The Great Lakes Entomologist

Volume 43
Numbers 1 - 4 - 2010 *Numbers 1 - 4 - 2010*

Article 4

April 2010

An Annotated Checklist of Wisconsin Mutillidae (Hymenoptera)

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Abstract

A survey of Wisconsin velvet ants (Hymenoptera: Mutillidae) conducted from literature searches, collection inventories, and two years of field work (2001-2002) yielded 28 species in three subfamilies. Of these, 23 species (representing 82% of the Wisconsin fauna and a 460% increase in the known species richness) are new state species records, having not previously been recorded in the published literature from the state. The known distributions of all Wisconsin species are reported by region and county, along with pertinent phenological, natural history, and other collection information, when known.

Mutillidae is a morphologically diverse, widespread family of wasps. Despite their nearly cosmopolitan distribution and relative abundance, most mutillid species have been poorly studied. Adult mutillids are typically moderately to densely pubescent and predominantly orange, reddish, brownish, or black; oftentimes they are marked with whitish, golden, or reddish contrasting spots or bands of pubescence. The apterous females are readily recognized and are often referred to by their common name, velvet ants, due to their superficial similarity in appearance to relatives in the Formicidae. Males of a few species, e.g., *Myrmilloides grandiceps* (Blake), are brachypterous, although males of most species are macropterous. There is usually also strong sexual dimorphism *vis-à-vis* size and coloration.

Worldwide, estimates of species richness range from 3,700 (Lelej and Nemkov 1997) to 5,000 (Brothers 1993) described species in seven subfamilies (Brothers 1995). Recent intensive collecting in tropical regions that historically have been poorly sampled has supported projections of at least 10,000 mutillid species in the world (Brothers 2006). Krombein (1979) catalogued 19 genera comprising 434 species and an additional 59 subspecies in the subfamilies Mutillinae, Myrmosinae, and Sphaeropthalminae in America north of Mexico. In the United States, species richness is greatest in the arid western and southwestern states (Krombein 1979), but mutillids are found throughout the country in a variety of relatively mesic habitats (personal observations).

Molecular analyses (e.g., Pilgrim and Pitts 2006) are beginning to better clarify the actual number of North American mutillid species. Many male and female mutillids, originally described as separate species, are being associated using molecular data. Pilgrim et al. (2008b) examined several sets of species with similar geographic ranges and used DNA sequence data to propose seven new synonyms for southwestern U.S. species of *Dasymutilla*. Many morphologically similar mutillid species have historically been described based on differences in integumental or setal color. Using a combination of morphological, natural history, and molecular data, Pilgrim et al. (2009) concluded that 10 *Dasymutilla* species listed in Krombein's (1979) catalog are indistinguishable from, and junior synonyms of *D. quadriguttata*. Pitts and Manley (2004) synonymized

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seven names with *Lomachaeta hicksi* Mickel and described three new species in the genus, while Williams and Pitts (2009) described an additional seven North American species. New genera are also still being described, such as *Schusterphotopsis* (Pitts 2003) and *Laminatilla* (Pitts 2007).

Despite increased mutillid research in the past 10+ years, a lack of comprehensive regional surveys of velvet ant species in the United States persists. Fattig (1943) published a list of mutillid species and new host records from Georgia, while Manley (1991) provided a species list and key to the mutillids of South Carolina. More recently, collecting efforts have been focused at a finer scale, producing lists of the mutillids of the Bitter Lake National Wildlife Refuge, New Mexico (Manley and Radke 2006), the Algodones Sand Dunes in California (Pitts et al. 2009), and Deep Canyon, California (Pitts et al. 2010b). Although these faunal lists provide excellent baseline data for these locations, they are of decreasing utility as one moves away from the pertinent study area. Manley (1991) listed 11 mutillid species found in Georgia and an additional 18 species found in Florida, none of which have been recorded from South Carolina. Pitts et al. (2010b) compared the nocturnal mutillid fauna of Deep Canyon to that of the Algodones Sand Dunes, two Californian sites approximately 90 miles apart. Although the two localities had similar numbers of nocturnal mutillid species (34 and 29 species, respectively), they have but 15 species in common. These apparent dramatic changes in species composition in areas separated by as few as 90 miles illustrate the importance of conducting surveys in different regions of the country.

