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Cover Page Footnote

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***Epeoloides pilosulus* (Cresson) (Hymenoptera: Apidae)
Rediscovered in Michigan, with Notes on the
Distribution and Status of its *Macropis* Hosts**

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Abstract

Epeoloides pilosulus (Cresson 1878) (Hymenoptera: Apidae) is one of the rarest bees in North America with only a handful of records since 1960. *Epeoloides pilosulus* is a brood parasite of *Macropis* bees, which until recently had not been collected in Michigan since 1944. Bee surveys in Midland County, Michigan have led to the rediscovery of *E. pilosulus* in this state – the first record in 74 years. Michigan becomes the fourth state where *E. pilosulus* has been rediscovered after Connecticut in 2006, New York in 2014 and Maine in 2016, and the sixth region in North America after Nova Scotia in 2002 and Alberta in 2010. State-wide bee surveys have also shown that the principal host, *Macropis nuda* (Provancher 1882), remains widespread in Michigan, and that *Macropis patellata* Patton 1880 is newly recorded for the state.

Key words: parasitic bee, oil bee, oligolege, bee surveys, *Lysimachia*

The status of wild bee species and populations has been the subject of a great deal of attention by the scientific community in recent years, with rapidly contracting distributions for bees such as *Bombus affinis* Cresson documented in the United States and Canada (Colla and Packer 2008; Cameron et al. 2011). Understanding population declines in wild bees outside of the genus *Bombus* has been more difficult, in part because many solitary bee species are rare in collections, either because they have small geographic ranges or because they are phenologically limited to a narrow flight period and require specialized collection effort in order to detect (Harrison et al. 2017). Indeed, in a study of the population trends of wild bees in the northeastern United States, 87 of the 438 species (19.9%) were represented by only 10 to 30 specimens over a 140-year period, making assessment of their historic and contemporary statuses challenging (Bartomeus et al. 2013).

One bee species that has been very infrequently recorded in North America is *Epeoloides pilosulus* (Cresson). *Epeoloides pilosulus* is a brood parasite of *Macropis* bees (Sheffield et al. 2004; Wagner and Ascher 2008), which are themselves specialists on *Lysimachia* species (Fig. 1A, Primulaceae), collecting pollen and floral oils exclusively

from this genus (Michez and Patiny 2005). Floral oils are mixed with pollen provisions and used to waterproof the linings of the cell wall (Cane et al. 1983), allowing *Macropis* to nest in the damp soils favored by *Lysimachia* species (Fig. 1B). *Epeoloides pilosulus* is thus twice restricted; first by the limited suite of bee species that it parasitizes and second by the narrow ecological niche occupied by its hosts.

Epeoloides pilosulus is consequently very rarely collected. Most specimens in Michigan were collected in the early part of the 20th century with the last record made in 1944. This fits into the overall trend for *E. pilosulus*, as the species was not recorded in North America between 1960 and 2002 (but see Sheffield and Heron 2018), until it was rediscovered in Nova Scotia based on two male specimens collected in a pan trap (Sheffield et al. 2004). There have only been four additional contemporary records of *E. pilosulus* in North America since then, in Connecticut (2006, Wagner and Ascher 2008), Alberta (2010, Sheffield and Heron 2018), New York (2014, <http://bugguide.net/node/view/954741>), and Maine (2016, Dibble et al. 2017). In Michigan, *E. pilosulus* is known from four counties in the central and southern Lower Peninsula (Berrien, Midland, Van Buren, and Wayne).

