parryi Engelm.
   Perennial; stems 10-45 cm tall, glandular-pubescent throughout; petioles glandular; leaves 2-7 cm wide, deeply 3-5 parted; inflorescence open and spreading; pedicels glandular-pubescent; sepals 6-10 mm long; petals 12-15 mm long, purple, pilose on petals 1/4-1/3 their length; style column 1.5-3 cm long, glandular, stylodia average 5.23 mm long; carpels 4-5 mm long; seeds 3-3.5 mm long, reticulate. No specimens of this plant have been seen from the state, but it should be looked for in the Uinta Mountains and in other parts of eastern Utah.

Another completely glandular species with which this species may be confused is G. viscosissimum. The distinctive characteristic separating them is the compact inflorescence of G. viscosissimum.

   Perennial; stems 30-90 cm tall, glabrous to pubescent; petioles long; leaves 3-15 cm wide, deeply 3-5 parted; inflorescence open; pedicels glandular-pubescent, glands usually purple; sepals 6-12 mm long; petals 1.5-2 cm long, white sometimes bluish, pilose 1/3-1/2 the petals' length; style column 2-2.5 cm long, glandular, stylodia average 4.06 mm long; carpel bodies 2.5-4.5 mm long. Found in partial shade or in rather moist ground.


   G. caespitosum sensu Rydb., G. furcatum sensu Hanks & Small
   Perennial; stems 20-70 cm long, glabrous to pubescent, not glan-
dular; petioles long on northern plants shorter in southern specimens; leaves 3-10 cm wide, 5-7 parted, cauline leaves much smaller; inflorescence open, spreading; pedicels glandular-pubescent; sepals 7-12 mm long; petals 1-1.5 cm long, purple, pilose $\frac{1}{4}$-1/3 their length; style column 2.5-3 cm long, styloidia average 5.23 mm long; carpel bodies 4-5 mm long. Open areas of the foothills and mountains.


This species is often confused with G. nervosum, which grows north of Utah. The difference between the two is in the inflorescence: G. nervosum has a compact inflorescence, and G. fremontii has a spreading inflorescence.

**Bibliography**


UTAH PLANT NOVELTIES IN
ASTRAGALUS AND YUCCA

Stanley L. Welsh

ABSTRACT.—Astragalus iselyi and A. stocksii are described as new species. The former is from the La Sal Mountains of Grand and San Juan counties in eastern Utah, and the latter is from the Henry Mountains in eastern Garfield County, Utah. Yucca toftiae is described as new from materials collected along Glen Canyon in San Juan and Kane counties, Utah.

Studies of plant collections taken from previously unexplored or little-known regions of Utah have demonstrated the presence of taxa not included in the known descriptions of plant species of the state. Two species of Astragalus and one of Yucca are included in the new entities. The La Sal Mountains and the Henry Mountains yielded the Astragalus species. The Yucca is from the margin of Glen Canyon.

Astragalus iselyi Welsh sp. nov.

Fig. 1

A Astragalo sabuloso Jones differt floribus parvioribus et petalis albidioribus carina immaculata et leguminibus parvioribus.

Herba perennis radice palari forti et caudice ramificanti; caules 8-25 cm alti recti aut ascendentes; stipulae 3-9 mm longae firmae purpurascentes amplectentes sed non connatae; folia 3.2-8.5 cm longa; foliola (3) 5-11 (13), 7-23 mm longa, 3-9 mm lata elliptica ad rhombica strigosa pilis simplicibus utrinque glabrescens; pedunculi 1.7-10 cm longi; racemi 1.2-3 cm longi, floribus 7 ad multus; bracteolae nullae; calyx strigulosus tubo cylindrico 5.5-6.3 mm longi dentibus 1.8-3.1 mm longis; subulatis; flores 17-18 mm longi, petalis ochroleucis, carina apice immaculato; leguminæ 25-32 (38) mm longa stricta subcylindrica unilocularia coriacea strigosa.

Utah: San Juan Co., La Sal Mts., Brumley Ridge, ca. 1.5 miles north of Pack Creek Ranch, on Morrison formation, in pinyon-juniper community, S. L. Welsh 10970, 5 May 1971 (Holotypus bry; Isotypi ISC, and many others); same locality, J. Pederson 23, 29 March 1967 (bry); S. Daines 39, 5 May 1971 (bry); C. Schoener 75, 11 June 1971 (bry). Grand Co., Paradox formation, gypsiferous clay, Onion Creek, Fisher Valley, S. L. Welsh 11929, 11929a, 30 May 1973 (bry).

