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BRIEF COMMUNICATION

Megachile (*Megachile*) *montivaga* (Hymenoptera: Megachilidae) nesting in live thistle (Asteraceae: *Cirsium*)

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Abstract. Although *Megachile* Latreille (leafcutter bees) are well known for their diverse nesting habits, records of the genus nesting in live plants are rare. Here, we report the widespread *Megachile* (*Megachile*) *montivaga* Cresson nesting in live thistle (*Cirsium neomexicanum* Gray), the first explicit record of this behavior in the Nearctic.

Much has been learned about nesting habits of leafcutter bees through the use of trap nests, but much less is known about their natural nesting choices (Krombein, 1967; Baker *et al*., 1985; Cardoso & Silveira, 2012). Here, we record a rarely encountered behavior for *Megachile* (*Megachile*) *montivaga* Cresson, 1878: nesting in live stems.

In May of 2012, while collecting bees in the Hualapai Mountains of northwestern Arizona, the two primary authors witnessed *Megachile* Latreille nesting in living thistles at two sites. The first site (N35.13854 W113.92284; WGS 84), visited on 11 May, was dominated by juniper and yucca, with blooming thistle patchily occupying occasional open areas. Here, a pollen-laden female of *Megachile* was observed entering a thistle and emerging several minutes later without pollen. The bee was immediately collected. Although the site had relatively few thistles, one of the roughly ten other plants also showed a similar hole. Both the initial nest and the additional excavated stem were collected. The bee and diagnostic plant samples were later identified and vouchered in the USDA-ARS National Pollinating Insect Collection (NPIC; BBSL817341) and Utah State Intermountain Herbarium (UTC00266393, UTC00266392) as *M. montivaga* and *Cirsium neomexicanum* Gray, respectively.

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Figures 1–2. Photographs of nesting by *Megachile* (*Megachile*) *montivaga* Cresson in thistle (photographs by Z.M. Portman). **1.** Nest entrance, with apparent associated small shavings from nest construction. **2.** Nest contents of field dissected thistle stem.

A second site (N35.141753 W113.931329; WGS 84) approximately 1 km away from the first was discovered on the following day, 12 May. This site was located directly roadside, along a roughly 100 m x 20 m transect of 30–50° slope on rocky soil. Few shrubs and many blooming thistles were present. A second female of *M. montivaga* (BBSL817103) was collected here, also nesting in an excavated thistle. Parts of the thistle in which the female was nesting (UTC00266394) and a second excavated thistle were pressed and similarly identified as *C. neomexicanum*. A third female of *M. montivaga* (BBSL817106) was collected visiting flowers of *C. neomexicanum*. Of the approximately 150 thistle plants present at this site, an estimated 20% exhibited similar holes. Plants with nest holes were evenly distributed across the site. There was no consistent cardinal orientation of nest entrances. Nest entrances were approximately circular or slightly oval with diameters of 3–4.5 mm, and small shavings were apparent around several of the entrances (Fig. 1). The height of the hole on the stem was variable (20–92 cm), apparently due to the differing stem widths (0.6–2 cm). There appeared to be a tendency toward entrance holes lower on smaller diameter stems, and no plants <1 meter in height were used.

