

# BANISTERIA

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA

ISSN 1066-0712

Published by the Virginia Natural History Society

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## RESEARCH ARTICLE

# ADDITIONS TO THE BEE (HYMENOPTERA: ANTHOPHILA) FAUNA OF THE GEORGE WASHINGTON MEMORIAL PARKWAY, VIRGINIA

BRENT W. STEURY

*U.S. National Park Service, 700 George Washington Memorial Parkway, Turkey Run Park Headquarters, McLean, Virginia 22101, USA*

Corresponding author: Brent W. Steury ([brent\\_steury@nps.gov](mailto:brent_steury@nps.gov))

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Editor: T. Fredericksen | Received 11 May 2022 | Accepted 21 June 2022 | Published 29 June 2022

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<https://virginianaturalhistorysociety.com/banisteria/banisteria.htm#ban56>

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**Citation:** Steury, B. W. 2022. Additions to the bee (Hymenoptera: Anthophila) fauna of the George Washington Memorial Parkway, Virginia. *Banisteria* 56: 1–9.

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## ABSTRACT

Seventy-six species and one subspecific taxon of bees (Hymenoptera: Anthophila) are added to the known fauna of the George Washington Memorial Parkway, a national park site in Fairfax and Arlington Counties, Virginia. These new park records raise the species richness of the park to 171 species and subspecies, in 31 genera, and five families. *Lasioglossum katherineae* Gibbs and *Lasioglossum zephyrus* (Smith) are documented from Virginia for the first time. Two non-native species, *Anthophora villosula* (Pallas) and *Megachile sculpturalis* Smith, are recorded from the park. Sex ratios, based on the number of collected individuals, are presented for all taxa except for *Lasioglossum*.

**Keywords:** adventive bees, Apoidea, biodiversity, Dyke Marsh Wildlife Preserve, Great Falls Park, national park, new state records, Potomac Gorge, sex ratios, Turkey Run Park.

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## INTRODUCTION

Very few inventories of bees have been conducted in Virginia. Fowler (2016) reports only one published bee inventory in the Commonwealth, although some unpublished reports exist (e.g. Scarpulla, 2012), and a relative paucity of published bee faunas in North America. This is the first Virginia bee inventory to focus primarily on wooded sites, use malaise traps to sample species, occur year-round, and be sustained for more than a decade.

More than 450 species of bees are found in Virginia (Virginia Department of Conservation and Recreation, 2022; unpublished list). Between 30% to 40% of pollen carrying bee species in the region are considered pollen specialists dependent upon gathering pollen from a single plant

family and often further restricting their diet to one genus or species (Fowler, 2016). Thus, plant biodiversity determines bee biodiversity and as more knowledge is gained about our native bee species, close linkages between subgroups of plants and bees are being documented.

The species richness of vascular plants in George Washington Memorial Parkway (GWMP) is remarkable for an area so close to the nation's capital. To date, 1,323 taxa have been recorded (Steury, 2011; pers. obs.), 1,020 from Great Falls Park alone (Steury et al., 2008). New park records of native vascular plants are still being found. As recently as 2020, a small population of the Virginia state rare orchid *Triphora trianthophora* (Sw.) Rydb. (Three Birds Orchid) (Orchidaceae) was discovered in Great Falls Park by Park Ranger, Jacquelyn Scholtz.

The first inventory of the bees of GWMP was conducted by Droege (2008) who documented 11 species, including the first Virginia record of *Anthidellum notatum* (Latreille), during a 30-hour rapid biological assessment of the Potomac Gorge in 2006. Steury et al. (2009) built on this survey by inventorying the bees of the 0.5 ha riverside outcrop prairie in Great Falls Park, Virginia, where *A. notatum* was collected. Combined, these inventories documented 94 species using only two methods (3.25 oz yellow, blue, or white pan traps and netting).

## STUDY SITES

The study sites include lands managed by the National Park Service as units of the GWMP in Fairfax and Arlington Counties, Virginia. Great Falls Park (323 ha), Turkey Run Park (297 ha), and the Arlington County section of the Potomac Heritage Trail fall within the Piedmont Plateau physiographic province. These sites are situated along the Potomac Gorge, a 24 km long, area of the Potomac River located just west of Washington, District of Columbia, that includes a steeply dissected landscape of bluffs, ravines, and floodplains along a high-gradient reach of the river. The vegetation of these park areas is dominated by maturing, second growth, although some trees are over 200 years old. They consist of primarily upland, deciduous woodlands with nutrient rich soils that contain globally rare plant community types (Fleming, 2007) and many state rare vascular plant species (Steury et al., 2008; Steury, 2011).