Astragalus iselyi is a near congener of A. sabulosus Jones. It is similar in habit, leaflet shape and number, and pod features. The flowers are consistently smaller in all parts. Even the average pod size seems smaller than in A. sabulosus. The flowers of A. iselyi are only 17-18 mm long, whereas those of A. sabulosus are 28-31 mm long. Both of these entities complete flowering during early spring-time, and it seems probable that the existence of A. iselyi has been

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Fig. 1. *Astragalus iselyi*. A, Habit sketch; B, Detail of pods.
obscured by the fact that most previous specimens were collected in fruit only.

It seems certain that the phase of the sabulosus-iselyi complex with massive flowers is that known as A. sabulosus. The measurements set forth in the original description (Jones, 1891) and in the Revision of North American Species of Astragalus (Jones, 1923:156-157) are those of the phase including the type of A. sabulosus. Materials collected on the La Sal Mountains by Rydberg and Garrett (9088, 19 July 1911 ut) and by Maguire et al. (16536, 14 July 1933 utc) are almost assuredly A. iselyi. From the present information, it seems that A. sabulosus is a plant of bajadas and drainages over Mancos Shale in the Thompson-Cisco region of Grand County. A. iselyi is also a selenophyte, but grows on the Paradox and Morrison formations on the foothills of the La Sal Mountains.

This species is named in honor of Duane Isely, legume specialist, teacher, colleague, and philosopher.

**Astragalus stocksii** Welsh sp. nov.

Fig. 2

Species habitu cum Astragalo musiniensi Jones differt foliis plus numerosis floribus parvioribus ochroleucis et leguminibus strigosis.

Herba perennis acaulis, caudice ligneo ramificanti, ferenti petiolis marcescentibus; stipulae lanceolatae 3-5 mm longae strigosae librae: folia 2.7-10.6 cm longa; foliola 7-13 mm longa obovata oblongo-lanceolata vel elliptica, plumbea ut aut argentea. supra viridia saepe, strigosa utrinque, truncata ad mucronata aut acuta ad apicem: pedunculus 1.1-4 cm longus; racemus (2) 3-8 floribus. compactus: bracteae lancei-subulatae, strigulosae; flores ascendentes. 15-16 mm longi; calyx strigulosus, tubo cylindrico, 9-9.2 mm longo, dentibus lancei-subulatis 2-2.8 mm longis; corolla ochroleuca, venis purpureostris, carina-apice maculata; alis apicibus purpurascenstibus; legumina unilocularia, compressa laterali. lanci-ovoidea, rostro elongato tenui contracto, stricta aut arcuata, strigosa.


*Astragalus stocksii* is compared to the distinctive A. musiniensis Jones in the above description. It is indeed similar to that entity both in having a persistent thatch of petioles and in shape and texture of the pods. Habitually it is apparently nearer to A. newberryi Gray and to A. eurekensis Jones. From the former, *A. stocksii* differs in the smaller, paler flowers and merely strigose pods, and from the latter it differs in having smaller flowers and merely strigose pods.

The species is named in honor of the late Davna L. Stocks, botanist, teacher, and extraordinary human being.
Fig. 2. *Astragalus stocksii*. A, Habit sketch; B, Detail of pod.

*Yucca toftiae* Welsh sp. nov.

Fig. 3

Differt haec species a *Yucca angustissima* in uterque amplitudine et habitu.

