*Zootaxa* 4097 (4): 567–574
http://www.mapress.com/j/zt/


**Article**

ISSN 1175-5326 (print edition)
**ZOOTAXA**
ISSN 1175-5334 (online edition)

http://doi.org/10.11646/zootaxa.4097.4.8
http://zoobank.org/urn:lsid:zoobank.org:pub:58D10345-229D-4ACE-9CDE-6B39CF1AFB3B

# Association of the female of *Perdita* (*Xeromacrotera*) *cephalotes* (Cresson), and a replacement name for *Perdita bohartorum* Parker (Hymenoptera: Andrenidae)

ZACHARY M. PORTMAN[1], TERRY GRISWOLD[2] & JAMES P. PITTS[3]

[1]*Department of Biology, Utah State University, 5305 Old Main Hill, Logan, UT 84322-5305 USA. E-mail: zportman@gmail.com*
[2]*USDA-ARS Pollinating Insects Research Unit, Utah State University, 5310 Old Main Hill, Logan UT 84322-5310 USA. E-mail: terry.griswold@ars.usda.gov*
[3]*Department of Biology, Utah State University, 5305 Old Main Hill, Logan, UT 84322-5305, USA. E-mail: jpitts@biology.usu.edu*

## Abstract

The monotypic *Perdita* subgenus *Xeromacrotera* Timberlake is currently known only from the male sex. Here, the female of *Perdita* (*Xeromacrotera*) *cephalotes* (Cresson, 1878) is associated, resulting in two new junior synonyms of *P.* (*X.*) *cephalotes*: *Perdita* (*Procockerellia*) *excellens* Timberlake, 1958, **new synonym** and *Perdita* (*Cockerellia*) *autumnalis* Timberlake, 1977, **new synonym**. The true number of maxillary palpi are reported, and updated subgeneric and species diagnoses are provided. In addition, *Perdita boharti* Portman & Griswold, **new name**, is designated as a replacement name for the primary junior homonym *P. bohartorum* Parker, 1983 (not *P. bohartorum* Timberlake, 1956) and is assigned to the related subgenus *Cockerellia* Ashmead.

**Key words:** *Perdita boharti*, bee, synonymy, sex association, distribution

## Introduction

The andrenid genus *Perdita* Smith, 1853 (Hymenoptera: Andrenidae) is the largest bee genus in North America, currently containing 630 species, 127 additional subspecies, and numerous undescribed taxa (these numbers reflect the changes made in this paper). Many of the species and subspecies are described from a single sex with 98 and 151 known from only the male or female sex, respectively (ZMP, unpublished data).

*Perdita* is split into 17 subgenera, of which seven comprise a monophyletic group: *Allomacrotera* Timberlake, 1960, *Callomacrotera* Timberlake, 1954, *Cockerellia* Ashmead, 1898, *Hexaperdita* Timberlake, 1954, *Pentaperdita* Cockerell and Porter, 1899, *Procockerellia* Timberlake, 1954, and *Xeromacrotera* Timberlake, 1954 (Timberlake 1954, Danforth 1996). In addition to the seven subgenera, there is one described species — *Perdita bohartorum* Parker, 1983 (not *Perdita bohartorum* Timberlake, 1956) — that falls within that group, but is not currently placed in a subgenus (Parker 1983). The seven subgenera and one miscellaneous species are united by the presence of copious branched or wavy scopal hairs (setae), simple tarsal claws in the females, and the unique shape of the male eighth sternum (Timberlake 1954, Danforth 1996). Within this monophyletic group, the relationships between the seven subgenera remain poorly resolved (Danforth 1996).

The subgenus *Xeromacrotera* contains one species, *Perdita cephalotes* (Cresson, 1878), which is currently only known from the male. This has hindered understanding of its phylogenetic placement due to the absence of female characters in morphological-based phylogenetic analysis (Danforth 1996, Michener 2007). In addition, one of the important phylogenetic and diagnostic characters in this group is the number of maxillary palpi, but it has been unclear whether *P. cephalotes* has five or six maxillary palpi, or is variable. Timberlake (1954) stated "the maxillary palpi tend perhaps to be five-jointed," reporting five in one specimen and six in another. Danforth (1996) found six palpi in the one specimen he dissected.

Here, for *P. cephalotes* the sexes of are associated and the number of maxillary palpi determined. In addition, a replacement name is provided for *P. bohartorum* Parker, 1983 and the subgeneric placement determined.

*Accepted by V. Gonzalez: 7 Mar. 2016; published: 4 Apr. 2016*

## Material and methods

Types of *P. cephalotes* and its synonyms were examined. A total of 952 (762 ♀ and 190 ♂) specimens of *P. cephalotes* and 101 specimens of *P. bohartorum* were examined for this study. Specimens were examined using a Leica M125 stereomicroscope with a Techniquip ProLine 80 LED ring light. Mouthparts of 22 specimens of *P. cephalotes* (11 of each sex) were studied to determine the number of maxillary palpi. Specimens were selected from representative locations throughout the range of *P. cephalotes* (Table 1). A Keyence VHX-500F digital microscope was used to examine the maxillary palpi at 200X magnification, as well as measure and take images of specimens. Terminology for morphological characters follows Michener (2007). Historic location data was georeferenced using Google Earth and maps were generated with ArcGIS software.