Methods

Preliminary data for this study were gathered from two primary sources. First, all relevant literature was reviewed and previous Wisconsin mutillid records were compiled. Collection records that specifically listed Wisconsin as a locality were noted; distribution maps that showed ranges over Wisconsin, but did not represent specimens collected in the state, were not treated as valid literature records for this study. Second, specimens from several research collections were examined and pertinent data were winnowed from mutillids housed therein. These insect collections included the University of Minnesota (UMSP), the Field Museum of Natural History (FMNH), Michigan State University (MSUC), the Milwaukee County Public Museum (MCPM), and the University of Wisconsin–Madison (WIRC). The WIRC is the primary reference collection and repository for insects collected in the state. Mutillidae holdings of the WIRC were reviewed for accuracy; numerous corrections were made to misidentified or misplaced specimens and the collection was greatly augmented by additional specimens collected as a result of this project. All codens indicated in parentheses follow Arnett et al. (1993).

Mutillids were hand-collected from various soil substrates and vegetation—most frequently the leaves and stems of scrub oaks. These diurnally-active specimens, mostly females, were gathered and dispatched with cyanide. Passive traps, including Townes-style Malaise traps and flight-intercept traps, were also used to collect male velvet ants. Pitfall traps and barrier-pitfall traps yielded numerous female and some male specimens. Propylene glycol was used in passive traps to kill and preserve specimens; they were transferred to ethyl alcohol (generally 80% EtOH) upon return to the laboratory. Most specimens were deposited either in the WIRC or the author's personal collection (CMBC).

Data from all mutillids examined in this study have been databased using Specify 6 software (Specify Software Project 2010). These data contribute to a dynamic and ever-growing source of information on insects collected in Wisconsin and are part of an ongoing project to catalog selected Wisconsin insect taxa.

Results

In the following checklist of Wisconsin Mutillidae, new state records are indicated by **boldfaced type**. The numbers of male and female specimens examined are reported for each species. Exceptional or unique collecting events are noted. To simplify county associations, we divided Wisconsin into nine, 8-county regions (Fig. 1) after Hilsenhoff (1995). Species previously recorded in the literature from Wisconsin are followed by the pertinent literature reference. Species recorded from the literature only are so noted. Phenological information pertains solely to adult Wisconsin mutillid records and has been extracted directly from labels accompanying specimens. During this survey, 1,191 female and 1,643 male mutillids were examined and databased.

At the onset of this survey, but five Wisconsin species of Mutillidae were known from the published literature. Below, we document 23 new species records bringing the total to 28 species of Wisconsin Mutillidae. Thus, 82% of the Wisconsin mutillid fauna is newly documented herein; this represents a 460% increase in the known species richness of Wisconsin Mutillidae.

Figure 1. Regional divisions (nine, 8-county areas) of Wisconsin (after Hilsenhoff 1995).

MYRMOSINAE

Myrmosa unicolor Say. (Krombein 1940) [26 females, 325 males examined]. Specimens were collected between 23 May and 12 September. The present distribution points indicate this species likely occurs throughout Wisconsin. **NW**: Bayfield, Burnett, Polk; **NC**: Oneida, Vilas; **NE**: Shawano; **WC**: Eau Claire, Jackson, Monroe; **EC**: Fond du Lac; **SW**: Grant; **SC**: Dane, Iowa, Lafayette, Sauk; **SE**: Jefferson, Milwaukee, Waukesha.

***Myrmosula parvula* (Fox). NEW STATE RECORD**. [1 female, 45 males examined]. Specimens were collected from 17 May to 21 September. All males examined were collected using unbaited, Townes-style Malaise traps. The single female examined was hand-collected from a sandy, grassy picnic area at Mirror Lake State Park in Sauk County. All records to date come from the southern four tiers of Wisconsin counties. **EC**: Fond du Lac; **SW**: Grant; **SC**: Iowa, Rock, Sauk.

SPHAEROPTHALMINAE

SPHAEROPTHALMINI

PSEUDOMETHOCINA

***Pseudomethoca frigida* (Smith). NEW STATE RECORD**. [26 females, 230 males examined]. Specimens were collected between 22 April and 28 September. The currently known distribution indicates *P. frigida* likely occurs throughout Wisconsin. **NW**: Bayfield, Burnett; **NC**: Oneida; **NE**: Brown, Marinette, Shawano; **WC**: Eau Claire, Jackson, Monroe; **C**: Waushara; **EC**: Fond du Lac; **SW**: Crawford, Grant; **SC**: Columbia, Dane, Rock, Sauk; **SE**: Jefferson, Kenosha, Walworth, Waukesha.

***Pseudomethoca sanbornii* (Blake). NEW STATE RECORD**. [33 females, 50 males examined]. Wisconsin specimens have been collected between 30 May and 28 September. Although this is a widely distributed species in the eastern U.S., most specimens collected and examined during the present study came from the southern and southwestern portions of the state, with the single specimen exception from Burnett County in far northwestern Wisconsin. **NW**: Burnett; **WC**: Jackson, Monroe; **SW**: Grant, Richland; **SC**: Dane; **SE**: Waukesha.