Planta acaulescens vel brevicaulescens, solitaria vel caespitosa; caules 0-7 (10) dm alti; folia 2-7.5 dm longa, 0.4-1.7 cm lata linearia
Fig. 3. *Yucca toftiae*. A. Habit sketch; B. Detail of leaf; C. Detail of flower; D. Detail of capsule and seeds.
plano-convexa vel concavo-convexa ad plano-carinata effusa rigide, viridia vel flavo-viridia, margo filifer; inflorescentiae 1.2-3.4 m altae, scapi folia 2-vel 6-plo longior; paniculae lineares vel ovoidae, 2.5-20 dm longae, ramulis 0-12 (23); flores numerosi globosi vel campanulati albi, cremei, vel viriduli plerumque exti rubro-purpurei suffusi, segmenta elliptica vel lanc-ovata, acuta; inflorescentiae 1.2-3.4 m altae, scapi folia 2-vel 6-plo longior; paniculae lineares vel ovoidae, 2.5-20 dm longae, ramulis 0-12 (23); flores numerosi globosi vel campanulati albi, cremei, vel viriduli plerumque exti rubro-purpurei suffusi, segmenta elliptica vel lanc-ovata, acuta; inflorescentiae 1.2-3.4 m altae, scapi folia 2-vel 6-plo longior; paniculae lineares vel ovoidae, 2.5-20 dm longae, ramulis 0-12 (23); flores numerosi globosi vel campanulati albi, cremei, vel viriduli plerumque exti rubro-purpurei suffusi, segmenta elliptica vel lanc-ovata, acuta; sepala (2.5-4.6 cm longa); petala (31-52 mm longa); filamenti staminale 7-24 mm longa; pistila 15-32 mm longa; stylus (3) 7-11 mm longi; capsulae erectae, 3.5-5.5 (6) cm longae, cylindricae, plurumque constrictae, ligneae et persistentes.


This entity grows on sandy alluvium and on sandstone outcrops along the shores of Lake Powell in Glen Canyon of eastern Kane and western San Juan counties, Utah. The affinities of Y. toftiae are with Y. angustissima Englem ex Trel, from which it differs in both size and habit. Habitually, Y. toftiae is similar to Y. utahensis Mckelvy and Y. verdiensis Mckelvy. From the former it differs in the inflorescence which branches only near the base (or not at all), and from the latter in the short pistils and longer woody capsules.

This striking taxon is named in honor of Catherine Ann Toft, botanist.

References


A NEW COMBINATION IN PENSTEMON
(SCROPHULARIACEAE)

James L. Reveal

One of the more distinctive beard-tongues found in the sandy portions of northern Arizona, southern and western Utah, and southeastern Nevada is *Penstemon angustifolius* ssp. *venosus*. The pinkish-lavender to pinkish flowers of ssp. *venosus* mark it as one of the more readily recognized of the penstemons found in this part of the western United States. The typical subspecies is found far to the east on the high plains of the central United States. The ssp. *angustifolius* generally has narrower, more sharply acute foliage, typical blue flowers that are shorter, and mature capsules that are shorter and narrower than those found in ssp. *venosus*. The bracts in the inflorescences of ssp. *angustifolius* are not venose on both sides as in ssp. *venosus*, and the former has the unfortunate feature of blackening upon drying. As a result of its green, glaucous foliage, bright pinkish to lavender flowers, and general rareness, the ssp. *venosus* is often collected preferentially by even the most seasoned collector.

Many collectors have noted their dissatisfaction with Keck’s placement of this plant with *Penstemon angustifolius*, but as yet no one has proposed a specific name for the taxon. So that a specific name might be available to Janice C. Beatley for her floristic work on the Nevada Test Site, the following combination is proposed:


As a distinct species, *Penstemon venosus* may be distinguished by its flower color, leaf size and shape, the nature of the floral bracts, and its disjunct distribution.

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DOMINANCE RELATIONSHIPS OF THE DARK KANGAROO MOUSE (MICRODIPODOPS MEGACEPHALUS) AND THE LITTLE POCKET MOUSE (PEROGNATHUS LONGIMEMBRIS) IN CAPTIVITY

Andrew R. Blaustein1 and Arthur C. Risser, Jr.1

Abstract.—Interspecific interactions between the little pocket mouse (Perognathus longimembris) and the dark kangaroo mouse (Microdipodops megacephalus) were tested in the laboratory. P. longimembris was statistically dominant over M. megacephalus. The dominant-subordinate relationships shown by our laboratory results indicate that interspecific aggression may be one mechanism involved in keeping these sympatric species ecologically separated.