Dyke Marsh Wildlife Preserve (234.5 ha, including 106.4 ha of open water) and Fort Hunt Park (41 ha) are situated on the Coastal Plain along the Potomac River. Dyke Marsh is a freshwater, tidal marsh dominated by narrow-leaf cattail (*Typha angustifolia* L.). A band of pumpkin ash (*Fraxinus profunda* [Bush] Bush) swamp (now largely dead standing trees with live stump sprouts due to emerald ash borer [*Agrilus planipennis* Fairmaire] infestation) is situated between the marsh and floodplain forest which is dominated by red and silver maple (*Acer rubrum* L. and *A. saccharinum* L.) and tulip poplar (*Liriodendron tulipifera* L.). Fort Hunt Park protects the remains of Endicott Period gun batteries and consists mostly of mowed turf grass with scattered large trees, mostly oaks (*Quercus* L. sp.) and maples (*Acer* L. sp.), picnic pavilions, and baseball diamonds.

A map of these park sites is provided in Steury (2011). The study area is located between latitudes 38.985° and 38.717° and longitudes -77.246° and -77.049°.

## MATERIALS AND METHODS

To assess the totality of the bee fauna of GWMP more thoroughly, bee specimens were sorted from Malaise trap samples collected at other sites in Great Falls Park, Turkey Run Park and Dyke Marsh Wildlife Preserve, additional pan trapping was conducted in Turkey Run Park and

occasional netting at Fort Hunt Park and the Arlington County section of the unpaved Potomac Heritage Trail.

Specimens were collected during a 12-year period (1998–2009) using Malaise traps, pan traps, and netting. Malaise trap samples were sorted for bees by citizen scientists at the GWMP Bug Lab. Morphospecies were selected for determination by microscopic examination of pinned specimens and through comparison with species in the GWMP collection from the studies by Droege (2008) and Steury et al. (2009). Morphospecies were identified at the United States Geological Survey's Bee Inventory and Monitoring Lab in Laurel, Maryland. Male specimens of *Lasioglossum* Curtis were not identified. The specimens resulting from this study are deposited at the Turkey Run Park Headquarters in McLean, Virginia.

Six Townes style Malaise traps (Townes, 1962) were set at Dyke Marsh, April 1998–December 1999 and three each at Great Falls and Turkey Run parks (March 2006–December 2009). Traps at Dyke Marsh were set each year in the same locations in open, tidal, freshwater marsh dominated by *T. angustifolia*; floodplain forest dominated by red and silver maple (*A. rubrum* and *A. saccharinum*) and tulip poplar (*L. tulipifera*); and at the marsh/forest ecotone. In Great Falls Park, a trap was set in each of three habitats: quarry site (dry, upland, mixed deciduous/coniferous forest), swamp (dominated by red maple), and floodplain forest (dominated by oaks and tulip poplar). In Turkey Run Park, one trap was set in upland forest dominated by oaks and tulip poplar and two traps in floodplain forest along the Potomac River (dominated by oaks, basswood [*Tilia americana* L.], and sycamore [*Platanus occidentalis* L.]).

In March–May 2005, pan traps consisting of 50 3.25 oz. Solo brand soufflé cups spaced approximately five meters apart were set at Turkey Run Park. The white cups were painted fluorescent yellow, fluorescent blue, or left non-fluorescent white. The cups were filled with a dilute detergent mixture of one gallon of water and a squirt of liquid, unscented, Dawn Blue® or Planet® brand dishwashing detergent. Cups of the three colors were alternated and placed along the edge of trails emanating from parking area C-1 once every two weeks. Routes varied slightly with each set. The average set time was 24 hours. Sets were planned to coincide with weather forecasts of sunny days and no rain.