***Pseudomethoca simillima* (Smith). NEW STATE RECORD**. [44 females, 47 males examined]. Collection dates for *P. simillima* range between 22 April and 28 September. All records of this species are from the southern half of Wisconsin. **WC**: Jackson, Monroe; **C**: Adams, Marquette, Wood; **EC**: Winnebago; **SW**: Richland, Grant; **SC**: Columbia, Dane, Green, Iowa, Sauk; **SE**: Jefferson, Waukesha.

SPHAEROPTHALMINA

***Dasymutilla asopus* (Cresson). NEW STATE RECORD**. [70 females, 31 males examined]. Wisconsin specimens have been collected between 08 May and 05 October. The present distribution points indicate this species likely occurs throughout Wisconsin. **NW**: Burnett; **NE**: Marinette, Shawano; **WC**: Dunn, Jackson, Monroe; **C**: Juneau, Marquette, Waushara; **EC**: Manitowoc; **SW**: Crawford, Grant, Pepin, Richland, Trempealeau; **SC**: Columbia, Dane, Green, Iowa, Rock, Sauk; **SE**: Waukesha.

***Dasymutilla bioculata* (Cresson). NEW STATE RECORD**. [46 females, 6 males examined]. This species has been collected between 09 July and 26 August. Although we have examined specimens from only seven Wisconsin counties, the range in Wisconsin, coupled with the known, fairly wide geographical distribution of *D. bioculata* suggests it occurs throughout the state. Presently, however, the only record from eastern Wisconsin comes from Racine County in the extreme southeastern corner of the state. **NW**: Burnett, Polk; **C**: Juneau, Wood; **SW**: La Crosse; **SC**: Sauk; **SE**: Racine.

***Dasymutilla canella* (Blake). NEW STATE RECORD**. [18 females, 54 males examined]. All females collected in Wisconsin were hand-collected from various sandy habitats. Most males were collected using Townes-style Malaise traps or flight-intercept traps, although one dealated male was hand-collected on 27 June. The earliest seasonal record for *D. canella* is from Bayfield County, the northernmost county in the state, from a Malaise trap sample dated 23–31 May. The latest recorded collection date is from Dane County in south-central Wisconsin; two females were collected on 01 September. The currently known distribution indicates *D. canella* likely occurs throughout Wisconsin. **NW**: Bayfield, Burnett; **NE**: Marinette, Shawano; **WC**: Eau Claire, Jackson, Monroe; **C**: Waushara; **SC**: Dane, Sauk; **SE**: Waukesha.

***Dasymutilla gibbosa* (Say). NEW STATE RECORD**. [19 females, 16 males examined]. Although most females were hand-collected from sandy substrates during our Wisconsin field work, one specimen was found five feet above ground, coursing an upper leaf of *Asclepias syriaca* Linnaeus in a thickly vegetated area on a Clark County roadside. Specimens have been collected from 12 July to 28 September. Specimens were collected and examined from the southern two-thirds of the state. **NE**: Oconto, Shawano; **WC**: Clark, Monroe; **C**: Adams; **EC**: Fond du Lac; **SW**: Grant; **SC**: Dane, Rock, Sauk; **SE**: Racine, Waukesha.

***Dasymutilla lepeletierii* (Fox). NEW STATE RECORD**. [171 females, 94 males examined]. The first seasonal record for any mutillid collected in Wisconsin is for a specimen of *D. lepeletierii*, taken in Milwaukee County on 07 April. The last collection record is 15 October. Specimens of *D. lepeletierii* were collected from the southern half of Wisconsin. **WC**: Jackson, Monroe; **C**: Adams, Portage, Waushara, Wood; **SW**: Grant, Richland, Trempealeau; **SC**: Columbia, Dane, Green, Iowa, Rock, Sauk; **SE**: Milwaukee, Waukesha.

***Dasymutilla macra* (Cresson). NEW STATE RECORD**. [3 males examined]. The collection dates for the three Wisconsin specimens range from 24 July to 03 September. As presently understood, this species is largely associated with the plains states, from North Dakota and Alberta south to New Mexico. Discovery of *D. macra* in Wisconsin extends the geographic boundary for the species eastward by over 250 miles. **WC**: Monroe; **SC**: Sauk.

***Dasymutilla monticola* (Cresson). NEW STATE RECORD**. [14 females, 1 male examined]. The only male collected during this study was taken using an aerial net as the specimen flew a few inches above sandy soil where females were present. As observed for *D. macra*, above, southwestern Wisconsin now marks the northeastern boundary for this species. Previously, it was not recorded east of North Dakota or north of Arkansas. Specimens were collected between 07 August and 22 September. **SW**: Grant, Trempealeau; **SC**: Sauk.

