First records of the resin bees, *Dianthidium pudicum pudicum* and *D. simile* (Hymenoptera: Megachilidae), in Manitoba, with a key to local species

Sarah J. Semmler[1], Marika Olynyk[2], Reid Miller[3] and Jason Gibbs[3]

[1]Living Prairie Museum, 2795 Ness Ave, Winnipeg MB, R3J 3S4
Email: ssemmler@winnipeg.ca

[2]Natural Resources Department, University of Manitoba, 220-70 Dysart Rd., Winnipeg MB, R3T 2M6
Email: marikaolynyk@gmail.com

[3]University of Manitoba, Department of Entomology, 12 Dafoe Rd., Winnipeg MB, R3T 2N2 Email: jason.gibbs@umanitoba.ca

Abstract – Here we present the first provincial records of the genus *Dianthidium* occurring in Manitoba. Records from multiple sites are documented for the western bee *D. pudicum pudicum* that represent the northeastern limit of its range in North America. In contrast, new records of the eastern species *D. simile* in Manitoba constitute the northwestern range limit of that species. Both species are illustrated and a key is provided to facilitate future recognition.

Introduction

Dianthidium Cockerell (Megachilidae: Anthidiini) is a genus of chalicodomiform bees endemic to North America. *Dianthidium* spp. are solitary bees and use plant resins in nest construction (Hicks 1927, 1933; Frohlich and Parker 1985; O'Brien 2007). No members of *Dianthidium* have been recorded from the province of Manitoba. Three species have been recorded from neighbouring states and provinces in online sources (www.discoverlife.org).

Dianthidium (*Dianthidium*) *pudicum pudicum* (Cresson, 1879) is found in open habitats in western North America. There are records of the nominal subspecies from Mexico (http://www.discoverlife.org/mp/20l?id=KSEM307326) and California north to British Columbia (Schwarz 1928; Grigarick and Stange 1968; Hurd 1979) and east into Saskatchewan (C. Sheffield, *pers. comm.*) and North Dakota (http://www.discoverlife.org/mp/20l?id=AMNH_BEE00165388). Specimens have been collected in a variety of habitats, including mountain areas (Grigarick and Stange 1968) and desert or dry shrubland (Wilson *et al*. 2008).

Dianthidium pudicum is a solitary, polylectic species with two recognized subspecies. Floral associations are primarily within the families Asteraceae and Fabaceae, but numerous other associations have been recorded, primarily for the subspecies, *D. p. consimile* (Ashmead, 1896) (Hurd 1979; http://discoverlife.org). The nominal subspecies has cream to white maculations and *D. p. consimile* has yellow maculations (Grigarick and Stange 1968). Nests are constructed using a combination of pebbles and plant resins adhered to rocks (Hicks 1927) or in the forks of branches (Grigarick and Stange 1968; Clement and Rust 1974).

Dianthidium (*D.*) *simile* (Cresson 1864) is a ground-nesting species that mixes plant resins with sand grains and plant debris to construct cells (O'Brien 2008). Shallow nests (1–5 cm) are built in small aggregations in lacustrine habitats near the base of grasses (O'Brien 2008). Records of *D. simile* come from Minnesota, Ontario, and south to Georgia (Mitchell 1962; Hurd 1979; Romankova 2003). The nearest documented records to Manitoba are from Sudbury, Ontario in Canada (Evans, 1896; Schwarz 1928; Romankova 2003) and Cass County, Minnesota in the USA (http://bugguide.net/node/view/212136/bgpage).

One other species *D.* (*D.*) *curvatum* (Smith 1854) has been recorded from Alberta (Sheffield *et al*. 2014) and North Dakota (http://www.discoverlife.org/mp/20l?id=AMNH_BEES16604), but is not known from Manitoba.

Here we present new records of occurrence for *D. p. pudicum* and *D. simile*, the first for Manitoba.