A 10 m x 15 m area of open, sandy soil with ground nesting bees was sampled by netting at Fort Hunt Park during two days in April 2014. The site is in the northwestern quadrant of the park between a picnic pavilion and a baseball diamond. A few hours of netting was also conducted along the Arlington County section of the Potomac Heritage Trail in July 2008.

One species, *Epeolus banksi* (Cockerell), was documented from the park based on literature reviews, and specimens of *Nomada electella* Cockerell from the park were located in the collections at the Smithsonian Institution U. S. National Museum (USNM). Species distributions are based on Ascher & Droege (2009). Specimens were collected by Edd Barrows (Dyke Marsh Wildlife Preserve), Jean Olson (Turkey Run Park), David Smith (Great Falls and Turkey Run Parks), and Brent Steury (all sites).

## RESULTS AND DISCUSSION

Three new genera, *Chelostoma* Latreille, *Habropoda* (Fabricius), and *Pseudopanurgus* Cockerell, 76 species and one subspecific taxon are added to the bee fauna of GWMP, raising the park's tally of documented bees to 170 species and one subspecific taxon, in 31 genera, and five families. Most of the new species records belong to the genera *Andrena* Fabricius (n = 25) and *Lasioglossum* (n = 19).

*Lasioglossum katherineae* Gibbs and *Lasioglossum zephyrus* (Smith) were first records for Virginia at the time of their collections (2006 and 1998 respectively). *Lasioglossum katherineae* is a recently described species (Gibbs, 2011). It is documented mostly from the northeastern United States, north to Maine, and sporadically south through the Appalachians to Florida and west to Wisconsin and Iowa (Ascher & Droege, 2009). Records of *L. zephyrus* are from across the northern half of North America from British Columbia and Oregon, east to Quebec, and south along the East Coast to West Virginia, Tennessee and Texas (Ascher & Droege, 2009).

Netting captured the only specimens of *Andrena fenningeri* Viereck, *Halictus confusus* Smith and *Megachile sculpturalis* Smith (Fig. 1). Pan traps captured seven species new to the park, but no species was captured only by pan trapping (see list of species). All other new park records were captured in Malaise traps.



**Figure 1.** The giant resin bee (*Megachile sculpturalis*) tending flowers of *Styphnolobium japonicum* (Japanese pagoda tree) along the Potomac Heritage Trail in Arlington County, Virginia, on 28 July 2008.

Two adventive species were documented from the study area in addition to *Apis mellifera* L. recorded by Steury et al. (2009). *Anthophora villosula* (Pallas) is a European species documented in North America only from Virginia and the District of Columbia (Ascher & Droege, 2009). *Megachile sculpturalis* is an Asian species first reported from North America in 1997 (Magnum & Brooks, 1997). It is readily observed in summer tending the leguminous flowers of the Asian tree *Styphnolobium japonicum* (L.) Schott (Japanese pagoda tree) planted in Lyndon Baines Johnson Memorial Grove and naturalized in nearby areas of the Potomac Gorge in

Arlington County. It is also a reported pollinator of *Pueraria montana* (Lour.) Merr. var. *lobata* (Willd.) Maesen & S.M. Almeida ex Sanjappa & Predeep (Kudzu) (Batra, 1998), another invasive plant species in the Potomac Gorge.

*Epeolus banksi* was documented from the study area, based on a review of published literature (Onuferko, 2018), from the Virginia side of Chain Bridge in 1922. The documented global range of this cleptoparasitic bee is restricted to the Potomac Gorge (Glen Echo, Maryland, and the Virginia side of Chain Bridge), Falls Church and Glencarlyn, Virginia, the Black Mountains of North Carolina, and Rock Creek Park in Washington, D. C. The host genus is presumably *Colletes* Latreille as with other *Epeolus* sp. (Onuferko, 2018), however the host species has not been documented. Five species of *Colletes* are recorded from GWMP (see list of species and Steury et al., 2009). Documented floral associations are from *Fragaria* L., *Solidago* L., and *Symphyotrichum* Nees. *Solidago* sp. and *Symphyotrichum* sp. are common in GWMP and *Fragaria* is also present (Steury et al., 2008; Steury, 2011). *Epeolus banksi* has not been collected anywhere since 1990 (Colla et al., 2012). Increased urbanization in the heart of its historic range may have further decreased the abundance of this rare species.