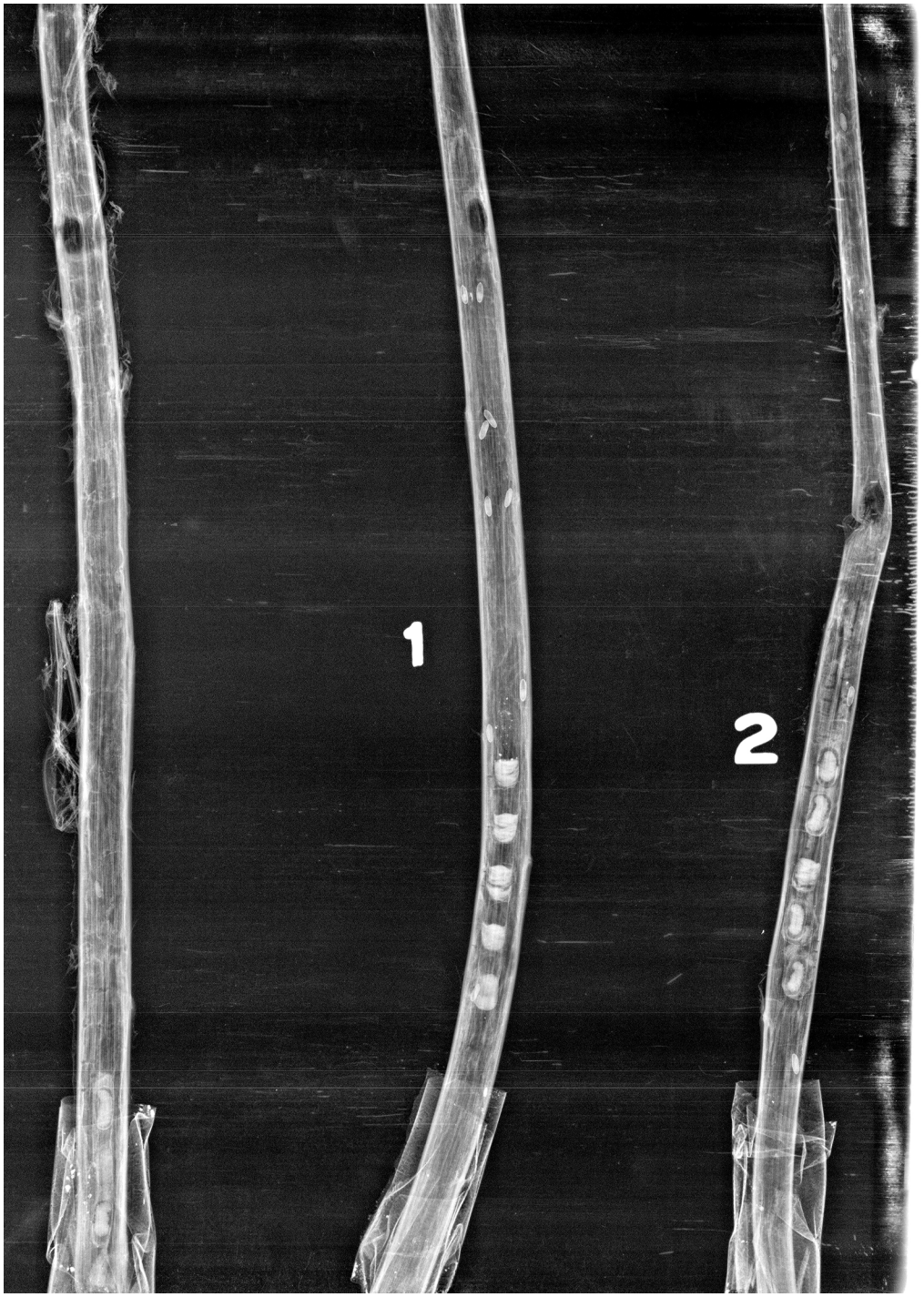
Field and lab dissection of the stems revealed linear, contiguous series of nest cells enveloped in petals (Fig. 2), the only known source for cell linings in *M. montivaga* (Michener, 2007). Of the dissected nests, some were lined entirely with purplish-orange petals (likely *Sphaeralcea* sp.) and others were lined with a combination of purplish-orange and white petals (likely Asteraceae sp.). Nearby specimens of both plants exhibited cutting damage. During construction of new nest cells, the second nesting female (BBSL817103) was visible through the nest entrance working within the stem. After initially entering with a full load of pollen, she was seen moving petals from the interior of the stem above the nest entrance to a nest cell below. This species may stockpile petals within the stem, though no dissection revealed such a stockpile. No additional barrier was found between the lowest cells and the base of the plant. The pollen provisions in the cells were uniformly yellow, mealy-moist, and sweet to the taste. All collected stems were subsequently transported to the NPIC in Logan, UT.