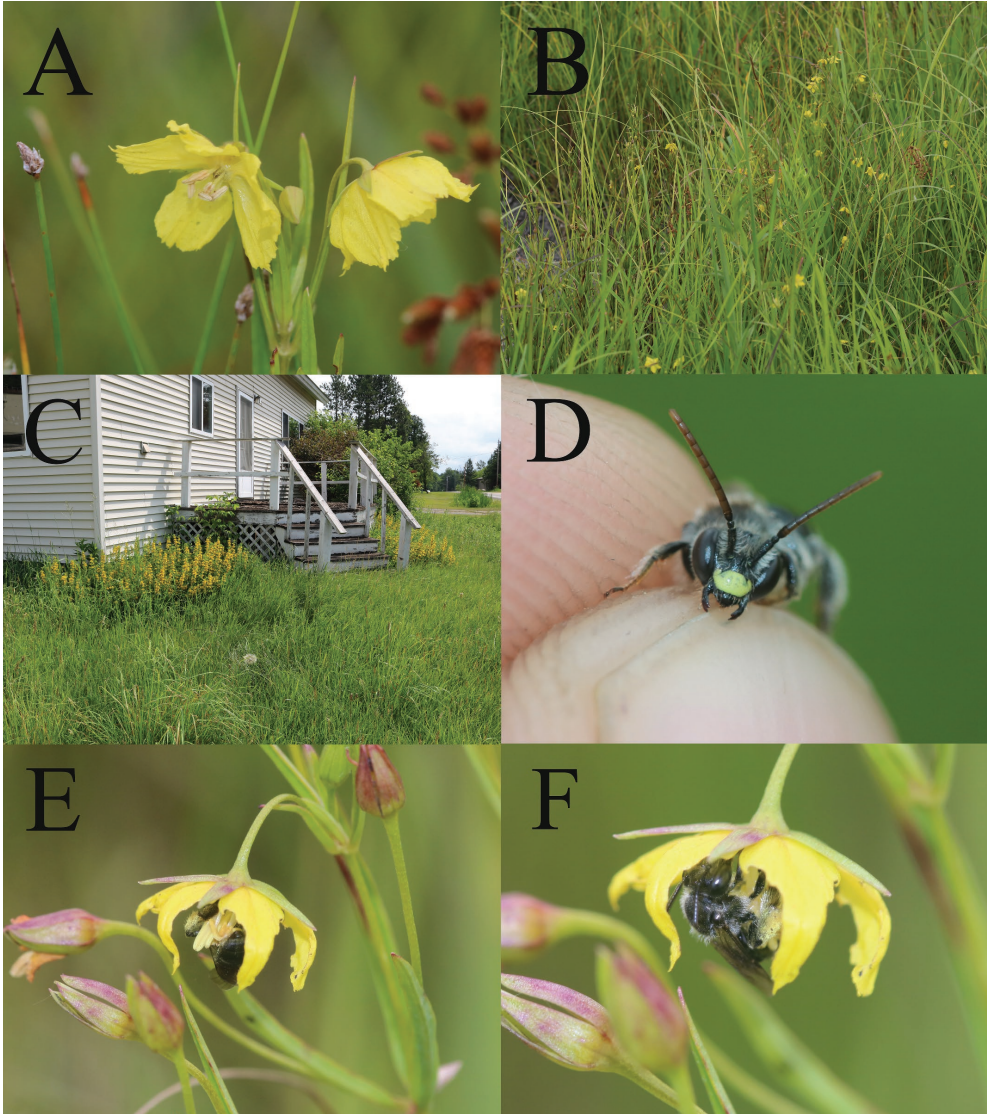


Figure 1. A. Fringed Loosestrife (*Lysimachia ciliata* L.) flower. B. *Lysimachia ciliata* in flower in damp prairie fen habitat at Ives Road Fen, Lenawee County. C. European Dotted Loosestrife (*Lysimachia punctata* L.) outside an abandoned house in Felch, Dickinson County. D-F. *Macropis nuda* (Provancher) individuals at Algonac State Park, St. Clair County. D. *Macropis nuda* male showing distinctive yellow facial maculations. E-F. *Macropis nuda* female collecting pollen from *L. ciliata*.

Only one species of *Macropis* has been recorded from Michigan – *Macropis nuda* (Provancher). *Macropis nuda* has a large range and is known from Canada, from British Columbia to Nova Scotia, and the United States, from Montana and Colorado to the New England states (Mitchell 1960; Michez and Patiny 2005; Sheffield and Heron 2018). However, like *E. pilosulus*, *M. nuda* appeared to have disappeared from Mich-

igan, being last recorded in 1959 and not rediscovered until 2017 in Hillsdale County (Gibbs et al. 2017).

The aim of this paper is to report on the findings of recent bee faunal surveys across Michigan that include the rediscovery of *E. pilosulus* and have expanded our understanding of the status of *Macropis* species in the state.

Methods

As part of our Michigan bee survey we visited the Averill Preserve (43.6618, -84.3500; managed by Little Forks Conservancy) in Midland County every other week from mid-June to mid-September in 2017 and 2018. During each visit, we spent one cumulative hour sampling bees using aerial nets, and we recorded which plants bees were caught on. Surveys focused on open habitats, with surveyors searching all flowering plants within these areas. Similar sampling methods were used at seven other sites in Midland, Ingham, Shiawassee, Kalamazoo, and Livingston counties. All bees were pinned and labelled at Michigan State University, and then identified to species at the University of Manitoba (JG and Joel Gardner). During collection at the Averill Preserve, a specimen of *E. pilosulus* was captured (see Results). This material is deposited in the Albert J. Cook Arthropod Research Collection at Michigan State University.