Materials and Methods

Collections using an aerial net were made by S. Semmler on 30 July 2014 in Rotary Prairie Nature Park, Winnipeg, Manitoba (49.898, -97.034, elevation approx. 230 m). Rotary Prairie consists of approximately eight hectares of remnant tall grass prairie, marsh/sedge meadow, stands of willow, and aspen forest. The park is surrounded by industrial and residential development. The collection was made on purple prairie clover (*Dalea purpurea* Vent.; Fabaceae) in a dry section of tall grass prairie southeast of an aspen forest edge. Numerous species of flowering plants occur in this site, including prairie sunflower (*Helianthus pauciflorus* Nutt.; Asteraceae), dwarf milkweed (*Asclepias ovalifolia* Decne.; Apocynaceae), black-eyed Susan (*Rudbeckia hirta* L.; Asteraceae), bottle gentian (*Gentiana andrewsii* Griseb.; Gentianaceae), and Canada thistle (*Cirsium arvense* L.; Asteraceae).

Collections using coloured pan traps (blue, yellow, white) were made by M. Olynyk in 2014–2015 on property owned and managed by the Nature Conservancy of Canada 5 km south of St. Lazare, Manitoba, approximately 4 km east of Provincial Highway 41 (50.403, -101.309, elevation approx. 465 m). Habitat consisted of upland tame grass pasture dominated by crested wheatgrass (*Agropyron cristatum* (L.) Gaert., seeded >25 years previously) with low-density floral resources in sandy soils. The pasture was bordered by hardwood forest on graded slopes dominated by oak, poplar, and various

shrubs. The site was managed by rotational cattle grazing. Flowering plants included common yarrow (*Achillea millefolium* L.; Asteraceae) harebell (*Campanula rotundifolia* L.; Campanulaceae), fleabane (*Erigeron glabellus* Nutt.; Asteraceae), alfalfa (*Medicago sativa* L.; Fabaceae) and Canada thistle (*C. arvense*).

Specimens were collected as part of an ongoing survey of pollinators in the Tall Grass Prairie Preserve (Rural Municipality of Stuartburn, 49.155, -96.740, elevation approx. 290 m) by R. Miller in July and August 2017. Collections were made using coloured pan traps at a prairie-wet meadow/carr site, which has been used for cattle grazing as recently as 2011. Nearby floral resources included swamp milkweed (*Asclepias incarnata* L.; Apocynaceae) and black-eyed Susan (*R. hirta*).

A combination of netting and coloured pan traps were used by J. Gibbs and G. Yuko Nozoe to sample bees at Birds Hill Provincial Park (50.01, -96.91, elevation approx. 260 m) in July 2017. Collections were targeted to several open, sandy clearings and fields that were surrounded by woods. Flowering plants in the areas sampled included spreading dogbane (*Apocynum androsaemifolium* L.; Apocynaceae), white sweet clover (*Melilotus albus* Medik.; Fabaceae), sunflower (*Helianthus* spp.), purple prairie clover (*D. purpurea*), white prairie clover (*Dalea candida* Michx. ex Willd.; Fabaceae), bladder campion (*Silene vulgaris* (Moench) Garcke; Caryophyllaceae) and harebell (*C. rotundifolia*). Bees were net collected by J. Gibbs on 19 August 2017 from Sandilands Provincial Forest in a staging area for all terrain vehicles (49.647, -96.26, elevation approx. 300 m). The site was an open clearing surrounded by woods. Flowering plants included goldenrods (*Solidago* spp.), asters (*Symphyotrichum* spp.; Asteraceae), fireweed (*Chamerion angustifolium* (L.) Holub; Onagraceae), and gumweed (*Grindelia squarrosa* (Pursh) Dunal; Asteraceae). Additional net collections were made on 9 July 2018 from the parking lot at the Tillenius Trail, Clematis Wildlife Management Area (50.61, -97.508, elevation approx. 275 m). Flowers included a diverse number of exotic weeds, including white sweet clover (*M. albus*) and bird's-foot trefoil (*Lotus corniculatus* L.: Fabaceae), and native species such as sunflower (*Helianthus* spp.), purple prairie clover (*D. purpurea*), and white prairie clover (*D. candida*).