***Dasymutilla nigripes* (Fabricius). NEW STATE RECORD**. [415 females, 128 males examined]. Wisconsin collection dates ranged from 29 April to 01 October. This was the most frequently collected Wisconsin mutillid species; the 543 *D. nigripes* specimens examined represent nearly 20% of the mutillids collected and databased during this study. The present distribution points indicate this species likely occurs throughout Wisconsin. **NW**: Barron, Burnett, Polk; **NE**: Marinette, Oconto, Shawano; **WC**: Eau Claire, Jackson, Monroe; **C**: Adams, Juneau, Marquette, Portage, Waushara, Wood; **SW**: Grant, Richland, Trempealeau; **SC**: Columbia, Dane, Green, Iowa, Rock, Sauk; **SE**: Jefferson, Waukesha.

***Dasymutilla quadriguttata* (Say). NEW STATE RECORD**. [109 females, 139 males examined]. Specimens were collected in Wisconsin between 01 May and 11 October. In North America, the northeastern distributional boundary of *D. quadriguttata* is now established as the southern half of Wisconsin. **WC**: Monroe; **C**: Green Lake, Juneau, Marquette, Waushara, Wood;

SW: Grant, Richland; **SC**: Columbia, Dane, Green, Iowa, Rock, Sauk; **SE**: Jefferson, Waukesha.

***Dasymutilla scaevola* (Blake). NEW STATE RECORD**. [3 females examined]. Although broadly distributed across the eastern United States, the three females of *D. scaevola* we documented during this study were from south-central Wisconsin. Their collection dates are 01 August, 29 August, and 15 September. **SC**: Dane, Sauk.

***Dasymutilla vesta* (Cresson). NEW STATE RECORD**. [93 females, 139 male examined]. The currently known distribution indicates *D. vesta* likely occurs throughout Wisconsin. This species has been collected in Wisconsin from 01 May to 25 October. **NW**: Bayfield, Burnett, Douglas, Polk; **NC**: Oneida; **NE**: Marinette, Shawano; **WC**: Dunn, Jackson, Monroe; **C**: Adams, Juneau, Marquette, Waushara, Wood; **EC**: Outagamie; **SW**: Crawford, Grant, Richland, Trempealeau; **SC**: Dane, Iowa, Rock, Sauk; **SE**: Jefferson, Ozaukee, Waukesha.

***Lomachaeta hicksi* Mickel. NEW STATE RECORD**. [4 males examined]. All specimens were collected in Townes-style Malaise traps. The earliest collection record in Wisconsin is from a sample dated 18-30 June; the latest record is from a sample dated 19 August–29 September. With very few collection records it is difficult to speculate on the Wisconsin distribution of this species. However, the available distribution points are all south of the distinctive Tension Zone (Curtis 1959) that runs through Wisconsin and into Michigan. **WC**: Jackson; **SC**: Rock; **SE**: Waukesha.

Photomorphus auriventris Schuster. (Brabant *et al.* 2010). [17 females, 31 males examined]. The original description of this species was based on males only; several females were collected during this study and have recently been described (Brabant *et al.* 2010). Females were hand-collected along a sandy path and recovered from unbaited, barrier-pitfall traps. Collection dates in Wisconsin range between 16 June and 12 September. The type locality of *P. auriventris* is Texas; few other records have been seen. Records from this study significantly reset the northern and eastern known ranges of this species. **WC**: Jackson, Monroe; **C**: Marquette; **SW**: Richland; **SC**: Columbia, Iowa, Sauk.

***Photomorphus impar* (Melander). NEW STATE RECORD**. [8 females, 26 males examined]. The collection dates for Wisconsin specimens range from 24 June–07 July for a Townes-style Malaise trap sample from Waukesha County to 25–29 August for a flight-intercept trap in Monroe County. The specimens we collected in the southern third of Wisconsin significantly extend the known northwestern geographical boundary of this species. **WC**: Monroe; **SW**: Richland; **SC**: Sauk; **SE**: Waukesha.

MUTILLINAE

Mutillini

Smicromyrmina

***Timulla dubitata* Mickel. NEW STATE RECORD**. [16 females, 17 males examined]. Specimens were collected between 28 May and 08 September. Wisconsin records were from the west- and south-central regions of the state, primarily from the "Driftless Area" (Curtis 1959). **WC**: Jackson, Monroe; **C**: Marquette; **SW**: Grant, Richland; **SC**: Iowa, Sauk.

***Timulla dubitatiformis* Mickel. NEW STATE RECORD**. [2 females examined]. The collection dates for the two specimens are 14 June and 01 September. Although this species is apparently widespread east of the Rocky Mountains (Krombein 1979), our limited collecting success suggests it may be restricted to the southern two tiers of Wisconsin counties. **SC**: Dane, Lafayette.