Codens for collections at which type specimens are located:

ANSP Academy of Natural Sciences, Philadelphia, Pennsylvania, USA.
BBSL USDA, Agricultural Research Service, Pollinating Insects—Biology, Management and Systematics Research, Logan, Utah, USA.
CAS California Academy of Sciences, San Francisco, California, USA.
USNM National Museum of Natural History, Washington D.C., USA.

**TABLE 1.** Locality of specimens with maxillary palpi examined.

| # | Sex | BBSL Number | State | County |
|---|---|---|---|---|
| 1 | male | BBSL672289 | NV | Clark |
| 2 | male | BBSL686902 | NV | Clark |
| 3 | male | BBSL846359 | CA | San Bernardino |
| 4 | male | BBSL846358 | CA | San Bernardino |
| 5 | male | 139232 | CA | Inyo |
| 6 | male | BBSL496626 | UT | Kane |
| 7 | male | BBSL496562 | UT | Kane |
| 8 | male | BBSL368834 | UT | Garfield |
| 9 | male | BBSL403008 | UT | Garfield |
| 10 | male | BBSL672279 | NV | Clark |
| 11 | male | BBSL687286 | NV | Clark |
| 12 | female | BBSL846371 | CA | San Bernardino |
| 13 | female | BBSL846373 | CA | San Bernardino |
| 14 | female | BBSL846376 | CA | San Bernardino |
| 15 | female | BBSL846367 | CA | San Bernardino |
| 16 | female | BBSL687317 | NV | Clark |
| 17 | female | BBSL687308 | NV | Clark |
| 18 | female | BBSL687283 | NV | Clark |
| 19 | female | BBSL373324 | UT | Garfield |
| 20 | female | BBSL368838 | UT | Garfield |
| 21 | female | BBSL388672 | UT | Kane |
| 22 | female | BBSL388675 | UT | Kane |

## Systematics

### Subgenus *Xeromacrotera* Timberlake, 1954

**Type species.** *Perdita cephalotes* (Cresson, 1878), ♂, by original designation and monotypy.

**Updated subgeneric diagnosis.** *Xeromacrotera* is defined by the following combination of characters: maxillary palpi six-segmented (generally appearing five-segmented due to a minute fifth joint), female with tarsal claws simple, frons shiny with dense deep punctures, and with simple, wavy scopal hairs. Male with bidentate hind tarsal claws and metasoma wider than mesosoma. *Xeromacrotera* can be separated from the closely-related subgenus *Cockerellia,* which has the maxillary palpi clearly six-segmented with a normal fifth joint. *Xeromacrotera* shares many characters with species of *Allomacrotera* and *Procockerellia*, which have the maxillary palpi three- or five-segmented. *Perdita cephalotes* can be distinguished from *Allomacrotera and Procockerellia* in the male sex by the combination of the bidentate tarsal claws and the broad metasoma, and the female can be distinguished by the shining and heavily punctate face, as well as the wavy rather than corkscrew-shaped scopal hairs.

**Remarks.** *Number of palpi.* Examination of the 22 specimens of *P. cephalotes* revealed that both sexes have six maxillary palpi (Fig. 1D). Measurements reveal that the maxillary palpi are reduced compared to related *Perdita*, largely due to the minute size of the fifth joint. The average total length of the maxillary palpi is 0.33 mm (n=12) with the average length of each joint approximately: 100 μm: 50 μm: 50 μm: 50 μm: 15 μm: 60 μm. Length and ratio of the maxillary palpi show no difference between the sexes. In many specimens, the maxillary palpi appear to be five-jointed due to the minuteness of the fifth joint. The fifth joint is particularly difficult to observe in the male, whose yellowish mouthparts lack contrast. Using the typical level of magnification used for specimen identification, most specimens of *P. cephalotes* would appear five-jointed.

**Sex association.** Likely due to the unique coloration of the male and the confusion regarding the number of maxillary palpi, the female of *P. cephalotes* has been described separately under two different names in different subgenera. Collections from the deserts of California, Nevada, and Utah have revealed *P. cephalotes* to be a relatively common species and allowed confident association of the sexes based on shared collection frequency and the shared characters of the maxillary palpi. When more than one specimen of *P. cephalotes* has been collected, males and females have been found together at 32 out of 55 unique collection events (at the same date and location). These associated collections have taken place throughout the range of *P. cephalotes*. The males are strongly associated with the females with only five instances of male *P. cephalotes* collected without the female. In addition to collection frequency, both sexes share the unique morphological character of shortened maxillary palpi with a minute fifth joint.

With the association of the female, it is now possible to better understand the relationship of *Xeromacrotera* to other subgenera. The female shares scopal hair morphology with the subgenera *Cockerellia* and *Pentaperdita* and it resembles *Procockerellia* and *Allomacrotera* in general appearance. However, *P. cephalotes* is not a match with any of those subgenera; in particular, the six-jointed maxillary palpi separate it from the subgenera *Procockerellia*, *Allomacrotera* and *Pentaperdita*, while the bidentate hind tarsal claws in the male and the presence of a lateral emargination on the fifth sternum of the female separate it from the subgenus *Cockerellia* (Danforth 1996). Due to its unique mix of characters, *Xeromacrotera* is here retained as a distinct subgenus with the combination of distinguishing characters as outlined above. More work is needed to understand the relationships between these subgenera, though *Xeromacrotera* may be sister to *Procockerellia* or *Cockerellia*.

