

## BEES OF WISCONSIN (HYMENOPTERA: APOIDEA: ANTHOPHILA)

Amy T. Wolf<sup>1</sup> and John S. Ascher<sup>2</sup>

### ABSTRACT

We present the first comprehensive assessment of Wisconsin's native bee species since the work of S. Graenicher in the early 1900's. Our review of published records and museum collections, combined with recent field surveys, yielded 388 verified, described bee species and additional morphospecies that await further analysis. Catalogued bee specimens have been collected from all 72 Wisconsin counties, although central and northern regions appear to be relatively under-sampled. Many of the species on the list have not previously been reported for Wisconsin, and nine of the newly reported species have not previously been documented from any adjacent state. At least 191 bee species known from Minnesota, Iowa, Illinois, Michigan, or Indiana have never been documented in Wisconsin, suggesting that our list of Wisconsin bee species is far from complete. We describe geographic affinities of Wisconsin's bee fauna and discuss changes in populations of several species over the past century. Regional extirpations, population declines, and establishment of exotic bees in the state are poorly known and will require significantly more attention if we hope to effectively conserve Wisconsin's native bees and their pollination services. Nevertheless, our analysis shows that Wisconsin is home to a rich diversity of native bees with a wide variety of life histories and ecological specializations.

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Despite growing recognition that native bees (Hymenoptera: Apoidea: Anthophila) are vital for the pollination of native and agricultural plants (Buchmann and Nabhan 1996, Allen-Wardell et al. 1998, Kevan 1999, Kremen et al. 2002, Cane 2003) few states have comprehensive published lists of bee species, let alone strategies for studying and conserving them. In Wisconsin, S. Graenicher's (1935) "Bee-fauna and vegetation of Wisconsin" has been the state's most complete document of bees and their floral hosts. Graenicher's work, along with those of his contemporaries Charles Robertson (1929) and J. F. W. Pearson (1933) in Illinois, provided some of the earliest and (to date) most authoritative data on North American bee faunas and bee-flower relationships. These authors, along with J. H. Lovell in New England, were among the first to document specialized pollen-host relationships (oligolecty) across an entire fauna, and their observations remain valuable to this day. Graenicher was particularly interested in documenting specialized floral associations among species of the andrenid genera *Andrena* (Graenicher 1905) and *Perdita* (Graenicher 1914), and he recorded the first observations of floral associations for many other northern bee species. Graenicher also documented host-cleptoparasite associations among Wisconsin bee species (e.g., Graenicher 1905, 1927).

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<sup>1</sup>Department of Natural and Applied Sciences, University of Wisconsin Green Bay, Green Bay, WI 54311. (e-mail: wolfa@uwgb.edu).

<sup>2</sup>Division of Invertebrate Zoology, American Museum of Natural History, Central Park West at 79<sup>th</sup> Street, New York, NY 10024-5192. (e-mail: ascher@amnh.org).

Mitchell (1960, 1962) cited state records for Wisconsin in his monographs of Eastern North American bees, but added few new species to the state list and did not cite certain of Graenicher's records which we have subsequently verified to be correct. Investigations during the same period by Medler and associates at the University of Wisconsin-Madison contributed significantly to our understanding of the Wisconsin bee fauna and bee ecology in general, particularly for the Megachilidae (Medler 1959, 1964a; Medler and Lussenhop 1968) and several other groups (Koerber and Medler 1958, Medler 1964b). These studies, and Medler and Carney's (1963) survey of Wisconsin bumble bees, represent the most important statewide inventories of native bee diversity since Graenicher's pioneering research, but no comprehensive survey of Wisconsin's bees has been published since Graenicher's 1935 paper.

The current work attempts to document the status of all native bee species across Wisconsin, drawing from previously published records, our own field research, recent surveys of native prairie bees by Wisconsin Department of Natural Resources scientists (R. Henderson and S. Sauer, Wisconsin DNR, Madison, WI), and identification of specimens borrowed from the Milwaukee Public Museum, the University of Wisconsin, Madison, and other collections.

Because they were conducted before the widespread application of insecticides and the extensive suburbanization of Wisconsin's rural landscape, Graenicher's studies provide an important baseline for assessing human impacts on Wisconsin's bee fauna. Resurveys of sites near Carlinville in southern Illinois (Marlin and LaBerge 2001) demonstrated that most of the identifiable bee species collected in the early 1900's were still present nearly a century later, but the Carlinville fauna contains many southern elements and lacks certain northern species present in the Wisconsin fauna.

Due to Graenicher's efforts, the Wisconsin state list is already relatively complete, but his 1935 study and Mitchell's compilation of records are difficult for all but the most dedicated specialist to interpret, since the taxonomy and nomenclature employed are quite out of date. Likewise, Graenicher's summary of floral relationships and other ecological data require updating in light of subsequent research on Wisconsin species conducted within the state and elsewhere in North America.

The primary goals of this paper are: 1) to compile a comprehensive and taxonomically current list of bee species known from the state of Wisconsin based on both historical and recent collections, 2) to present more detailed information about the distribution of bees within the state, 3) to compare the bee fauna of Wisconsin with that of nearby states, particularly Minnesota, Michigan, Iowa, Indiana, and Illinois, 4) to summarize important ecological attributes of Wisconsin bees, and 5) to discuss changes in the Wisconsin bee fauna between the early twentieth century (summarized as of 1935) and today (early 2000's).

We hope to provide a new baseline for future field studies of Wisconsin bees, leading to a list of endangered and threatened species and subsequent conservation efforts to prevent species declines and extinctions. We also intend to characterize the occurrence, phenology, and habits of common species that are likely to be of particular importance as pollinators. Epidemics of parasites (Sammataro et al. 2000) and recent reports of colony collapse disorder (Johnson 2007, Stokstad 2007) in populations of the introduced honey bee, *Apis mellifera* (L.), suggest that native bees might play an increasingly important economic role in addition to their obvious significance as pollinators in natural ecosystems.

## METHODS

We compiled data from a variety of sources including the scientific literature, museum specimens, and recent field collections. Graenicher's (1935) "Bee-fauna and vegetation of Wisconsin" provided the base list. Species occurrences

in Wisconsin and nearby states also were compiled from Mitchell's two volume monograph on bees of the eastern United States (1960, 1962) and subsequent generic revisions of *Andrena* (Bouseman and LaBerge 1979; LaBerge 1967, 1969, 1971, 1973, 1977, 1980, 1986, 1987, 1989; Donovan 1977; LaBerge and Bouseman 1970; LaBerge and Ribble 1972, 1975; Ribble 1967, 1968, 1974) and of other genera (Baker 1975; Broemeling 1988; Broemeling and Moalif 1988; Brooks 1983; Brooks and Griswold 1988; Coelho 2004; Daly 1973; Evans 1972; Hurd and Linsley 1964; Hurd and Linsley 1972; LaBerge 1961; McGinley 1986, 2003; Milliron 1971, 1973a, 1973b; Ordway 1966; Rightmyer 2008; Roberts 1972; Rust 1974; Shanks 1977; Shinn 1967; Snelling 1968, 1970, 1990; Snelling and Stage 1995; Timberlake 1960, 1968, 1969, 1975, 1976). Additional papers were consulted to clarify names, taxonomic status, and subgeneric placement of regional species (e.g., Brooks 1988, Urban 2001, Gusenleitner et al. 2005, Williams et al. 2008).