*Nomada* Scopoli sp. MR2 is a name assigned to a molecularly and morphologically distinct species that a current name cannot be ascribed to. Similarly, two distinct species of *Sphcodes* Latreille could not be identified with confidence and were left as *Sphcodes* sp. A and B. Taxonomic keys sufficient for all potential species of *Lasioglossum* males, *Pseudopanurgus*, and *Nomada* (white setae group) do not exist, so these taxa were left unidentified.

Sites contributing the largest number of bee species records previously undocumented from GWMP are Great Falls Park (n = 50), Turkey Run Park (n = 35) and Dyke Marsh Wildlife Preserve (n = 24). All species documented only from Dyke Marsh Wildlife Preserve (n = 13; see list of species) have not been captured in GWMP since 1998 or 1999, perhaps indicating recent declines in these species' populations or a restriction of their range within GWMP. Greater inventory efforts are needed to determine the status of these species in the park. Thirty species are first records for the Potomac Gorge based on specimen records in Brown (2008) (see list of species).

Comparisons of the bee species richness documented in this inventory of a mostly wooded, approximately 900 ha, section of GWMP to other nearby areas is complicated due to the differences in habitat condition among sites, collection effort, number of years surveyed, techniques used, and the experience of the collectors. A compilation of all the records of bees collected in Washington, D. C. (17,700 ha) includes bees that were surveyed over 100 years ago when parts of Washington were still in farmland (Sam Droege, in litt., 2022). This compilation yielded a species total of roughly 180 species including several historic records of species that no longer appear to be part of the local fauna. Thus, GWMP has only 10 fewer bee species recorded from an area only 5% as large as Washington, D. C. On the United States Fish and Wildlife Service, Patuxent Research Refuge (5240 ha) in Prince George's and Anne Arundel counties of Maryland approximately 220 species have been documented (Sam Droege, in litt., 2022). It should be noted that the United States Geological Survey Bee Laboratory is located on the refuge.

## LIST OF SPECIES

Nomenclature follows Ascher & Droege (2009). The number of male and female specimens in the collection at GWMP is indicated in parentheses after each taxon. Collections sites are abbreviated as DM (Dyke Marsh Wildlife Preserve), FH (Fort Hunt), GF (Great Falls Park), PH (Potomac Heritage Trail, Arlington County section), and TR (Turkey Run Park). Collection

methods are listed as mt (Malaise trap), nt (netted), or pt (pan trap). The periods of adult activity are given based on dates when live collected taxa have been documented in the park. Dates separated by an en dash (–) indicate that the taxon was documented on at least one day during each month within this continuum of months, whereas dates separated by a comma represent individual observation dates. For traps set over multiple weeks, the first day of the set is used as the earliest date and the last day of the set as the latest date. Months are indicated by their three-letter acronym. New state records are indicated by an exclamation mark (!). Non-native species are marked with a dagger (†). Species newly documented from the Potomac Gorge are indicated with an asterisk (\*).