### *Perdita* (*Xeromacrotera*) *cephalotes* (Cresson, 1878)

(Fig. 1)

*Macrotera cephalotes* Cresson, 1878: 71, ♂. Holotype data: Nevada (ANSP).

*Perdita cephalotes*; Cockerell, 1896: 78.

*Perdita* (*Xeromacrotera*) *cephalotes*; Timberlake, 1954: 412.

*Perdita* (*Procockerellia*) *excellens* Timberlake, 1958: 384, ♀. Holotype data: UT, Grand Co., Moab (CAS type no. 14513). **New synonym.**

*Perdita* (*Cockerellia*) *autumnalis* Timberlake, 1977: 281, ♀. Holotype data: CA, Inyo County, Death Valley National Monument, 2.4 km SW of Wildrose Station (CAS type no. 12664). **New synonym.**

**Diagnosis of male.** Average body length: 5.1 mm (3.8–6.1 mm, n=32). The male can be easily recognized by its relatively large body size, bidentate hind tarsal claws, and distinctive yellow coloration over most of the body. The vertex is crossed by a more-or-less complete transverse brown or metallic blue band, the mesosoma is marked with metallic blue, and the metasoma is often marked with brown on the first tergum and has faded brown bands at the borders of the other terga. Individuals generally have large, quadrate heads. However, there is a large range of head sizes with a continuous gradation from small-headed males with oval heads (Fig. 1A) to the large-headed males with quadrate heads (Fig. 1B). Head width ranges from 1.2–2.2 mm and is linearly related to body size. Most males have intermediate-sized heads and cluster around the average of 1.7 mm head width. Genitalia and eighth sternum are illustrated in Timberlake (1954: Figs. 109, 110, and 170).

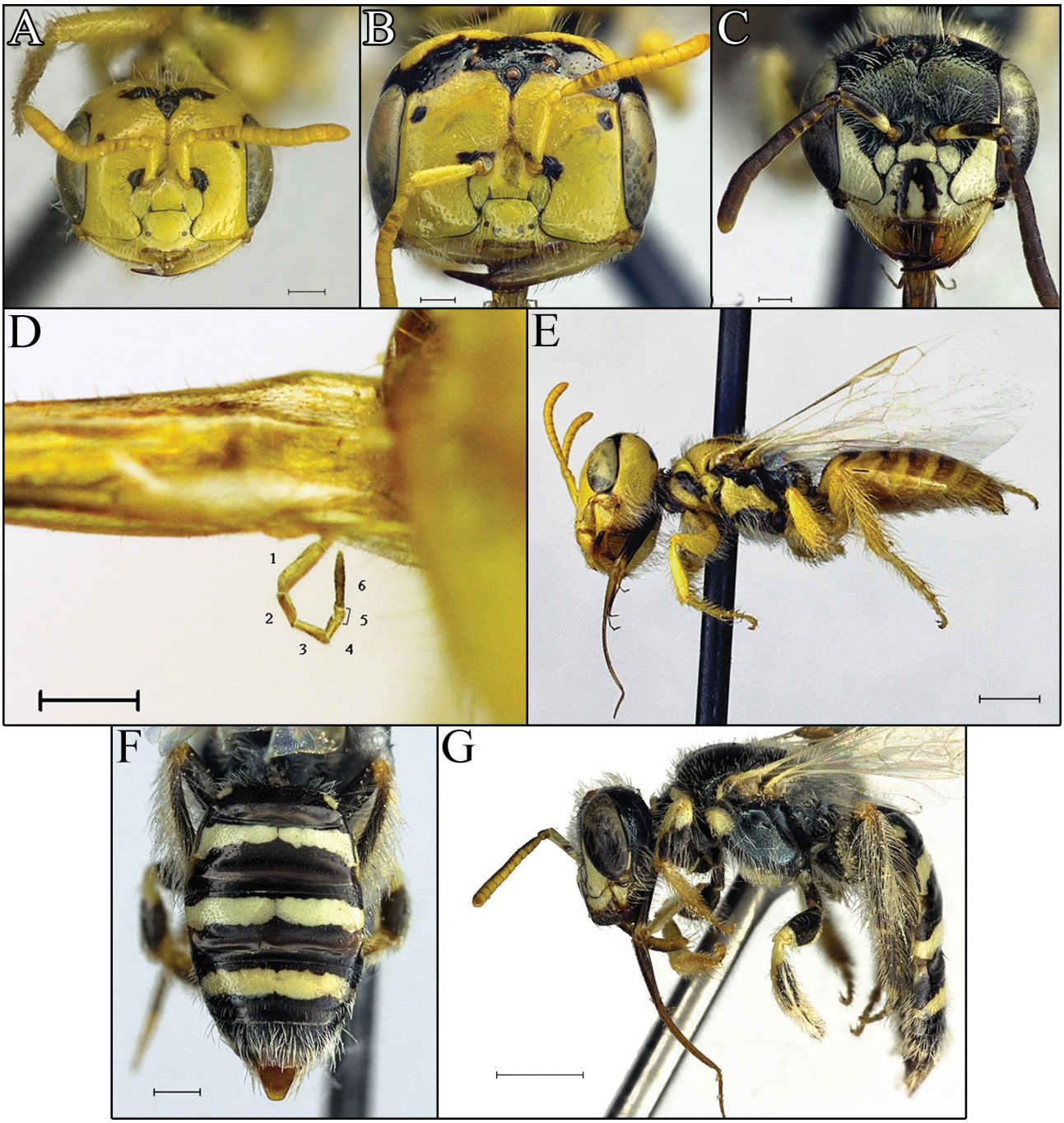


**FIGURE 1.** *Perdita cephalotes* (Cresson). (A) Small-headed male face. Scale bar = 250 µm. (B) Large-headed male face. Scale bar = 250 µm. (C) Female face. Scale bar = 250 µm. (D) Male maxillary palpi, showing minute fifth palp. Maxillary palpi are similar in both sexes. Scale bar = 100 µm. (E) Male side view. Scale bar = 1 mm. (F) Female metasoma. Scale bar = 250 µm. (G) Female lateral view. Scale bar = 1 mm.