During 2006, ATW visited the two major bee collections in Wisconsin, the Milwaukee Public Museum (MPM) and the Insect Research Collection at the University of Wisconsin-Madison (IRCW). All specimens collected from Wisconsin were viewed, and data were transcribed for each of the nearly 300 Wisconsin bee species recorded in these collections (Table 1). Specimens of interest or uncertain taxonomy were sent in 2008 to JSA by Susan Borkin (MPM) and Steven Krauth (IRCW). Specimens of *Lasioglossum (Dialictus)* were sent to Jason Gibbs at York University for identification based on both morphology and DNA sequences as part of his integrative taxonomic studies of the group (Gibbs 2007, 2009). Wisconsin specimens in the American Museum of Natural History (AMNH) were identified by JSA and recorded in the AMNH Bee Database available online at Discover Life (Ascher 2007, [http://www.discoverlife.org/mp/20m?kind=AMNH\\_BEE](http://www.discoverlife.org/mp/20m?kind=AMNH_BEE)).

The most extensive and historically important collection of Wisconsin bees was assembled by S. Graenicher and is housed at the Milwaukee Public Museum. The majority of Graenicher's bee specimens were obtained at or near Milwaukee during the early 20<sup>th</sup> century (Graenicher 1935), but his collection also includes significant material from western Wisconsin. In 1909, 1910, and 1911, he and assistants took part in three collecting expeditions of the Milwaukee Public Museum along the western border of Wisconsin from the headwaters of the St. Croix River in Douglas County southward along the St. Croix and Mississippi Rivers to the southwestern corner of the state at Rutledge in Grant County (opposite Dubuque, Iowa). Graenicher studied additional bees from diverse localities obtained by himself, staff members of the Museum, and other collectors.

The Insect Research Collection at the University of Wisconsin-Madison (IRCW) includes an even larger number of Wisconsin species (Table 1). J. T. Medler and R. E. Fye deposited approximately 20,000 bees from their various research projects, and specimens have been added to the collection by numerous other field investigators.

Recent collections were made by ATW and students/colleagues during 2005-2007. Most of these specimens were identified to species by JSA. Sam Droege provided expert identification and verification of a number of difficult species from these recent collections. Prairie invertebrate surveys conducted by the Wisconsin Department of Natural Resources beginning in 1994 (R. Henderson and S. Sauer pers. comm.) also contributed to our knowledge of the Wisconsin bee fauna. Specimens from this collection, including new state records of *Lasioglossum (Dialictus)* and other bee species, were identified by Michael Arduser of the Missouri Department of Conservation. He also identified bees from a recent study of Wisconsin cranberry bogs by Hannah Gaines of the University of Wisconsin-Madison, thereby adding several more new species to the Wisconsin state list.

**Table 1.** Sources of specimens used for compiling Wisconsin bee species list.

Collection	Total Species	Unique Species
Milwaukee Public Museum (MPM)	199	31
UW-Madison Entomology Collection (IRCW)	262	52
UW-Green Bay Richter Museum	185	33
American Museum of Natural History	45	3
Other (published records)		39
WDNR Prairie Invertebrate Inventory		5
<b>Wisconsin Species List (all records)</b>	<b>388</b>	

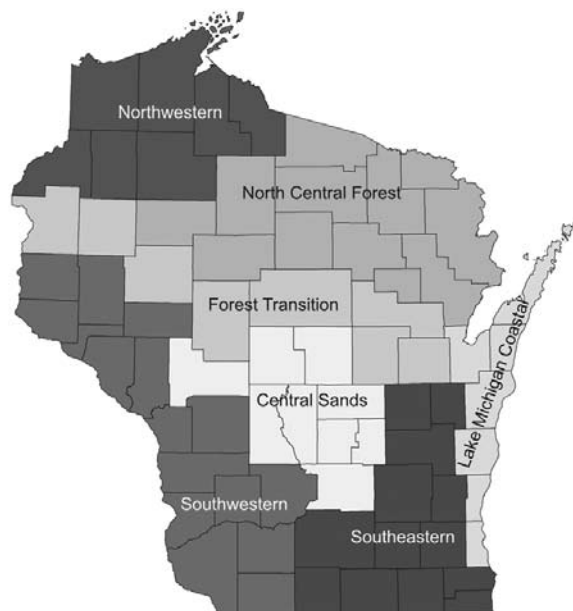
We illustrate the approximate geographic distribution of each bee species by identifying regions of the state where it has been reported historically or collected recently. Our regions follow the Ecological Landscapes of Wisconsin developed by the Wisconsin Department of Natural Resources (1999). Each county was assigned to the ecological landscape that encompasses most of its area. In order to simplify our analysis, we grouped the original 16 ecological landscapes into 7 categories (Figure 1). The Southern Lake Michigan Coastal, Central Lake Michigan Coastal, and Northern Lake Michigan Coastal landscapes were combined into the Lake Michigan Coastal (LM) category. The Southeast Glacial Plains (SE) was left as a single category. The Southwest Savanna, Western Prairie, and Western Coulee and Ridges landscapes were combined into a Southwestern Wisconsin (SW) category. The Central Sand Hills and Central Sand Plains landscapes were combined into the Central Sands (CS) category. The Northeast Sands, Northern Highlands, and North Central Forest landscapes were combined into the Northern Forest (NF) category, and the Northwest Sands, Northwest Lowlands, and Superior Coastal Plain were combined into the Northwestern Wisconsin (NW) category. Finally, the extensive Forest Transition landscape was left as its own category (FT). County records were compiled from published localities and specimen label data. Occurrences for *Bombus* were supplemented with distributions published by Medler and Carney (1963).

Species-specific descriptions of nesting behavior, sociality, and host interactions were compiled by JSA from published sources (e.g., Eickwort et al. 1981, Giles and Ascher 2006, Hurd 1979 and references therein), personal communications (pers. comm.), and records from the American Museum of Natural History's bee collection. Faunal studies of bees were consulted for ecological data, including all those known to us from the Midwestern USA and certain extralimital studies such as those by MacKay and Knerer (1979, updated by Gixti and Packer 2006) from southern Ontario and by Giles and Ascher (2006) from southern New York State and Romey et al. (2007) from the Adirondack Mountains of New York State.