Specimens are deposited in the Living Prairie Museum entomological collection (LPMEC) and the J.B. Wallis-R.E. Roughley Museum of Entomology (WRME) at the University of Manitoba. Identifications were made using published keys (Schwarz 1926; Timberlake 1943; Grigarick and Stange 1968; Packer *et al*. 2007) and comparison to voucher material at WRME. The novelty of distribution records was assessed using published literature (*e.g.*, Grigarick and Stange 1968; Hurd 1979; Romankova 2004; Sheffield *et al*. 2014), online records (http://discoverlife.org; http://bugguide.net), and personal communication with C. Sheffield (1 June, 2017) of the Royal Saskatchewan Museum, D. Robson (25 May, 2017) of the Manitoba Museum, and S. Cardinal (25 May, 2017) of the Canadian National Collection of Insects, Arachnids, and Nematodes (CNC).

Results

We recorded five females and six males of *D. p. pudicum* from four sites in southern Manitoba during 2014 to 2017. Two females and one male of *D. simile* were collected from one location in the southeast of the province in 2017. Detailed specimen records are provided below.

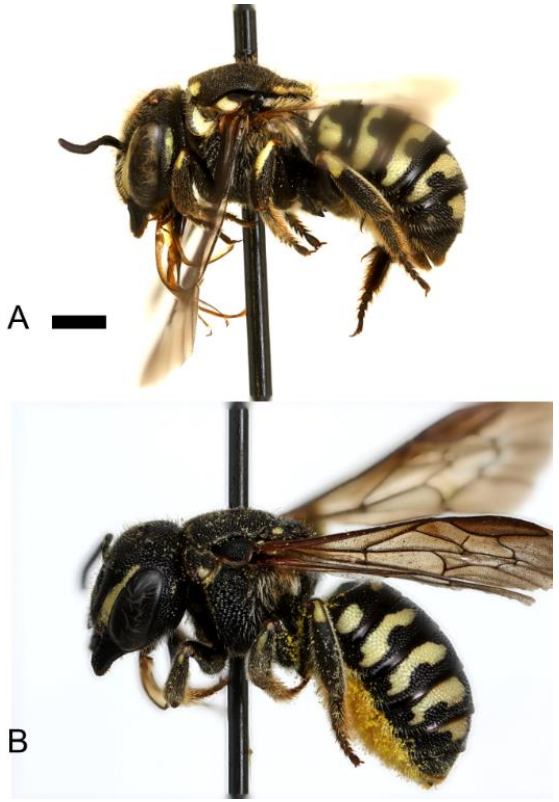

Figure 1. (A) *Dianthidium pudicum pudicum*, female. (B) *Dianthidium simile*, female. Scale bar = 1 mm.

***Dianthidium* (*Dianthidium*) *pudicum pudicum* (Cresson 1879)**

(Figs. 1A; 2A; 3A, C)

New provincial records. MANITOBA: *Division No. 1:* Tall Grass Prairie Preserve, 49.155, -96.740, ex. blue bowl trap, 6–8 July, 2017, leg. R. Miller (1 ♀ JBWM); *Division No. 11*: Winnipeg, Rotary Prairie Provincial Park, 49.898, -97.034, ex. *Dalea purpurea* (Fabaceae), 30 July, 2014, leg. S. Semmler (1 ♀ LPMEC; Fig. 1); *Division No. 12*: Birds Hill Provincial Park, 50.013, -96.921, 2 July, 2017, ex. pan trap, leg. J. Gibbs, G.Y. Nozoe (1 ♀ JBWM); Birds Hill Provincial Park, 50.015, -96.916, 2 July, 2017, ex. pan