**Diagnosis of female.** Average body length: 6.2 mm (5.7–6.6 mm, n=10). The female can be recognized by its distinct pattern of facial markings and smooth, shining, and distinctly punctate vertex, frons, and scutum. *Perdita cephalotes* can be separated from many superficially similar *Perdita* by its broadly wavy scopal hairs (rather than straight or tightly corkscrew-shaped), the simple hind tarsal claws, and the broadly truncate pygidial plate. The extent of the light markings can be variable. The clypeus ranges from almost entirely white with dark marks limited to an upside-down U-shape to almost entirely dark with light edges and/or a median white stripe. The white tergal bands can be entire or narrowly interrupted, and the band on the fifth tergum can be present or absent.

**Biology.** *Perdita cephalotes* appears to limit its pollen gathering to flowers of rabbitbrush (*Ericameria* and *Chrysothamnus*, Asteraceae, tribe Astereae). The flight period of *P. cephalotes* is late season, in synchrony with its rabbitbrush pollen source. Specimens have been collected primarily from late August to October, with a couple records in early November.

**Distribution.** *Perdita cephalotes* is found in Arizona, California, Nevada, and Utah. It is distributed throughout the eastern Mojave Desert and the southern Colorado Plateau of the arid southwestern United States (Fig. 2). There is a single record from the Sonoran Desert, in San Diego County, California, collected on 5 November 1984; based on other bees collected by the same collector (K.W. Cooper) this record appears to be valid (D. Yanega, personal communication). The lack of other *P. cephalotes* records from this region may be due to a lack of collection effort that late in the season.

**Floral records. Asteraceae** (169 ♂ 726 ♀): *Chrysothamnus depressus* Nutt. 2 ♂ 3 ♀, *Chrysothamnus linifolius* Greene 15 ♂ 43 ♀, *C.* sp. 7 ♂ 30 ♀, *Chrysothamnus viscidiflorus* (Hook.) Nutt. 11 ♂ 81 ♀, *Ericameria nauseosa* (Pall. Ex Pursh) G.L. Nesom & Baird 100 ♂ 388 ♀, *Ericameria paniculata* (A. Gray) Rydb. 33 ♂ 175 ♀, *Ericameria parryi* (A. Gray) G.L. Nesom & Baird 5 ♀, *Gutierrezia microcephala* (DC.) A. Gray 1 ♂, *Gutierrezia sarothrae* (Pursh) Britton & Rusby 1 ♀, **Cleomaceae** (1 ♀): *Cleome lutea* Hook. 1 ♀, **Polygonaceae** (1 ♂): *Eriogonum racemosum* Nutt. 1 ♂.

**Note:** Due to the relatively recent taxonomic transfer of some common *Chrysothamnus* to *Ericameria* (Nesom & Baird, 1993) often long after original floral associations were made, specimens associated with *Chrysothamnus* sp. (i.e. floral records on *Chrysothamnus* that are lacking a specific epithet) may have actually been caught on *Ericameria*.

**Type material examined.** *Macrotera cephalotes* holotype data: Nevada, H. Edwards (ANSP). *Perdita excellens* holotype data: UT, Grand Co., Moab, 16 September 1943, G.F. Knowlton (CAS type no. 14513). *Perdita autumnalis* holotype data: CA, Inyo County, Death Valley National Monument, 2.4 km (1.5 miles) SW of Wildrose Station, 6 November 1968, P.H. Arnaud, Jr., on *Chrysothamnus paniculatus* [=*Ericameria paniculata*] (CAS type no. 12664).