## RESULTS

So far, investigators in Wisconsin have collectively documented 388 described bee species (Table 2) representing 44 genera and 6 families. Many of these species have not previously been documented from Wisconsin in the published literature or in entomological collections, including 30 newly reported species collected by UW-Green Bay researchers during 2005-07.

At least nine non-native species are found in Wisconsin (Table 2). Two of these, *Megachile sculpturalis* (Smith) and *Anthidium manicatum* (L.), have been detected in the state only during the last few years.



**Figure 1.** Landscape regions used to describe distributions of Wisconsin bee species in Table 2. Boundaries combine similar regions from the Wisconsin Department of Natural Resources' (1999) Ecological Landscapes of Wisconsin.

Several bee species recorded from Wisconsin by early workers were not verified in subsequent revisions or by us, and we have excluded from the state list certain reported occurrences inconsistent with modern knowledge of species ranges, such as Graenicher's (1935) Wisconsin record of *Colletes productus* (cf. Stephen, 1954). His records of *Perdita (Perdita) bruneri* Cockerell pertain to *P. swenki* (cf. Timberlake 1960). We regard the occurrence of *Bombus (Cullumanobombus) fraternus* (Smith, 1854) in Wisconsin as hypothetical and do not include it on the list of fully verified species. The sole published Wisconsin record is of one worker from Green Lake collected July, 1911, in the University of Wisconsin (IRCW) collection (Frison, 1921). This record was subsequently cited by Graenicher (1935) but not by Medler and Carney (1963). A specimen located in IRCW with these collection details is a *Bombus auricomus*.

Additions to the documented bee fauna of Wisconsin and species whose status is poorly known are briefly described below. These notes are meant to help guide future inventory and conservation efforts.

#### Andrenidae

***Andrena (Andrena) carolina* (Viereck, 1909).** This *Vaccinium* specialist is documented in Wisconsin from just one specimen collected in July 1909 at Solon Springs in Douglas County (MPM). *A. carolina* is widely distributed in eastern U.S., including records from Indiana, Michigan, and Minnesota.

***Andrena (Andrena) clarkella* (Kirby, 1802).** A northern willow specialist, *A. clarkella* is known in Wisconsin from a male collected by T. Erdman on 18 April 2006 (on a banana) in Oconto County and an undated female collected in Shawano County (IRCW).

***Andrena (Callandrena sensu lato) placata* Mitchell 1960.** This specialist on Asteraceae was collected at several native grasslands in southern

Table 2. List of verified Wisconsin bee species, including historical and recent records. Columns give geographic distribution (x = present) in landscape regions shown in Fig. 1. NW = Northwestern Wisconsin, NF = North Central Forest, FT = Forest Transition, LM = Lake Michigan Coastal, CS = Central Sands, SW = Southwestern Wisconsin, and SE = Southeastern Wisconsin. Season gives months when species are known to fly across their entire range, including areas with climates far warmer than Wisconsin. In Wisconsin the season of bee activity is relatively short, e.g., native bees are not active prior to April. Monthly occurrences that we regard as atypical for the species are placed in brackets. General information about nest type (S = Soil; C = Cavity; H = hive; Pithy stem or similar substrate, W = wood; [S] = parasite of a host nesting in soil, [C] = parasite of a host nesting in cavities; [H] = parasite of a host nesting in a hive); sociality (S = solitary in the broad-parasitic sense, including communal [S/Comm.], subsocial [S/Sub.], and all other non-eusocial, pollen-collecting taxa; E = eusocial; or P = parasitic) and host species (pollen plant for specialized pollen-collecting species including oligoleges; bee for parasitic species) was compiled by JSA. Non-native species are indicated with an asterisk (\*); *Megachile centuncularis* is cited with an asterisk and question mark (\*) since its status as a native species is questionable (see Giles and Ascher, 2006).

SPECIES	NW NF FT LM CS SW SE							SEASON (Not WI specific)	NEST	SOCIALITY	HOST
	NW	NF	FT	LM	CS	SW	SE				
<b>Andrenidae</b>											
<i>Andrena (Andrena) carolina</i> (Viereck, 1909)	x							4-7	S	S	<i>Vaccinium</i>
<i>Andrena (Andrena) clarkella</i> (Kirby, 1802)		x	x					3-8	S	S	<i>Salix</i>
<i>Andrena (Andrena) frigida</i> Smith, 1853	x		x	x			x	2-7	S	S	<i>Salix</i>
<i>Andrena (Andrena) mandibularis</i> Robertson, 1892			x	x			x	3-7	S	S	
<i>Andrena (Andrena) milwaukeensis</i> Graenicher, 1903			x	x			x	3-8	S	S	
<i>Andrena (Andrena) rufosignata</i> Cockerell, 1902							x	4-8	S	S	
<i>Andrena (Andrena) thaspis</i> Graenicher, 1903		x	x	x			x	4-8	S	S	
<i>Andrena (Andrena) tridens</i> Robertson, 1902								3-7	S	S	
<i>Andrena (Callandrena s.l.) aliciae</i> Robertson, 1891			x	x			x	7-9	S	S	Asteraceae
<i>Andrena (Callandrena s.l.) asteris</i> Robertson, 1891		x		x	x		x	8-10	S	S	Asteraceae
<i>Andrena (Callandrena s.l.) helianthi</i> Robertson, 1891			x	x	x		x	7-9	S	S	Asteraceae
<i>Andrena (Callandrena s.l.) krigiana</i> Robertson, 1901								3-7	S	S	Asteraceae
<i>Andrena (Callandrena s.l.) placata</i> Mitchell, 1960							x	7-9	S	S	Asteraceae
<i>Andrena (Callandrena s.l.) rudbeckiae</i> Robertson, 1891							x	6-8	S	S	Asteraceae
<i>Andrena (Callandrena s.l.) simplex</i> Smith, 1853							x	7-9	S	S	Asteraceae
<i>Andrena (Chemidandrena) canadensis</i> Dalla Torre, 1896	x			x	x		x	8-10	S	S	Asteraceae
<i>Andrena (Chemidandrena) chromotricha</i> Cockerell, 1899			x	x	x		x	7-9	S	S	Asteraceae
<i>Andrena (Chemidandrena) hirticincta</i> Provancher, 1888	x			x	x		x	8-10	S	S	Asteraceae