The records of *Macropis* species for Michigan stated in this paper are based on the collections of the lead author as part of his efforts to survey wild bees in every county in Michigan. His material is deposited at the J.B. Wallis / R. E. Roughley Museum of Entomology, University of Manitoba. Historic records of *E. pilosulus* and *M. nuda* collections were taken from the most recent summary of the Michigan bee fauna (Gibbs et al. 2017).

Results

Epeoloides pilosulus (Cresson 1878)

Current records: Midland Co.: Midland, Averill Preserve, 43.6618, -84.3500, M. Killewald, 28 June 2018, 1♀, (BH_010955), *Lysimachia nummularia* L.

The specimen was collected as it was patrolling a small patch of *L. nummularia* flowers along a walkway.

Macropis (Macropis) nuda (Provancher 1882)

Current records: Alcona Co.: Black River, Black River Road x La Vigne Road, 44.815, -83.324, T.J. Wood, 15 July 2018, 1♀, *Apocynum androsaemifolium* L.; **Alpena Co.:** Mackinaw State Forest, Long Rapids Rd x Truax Creek, 45.116, -83.823, T.J. Wood, 15 July 2018, 1♂, 1♀, *Lysimachia ciliata* L.; **Dickinson Co.:** Foster City, Felch, 45.996, -87.825, T.J. Wood, 30 June 2018, 2♂, *Lysimachia punctata* L., Fig. 2C; **Hillsdale Co.:** Pittsford State Game Area, 41.866, -84.522, T.J. Wood, 8 July 2017, 1♂, *Apocynum cannabinum* L.; **St. Clair Co.:**

Algonac State Park, 42.650, -82.531, T.J. Wood, 14 July 2018, 1♂, 1♀, *L. ciliata*, Fig. 1D-F; **Tuscola Co.:** Dayton, S Plain Road x James Road, 43.462, -83.268, T.J. Wood, 25 June 2018, 1♂, 1♀, *L. ciliata*.

Macropis nuda was not known from Alcona, Hillsdale, St. Clair and Tuscola counties prior to its discovery there in 2017–2018. The historic and contemporary distributions are shown in Fig. 2A.

Macropis (Macropis) patellata Patton 1880

Current records: Lenawee Co.: Ives Road Fen Preserve, 41.967, -83.945, T.J. Wood, 8 July 2018, 3♂, *L. ciliata*.

Males and females were abundant at an area of restored prairie fen in south-east Michigan with regenerating wetland vegetation (Fig. 2B). No females were collected as TJW believed at the time that these bees were *M. nuda*, and consequently did not collect any females in order to avoid depleting the population. It was not until they were inspected under the microscope that their true identity was determined.

Discussion

The rediscovery of *E. pilosulus* in Midland County suggests that the species has been present in Michigan continuously since it was first discovered over a century ago. Although *M. nuda* was not also found at the same site, the host and the parasite are often detected using different sampling techniques, with the parasite detected using bowl traps and the host using aerial netting in both Nova Scotia and Connecticut (Sheffield et al. 2004; Wagner and Ascher 2008). Contemporary records of *M. nuda* suggest that this species remains most common in the Saginaw Bay region of eastern Michigan (Fig. 2A).

All pollen foraging *M. nuda* females along with several males were collected from Fringed Loosetrife (*L. ciliata*). This is in common with other studies in eastern North America (Cane et al. 1983). Males were also collected patrolling around the introduced European Dotted Loosetrife (*L. punctata*) in Dickinson County (Fig. 1C), suggesting that it may also be visited by females of this species. In Europe, *L. punctata* is visited for pollen and oil by the native *M. fulvipes* (Fabricius) (Michez and Patiny 2005). In contrast, the European Creeping Jenny (*L. nummularia*) is not visited by *Macropis* species (Cane et al. 1983) as it does not produce oil. This may explain why *E. pilosulus* was found at the Averill Preserve site but *M. nuda* was not. Surveys