**Additional material examined. ARIZONA: Coconino County:** The Gap (36.3033 -111.4489): 1 ♀, 25 Sep 1960, G.E. Bohart, *Cl. lutea*. **CALIFORNIA: Inyo County:** Darwin Falls (36.32077 -117.52451): 3 ♂ 3 ♀, 10 Oct 1976, T.L. Griswold; Grapevine Ranger Station (36.99 -117.36): 1 ♀, 21 Oct 1978, T.L. Griswold, *C.* sp.; Keeler, 10 mi SE (36.36106 -117.78434): 2 ♀, 23 Sep 1987, T.L. Griswold; Swansea, 2 km NW (36.53634 -117.92015): 50 ♂ 260 ♀, 19 Sep 1993, T.L. Griswold, *E. nauseosa*; Titus Canyon, Death Valley NP (36.8463 -117.059): 1 ♂, 22 Oct 2001, T.L. Griswold, *E. nauseosa*; **San Bernardino County:** Lanfair Valley (35.127 -115.1828): 1 ♂ 1 ♀, 19 Sep 1994, T.L. Griswold, *E. nauseosa*; Lanfair Valley (35.1422 -115.2953): 2 ♀, 11 Sep 1994, T.L. Griswold, *E. nauseosa*; Shadow Valley (35.44319 -115.67215): 1 ♂ 3 ♀, 20 Sep 1994, T.L. Griswold; Valley Wells (35.4585 -115.6903): 11 ♂ 16 ♀, 24 Sep 1987, T.L. Griswold; Watson Wash (34.91416 -115.20248): 2 ♀, 19 Sep 1994, T.L. Griswold; 4 ♀, 20 Sep 1994, T.L. Griswold; **San Diego County:** Canebrake (32.9036 -116.2489): 1 ♂, 5 Nov 1984, K.W. Cooper. **NEVADA: Clark County:** Black Butte, 2.6 mi SE (36.4744 -114.1602): 3 ♀, 6 Oct 2004, T.L. Griswold, *E. paniculata*; Cow Spr., 6.06 mi ENE (35.6034 -114.9178): 2 ♀, 10 Oct 2005, T.L. Griswold, *E. paniculata*; Cow Spr., 6.33 mi NE (35.6359 -114.9399): 7 ♂ 49 ♀, 10 Oct 2005, T.L. Griswold, *E. paniculata*; Cow Spr., 6.82 mi NNE (35.6545 -114.9555): 13 ♂ 38 ♀, 10 Oct 2005, T.L. Griswold, *E. paniculata*; Elephant Rock, 1.61 mi WSW (36.4251 -114.4892): 3 ♂ 18 ♀, 12 Oct 2005, T.L. Griswold, *E. paniculata*; Gale Hills, 3.37 mi SW (36.1903 -114.7355): 1 ♀, 12 Oct 2005, T.L. Griswold, *E. paniculata*; Goodsprings, SE (35.8242 -115.4182): 1 ♂, 8 Oct 1998, T.L. Griswold, *G. microcephala*; Juniper Mine, 8.58 mi NW (35.3132 -114.8747): 1 ♀, 11 Oct 2005, T.L. Griswold, *E. paniculata*; Piute Rng [Range], 5.84 mi NE (35.2731 -114.9163): 6 ♀, 11 Oct 2005, T.L. Griswold, *E. paniculata*; Piute Rng [Range], 6.99 mi NE (35.2754 -114.8972): 10 ♂ 48 ♀, 11 Oct 2005, T.L. Griswold, *E. paniculata*; Red Rock Spr., 2.82 mi ENE (36.4756 -114.1637): 9 ♀, 13 Oct 2005, T.L. Griswold, *E. paniculata*; Yucca Gap (36.4443 -115.2692): 2 ♂ 4 ♀, 7 Oct 1998, T.L. Griswold; Yucca Gap (36.4467 -115.2555): 2 ♂ 20 ♀, 7 Oct 1998, T.L. Griswold, *E. nauseosa*. **UTAH: Garfield County:** Horse Pasture, 3.9 mi S (37.6447 -