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST SOCIALITY	HOST
<i>Andrena (Cnemidandrena) nubecula</i> Smith, 1853			x		x		x	7-10	S	Asteraceae
<i>Andrena (Cnemidandrena) parrassiae</i> Cockerell, 1902	x		x					8-9	S	Asteraceae
<i>Andrena (Cnemidandrena) peckhami</i> Cockerell, 1902	x	x	x			x		9	S	Asteraceae
<i>Andrena (Cnemidandrena) runcinatae</i> Cockerell, 1906							x	7-10	S	Asteraceae
<i>Andrena (Gonandrena) bradleyi</i> Viereck, 1907	x	x						3-9	S	Ericaceae
<i>Andrena (Euandrena) geranii</i> Robertson, 1891		x	x		x		x	4-7	S	
<i>Andrena (Euandrena) nigrihirta</i> (Ashmead, 1890)	x							3-8	S	
<i>Andrena (Euandrena) phaceliae</i> Mitchell, 1960			x					4-6	S	
<i>Andrena (Gonandrena) fragilis</i> Smith, 1853 ( <i>Svida</i> )			x		x		x	5-7	S	<i>Cornus</i>
<i>Andrena (Gonandrena) integra</i> Smith, 1853 ( <i>Svida</i> )			x					5-8	S	<i>Cornus</i>
<i>Andrena (Gonandrena) persimulata</i> Viereck, 1917 ( <i>Svida</i> )			x					4-7	S	<i>Cornus</i>
<i>Andrena (Gonandrena) platyparia</i> Robertson, 1895 ( <i>Svida</i> )							x	5-7	S	<i>Cornus</i>
<i>Andrena (Holandrena) cressonii</i> Robertson, 1891			x	x				3-8	S	
<i>Andrena (Iamelissa) violae</i> Robertson, 1891						x		4-7	S	<i>Viola</i>
<i>Andrena (Larandrena) miserabilis</i> Cresson, 1872	x	x	x		x		x	1-7 [8-9]	S	
<i>Andrena (Leucandrena) barbibrabis</i> (Kirby, 1802)	x		x					3-7 [8-9]	S	
<i>Andrena (Leucandrena) erythronii</i> Robertson, 1891			x	x				3-6	S	<i>Erythronium</i>
<i>Andrena (Melandrena) barbara</i> Bouseman and LaBerge, 1979								2-6	S	
<i>Andrena (Melandrena) carlini</i> Cockerell, 1901			x	x		x		3-7 [8]	S	
<i>Andrena (Melandrena) commoda</i> Smith, 1879	x	x	x			x		4-7	S	
<i>Andrena (Melandrena) dunningi</i> Cockerell, 1898					x			2-7 [8]	S	
<i>Andrena (Melandrena) nivalis</i> Smith, 1853	x	x	x		x		x	2-8	S	
<i>Andrena (Melandrena) regularis</i> Malloch, 1917			x	x		x		4-7	S	
<i>Andrena (Melandrena) vicina</i> Smith, 1853	x	x	x		x		x	3-7 [8-9]	S	

Table 2. Continued

SPECIES	NW NF FT LM CS SW SE							SEASON (Not WI specific)	NEST SOCIALITY	HOST
	NW	NF	FT	LM	CS	SW	SE			
<i>Andrena (Micrandrena) illinoensis</i> Robertson, 1891				x			x	3-7	S	Rosaceae
<i>Andrena (Micrandrena) melanothroa</i> Cockerell, 1898				x				3-7	S	<i>Salix</i>
<i>Andrena (Micrandrena) salictaria</i> Robertson, 1905		x						3-6	S	<i>Salix</i>
<i>Andrena (Micrandrena) ziziae</i> Robertson, 1891				x				4-6 [7, 9]	S	<i>Salix</i>
<i>Andrena (Parandrena) andreinoides</i> (Cresson, 1878)				x				3-8	S	<i>Salix</i>
<i>Andrena (Parandrena) wellesleyana</i> Robertson, 1897								3-7	S	<i>Salix</i>
<i>Andrena (Platandrena) crataegi</i> Robertson, 1893		x		x				3-8	S	<i>Geranium</i>
<i>Andrena (Platandrena) distans</i> Provancher, 1888		x		x				4-6 [10]	S	<i>Claytonia</i>
<i>Andrena (Ptilandrena) erigeniae</i> Robertson, 1891				x				2-5 [7-8]	S	
<i>Andrena (Rhacandrena) brevipalpis</i> Cockerell, 1930		x						5-10	S	
<i>Andrena (Rhacandrena) robertsonii</i> Dalla Torre, 1896		x						4-8	S	
<i>Andrena (Scaphandrena) arabis</i> Robertson, 1897								4-5	S	
<i>Andrena (Scaphandrena) alleghaniensis</i> Viereck, 1907		x						4-7	S	
<i>Andrena (Scrapteropsis) imitatrix</i> Cresson, 1872								3-7	S	
<i>Andrena (Simandrena) nasonii</i> Robertson, 1895				x				3-7	S	
<i>Andrena (Simandrena) wheeleri</i> Graenicher, 1904		x		x				4-7	S	
<i>Andrena (Taenandrena) wilkella</i> (Kirby, 1802)*		x		x				4-9	S	
<i>Andrena (Thysandrena) bisalicis</i> Viereck, 1908				x				2-9 [10]	S	
<i>Andrena (Thysandrena) u-scripta</i> Viereck, 1904				x				5-6	S	
<i>Andrena (Trachandrena) ceanothi</i> Viereck, 1917		x		x				4-6	S	
<i>Andrena (Trachandrena) forbesii</i> Robertson, 1891		x		x				4-6	S	
<i>Andrena (Trachandrena) hippotes</i> Robertson, 1895		x		x				4-6	S	
<i>Andrena (Trachandrena) mariae</i> Robertson, 1891		x		x				4-7	S	<i>Salix</i>
<i>Andrena (Trachandrena) miranda</i> Smith, 1879		x		x				5-8	S	
<i>Andrena (Trachandrena) nuda</i> Robertson, 1891				x				4-6	S	
<i>Andrena (Trachandrena) quintilis</i> Robertson, 1898								4-7	S	
<i>Andrena (Trachandrena) rehni</i> Viereck, 1907				x				6-7	S	
<i>Andrena (Trachandrena) rugosa</i> Robertson, 1891				x				4-6	S	
<i>Andrena (Trachandrena) sigmundi</i> Cockerell, 1902								5-7	S	<i>Salix</i>



Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST SOCIALITY	HOST
<i>Andrena (Trachandrena) spiraeana</i> Robertson, 1895			x		x	x	x	6-8	S	S
<i>Andrena (Trachandrena) virginiana</i> Mitchell, 1960	x				x	x	x	6-8	S	S
<i>Andrena (Tylandrena) erythrogaster</i> (Ashmead, 1890)		x		x	x	x	x	2-7	S	<i>Salix</i>
<i>Andrena (Tylandrena) perplexa</i> Smith, 1853			x		x	x	x	3-6	S	S
<i>Andrena (Tylandrena) wilmatiae</i> Cockerell, 1906			x		x	x	x	5-7	S	S
<i>Calliopsis (Calliopsis) andreniformis</i> Smith, 1853	x	x	x		x	x	x	4-10	S	S
<i>Calliopsis (Verbenapis) nebraskensis</i> Crawford, 1902				x		x	x	6-9	S	S
<i>Perdita (Cockerellia) albipennis</i> Cresson, 1868								6-9	S	<i>Verbena</i>
<i>Perdita (Perdita) gerhardi</i> Viereck, 1904	x						x	4-9	S	<i>Helianthus</i>
<i>Perdita (Perdita) halictoides</i> Smith, 1853			x		x			4-10	S	<i>Monarda</i>
<i>Perdita (Perdita) maculigera</i> Cockerell, 1896			x		x			3-7	S	<i>Physalis</i>
<i>Perdita (Perdita) perpallida</i> Cockerell, 1901				x		x		7-8	S	<i>Salix</i>
<i>Perdita (Perdita) svenki</i> Crawford, 1915	x							7-9	S	<i>Petalostemon</i>
<i>Protandrena bancroftii</i> Dunning, 1897								7-9	S	Asteraceae
<i>Pseudopanurgus albitarsis</i> (Cresson, 1872)								5-9	S	S
<i>Pseudopanurgus andrenoides</i> (Smith, 1853)								6-9	S	Asteraceae
<i>Pseudopanurgus labrosus</i> (Robertson, 1895)								8-10	S	Asteraceae
<i>Pseudopanurgus nebrascensis</i> (Crawford, 1903)								7-9	S	Asteraceae
<i>Pseudopanurgus parvus</i> (Robertson, 1892)		x						8-9	S	Asteraceae
<i>Pseudopanurgus rudbeckiae</i> (Robertson, 1895)			x				x	6-9	S	Asteraceae
<b>Apidae</b>								8-10	S	Asteraceae
<i>Anthophora (Clisodon) terminalis</i> Cresson, 1869	x	x		x	x	x	x	5-9	W	S
<i>Anthophora (Lophanthophora) ursina</i> Cresson, 1869								5-6	S	S
<i>Anthophora (Melea) abrupta</i> Say, 1837			x				x	3-9	S	S
<i>Anthophora (Melea) bombooides</i> Kirby, 1837	x							3-8	S	S
<i>Anthophora (Mystacanthophora) walshii</i> Cresson, 1869	x							7-8	S	S
<i>Apis (Apis) mellifera</i> Linnaeus, 1758*	x	x	x	x	x	x	x	1-12	H	E
<i>Bombus (Bombus) auricomus</i> (Robertson, 1903)	x	x	x	x	x	x	x	5-10	H	E
<i>Bombus (Bombus) affinis</i> Cresson, 1863			x		x	x	x	4-10	H	E

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST	SOCIALITY	HOST
<i>Bombus (Bombus) terricola</i> Kirby, 1837	x	x	x	x	x	x	x	4-10	H	E	E
<i>Bombus (Cullumanobombus) griseocollis</i> (DeGeer, 1773)	x	x	x	x	x	x	x	2-10	H	E	E
<i>Bombus (Cullumanobombus) rufocinctus</i> Cresson, 1863	x	x	x	x	x	x	x	2-10	H	E	E
<i>Bombus (Psithyrus) ashtoni</i> (Cresson, 1864)	x	x	x	x	x	x	x	5-10	[H]	P	<i>Bombus</i>
<i>Bombus (Psithyrus) citrinus</i> (Smith, 1854)	x	x	x	x	x	x	x	5-10	[H]	P	<i>Bombus</i>
<i>Bombus (Psithyrus) fernaldae</i> (Franklin, 1911)	x	x	x	x	x	x	x	4-9	[H]	P	<i>Bombus</i>
<i>Bombus (Psithyrus) insularis</i> (Smith, 1861)	x	x	x	x	x	x	x	3-10	[H]	P	<i>Bombus</i>
<i>Bombus (Psithyrus) variabilis</i> (Cresson, 1872)	x	x	x	x	x	x	x	6-11	[H]	P	<i>Bombus</i>
<i>Bombus (Pyrobombus) bimaculatus</i> Cresson, 1863	x	x	x	x	x	x	x	2-9	H	E	E
<i>Bombus (Pyrobombus) frigidus</i> Smith, 1854	x	x	x	x	x	x	x	6-8	H	E	E
<i>Bombus (Pyrobombus) impatiens</i> Cresson, 1863	x	x	x	x	x	x	x	1-11	H	E	E
<i>Bombus (Pyrobombus) perplexus</i> Cresson, 1863	x	x	x	x	x	x	x	4-10	H	E	E
<i>Bombus (Pyrobombus) sandersoni</i> Franklin, 1913	x	x	x	x	x	x	x	4-10	H	E	E
<i>Bombus (Pyrobombus) ternarius</i> Say, 1837	x	x	x	x	x	x	x	4-10	H	E	E
<i>Bombus (Pyrobombus) vagans</i> Smith, 1854	x	x	x	x	x	x	x	5-10	H	E	E
<i>Bombus (Subterraneobombus) borealis</i> Kirby, 1837	x	x	x	x	x	x	x	5-10	H	E	E
<i>Bombus (Thoracobombus) fervidus</i> (Fabricius, 1798)	x	x	x	x	x	x	x	4-10	H	E	E
<i>Bombus (Thoracobombus) pensylvanicus</i> (DeGeer, 1773)	x	x	x	x	x	x	x	4-10	H	E	E
<i>Ceratina (Zadontomerus) calcarata</i> Robertson, 1900	x	x	x	x	x	x	x	3-10	P	S/Sub.	S/Sub.
<i>Ceratina (Zadontomerus) dupla</i> Say, 1837	x	x	x	x	x	x	x	4-9	P	S/Sub.	S/Sub.
<i>Ceratina (Zadontomerus) strenua</i> Smith, 1879	x	x	x	x	x	x	x	5-8	P	S/Sub.	S/Sub.
<i>Epeloides pilosula</i> (Cresson, 1878)	x	x	x	x	x	x	x	6-7	[S]	P	<i>Macropis</i>
<i>Epeloides ainsliei</i> Crawford, 1932	x	x	x	x	x	x	x	6-9	[S]	P	<i>Colletes</i>
<i>Epeloides autumnalis</i> Robertson, 1902	x	x	x	x	x	x	x	7-10 [6]	[S]	P	<i>Colletes</i>
<i>Epeloides bifasciatus</i> Cresson, 1864	x	x	x	x	x	x	x	2-9	[S]	P	<i>Colletes</i>
<i>Epeloides interruptus</i> Robertson, 1900	x	x	x	x	x	x	x	4-7	[S]	P	<i>Colletes</i>
<i>Epeloides lectoides</i> Robertson, 1901	x	x	x	x	x	x	x	6-9	[S]	P	<i>Colletes</i>
<i>Epeloides minimus</i> (Robertson, 1902)	x	x	x	x	x	x	x	5-8	[S]	P	<i>Colletes</i>
<i>Epeloides pusillus</i> Cresson, 1864	x	x	x	x	x	x	x	4-5,8-10 [7]	[S]	P	<i>Colletes</i>