trap, leg. J. Gibbs, G.Y. Nozoe (1 ♀ JBWM); Birds Hill Provincial Park, 50.015, -96.916, 9 July, 2017, ex. pan trap, leg. J. Gibbs, G.Y. Nozoe (1 ♂ JBWM); Birds Hill Provincial Park, 50.007, -96.910, 9 July 2017, ex. pan trap, leg. J. Gibbs, G.Y. Nozoe (1 ♂ JBWM); Birds Hill Provincial Park, 50.014, -96.917, 9 July, 2017, ex. net, leg. J. Gibbs, G.Y. Nozoe (1 ♂ JBWM); Birds Hill Provincial Park, 50.014, -96.917, 19 July 2017, ex. net, leg. J. Gibbs, G.Y. Nozoe (1 ♂ JBWM); *Division No. 15*: 5 km S of St. Lazare, 50.403, -101.309, ex. blue pan trap, 11 August 2014, leg. M. Olynyk (1 ♂ JBWM; Fig. 2); 5 km S of St. Lazare, 50.403, -101.309, ex. pan trap, 26 June 2015, leg. M. Olynyk (1 ♀ 1 ♂ JBWM).

***Dianthidium* (*Dianthidium*) *simile* (Cresson 1864)**

(Figs. 1B; 2B; 3B, D)

New provincial records: MANITOBA: *Division No. 1*: Sandilands Provincial Forest, 49.647, -96.260, ex. *Grindelia* (Asteraceae), 19 August 2017, leg. J. Gibbs (2 ♀♀ 1 ♂ JBWM). An additional male was video recorded mating with one of the above females on a *Grindelia* flower (https://youtu.be/DvehIs-uKD0), but escaped collection.

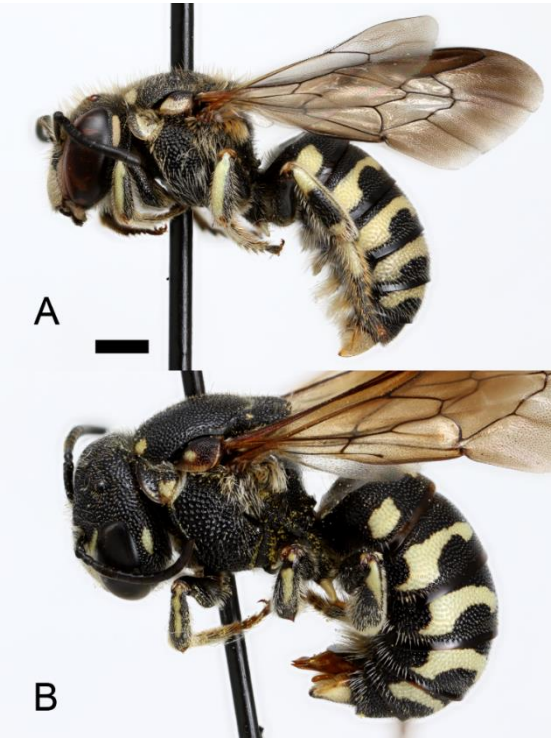

Figure 2. (A) *Dianthidium pudicum pudicum*, male. (B) *Dianthidium simile*, male. Scale bar = 1 mm.