In certain areas of northern Nevada, the dark kangaroo mouse (Microdipodops megacephalus) and the little pocket mouse (Perognathus longimembris) are sympatric (Hall and Kelson, 1959). These species are similar in size and, being primarily granivorous (Hall, 1946), probably have similar feeding habits. As compared with what is known about other members of their family (Heteromyidae), little is known about the ecology of these species. This study investigates the possibility that interspecific agonistic behavior may be a mechanism by which ecological isolation occurs between these two species in the field. To assess this possibility we observed interspecific interactions between pairs of captive M. megacephalus and P. longimembris. The possible role of interspecific agonistic behavior in the habitat segregation of small mammals has been reviewed by Grant (1972).

Three Microdipodops (two females and one male) and four Perognathus (two females and two males) were trapped in Warm Springs Valley, Washoe Co., Nevada. The animals were caged individually in steel cages measuring 34 x 24 x 24 cm. The front of each cage was covered with 1 x 1.25-inch hardware mesh. Sand one centimeter deep was placed in each cage. The cages were cleaned periodically. A mixture of sunflower seeds, rolled oats, and millet was given to the animals daily. Lettuce was provided once a week. No water was provided. The housing cages were placed under a 12-hour light—12-hour dark controlled photoperiod. The light and dark periods were reversed, allowing these normally nocturnal animals to be observed during convenient daytime sessions. The light phase was illuminated by two incandescent 60-watt white light bulbs, and the dark phase was slightly illuminated by two incandescent 25-watt red light bulbs.

Encounters took place in a cage measuring 34.5 x 45.7 x 122 cm. Three sides of the cage were aluminum, and the front was plexiglas. The top was covered with .25-inch hardware cloth, and an aluminum partition divided the cage into two equal sections, each

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containing a nesting area and a food dish. Two cm of sand covered the floor of the cage and was replaced after each interaction.

To begin an interaction, one rodent was placed on each side of the central partition. The cage was subjected to the same reversed photoperiod as the housing cages. The animals were left alone for at least 24 hours as an adjustment period. Then the partition was removed, and the behavior and interrelationships of the rodents were recorded for 15 minutes. Interactions with the same two individuals were not repeated. At least two days were allowed to elapse before an individual was used again. All trials were conducted between 1000 hr and 1500 hr.

Any overt interaction between two animals was called an encounter. Agonistic encounters usually ended when one animal took the dominant role by attacking and chasing its opponent and the other became subordinate by escaping or trying to defend its nest area from attack.

The behavioral patterns and postures observed between the mice were classified into five major categories. These have been modified from Eisenberg (1963).

**Upright posture.**—The animal assumes a posture with the long axis of the body at an angle greater than 45 degrees to the substrate.

**Rushing.**—The animal usually has an elongated posture. The ears are erect and the eyes are wide open. When the opponent is reached, the animal may strike at it with its forepaws. This is the major aggressive movement.

**Chase.**—The animal runs after the opponent and tries to bite its rump.

**Nest defense.**—This usually involves an upright posture in defending a nest area from an opponent. It may involve short elongate rushes whereby the defender rushes in short spurts, not straying far from its nest area.

**Escape leap.**—Wild erratic jumps are used to escape a rush or subsequent chase.

Fighting usually began within the first two minutes after the partition was lifted and was initiated by *P. longimembris* in 11 of 12 interactions. The predominant patterns during interactions were rushing by *Perognathus* and escape leaping by *Microdipodops*. *Perognathus* was usually deliberate in rushing *Microdipodops* and when moving away it assumed a slow quadrupedal gait. *Microdipodops* defended its nest area vigorously during interactions but was usually driven away by *Perognathus*. Rushing by *Perognathus* also induced *Microdipodops* to defend its nest area via an upright stance or via a partial rush; that is, *Microdipodops* started to rush *Perognathus* but stopped short, not advancing far from its nest area. If *Microdipodops* escape leaped, *Perognathus* usually moved away or, rarely, chased *Microdipodops*. If *Microdipodops* defended its nest area, *Perognathus* would usually move away only to return several
seconds later, rush Microdipodops and take over its nest area. Microdipodops only entered the Perognathus half of the cage after they were rushed or chased. Although Eisenberg (1963) noted chasing and locking fight (two animals meet and lock together by gripping with all four limbs) to be quite common between pocket mice intra-specifically, chasing was not frequent and locking fight did not occur in the present study. During interactions both species squealed in high-pitched tones. However, Microdipodops vocalized more often and this usually occurred when defending a nest area.