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST SOCIALITY	HOST
<i>Epoptus scutellaris</i> Say, 1824						x		6-10	[S]	<i>Colletes</i>
<i>Eucera (Synhalonia) atriventris</i> (Smith, 1854)	x		x				x	3-8	S	S
<i>Eucera (Synhalonia) hamata</i> (Bradley, 1942)							x	4-8	S	S
<i>Holcopasites calliopsidis</i> (Linsley, 1943).							x	5-10	[S]	Panurginae
<i>Melissodes (Callimelissodes) coloradensis</i> Cresson, 1878			x					7-10	S	S
<i>Melissodes (Eumelissodes) agilis</i> Cresson, 1878	x		x			x	x	5-11	S	Asteraceae
<i>Melissodes (Eumelissodes) denticulata</i> Smith, 1854					x	x		5-10	S	Asteraceae
<i>Melissodes (Eumelissodes) dentiventris</i> Smith, 1854					x	x		6-9	S	Asteraceae
<i>Melissodes (Eumelissodes) drurietta</i> (Kirby, 1802)	x		x		x	x	x	5-11	S	Asteraceae
<i>Melissodes (Eumelissodes) illata</i> Lovell and Cockerell, 1906		x						7-9	S	Asteraceae
<i>Melissodes (Eumelissodes) menuachus</i> Cresson, 1868			x					7-10	S	Asteraceae
<i>Melissodes (Eumelissodes) nivea</i> Robertson, 1895								7-10	S	Asteraceae
<i>Melissodes (Eumelissodes) subillata</i> LaBerge, 1961		x			x			6-9	S	Asteraceae
<i>Melissodes (Eumelissodes) trinodis</i> Robertson, 1901	x		x			x	x	7-10	S	Asteraceae
<i>Melissodes (Eumelissodes) wheeleri</i> Cockerell, 1906								4-10	S	Asteraceae
<i>Melissodes (Heliomelissodes) desponsa</i> Smith, 1854	x		x		x	x	x	6-10	S	Asteraceae
<i>Melissodes (Melissodes) bimaculata</i> (Lepeletier, 1825)	x		x			x	x	2-10	S	<i>Cirsium</i>
<i>Neolarra vigilans</i> (Cockerell, 1895)						x		4-10	[S]	<i>Perdita</i>
<i>Nomada affabitis</i> Cresson, 1878							x	3-6	[S]	<i>Eucera</i> ( <i>Synhalonia</i> )
<i>Nomada aquilarum</i> Cockerell, 1903								7-8	[S]	P
<i>Nomada armatella</i> Cockerell, 1903	x							5-8	[S]	<i>Andrena</i>
<i>Nomada articulata</i> Smith, 1854		x			x	x	x	5-7	[S]	Agapostemon
<i>Nomada australis</i> Mitchell, 1962			x					4-6	[S]	Agapostemon
<i>Nomada banksi</i> Cockerell, 1907	x		x				x	8-9	[S]	<i>Andrena</i>
<i>Nomada bella</i> Cresson, 1863					x	x	x	3-4	[S]	<i>Andrena</i>
<i>Nomada besseyi</i> Swenk, 1913								7-9 [4]	[S]	P
<i>Nomada ceanothi</i> Cockerell, 1907		x					x	4-6	[S]	<i>Andrena</i>
<i>Nomada composita</i> Mitchell, 1962								6-7	[S]	<i>Andrena</i>

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST SOCIALITY	HOST
<i>Nomada cressonii</i> Robertson, 1893	x		x	x	x	x	x	4-7	[S]	<i>Andrena</i>
<i>Nomada cuneata</i> (Robertson, 1903)	x	x	x	x	x	x	x	6 [10]	[S]	<i>Andrena</i>
<i>Nomada denticulata</i> Robertson, 1902	x		x	x	x		x	5-6	[S]	<i>Andrena</i>
<i>Nomada depressa</i> Cresson, 1863						x	x	4-7	[S]	<i>Andrena</i>
<i>Nomada florilega</i> Lovell and Cockerell, 1905								5-8	[S]	<i>Andrena</i>
<i>Nomada graenicheri</i> Cockerell, 1905	x		x			x		8	[S]	<i>Andrena</i>
<i>Nomada hydrophylli</i> Swenk, 1915			x					5-6	[S]	<i>Andrena</i>
<i>Nomada illinoensis</i> Robertson, 1900	x		x			x		4-6	[S]	<i>Andrena</i>
<i>Nomada imbricata</i> Smith, 1854							x	4-6	[S]	<i>Andrena</i>
<i>Nomada lehighensis</i> Cockerell, 1903	x							3-7	[S]	<i>Andrena</i>
<i>Nomada lepida</i> Cresson, 1863								5-7	[S]	<i>Andrena</i>
<i>Nomada luteoloides</i> Robertson, 1895		x			x	x	x	4-6	[S]	<i>Andrena</i>
<i>Nomada maculata</i> Cresson, 1863	x		x	x	x	x	x	4-6	[S]	<i>Andrena</i>
<i>Nomada oblitterata</i> Cresson, 1863			x		x		x	5-6	[S]	<i>Andrena</i>
<i>Nomada ovata</i> (Robertson, 1903)			x				x	5-6	[S]	<i>Andrena</i>
<i>Nomada perplexa</i> Cresson, 1863			x				x	6-7	[S]	<i>Andrena</i>
<i>Nomada placida</i> Cresson, 1863							x	7-9	[S]	<i>Andrena</i>
<i>Nomada pseudops</i> Cockerell, 1905								4-6	[S]	<i>Andrena</i>
<i>Nomada pygmaea</i> Cresson, 1863			x	x	x	x	x	4-6 [8]	[S]	<i>Andrena</i>
<i>Nomada rubicunda</i> Olivier, 1811			x			x	x	5-7	[S]	<i>Andrena</i>
<i>Nomada sayi</i> Robertson, 1893	x		x				x	4-7	[S]	<i>Andrena</i>
<i>Nomada superba</i> Cresson, 1863			x		x	x	x	4-7	[S]	<i>Andrena</i> <i>Euclera</i> <i>(Synhalonia)</i>
<i>Nomada texana</i> Cresson, 1872								4-10	[S]	<i>Agapostemon</i>
<i>Nomada vicina</i> Cresson, 1863	x		x		x	x	x	8-10	[S]	<i>Andrena</i>
<i>Nomada victa</i> Say, 1837								7-9	[S]	<i>Andrena</i>
<i>Nomada wisconsinensis</i> Graenicher, 1911	x		x		x	x	x	6-7	[S]	<i>Andrena</i>
<i>Nomada xanthura</i> Cockerell, 1908			x				x	5-6	[S]	<i>Andrena</i>
<i>Svastra (Epimelissodes) obliqua</i> (Say, 1837)	x		x		x	x	x	4-11	S	Asteraceae