Three of the stems were x-rayed on 16 November 2012, revealing nest cells below the nest entrance in all three cases (Fig. 3). Nest depth varied from 9 to 22 cm. Three stems were stored over winter at 4° C, while one nest was stored at room temperature. The x-rayed nests contained from 5 to 7 completed nest cells. These are minimum numbers of cells per nest, since at least two nests were actively being provisioned at the time of collection. Of the 21 cells, only five bees completed development. The cause of the low success rate is likely due to mortality associated with transport to the NPIC. A first male, female, and second male emerged on 20 June, 1 July, and 5 July 2013, respectively. All developed bees were identified as *M. montivaga* and deposited in the NPIC (BBSL963864, BBSL963865, and BBSL963866, respectively).

This discovery of *M. montivaga* nesting in living stems is unexpected, given numerous publications on the biology of this species (Baker *et al*., 1985; Sheffield *et al*., 2011, and references therein). This species is found throughout much of the United States, southern Canada, and northern and central Mexico (Mitchell, 1962). *Megachile montivaga* appears to have a wide nesting niche. There are numerous records of this species nesting in the ground and traps (Baker *et al*., 1985; Parker, 1986; Parker & Bohart, 1966; Sheffield *et al*., 2011). While not explicitly stated, Parker & Bohart's (1966) record of *M. montivaga* nesting in *Sambucus* was in living stems (F. Parker, pers. comm., 26 January 2015). There are also records of *M. montivaga* nesting in the stems of sunflower (Hicks, 1926), mullein (Hobbs & Lilly, 1954), and *Rhus* (Rau, 1934). An unpublished record of *M. montivaga* nesting in a plant stem was found in a survey of NPIC material (BBSL847992). The specimen was collected by H.R. Lawson on 13 June 1987, from "Box Butte Co.-Nebr" with a label "nesting in stem of *P. haydenii*". Unfortunately it was not reported in accounts of the biology of *Penstemon haydenii* Watson (Lawson *et al*., 1989; Tepedino *et al*., 2006). In all these instances of stem nesting, the possibility exists that the nests were constructed while the plants were still living.

The distinction between live and dead vegetation is important because live plants are better defended than dead plants. This includes physical defenses like latex, spines, trichomes, or hard outer coatings, as well as the chemical defenses plants may employ (Moore *et al*., 1998). Nesting in live plants may allow the bee to co-opt the plants' defenses to protect its offspring. Alternatively, nesting in living stems may represent the lack of other suitable nest sites or the ease of excavation in pithy plants. There may be risks with nesting in relatively soft stems such as *Cirsium* since nest excavation or herbivory may damage the integrity of the stem. The impact of nesting activity on thistles at the individual and population level is unknown, but two thistles at our second site were observed bent to the ground at the location of the nest entrances. The proximity

Figure 3. X-ray of three/four nest stems. Nest entrances appeared as darker patches along the stem and larvae at various stages of development were revealed. The small ovals embedded in the pith are fly pupae, reared and identified as Scathophagidae sp.; they appear to be phytophagous and unassociated with the bees. The height of each number is 1 cm.



to pollen and nectar may also be a factor. As noted above, *M. montivaga* was observed visiting flowers of *C. neomexicanum*. While *M. montivaga* is a generalist and visits a wide diversity of plant families, it shows a preference for Asteraceae (57%, n = 126) and has been previously associated with *Cirsium* (NPIC, 2015).

Use of living plants as nesting sites for species of *Megachile* appears rare. The only other species of *Megachile* definitively recorded nesting in live plants is *M.* (*M.*) *genalis* Morawitz, 1880, an Eastern Hemisphere species widely distributed across Palearctic Asia and Europe (Ruhnke, 2000). That both *M. genalis* and *M. montivaga* are in the same subgenus is intriguing, given their apparent biological similarities. As in *M. montivaga*, *M. genalis* was also reported in live thistle (*Carduus*, *Echinops*), though the latter is known from a number of additional plants and their nesting behavior differs in at least two aspects. While *M. genalis* has nest cells above or below the entrance, *M. montivaga* only constructs cells below. This may be tied to the apparent storage of petals observed in *M. montivaga*. Further, *M. genalis* lines its cells with leaves rather than petals. According to Ruhnke (2000), *M. genalis* excavates its own nests. Evidence suggests *M. montivaga* similarly excavates its own nest, although we did not observe this. The appropriate size of the nest entrances, presence of one hole per stem, and scrapings left at the hole margins (Fig. 1) all suggest this.