Timulla leona (Blake). (Krombein 1979). [no specimens were examined]. This species is included as a literature record only; no specimens from Wisconsin

were collected or examined during this study. Specimens examined by Mickel (1937) were collected between 01 May in Brownsville, Texas and 06 October in Havana, Illinois.

***Timulla subhyalina* Mickel. NEW STATE RECORD**. [2 males examined]. Two males were caught during this study on flowers of *Daucus carota* (Linnaeus) on the edge of a sand quarry in an oak savanna. Females of this species are presently unknown. The Wisconsin specimens were collected on 11 August. Collection data for specimens examined by Mickel (1937) ranged from 07 July for a Fargo, North Dakota specimen to 08 September for a specimen collected at Castle Rock, South Dakota. **WC**: Monroe.

Timulla vagans (Fabricius). (Mickel 1937). [31 females, 13 males examined]. Collection dates range from 13 July to 16 September for Wisconsin specimens. All specimens of *T. vagans* were collected from the southern half of Wisconsin, all south of the Tension Zone. **WC**: Monroe; **C**: Juneau; **SW**: Grant; **SC**: Dane, Rock, Sauk; **SE**: Milwaukee, Racine, Waukesha.

EPHUTINI

***Ephuta conchate* (Say). NEW STATE RECORD**. [15 females, 176 males examined]. Two females were hand-collected on or near rocks in prairies; one female was collected while crawling across a *Formica* sp. (Hymenoptera: Formicidae) mound in a sandy oak barrens. Collection dates in Wisconsin range from 13 June to 22 September. Although rather widely collected in the state, we found specimens neither in the northeastern quarter nor the extreme southeastern counties. **NW**: Bayfield, Burnett; **WC**: Jackson, Monroe; **EC**: Fond du Lac; **SW**: Crawford, Richland; **SC**: Iowa, Sauk.

***Ephuta pauxilla* Bradley. NEW STATE RECORD**. [65 males examined]. Collection dates range from 27 June to 03 October in Wisconsin for this species. Interestingly, the Wisconsin distribution of *E. pauxilla* closely resembles that of *E. conchate* (see above). **NW**: Bayfield, Burnett; **WC**: Jackson, Monroe; **EC**: Fond du Lac; **SC**: Iowa, Sauk.

***Ephuta puteola* (Blake). NEW STATE RECORD**. [6 females examined]. This species is known thus far from the female sex, only. Four of the six specimens from the present Wisconsin survey were hand-collected; the remaining two specimens were recovered from pitfall traps; their collection dates ranged from 09–23 June to 12 September. Specimens recorded in the present survey extend the known northwestern geographical boundary of the species. **WC**: Monroe; **C**: Juneau; **SW**: Grant.

Ephuta scrupea (Say). (Krombein 1979). [1 female, 1 male examined]. The collection dates for the male and female specimens are 19 August–29 September and 01 October, respectively. These specimens from the southern third of Wisconsin define the northwestern geographical boundary of *E. scrupea.* **SC**: Sauk; **SE**: Waukesha.

Discussion

The taxonomic position of Myrmosinae has historically been a matter of some disagreement, with various authors recognizing it at the family level (e.g., Ashmead 1899, 1903; Bradley 1917; Pilgrim et al. 2008a), or as a subfamily in Mutillidae (e.g., André 1903, Brothers 1975, Brothers and Carpenter 1993, Brothers 1999). It has also been included in Tiphiidae (Krombein 1940), where it retained subfamilial rank. Since placement of this taxon remains uncertain and beyond the scope of this survey, we chose a conservative approach, including it as a subfamily within Mutillidae.

Mutillid taxonomy has been in flux in recent years, resulting in several nomenclatural changes affecting mutillid species found in Wisconsin. For example, *D. interrupta*, initially considered a distinct species during this study,

has recently been synonymized with *D. quadriguttata*, along with nine other species, based on genetic similarity (Pilgrim et al. 2009). Traditionally, *D. quadriguttata* and its 10 newly proposed synonyms were separated on the basis of integument and pubescence color differences. It is now recognized that integument and/or pubescence color can vary, sometimes greatly, between individuals of the same species (e.g., Manley 1980, Williams and Manley 2006, Pilgrim et al. 2009, Wilson and Pitts 2009).

Dasymutilla bioculata and *D. lepeletierii* are two additional species in Wisconsin whose females are separated by a single, color-based character—the color of the apical fringe of metasomal tergite three: pale and glittering in *D. lepeletierii*, black in *D. bioculata*. Similarly, males of *D. nigripes* (known from both sexes) and *D. macra* (known only from the male sex) are separated solely on the basis of the integumental color of the second metasomal sternite: ferruginous in *D. nigripes* and mahogany or black in the case of *D. macra*. Future molecular analyses will likely clarify the relationships amongst these two species pairs.