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST SOCIALITY	HOST
<i>Tripeolus concavus</i> (Cresson, 1878)		x				x	x	5-10	[S]	<i>Suastra</i>
<i>Tripeolus cressonii</i> (Robertson, 1897)	x	x		x		x	x	6-10	[S]	<i>Melissodes</i>
<i>Tripeolus donatus</i> (Smith, 1854)	x	x	x			x	x	7-10	[S]	<i>Melissodes desponsa</i>
<i>Tripeolus helianthi</i> (Robertson, 1897)		x					x	6-10	[S]	<i>Melissodes</i>
<i>Tripeolus lunatus</i> (Say, 1824)		x				x	x	3-10	[S]	<i>Melissodes bimaculatus</i>
<i>Tripeolus oblitteratus</i> Graenicher, 1911		x				x		7-10	[S]	<i>Melissodes</i>
<i>Tripeolus pectoralis</i> (Robertson, 1897)	x						x	5, 7-11	[S]	<i>Melissodes (Eumelissodes)</i>
<i>Tripeolus remigatus</i> (Fabricius, 1804)						x	x	5-10	[S]	<i>Peponapis and Xenoglossa</i>
<i>Tripeolus simplex</i> Robertson, 1903		x				x	x	7-8	[S]	<i>Suastra</i>
<i>Xenoglossa (Eoxenoglossa) strenua</i> (Cresson, 1878)						x		5-11	S	<i>Cucurbita</i>
<i>Xeromelecta (Melectomorpha) californica</i> (Cresson, 1878)								3-10	[S]	<i>Anthophora</i>
<i>Xeromelecta (Melectomorpha) interrupta</i> (Cresson, 1872)							x	7-9	[S]	<i>Anthophora</i>
<i>Xylocopa (Xylocopoides) virginica</i> (Linnaeus, 1771)							x	3-10	W	S/Sub.
<b>Colletidae</b>										
<i>Colletes aberrans</i> Cockerell, 1897	x							6-8	S	<i>Suastra</i>
<i>Colletes albescens</i> Cresson, 1868	x					x	x	6-8	S	<i>Suastra</i>
<i>Colletes americanus</i> Cresson, 1868						x	x	5-11	S	<i>Suastra</i>
* <i>Colletes andrewsi</i> Cockerell, 1906								5-7	S	<i>Suastra</i>
<i>Colletes brevicornis</i> Robertson, 1897						x	x	3-6	S	<i>Suastra</i>
<i>Colletes compactus</i> Cresson, 1868								7-11	S	<i>Suastra</i>
<i>Colletes consors</i> Cresson, 1868								4-8	S	<i>Suastra</i>
<i>Colletes impunctatus</i> Nylander, 1852								6-7	S	<i>Suastra</i>
<i>Colletes inaequalis</i> Say, 1837								3-7 [8-9]	S	<i>Suastra</i>
<i>Colletes kincaidii</i> Cockerell, 1898		x				x	x	6-9	S	<i>Suastra</i>
<i>Colletes latitaris</i> Robertson, 1891								3-9	S	<i>Physalis</i>

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST SOCIALITY	HOST
<i>Colletes nudus</i> Robertson, 1898						x		4-8	S	S
<i>Colletes simulans</i> Cresson, 1868	x	x	x	x		x		1, 5-11	S	S Asteraceae
<i>Colletes susanna</i> e Swenk, 1925						x		7-8	S	S
<i>Colletes validus</i> Cresson, 1868						x		3-7	S	S
<i>Colletes willistoni</i> Robertson, 1891			x					3-9	S	S
<i>Colletes wilmatiae</i> Cockerell, 1904	x					x		6-9	S	S
<i>Hylaeus (Cephalylaeus) basalis</i> (Smith, 1853)	x	x	x	x		x		5-8	C	S Rosaceae
<i>Hylaeus (Hylaeus) annulatus</i> (Linnaeus, 1758)	x	x	x	x		x		4-10	C	S
<i>Hylaeus (Hylaeus) fedorica</i> (Cockerell, 1909)								6-7	C	S
<i>Hylaeus (Hylaeus) leptcephalus</i> (Morawitz, 1870)*								5-9	C	S
<i>Hylaeus (Hylaeus) mesillae</i> (Cockerell, 1896)	x	x	x	x		x		4-10	C	S
<i>Hylaeus (Hylaeus) saniculae</i> (Robertson, 1896)			x					6-8	C	S
<i>Hylaeus (Hylaeus) verticalis</i> (Cresson, 1869)	x					x		4-8	C	S
<i>Hylaeus (Prosopis) affinis</i> (Smith, 1853)	x	x	x	x		x		4-10	C	S
<i>Hylaeus (Prosopis) illinoensis</i> (Robertson, 1896)								6-9	C	S
<i>Hylaeus (Prosopis) modestus</i> Say, 1837	x	x	x	x		x		5-9	C	S
<i>Hylaeus (Prosopis) nelumbonis</i> (Robertson, 1890)						x		3-8	C	S Nymphaeales
<b>Halicidae</b>										
<i>Agapostemon (Agapostemon) sericeus</i> (Förster, 1771)	x	x	x	x		x		4-10	S	S
<i>Agapostemon (Agapostemon) splendens</i> (Lepelletier, 1841)	x					x		4-8	S	S
<i>Agapostemon (Agapostemon) texanus</i> Cresson, 1872	x	x	x	x	x	x		4-9	S	S
<i>Agapostemon (Agapostemon) virescens</i> (Fabricius, 1775)	x	x	x	x		x		5-10	S	S
<i>Augochlora (Augochlora) pura</i> (Say, 1837)	x	x	x	x		x		4-10	W	S
<i>Augochlarella aurata</i> (Smith, 1853)	x	x	x	x		x		4-10	S	E
<i>Augochlarella persimilis</i> (Viereck, 1910)						x		3-9	S	E
<i>Augochloropsis (Paraugochloropsis) metallica</i> (Fabricius, 1793)	x	x	x	x		x		3-11	S	S
<i>Augochloropsis (Paraugochloropsis) sumptuosa</i> (Smith, 1853)			x			x		4-11	S	S