111.0702): 6 ♂ 13 ♀, 11 Sep 2001, R. Andrus, *E. nauseosa*; 2 ♂, 11 Sep 2002, L. Topham, *C. depressus*; 3 ♀, 11 Sep 2002, L. Wilson, *C. depressus*; 1 ♂ 3 ♀, 13 Sep 2000, A. Worley, *E. nauseosa*; 8 ♂ 4 ♀, 13 Sep 2000, M. Sunseri, *E. nauseosa*; 1 ♀, 13 Sep 2000, M. Sunseri, *G. sarothrae*; 3 ♂ 5 ♀, 22 Sep 2003, A. Johansen, *C.* sp.; 2 ♂ 4 ♀, 22 Sep 2003, S.M. Higbee, *E. nauseosa*; 1 ♀, 27 Sep 2000, A. Worley, *E. nauseosa*; 5 ♂ 8 ♀, 27 Sep 2002, B. Bradley, *C. linifolius*; 1 ♂ 3 ♀, 27 Sep 2002, O.J. Messinger, *C. linifolius*; 2 ♀, 29 Aug 2001, K. Moredock, *C.* sp.; 1 ♀, 4 Oct 2000, A. Worley, *E. nauseosa*; 1 ♂ 3 ♀, 4 Oct 2000, S. Jenkins, *E. nauseosa*; 2 ♂, 4 Sep 2000, A. Worley, *E. nauseosa*; 1 ♂ 9 ♀, 4 Sep 2000, O.J. Messinger, *E. nauseosa*; 2 ♂ 2 ♀, 8 Sep 2003, A. Johansen, *E. nauseosa*; 1 ♂ 2 ♀, 8 Sep 2003, S.M. Higbee, *E. nauseosa*; Twentyfive Mile Wash (37.5596 -111.3048): 1 ♀, 18 Sep 2003, A. Johansen, *E. nauseosa*; White Point, 2.3 mi NNW (37.537 -111.322): 1 ♂, 17 Sep 2001, R. Andrus, *E. nauseosa*; 1 ♀, 5 Sep 2001, V. Bourguignon, *C. linifolius*; White Point, 3.4 mi NNW (37.5608 -111.3236): 1 ♀, 29 Sep 2000, M. Sunseri, *E. nauseosa*; **Kane County:** Cottonwood Spr., 1.3 mi NNE (37.2609 -112.3246): 1 ♀, 20 Sep 2000, A. Worley, *E. nauseosa*; 1 ♂ 1 ♀, 20 Sep 2000, M. Sunseri, *E. nauseosa*; 1 ♂ 6 ♀, 4 Oct 2000, M. Sunseri, *E. nauseosa*; 11 ♀, 4 Oct 2000, O.J. Messinger, *E. nauseosa*; Dance Hall Rock, 1.82 mi NW (37.3811 -111.1126): 8 ♀, 20 Sep 2001, R. Andrus, *E. nauseosa*; 2 ♂ 3 ♀, 21 Sep 2000, A. Worley, *E. nauseosa*; 1 ♀, 21 Sep 2000, S. Jenkins, *E. nauseosa*; 7 ♀, 26 Sep 2002, L. Wilson, *C. viscidiflorus*; 6 ♀, 26 Sep 2002, O.J. Messinger, *C. linifolius*; 6 ♂ 3 ♀, 4 Oct 2000, M. Sunseri, *E. nauseosa*; 2 ♂ 6 ♀, 4 Oct 2000, O.J. Messinger, *E. nauseosa*; Dry Fork, N (37.441 -111.2307): 6 ♀, 10 Oct 2002, B. Bradley, *C. viscidiflorus*; 1 ♀, 10 Oct 2002, H. Ikerd, *C. viscidiflorus*; 4 ♂ 8 ♀, 26 Sep 2002, B. Bradley, *C. linifolius*; 1 ♀, 30 Sep 2003, J. Tolliver, *E. nauseosa*; Dry Fork, near Spooky Gulch (37.4829 -111.2044): 1 ♀, 26 Sep 2000, A. Worley, *E. nauseosa*; Lick Wash, 1.13 mi W mouth (37.3553 -112.1995): 1 ♂, 10 Sep 2003, A. Johansen, *Er. racemosum*; Nipple Spr., 1.0 mi E (37.189 -111.5368): 3 ♂, 1 Oct 2002, L. Topham, *C. linifolius*; 3 ♀, 1 Oct 2002, L. Wilson, *C. linifolius*; 1 ♂ 6 ♀, 9 Oct 2002, O.J. Messinger, *C.* sp.; Rock House Cave, 0.57 mi W (37.1774 -111.9151): 1 ♀, 25 Sep 2003, A. Johansen, *E. parryi*; 4 ♀, 25 Sep 2003, O.J. Messinger, *E. parryi*; Stony Point, 2.27 mi SE (37.23465 -111.5252): 1 ♀, 25 Sep 2002, A. Johansen, *E. nauseosa*; 2 ♂ 5 ♀, 25 Sep 2003, A. Johansen, *E. nauseosa*; 7 ♂ 13 ♀, 25 Sep 2003, O.J. Messinger, *E. nauseosa*; Tibbet Canyon (37.1606 -111.5392): 2 ♂, 1 Oct 2002, L. Topham, *C. linifolius*; 1 ♂, 1 Oct 2002, L. Topham, *C. viscidiflorus*; 14 ♀, 1 Oct 2002, L. Wilson, *C. linifolius*; 3 ♂ 15 ♀, 8 Oct 2002, O.J. Messinger, *C.* sp.; Tibbet Canyon (37.1945 -111.5984): 1 ♂, 25 Sep 2002, A. Johansen, *C. viscidiflorus*; 1 ♀, 25 Sep 2002, O.J. Messinger; 1 ♀, 25 Sep 2002, O.J. Messinger, *C. viscidiflorus*; 2 ♂, 25 Sep 2003, A. Johansen; 3 ♂ 23 ♀, 25 Sep 2003, A. Johansen, *C. viscidiflorus*; 6 ♂ 43 ♀, 25 Sep 2003, O.J. Messinger, *C. viscidiflorus*; **Wayne County:** Capitol Reef National Park (38.15 -111.1667): 1 ♀, 21 Sep 1985, W.P. Nye, *C.* sp.

### *Perdita* (*Cockerellia*) *boharti* Portman & Griswold, New name

*Perdita bohartorum* Parker, 1983: 229, ♀♂. Holotype data: ♂, Utah, Emery Co., sandy ridge E. of Little Gilson Butte, 5100', 29 May 1981, F.D. Parker and S.F. Parker (USNM type no. 100071, not examined).

**Diagnosis of male.** In Timberlake's (1954) key to *Cockerellia*, the male of *P. boharti* keys out to either *P. lacteipennis lacteipennis* Swenk and Cockerell (=*P. albipennis albipennis* (Cresson)) or *P. bequaerti bequaerti* Viereck, depending on choice of the color of the wing veins. In either case, the male of *P. boharti* is distinct from all other *Cockerellia* in having a large protrusion on the second sternum. Genitalia, face, and unique sternal modifications are illustrated in Parker (1983: Figs. 1–7).

**Diagnosis of female.** In Timberlake's (1954) key to *Cockerellia*, the female keys out to *P. lacteipennis lacteipennis* (=*P. albipennis albipennis*). *Perdita boharti* can be separated by the more copious scopal hairs, the lack of a median apical emargination on the pygidial plate, and the relatively long and fine hairs on the scutum (compared to the short and thick hairs on the scutum of *P. albipennis albipennis*).

**Biology.** According to Parker (1983), *P. boharti* specialize on the pollen of *Scabrethia scabra* (Hook.) W.A. Weber (Asteraceae, tribe Heliantheae, badlands mule-ears). Because *Scabrethia* is a monotypic genus, *P. boharti* may be monolectic, limiting its pollen collection to a single plant species. The known flight period of *P. boharti* is May to June and *P. boharti* has only been collected in the San Rafael Desert of the Colorado Plateau (Fig. 2). It is a ground-nesting bee (F.D. Parker, personal communication).