Krombein (1979) speculated *E. pauxilla* is almost certainly the male of *E. puteola*. This study lends some support to that notion in that both species have been collected in Wisconsin and overlap in distribution. The only other *Ephuta* species collected in Wisconsin, *E. conchate* and *E. scrupea*, are known from both sexes. Recently, Pitts and Manley (2007) synonymized *E. tentativa* Schuster with *E. pauxilla,* based on the collection of a pair *in copula*. However, they acknowledged that with their new synonymy, a male-only species no longer exists with such an extensive range as that of *E. puteola.* For the present, both *E. pauxilla* and *E. puteola* are retained since proposing taxonomic changes is beyond the scope and intent of this paper.

While microhabitat affinities for particular species are not clear from our survey, our study reaffirmed that a variety of sampling techniques is required for surveying mutillid species richness. Females were not uncommonly found climbing in vegetation, especially scrub oak, oak, and oak-pine barrens. Beating and sweeping scrub oak and then hand-collecting dislodged females were valuable sampling methods. Malaise and barrier-pitfall traps set in oak and oak-pine savannas were likewise productive sampling strategies. Although the use of light traps has proven quite productive in the southwestern U.S., producing upwards of 1,000 specimens in a single night (Pitts et al. 2010a), night collecting in Wisconsin has not yielded any mutillids. The known ranges of nocturnal mutillid species do not extend into Wisconsin, so this was not unexpected.

As has been noted in other surveys (e.g., Lisberg and Young 2003, Dunford and Young, 2004), Wisconsin is geographically unique. Bound by the Mississippi River on the west, the Great Lakes of Superior on the north and Michigan on the east, as well as displaying a vivid ecoclimatic Tension Zone, Wisconsin exhibits an exceptional topography and poses many faunal hurdles and challenges. Several mutillid species appear to attain their easternmost geographical limits in the state—particularly in association with the Driftless Area (i.e., *D. macra*, *D. monticola*, *D. quadriguttata*, *L. hicksi*, and *P. auriventris*). Other, more eastern mutillid species presently appear to have Wisconsin delimiting their western and especially northwestern, geographical boundaries (i.e., *P. impar*, *E. puteola*, and *E. scrupea*).

The Tension Zone, a climatic gradient important in defining plant communities, certainly with edaphic correlations, bears significantly on the presently understood northern geographic boundaries for many of the mutillid species recorded in this survey. Our data suggest *M. parvula*, *P. simillima*, *D. lepeletierii*, *D. macra*, *D. monticola*, *D. scaevola*, *L. hicksi*, *P. auriventris*, *P. impar*, *T. dubitata*, *T. dubitatiformis*, *T. subhyalina*, *T. vagans*, *E. puteola*, and *E. scrupea* may be among these more "southern" Wisconsin species. Our survey can point to no single "northern" Wisconsin mutillid species. Nonetheless, the discovery that as many as nine of our 28 mutillid species (*M. unicolor*, *P. frigida*, *D. asopus*,

D. bioculata, *D. canella*, *D. nigripes*, *D. vesta*, and perhaps *E. conchate* and *E. pauxilla*)—approximately one-third of the species richness in Wisconsin—can be found throughout the state is noteworthy. Remarkably, six species (*M. unicolor*, *P. frigida*, *D. canella*, *D. vesta*, *E. conchate* and *E. pauxilla*)—over 20% of the Wisconsin mutillid fauna—were collected from Bayfield County, the northernmost point in the state, bordered to the north by Lake Superior.

It is evident from our sampling, albeit only as thorough as two field seasons would allow, that collecting bias (*vis-à-vis* somewhat limited sampling effort in the northeastern counties) might explain at least a few of the gaps noted (e.g., *E. conchate* and *E. pauxilla*). Future sampling should concentrate on the eastern side of the state.

Like most biotic surveys and checklists, this contribution seeks merely to point out some attributes of the fauna, to note some of the pitfalls and unaddressed questions springing from our work, and to establish a baseline for future work. We hope it will be useful to future taxonomists, ecologists, naturalists, land managers, and students of velvet ants.

Acknowledgements

We would like to thank past and present members of the Young Lab for their collecting efforts during this study: Rachel Arango, Peter DeVries, John Dorshorst, James Dunford, Jeffrey Gruber, Nathan Hoftiezer, Kyle Johnson, Kerry Katovich, Nadine Kriska, Krista Hamilton, Anneke Lisberg, Daniel Marschalek, Michele Price, the late Alistair Ramsdale, and Andrew Williams. We thank the following individuals for providing specimens for examination: Susan S. Borkin (MCPM), Philip J. Clausen (UMSP), Colin Favret (INHS), David G. Furth (NMNH) E. Richard Hoebeke (CUIC), Steven J. Krauth (WIRC), Frederick W. Stehr (MSUC), and Margaret K. Thayer (FMNH). The Wisconsin chapter of The Nature Conservancy, the WI-DNR, and several generous private landowners (Katovich, Norman, and Wedel families) permitted access to valuable collecting sites across the state. Finally, we thank two anonymous reviewers for providing a critical review of, and valuable comments on, the manuscript.