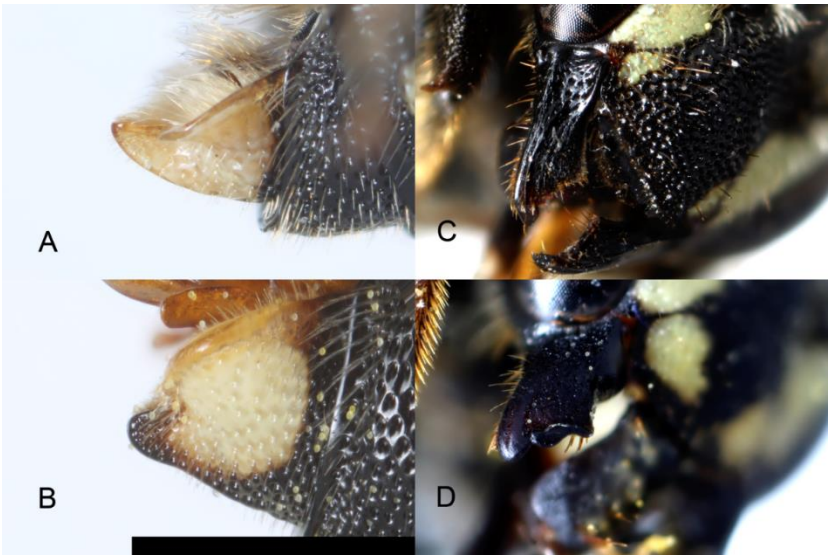

Figure 3. Lateral view of tergum 7 in males of (A) *Dianthidium pudicum pudicum* and (B) *Dianthidium simile.* Comparison of preapical tooth on mandibles of female (C) *Dianthidium pudicum pudicum* and (D) *Dianthidium simile*. Scale bar = 1 mm.

Key to *Dianthidium* in Manitoba

1. Fore coxa with apicoventral spine 2
- Fore coxa without apicoventral spine 3

2. Face lateral maculation narrow above; mesoscutum anterior maculation small, widely separated from tegula ..... *Dianthidium simile*
- Face lateral maculation not narrow above; mesoscutum anterior to maculation large, narrowly separated from tegula (known from Minnesota and North Dakota) ..... *Dianthidium curvatum*

3. Mandible of female with distinct preapical tooth; male T7 with distance between median and lateral lobes half apical width of lateral lobe; both sexes with legs marked extensively with red maculations .... *Dianthidium concinnum*
- Mandible of female without distinct preapical tooth; male T7 with distance between median and lateral lobes subequal to apical width of lateral lobe; legs of both sexes marked with pale yellow to ivory maculations .... *Dianthidium pudicum*

Discussion

Dianthidium pudicum pudicum has an extensive range in western Canada, but until recently, no specimens had been reported east of Saskatchewan. Provincial records at the CNC include British Columbia and Alberta (S. Cardinal, *pers. comm.*). The species appears to be common in Saskatchewan, particularly in the southwest (C. Sheffield, *pers. comm.*). There are no specimens at the Manitoba Museum (D. Robson, *pers. comm.*) and the specimens recorded here are the first representatives for the WRME.

Dianthidium simile is an eastern species that reaches its northwestern range limit in eastern Manitoba. The collection reported here is approximately 240 km further north than any previous record (http://bugguide.net/node/view/212136/bgpage) and 1000 km further west than the nearest Canadian record in Sudbury, Ontario (Evans, 1896; Romanokova 2003). This gap is not too surprising given the limited sampling effort in the northern Great Lakes Region.

The recent detection of these species may be due to increased sampling effort for pollinators in the province. Few published studies have included extensive surveys of bee fauna in Manitoba, with most occurring in the last 10 years (Patenaude 2007, Robson 2008, Semmler 2015, Olynyk 2017). However, Birds Hill Provincial Park and Sandilands Provincial Forest were repeatedly sampled for bees in the 1970's and 1980's—specimens deposited at JBWM—without collecting any *Dianthidium*. It is somewhat surprising that no specimens of either species have been captured previously. There is not sufficient evidence for a range expansion at this time, but similar patterns suggestive of range extensions have recently been documented for other solitary bee species (Gibbs *et al*. 2014: Zarrillo *et al*. 2016). Note: Following acceptance of the manuscript, three females of *Dianthidium* (*Dianthidum*) *concinnum* (Cresson 1872), a new record for Canada, were collected from Spruce Woods Provincial Park. Females have a distinct preapical tooth, procoxa unarmed, and have distinctly red legs. They are deposited in JBWM. The closest known record is from Badlands National Park, South Dakota.

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