During 12 interactions of all combinations of sex pairings between Microdipodops and Perognathus, P. longimembris was dominant 11 times (Table 1). In one interaction involving a female of each species, neither individual was clearly dominant over the other. In all other cases, Perognathus was clearly dominant regardless of sex. Perognathus was equally dominant in both halves of the cage. Since each individual was used in more than one trial, the Mann-Whitney U test (Wilcoxon's two-sample test) was utilized to determine whether P. longimembris is significantly dominant over M. megacephalus. The Mann-Whitney U test in this case can be computed as the number of times a P. longimembris was dominant over M. megacephalus out of the 12 possible combinations (see Sokal and Rohlf, 1969). In this case, the “U” of the Mann-Whitney U test is either 0 or 1; the probability of this occurring if there is no difference between the species is either 1 or 2 (1 < P < 2). Thus, P. longimembris is significantly dominant over M. megacephalus. How does this compare with Grant’s (1972) generalization that larger species are usually dominant over smaller species? We decided to compare differences in weights between the two species by utilizing Student’s t test for the difference between mean weights and found that P. longimembris, the dominant species, was significantly lighter (P < 0.05; N = 4, $\bar{X} = 7.38$g, SE±0.69) than Microdipodops (N = 3, $\bar{X} = 10.5$g, SE±0.88).

The dominant-subordinate relationships between these two species may be a mechanism by which these species are ecologically separated in the field. O'Farrell's (1973) population study of the desert rodents in the same area where we collected our experimental ani-

**Table 1.** Dominance relationships in Microdipodops megacephalus (Mm)—Perognathus longimembris (Pl) interactions. Percentages are in parentheses.

<table>
<thead>
<tr>
<th>Combination</th>
<th>Number of interactions</th>
<th>Mm-dom</th>
<th>Pl-dom</th>
<th>None-dom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Mm-Female Pl</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Male Mm-Male Pl</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Female Mm-Male Pl</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Female Mm-Female Pl</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>12</strong></td>
<td><strong>0</strong></td>
<td><strong>11 (91.7)</strong></td>
<td><strong>1 (8.3)</strong></td>
</tr>
</tbody>
</table>
mals lends credence to this idea. His data show that on a 2.7 hectare grid *M. megacephalus* emerged in early March and steadily increased until the middle of April. Towards the end of April, a steady decline of *Microdipodops* corresponded with the emergence and increase in numbers of *P. longimembris*. During the summer very few *Microdipodops* were captured and *Perognathus* covered the entire grid. In September *Perognathus* activity declined and *Microdipodops* activity again increased. Throughout the spring and fall, the centers of activity of the two species did not overlap. Thus, they were spatially isolated. O'Farrell (1973) believes that *P. longimembris* is the more general species and occupies a broader niche than *Microdipodops* because it was found on all habitat types on the grid while *Microdipodops* was generally restricted to areas of fine, loose sand. Furthermore, O'Farrell (1973) believes that *M. megacephalus* probably occupies an included niche within the fundamental niche of *P. longimembris* (see Miller, 1967, for terminology). An interesting situation may exist in Warm Springs Valley because the more general species (*P. longimembris*) appears to be competitively superior to the specialized species (*M. megacephalus*). This is not common, according to Miller (1967). He stated that if there are two sympatric species one of which occupies a smaller included niche within the broader niche of the other, then for coexistence to continue, the species occupying the smaller niche must be the superior competitor.

How, then, has *Microdipodops* avoided extinction? The answer to this question lies in the temporal aspects of the niches of the two species. As stated above, O'Farrell (1973) found that *P. longimembris* is active primarily during the summer while *M. megacephalus* is active primarily during the spring and the fall. Thus, temporally, *P. longimembris*, the superior competitor, has the narrower niche; and if a time axis were included in *Microdipodops*'s fundamental niche, this species niche would not be totally within the fundamental niche of *P. longimembris*. Presumably, *M. megacephalus* would not show decreased summer activity if *P. longimembris* were absent. When the temporal components of the niche are taken into account, it is seen that this system may conform to Miller's (1967) generalization. The dominant-subordinate relationships shown by our laboratory results and the fact that *M. megacephalus* apparently becomes rare as *Perognathus* increases in summer may indicate that interspecific aggression is one mechanism by which ecological isolation is maintained between *P. longimembris* and *M. megacephalus* in the field.

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**Literature Cited**