Literature Cited

André, E. 1903 . Mutillidae, pp. 1-77, 3 plates. *In* P. Wytsman (ed.), Genera Insectorum. V. Verteneuil and L. Desmet, Brussells.

Arnett Jr., R. H., G. A. Samuelson, and G. M. Nishida. 1993. The insect and spider collections of the world, 2nd ed. Sandhill Crane Press, Inc., Gainesville, FL.

Ashmead, W. H. 1899. Super-families in the Hymenoptera and generic synopses of the families Thynnidae, Myrmosidae and Mutillidae. Journal of the New York Entomological Society 7: 45-60.

Ashmead, W. H. 1903. Classification of the fossorial, predaceous and parasitic wasps, or the Superfamily Vespoidea. Family XLI.—Myrmosidae. The Canadian Entomologist 35: 199-202.

Brabant, C. B., K. A. Williams, and J. P. Pitts. 2010. True females of the subgenus *Photomorphus* Schuster (Hymenoptera: Mutillidae). Zootaxa 2559: 58-68.

Bradley, J. C. 1917. Contributions toward a monograph of the Mutillidae and their allies of America North of Mexico. IV. A review of the Myrmosidae. Transactions of the American Entomolological Society 43: 247-290.

Brothers, D. J. 1975. Phylogeny and classification of the Aculeate Hymenoptera, with special reference to Mutillidae. The University of Kansas Science Bulletin 50: 483-648.

Brothers, D. J. 1993. Family Mutillidae, pp. 187-201. *In* H. Goulet and J. T. Huber (eds.), Hymenoptera of the World: An Identification Guide to Families. Research Branch Agriculture Canada, Ottawa.

Brothers, D. J. 1995. Mutillidae, pp. 541–548. *In* P. E. Hanson and I. D. Gauld (eds.), The Hymenoptera of Costa Rica. Oxford University Press, New York, NY.

Brothers, D. J. 1999. Phylogeny and evolution of wasps, ants and bees (Hymenoptera, Chrysidoidea and Apoidea). Zoologica Scripta 28: 233-249.

Brothers, D. J. 2006. Capítulo 54: Familia Mutillidae, pp. 577–593. *In* F. Fernández and M. J. Sharkey (eds.), Introducción a los Hymenoptera de la Región Neotropical. Sociedad Columbiana de Entomología y Universidad Nacional de Colombia, Bogotá, D.C.

Brothers, D. J., and J. M. Carpenter. 1993. Phylogeny of Aculeata: Chrysidoidea and Vespoidea (Hymenoptera). Journal of Hymenoptera Research 2: 227-304.

Curtis, J. T. 1959. The vegetation of Wisconsin. An Ordination of Plant Communities. University of Wisconsin Press, Madison.

Dunford, J. C., and D. K. Young. 2004. An annotated checklist of Wisconsin darkling beetles (Coleoptera: Tenebrionidae) with comparisons to the Western Great Lakes fauna. Transactions of the American Entomological Society 130: 57-76.

Fattig, P. W. 1943. The Mutillidae or velvet ants of Georgia. Emory University Museum Bulletin 1: 1-24.

Hilsenhoff, W. L. 1995. Aquatic Hydrophilidae and Hydraenidae of Wisconsin (Coleoptera). 2. Distribution, habitat, life cycle and identification of species of Hydrobiini and Hydrophilini (Hydrophilidae: Hydrophilinae). The Great Lakes Entomologist 28: 97-126.

Krombein, K. V. 1940. Studies in the Tiphiidae (Hymenoptera Aculeata) IV. A revision of the Myrmosinae of the New World with a discussion of Old World species. Transactions of the American Entomological Society 65: 415-465.

Krombein, K. V. 1979. Family Mutillidae, pp. 1276-1314. *In* K. V. Krombein, P. D. Hurd, D. R. Smith, and B. D. Burks (eds.), Catalog of the Hymenoptera in America North of Mexico, Vol. 2, Apocrita (Aculeata). Smithsonian Institution Press, Washington, D. C.

Lelej, A. S., and P. G. Nemkov. 1997. Phylogeny, evolution and classification of Mutillidae (Hymenoptera). Far Eastern Entomologist 46: 1-24.