This paper represents the second definitive record of *Megachile* nesting in live plants, and the first explicit record for any Nearctic species. More investigation is needed in order to determine whether nesting in living stems is a widespread and overlooked behavior or an evolutionary innovation limited to the subgenus *Megachile s.str*. Further, this observation serves as a reminder of how much there is left to learn about nesting behavior in leafcutter bees.

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REFERENCES

Baker, J.R., E.D. Kuhn, & S.B. Bambara. 1985. Nests and immature stages of leafcutter bees (Hymenoptera: Megachilidae). *Journal of the Kansas Entomological Society* 58(2): 290–313.

Cardoso, C.F., & F.A. Silveira. 2012. Nesting biology of two species of *Megachile* (*Moureapis*) (Hymenoptera: Megachilidae) in a semideciduous forest reserve in southeastern Brazil. *Apidologie* 43(1): 71–81.

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.

Hicks, C.H. 1926. Nesting habits and parasites of certain bees of Boulder County, Colorado. *University of Colorado Studies* 15: 217–252.

Hobbs, G.A., & C.E. Lilly. 1954. Ecology of the species of *Megachile* Latreille in the mixed prairie region of southern Alberta with special reference to pollination of alfalfa. *Ecology* 35(4): 453–462.

Krombein, K.V. 1967. *Trap-Nesting Wasps and Bees: Life Histories, Nests and Associates*. Smithsonian Press; Washington, D.C.; vi+570 pp.

Lawson, H.R., V.J. Tepedino, & T.L. Griswold. 1989. Pollen collectors and other insect visitors to *Penstemon haydenii* S. Wats. In: Bragg, T.B. & J. Stubbendieck (Eds.), *Proceedings of the Eleventh North American Prairie Conference: Prairie Pioneers: Ecology, History, and Culture*: 233–236. University of Nebraska Printing; Lincoln, NE; xii+292 pp.

Michener, C.D. 2007. *The Bees of the World* [2nd Edition]. Johns Hopkins University Press; Baltimore, MD; xvi+[i]+953 pp., +20 pls.

Mitchell, T.B. 1962. *Bees of the Eastern United States* [Volume 2]. North Carolina Agricultural Experiment Station [Technical Bulletin No. 152]; Raleigh, NC; 557 pp.

Moore, R., W.D. Clark, & D.S. Vodopich. 1998. *Botany* [2nd Edition]. McGraw-Hill; New York, NY; xxiv+919 pp.

Morawitz, F. 1880. Ein Beitrag zur Bienen-Fauna Mittel-Asiens. *Bulletin de l'Académie Impériale des Sciences de St.-Pétersbourg* 10: 443–518.

NPIC. 2015. National Pollinating Insects Collection Database; United States Department of Agriculture, Agricultural Research Service, Pollinating Insect Research Unit, Logan, Utah. [last accessed 31 May 2014].

Parker, F.D. 1986. Nesting, associates, and mortality of *Osmia sanrafaelae* Parker. *Journal of the Kansas Entomological Society* 59(2): 367–377.

Parker, F.D., & R.M. Bohart. 1966. Host-parasite associations in some twig-nesting Hymenoptera from western North America. *Pan-Pacific Entomologist* 42(2): 91–98.

Rau, P. 1934. Notes on the behavior of certain solitary and social bees. *Transactions of the Academy of Science of Saint Louis* 28(6): 219–224.

Ruhnke, H. 2000. Zur Nistbiologie der *Megachile genalis* Mor. (Hymenoptera: Apidae). *Mitteilungen der Deutschen Gesellschaft für Allgemeine und Angewandte Entomologie* 12(1–6): 513–516.

Sheffield, C.S., C. Ratti, L. Packer, & T.L. Griswold. 2011. Leafcutter and mason bees of the genus *Megachile* Latreille (Hymenoptera: Megachilidae) in Canada and Alaska. *Canadian Journal of Arthropod Identification* 18: 1–107.

Tepedino, V.J., W.R. Bowlin, & T.L. Griswold. 2006. Pollination biology of the endangered Blowout Penstemon (*Penstemon haydenii* S. Wats.: Scrophulariaceae) in Nebraska. *Journal of the Torrey Botanical Society* 133(4): 548–559.

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