### Short-tongued bees

#### Family Andrenidae

- Andrena arabis* Robertson – (2♂, 4♀); GF; 18 Mar–20 May; mt.  
*Andrena bisalicis* Viereck – (1♀); GF; 1–20 May; mt.  
 \**Andrena confederata* Viereck – (1♂, 1♀); GF, TR; 10 Apr–18 Jun; mt.  
 \**Andrena cornelli* Viereck – (5♂, 7♀); GF, TR; 10–30 Apr; mt.  
 \**Andrena distans* Provancher – (1♀); GF; 1–20 May; mt.  
*Andrena dunningi* Cockerell – (1♂); GF; 10–30 Apr; mt.  
*Andrena fenningeri* Viereck – (1♀); FH, 23 Apr; nt.  
*Andrena fragilis* Smith – (1♀); DM; 26 May–6 Jun; mt.  
*Andrena geranii* Robertson – (1♀); TR; 10–30 Apr; mt.  
 \**Andrena heraclei* Robertson – (28♀); GF, TR; 10 Apr–20 May; mt.  
*Andrena hippotes* Robertson – (7♀); GF, TR; 1 May–30 Jun; mt.  
*Andrena ilicis* Mitchell – (8♂, 2♀); DM, GF, TR; 18 Mar–20 May, mt.  
 \**Andrena illini* Bouseman and LaBerge – (20♂); GF, TR; 18 Mar–30 Apr; mt.  
*Andrena macoupinensis* Robertson – (2♂); TR; 10–30 Apr; mt.  
*Andrena mandibularis* Robertson – (6♂, 9♀); GF, TR; 10–30 Apr; mt.  
*Andrena mariae* Robertson – (2♀); TR; 10–30 Apr; mt.  
 \**Andrena nuda* Robertson – (10♀); GF, TR; 10 Apr–5 Jun, 16–22 Aug; mt.  
 \**Andrena phaceliae* Mitchell – (1♀); GF; 21 May–18 Jun; mt.  
*Andrena pruni* Robertson – (13♂, 17♀); GF, TR; 11 Apr–5 Jun; mt.  
*Andrena robertsonii* Dalla Torre – (53♂, 18♀); DM, GF, TR; 10 Apr–18 Jun; mt.  
*Andrena rugosa* Robertson – (9♀); GF, TR; 10 Apr–20 May; mt.  
*Andrena sayi* Robertson – (1♀); TR; 10–30 Apr; mt.  
*Andrena simplex* Smith – (1♀); DM; 13 Sep (date range not indicated on label); mt.  
*Andrena spiraeana* Robertson – (42♀); DM, GF, TR; 10 Apr–30 Jun; mt.  
*Andrena ziziaeformis* Cockerell – (1♀); GF; 10–30 Apr; mt.  
 \**Pseudopanurgus* sp. – (1♂); GF; 18 Aug–4 Sep; mt.

#### Family Colletidae

- Colletes aestivalis* Patton – (3♂); GF; 21 May–18 Jun, 16–22 Aug; mt.  
*Colletes ciliatus* Patton – (2♂); DM; 28 Aug–11 Sep; mt.  
 \**Colletes eulophi* Robertson – (1♀); GF; 21 May–18 Jun; mt.

\**Hylaeus mesillae* (Cockerell) – (1♂, 3♀); DM; 23 May–6 Jun, 23 Aug (date range not indicated on label); mt.

\**Hylaeus sparsus* (Cresson) – (3♂, 5♀); GF; 1 May–30 Jun, 16–22 Aug, mt.

### Family Halictidae

*Augochloropsis metallica* (Fabricius) subsp. *fulgida* Smith – (15♀); DM; 19 Apr–24 Jun, 2–29 Aug; mt.

*Halictus confusus* Smith – (1♀); FH; 23 Apr; nt.

*Lasioglossum abanci* (Crawford) – (1♀); DM; 14–24 June; mt.

\**Lasioglossum birkmanni* (Crawford) – (8♀); GF, TR; 10 Apr–17 Jul; mt.

\**Lasioglossum cattellae* (Ellis) – (2♀); TR; 10 Apr–20 May; mt.

\**Lasioglossum coreopsis* (Robertson) – (1♀); GF; 14–26 Jul; mt.

*Lasioglossum coriaceum* (Smith) – (1♀); DM; 11–26 Oct; mt.

\**Lasioglossum ephialtum* Gibbs – (21♀); DM, GF, TR; 10 Apr–6 Jun, 16 Aug–12 Sep, mt.

*Lasioglossum foxii* (Robertson) – (48♀); GF, TR; 18 Mar–22 Aug; mt.

\**Lasioglossum gotham* Gibbs – (47♀); DM, GF, TR; 18 Mar–20 Jul; mt, pt.

*Lasioglossum illinoense* (Robertson) – (1♀); DM; 18 Jul (date range not indicated on label); mt.

\*!*Lasioglossum katherineae* Gibbs – (17♀); GF; 18 Mar–5 Jun, 16–22 Aug, mt.

\**Lasioglossum nigroviride* (Graenicher) – (4♀); GF; 10 Apr–18 Jun; mt.

*Lasioglossum obscurum* (Robertson) – (3♀); DM, TR; 23–26 May, 29 Aug; mt, pt.

\**Lasioglossum planatum* (Lovell) – (6♀); GF, TR; 29 Mar–30 Jun; mt, pt.

\**Lasioglossum smilacinae* (Robertson) – (16♀); DM, GF, TR; 29 Mar–20 Jul; mt, pt.