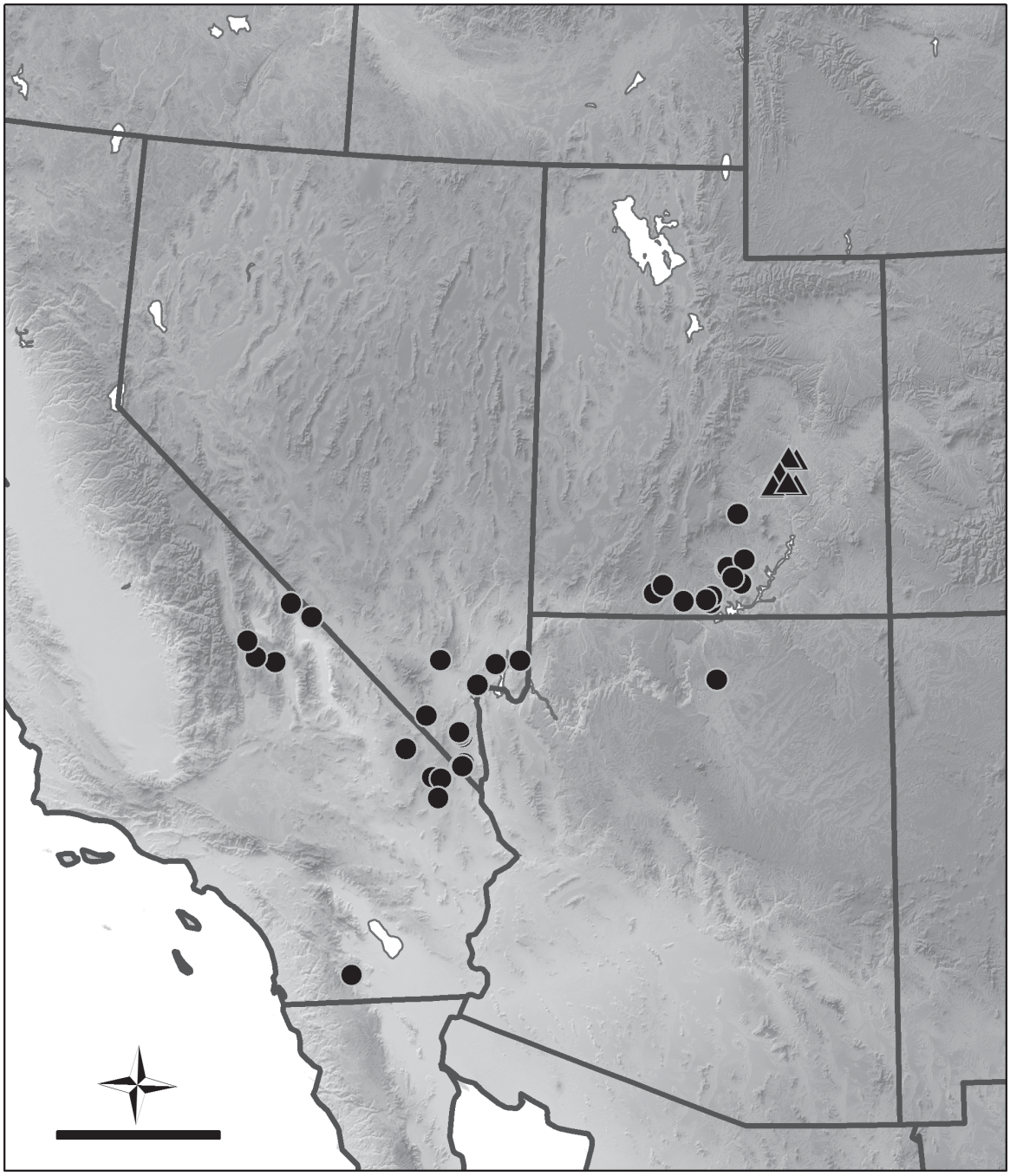

**FIGURE 2.** Distribution of *P. cephalotes* (circles) and *P. boharti* (triangles). Scale bar = 200 km.

**Remarks.** *Perdita bohartorum* Parker, 1983 is a primary junior homonym of *Perdita bohartorum* Timberlake, 1956. Parker (1983) did not place *P. boharti* into a subgenus. It is here assigned to the subgenus *Cockerellia* based on the following combination of characters laid out in Timberlake (1954): (1) maxillary palpi six-segmented, (2) male hind tarsal claws simple, and (3) female scopal hairs wavy and simple.

**Floral records. Asteraceae:** *Scabrethia scabra* 19 ♂ 3 ♀.

**Type material examined.** Paratype data: 11 ♂, Utah, Emery Co., sandy ridge E. of Little Gilson Butte, 5100', 29 May 1981, F.D. Parker and S.F. Parker (BBSL).