Lisberg, A., and D. K. Young. 2003. An annotated checklist of Wisconsin Mordellidae (Coleoptera). Insecta Mundi 17: 195-202.

Manley, D. G. 1980. *Dasymutilla phoenix* (Fox), a new synonym of *D. foxi* (Cockerell) (Hymenoptera: Mutillidae). Pan-Pacific Entomologist 56: 153-154.

Manley, D. G. 1991. The Velvet Ants (Hymenoptera: Mutillidae) of South Carolina. Clemson University, South Carolina Agricultural Experiment Station, Technical Bulletin 1100, iv + 55 p.

Manley, D. G., and W. R. Radke. 2006. Velvet ants (Hymenoptera: Mutillidae) of the Bitter Lake National Wildlife Refuge, New Mexico, with descriptions of new species. The Southwestern Naturalist 51: 536-541.

Mickel, C. E. 1937. The mutillid wasps of the genus *Timulla* which occur in North America north of Mexico. Entomologica Americana 17: 57-119.

Pilgrim, E. M., and J. P. Pitts. 2006. A Molecular Method for Associating the Dimorphic Sexes of Velvet Ants (Hymenoptera: Mutillidae). Journal of the Kansas Entomological Society 79: 222-230.

Pilgrim, E. M., C. D. von Dohlen, and J. P. Pitts. 2008a. Molecular phylogenetics of Vespoidea indicate paraphyly of the superfamily and novel relationships of its component families and subfamilies. Zoologica Scripta 37: 539-560.

Pilgrim, E. M., K. A. Williams, and J. P. Pitts. 2008b. Sex association and synonymy in southwestern US species of *Dasymutilla* (Hymenoptera: Mutillidae). Pan-Pacific Entomologist 84: 57-68.

Pilgrim, E. M., K. A. Williams, D. G. Manley, and J. P. Pitts. 2009. Addressing the *Dasymutilla quadriguttata* species-group and species-complex (Hymenoptera: Mutillidae): several distinct species or a single, morphologically variable species? Journal of the Kansas Entomological Society 82: 231-249.

Pitts, J. P. 2003. *Schusterphotopsis*, a new genus of Sphaeropthalminae (Hymenoptera: Mutillidae) from California, with notes on the closely related genera *Acrophotopsis* Schuster and *Dilophotopsis* Schuster. Zootaxa 333: 1-7.

Pitts, J. P. 2007. Review of *Odontophotopsis* Viereck (Hymenoptera: Mutillidae), Part 1, with a description of a new genus *Laminatilla*. Zootaxa 1619: 1-43.

Pitts, J. P., and D. G. Manley. 2004. A revision of *Lomachaeta* Mickel, with a new species of *Smicromutilla* Mickel (Hymenoptera: Mutillidae). Zootaxa 474: 1-27.

Pitts, J. P., and D. G. Manley. 2007. Synonymy of *Ephuta tentativa* Schuster and *E. pauxilla* Bradley (Hymenoptera: Mutillidae). Journal of Entomological Science 42(3): 341-344.

Pitts, J. P., J. S. Wilson, K. A. Williams, and N. F. Boehme. 2009. Velvet ants (Hymenoptera: Mutillidae) of the Algodones sand dunes of California, USA. Zootaxa 2131: 1-53.

Pitts, J. P., J. S. Wilson, and C. D. von Dohlen. 2010a. Evolution of the nocturnal Nearctic Sphaeropthalminae velvet ants (Hymenoptera: Mutillidae) driven by Neogene orogeny and Pleistocene glaciation. Molecular Phylogenetics and Evolution 56: 134-145.

Pitts, J. P., J. S. Wilson, K. A. Williams, and N. F. Boehme. 2010b. Nocturnal velvet ant males (Hymenoptera: Mutillidae) of Deep Canyon, California including four new species and a fifth new species from Owens Lake Valley, California. Zootaxa 2553: 1-34.

Specify Software Project. 2010. Specify Software. Version 6.2.06. [Software]. Available from (http://www.specifysoftware.org).

Williams, K. A., and D. Manley. 2006. A new color variant of *Dasymutilla gloriosa* (Saussure) from Mexico (Hymenoptera: Mutillidae). Pan-Pacific Entomologist 82: 103-104.

Williams, K. A., and J. P. Pitts. 2009. Eight new species of *Lomachaeta* Mickel and the synonymy of *Smicromutilla* Mickel (Hymenoptera: Mutillidae). Journal of Hymenoptera Research 18: 227-243.

Wilson, J. S., and J. P. Pitts. 2009. Species boundaries of *Sphaeropthalma unicolor* (Hymenoptera: Mutillidae): is color useful for differentiating species? Journal of Hymenoptera Research 18: 212-226.