*Lasioglossum* sp. (near *atwoodi* Gibbs) – (10♀); DM; 20 Jun–11 Sep; mt.

\**Lasioglossum subviridatum* (Cockerell) – (14♀); GF, TR; 10 Apr–26 May, 3 Jul–9 Aug; mt, pt.

*Lasioglossum versans* (Lovell) – (17♀); TR; 29 Mar–24 Aug; mt, pt.

\**Lasioglossum weemsi* (Mitchell) – (14♀); DM, GF, TR; 18 Mar–12 Apr, 30 Jul–11 Oct; mt, pt.

!*Lasioglossum zephyrus* (Smith) – (9♀); DM, GF, TR; 10 Apr–24 Jun, 12 Sep (date range not indicated on label); mt.

*Sphcodes aroniae* Mitchell – (10♂, 1♀); GF, TR; 10 Apr–20 May, 16–22 Aug; mt.

*Sphcodes* sp. A – (4♀); DM; 9 May (date range not indicated on label); mt.

*Sphcodes* sp. B – (1♀); GF; 16–22 Aug; mt.

### Long-tongued bees

#### Family Apidae

*Anthophora abrupta* Say – (8♂, 9♀); DM, GF; 1 May–30 Jun, 16–22 Aug, mt.

\*†*Anthophora villosula* (Pallas) – (8♂, 1♀); GF, TR; 18 Mar–20 May; mt.

*Bombus citrinus* (Smith) – (1♀); DM; 17–26 May; mt.

*Bombus pensylvanicus* (De Geer) – (1♂, 6♀); DM; 12 Apr–26 May, 12 Aug–27 Sep; mt.

\**Ceratina mikmaqi* Rehan and Sheffield – (2♀); GF, TR; 10–30 Apr, 19–30 Jun; mt.

*Epeolus banksi* (Cockerell) – Reported from GWMP by Onuferko (2018) from the Virginia side of Chain Bridge in the Potomac Gorge.

*Habropoda laboriosa* (Fabricius) – (3♂); GF, TR; 10–30 Apr; mt.

*Melissodes bimaculatus* (Lepeletier) – (8♀); DM; 1 Aug–12 Sep; mt.



- Melissodes denticulatus* Smith – (1♂); DM; 12–28 Aug; mt.  
 \**Nomada depressa* Cresson – (1♂, 3♀); GF, TR; 10 Apr–30 Jun; mt.  
*Nomada electella* Cockerell – (3♀ USNM); DM; 10–25 Jun; mt.  
 \**Nomada lehighensis* Cockerell – (1♀); GF; 10–30 Jun; mt.  
*Nomada luteola* Olivier – (1♀); TR; 10–30 Jun; mt.  
*Nomada sayi* Robertson or *N. illinoensis* Robertson – (12♂, 8♀); GF, TR; 18 Mar–30 Jun; mt.  
*Nomada* sp. (MR2) – (1♀); GF; 23 May–5 Jun; mt.  
*Nomada* sp. (white setae group) – (22♂, 1♀); DM, GF; 10 Apr–16 Aug, mt.

### Family Megachilidae

- \**Chelostoma philadelphi* (Robertson) – (6♂, 4♀); GF; 23 May–5 Jun; mt.  
 \**Coelioxys porterae* Cockerell – (3♀); GF; 21 May–18 Jun; mt.  
 \**Hoplitis simplex* (Cresson) – (1♀); GF; 23 May–5 Jun; mt.  
*Megachile campanulae* (Robertson) – (1♂, 1♀); GF; 19–30 Jun; mt.  
 \**Megachile gemula* Cresson – (3♀); GF; 1 May–18 Jun; mt.  
 †*Megachile sculpturalis* Smith – (1♂); PH; 28 Jul; nt.

### ACKNOWLEDGEMENTS

I give heart-felt acknowledgement to the GWMP Bug Lab volunteers Judy Buchino, Pat Findikoglu, Peggy Finn, Tom Hahn, Sarah Hill (deceased), Ann Kelly, Eileen Miller, Susan Sprenke, Jerry Taylor and Jane Whitaker for sorting bees from Malaise trap samples. Sam W. Droege, USGS Patuxent Wildlife Research Center, provided insightful comments on the preliminary draft manuscript.

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