**Additional Material examined. UTAH: Emery County:** Big Flat Top, NE (38.5197 -110.4463): 1 ♂, 25 May 1992, T.L. Griswold; 1 ♂, 25 May 1992, T.L. Griswold, *S. scabra*; Iron Wash, 2.5 mi SW (38.77495 -110.32667): 1 ♂, 13 Jun 1983, T.L. Griswold, *S. scabra*; Little Flat Top, 0.5 mi E (38.5404 -110.4813): 1 ♂, 30 May 1991, T.L. Griswold, *S. scabra*; 1 ♂, 03 Jun 1991, T.L. Griswold, *S. scabra*; Little Flat Top, San Rafael Desert

(38.5333 -110.4833): 3 ♂ 1 ♀, 28 May 1985, F.D. Parker; Little Gilson Butte, 3.2 air mi NE (38.6299 -110.568): 3 ♂, 28 May 1985, D.K. Broemeling; 6 ♂, 28 May 1985, F.D. Parker; 2 ♂, 28 May 1985, R.T. Griswold; 1 ♂, 28 May 1985, T.L. Griswold; 8 ♂, 28 May 1985, T.L. Griswold, *S. scabra*; 7 ♂, 30 May 1991, T.L. Griswold; Little Gilson Butte, E side (38.5921 -110.6009): 21 ♂ 7 ♀, 04 Jun 1982, F.D. Parker; San Rafael Desert (38.7979 -110.4413): 1 ♂ 3 ♀, 13 Jun 1991, T.L. Griswold, *S. scabra*; **Wayne County:** Big Flat Top, 7 mi E (38.4893 -110.33593): 1 ♀, 29 May 1985, F.D. Parker; Hanksville, 7 mi N (38.46438 -110.67258): 3 ♂, 30 May 1991, T.L. Griswold, *S. scabra*; 7 ♂ 6 ♀, 03 Jun 1991, T.L. Griswold; Hwy 24, 1 mi S Emery County line (38.48673 -110.65862): 3 ♂, 30 May 1991, T.L. Griswold, *S. scabra*.

**Etymology.** *Perdita boharti* was chosen based on the preferences of F.D. Parker, who originally described the species. It continues the purpose of the original name honoring the brothers Bohart.

## Acknowledgements

We would like to thank Jack Neff for helpful comments on the manuscript as well as Bob Zuparko (CAS) and Jason Weintraub (ANSP) for providing access to types, B. Rozick for databasing, measuring, and mapping specimens, S. Burrows and E. Sadler (USU Department of Biology) for assistance with figures, and H. Ikerd (BBSL) for assistance with databasing and figures. This material is based upon work supported by the National Science Foundation Graduate Research Fellowship under grant number DGE-1147384 to ZP. Funding was also provided by a Utah State University Graduate Enhancement Award and a USU Ecology Center Research Award. This research was supported by the Utah Agricultural Experiment Station, Utah State University, and approved as journal paper number 8845.

## References

Ashmead, W.H. (1897) Some new genera of bees. *Pysche*, 8, 282–285. http://dx.doi.org/10.1155/1898/70320

Cockerell, T.D.A. (1896) The bees of the genus *Perdita* F. Smith. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 48, 25–107.

Cockerell, T.D.A. & Porter, W. (1899) Contributions from the New Mexico Biological Station—VII. Observations on bees, with descriptions of new genera and species. *Annals and Magazine of Natural History*, 7 (4), 403–421. http://dx.doi.org/10.1080/00222939908678225

Cresson, E.T. (1878) Descriptions of new North American Hymenoptera in the collection of the American Entomological Society. *Transactions of the American Entomological Society*, 7, 61–136.

Danforth, B. (1996) Phylogenetic analysis and taxonomic revision of the *Perdita* subgenera *Macrotera*, *Macroteropsis*, *Macroterella*, and *Cockerellula* (Hymenoptera: Andrenidae). *The University of Kansas Science Bulletin*, 55 (16), 635–692.

Michener, C.D. (2007) *The bees of the world*, Second Edition. Johns Hopkins University Press, Baltimore and London, 953 pp.

Nesom, G.L. & Baird, G.I. (1993) Completion of *Ericameria* (Asteraceae: Astereae), diminution of *Chrysothamnus*. *Phytologia,* 75 (1), 74–93.

Parker, F.D. (1983) A new *Perdita* from Utah's San Rafael Desert (Hymenoptera: Andrenidae). *Pan-Pacific Entomologist*, 59 (1–4), 229–232.

Smith, F. (1853) *Catalogue of hymenopterous insects in the collection of the British Museum, Part 1. Andrenidae and Apidae*. Trustees of the British Museum, London, 197 pp.

Timberlake, P.H. (1954) A revisional study of the bees of the genus *Perdita* F. Smith, with special reference to the fauna of the Pacific Coast, Part I. *University of California Publications in Entomology*, 9 (6), 345–432.

Timberlake, P.H. (1956) A revisional study of the bees of the genus *Perdita* F. Smith, with special reference to the fauna of the Pacific Coast, Part II. *University of California Publications in Entomology*, 11 (5), 247–350.

Timberlake, P.H. (1958) A revisional study of the bees of the genus *Perdita* F. Smith, with special reference to the fauna of the Pacific Coast, Part III. *University of California Publications in Entomology,* 14 (5), 303–410.

Timberlake, P.H. (1960) A revisional study of the bees of the genus *Perdita* F. Smith, with special reference to the fauna of the Pacific Coast, Part V. *University of California Publications in Entomology*, 17 (1), 1–156.

Timberlake, P.H. (1977) Descriptions of new species of *Perdita* (Hymenoptera, Apoidea) in the collection of the California Academy of Sciences. *Proceedings of the California Academy of Sciences*, 41 (10), 281–295.