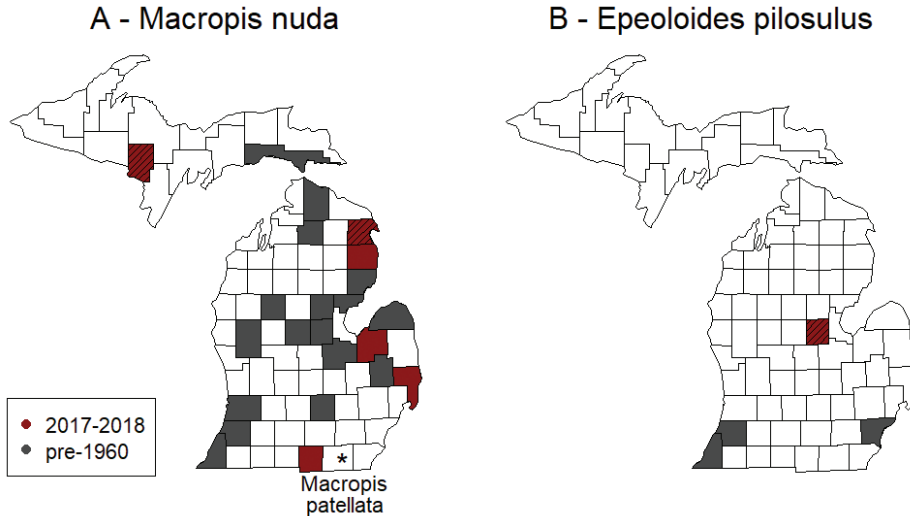


Figure 2. A. Distribution of *Macropis nuda* (Provancher) in Michigan at a county-level resolution. The single new record of *Macropis patellata* Patton is marked with an asterisk. B. Distribution of *Epeoloides pilosulus* (Cresson) in Michigan at a county-level resolution. Pre-1960 records are marked in gray and 2017–2018 records are marked in red. Hatching indicates records of the species in both time periods.

were restricted to dry, open areas, where no other *Lysimachia* species were present, although they may have been present in damp riverine areas nearby. Individual females of *M. nuda* collected on Indian Hemp (*A. cannabinum*) and Spreading Dogbane (*A. androsaemifolium*) showed no evidence of pollen collection and were visited solely for nectar. Though restricted to *Lysimachia* for pollen and floral oils, *Macropis* species have been recorded visiting many plant families for nectar (Pekkarinen et al. 2003; Michez and Patiny 2005), including *Apocynum* by *M. nuda* (Cane et al. 1983).

Macropis patellata is known to occur in the eastern United States from North Carolina north to Vermont and west to Iowa and Nebraska (Mitchell 1960; Michez and Patiny 2005; Ascher and Pickering 2018). Surprisingly, the species has never been recorded from Indiana or Ohio, so this record from south-eastern Michigan fills a distributional gap and suggests that, in addition to these two states, the species may also be present in southern Ontario. Most of the data used to determine the distribution of this bee are old, and the species was highlighted as potentially being of conservation concern due to a lack of recent records in the northeastern United States (Bartomeus et al. 2013). The two other *Macropis* species known from North America, *M. ciliata* Patton 1880 and *M. steironematis* Robertson 1891, have a similar distribution to *M. patellata*, being

found in some Atlantic states and parts of the Midwest, but have not been recorded from Michigan, Indiana or Ohio (Michez and Patiny 2005; Ascher and Pickering 2018). Continued targeted searching may reveal the presence of one or both of these additional *Macropis* species in this region.

The rediscovery of *M. nuda* (Gibbs et al. 2017) and *E. pilosulus*, as well as the discovery of *M. patellata*, in Michigan highlights some potential consequences of low sampling effort for bees over long periods of time. These include a high likelihood of missing bees that have restricted geographical ranges or that exploit a narrow range of host plants, as well as the potential to consider a bee rare when it has instead been poorly sampled. The level of active sampling for bees in Michigan has, until very recently, been low in comparison with the historical baseline. The year of the most recent previous record for *M. nuda* (1959) coincides with the final collection period of R.R. Dreisbach, a prolific amateur entomologist who collected bees extensively across the whole state (Fischer 1965). *Macropis nuda* and *E. pilosulus* were almost certainly continuously present in Michigan for the last 60–70 years, and the absence of records for these species likely reflects low sampling effort rather than a genuine population decline. More regular and extensive sampling is needed to inform conservation efforts along with targeted searches to understand the

abundance and distribution of specialized species that have narrow ecological niches which make them difficult to detect. General bee surveys in North America are likely at an all-time high, but many species of conservation concern may best be studied with more focused efforts.

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Survey work was funded by USDA NIFA grant 2017-68004-26323. Our thanks go to Gary Parsons for access to the insect collection at MSU, to The Little Forks Conservancy for allowing access to the Averill site, and to The Nature Conservancy for allowing access to the Ives Road Fen site.

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