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST SOCIALITY	HOST
<i>Dieunomia (Dieunomia) heteropoda</i> (Say, 1824)			x					6-10	S	<i>Helianthus</i>
<i>Dufourea marginata</i> (Cresson, 1878)		x				x		6-9	S	Asteraceae
<i>Dufourea monardae</i> (Viereck, 1924)			x				x	7-8	S	<i>Monarda</i> and <i>Agastache</i>
<i>Dufourea novaeangliae</i> (Robertson, 1897)	x		x			x		7-8	S	<i>Pontederia</i>
<i>Haliictus (Nealictus) parallelus</i> Say, 1837	x		x			x		3-8	S	E
<i>Haliictus (Odonalictus) ligotus</i> Say, 1837		x	x			x		3-10	S	E
<i>Haliictus (Protohaliictus) rubicundus</i> (Christ, 1791)	x	x	x			x		3-9	S	E
<i>Haliictus (Seladonia) confusus</i> Smith, 1853	x	x	x			x		4-10	S	E
<sup>1</sup> <i>Lasioglossum (Dialictus) admirandum</i> (Sandhouse, 1924) auct.							x	3-9	S	E
<i>Lasioglossum (Dialictus) albipenne</i> (Robertson, 1890)	x		x			x		5-9	S	E
<i>Lasioglossum (Dialictus) anomalum</i> (Robertson, 1892)			x			x		5-9	S	E
<i>Lasioglossum (Dialictus) atlanticum</i> (Mitchell, 1960)			x					4-9	S	E
<i>Lasioglossum (Dialictus) bruneri</i> (Crawford, 1902)					x			2-10	S	E
<i>Lasioglossum (Dialictus) cattlelae</i> (Ellis, 1913)						x		5-9	S	E
<i>Lasioglossum (Dialictus) cephalotes</i> (Dalla Torre, 1896)								5-8	[S]	<i>Lasioglossum</i>
<i>Lasioglossum (Dialictus) coeruleum</i> (Robertson, 1893)	x							3-10	W	E
<i>Lasioglossum (Dialictus) coreopsis</i> (Robertson, 1902)							x	6-8	S	E
<i>Lasioglossum (Dialictus) cressonii</i> (Robertson, 1890)			x			x		3-10	W	E
<i>Lasioglossum (Dialictus) divergens</i> (Lovell, 1905)	x		x					6-7	S	S
<i>Lasioglossum (Dialictus) dreisbachi</i> (Mitchell, 1960)			x					5-8	S	E
<i>Lasioglossum (Dialictus) ellisiae</i> (Sandhouse, 1924)						x		7-8	S	E
<i>Lasioglossum (Dialictus) foxii</i> (Robertson, 1895)			x			x		4-9	S	S
<i>Lasioglossum (Dialictus) hartii</i> (Robertson, 1892)	x	x	x					5-8	S	E
<i>Lasioglossum (Dialictus) hemimelas</i> (Cockerell, 1901)								Unavailable	S	E
<i>Lasioglossum (Dialictus) heterognathum</i> (Mitchell, 1960)			x			x		4-9	S	E
<i>Lasioglossum (Dialictus) illinoense</i> (Robertson, 1892)						x		3-10	S	E
<i>Lasioglossum (Dialictus) imitatum</i> (Smith, 1853)	x		x			x		4-10	S	E

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST SOCIALITY	HOST
<i>Lasioglossum (Dialictus) laevisimum</i> (Smith, 1853)	x	x					x	3-10	S	E
<i>Lasioglossum (Dialictus) lineatulum</i> (Crawford, 1906)	x	x	x	x		x	x	4-10	S	E
<i>Lasioglossum (Dialictus) macropinense</i> (Robertson, 1895)		x	x	x		x		4-9	S	S
<i>Lasioglossum (Dialictus) nigroviride</i> (Graenicher, 1911)		x					x	4-10	S	E
<i>Lasioglossum (Dialictus) nymphaearum</i> (Robertson, 1895)					x		x	4-10	S	E
<sup>2</sup> <i>Lasioglossum (Dialictus) oblongum</i> (Lovell, 1905)	x	x	x			x	x	3-10	W	E
<i>Lasioglossum (Dialictus) obscurum</i> (Robertson, 1892)							x	4-10	S	E
<i>Lasioglossum (Dialictus) paradmirandum</i> (Knerer and Atwood, 1966)							x		S	E
<i>Lasioglossum (Dialictus) pectorale</i> (Smith, 1853)	x	x	x	x		x	x	4-9	S	S
<i>Lasioglossum (Dialictus) perpunctatum</i> (Ellis, 1913)				x	x	x		3-11	S	S
<i>Lasioglossum (Dialictus) pictum</i> (Crawford, 1902)							x	4-9	S	E
<sup>3</sup> <i>Lasioglossum (Dialictus) pilosum</i> (Smith, 1853)	x	x	x	x		x	x	4-9	S	E
<sup>4</sup> <i>Lasioglossum (Dialictus) planatum</i> (Lovell, 1905)							x	2-10	S	E
<i>Lasioglossum (Dialictus) pruinosum</i> (Robertson, 1892)							x		S	E
<i>Lasioglossum (Dialictus) rohveri</i> (Ellis, 1915)	x			x		x	x	3-10	S	E
<i>Lasioglossum (Dialictus) rufitarse</i> (Zetterstedt, 1838)							x	4-9	S	E
<i>Lasioglossum (Dialictus) sagax</i> (Sandhouse, 1924)								4-6	S	S
<i>Lasioglossum (Dialictus) subviridatum</i> (Cockerell, 1938)							x		S	E
<i>Lasioglossum (Dialictus) succinipenne</i> (Ellis, 1913)							x	5-8	S	E
<i>Lasioglossum (Dialictus) tegulare</i> (Robertson, 1890)		x		x		x	x	1-12	S	E
<i>Lasioglossum (Dialictus) testaceum</i> (Robertson, 1897)								5-6	S	E
<i>Lasioglossum (Dialictus) versans</i> (Lovell, 1905)		x						4-10	S	E
<i>Lasioglossum (Dialictus) vierecki</i> (Crawford, 1904)	x	x	x	x		x	x	4-9	S	E
<i>Lasioglossum (Dialictus) viridatum</i> (Lovell, 1905)							x	4-10	S	E
<i>Lasioglossum (Dialictus) zephyrum</i> (Smith, 1853)					x		x	3-10	S	E
<i>Lasioglossum (Eulytaeus) cinctipes</i> (Provancher, 1888)	x						x	3-9	S	E
<i>Lasioglossum (Eulytaeus) netumbonis</i> (Robertson, 1890)							x	3-11	S	S
<i>Lasioglossum (Eulytaeus) quebecense</i> (Crawford, 1907)		x					x	3-9	S	S

Nymphaeales?



Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST SOCIALITY	HOST
<i>Lasioglossum (Evyllaesus) swenki</i> (Crawford, 1906)						x		8	S	S
<i>Lasioglossum (Evyllaesus) truncatum</i> (Robertson, 1901)	x		x			x		3-10	S	E
<i>Lasioglossum (Hemihalticus) lustrans</i> (Cockerell, 1897)						x		4-9	S	S
<i>Lasioglossum (Lasioglossum) acuminatum</i> McGinley, 1986	x	x	x		x	x	x	4-10	S	S
<i>Lasioglossum (Lasioglossum) athabascense</i> (Sandhouse, 1933)							x	4-10	S	S/Comm.
<i>Lasioglossum (Lasioglossum) coriaceum</i> (Smith, 1853)	x	x	x	x	x	x	x	3-10	S	S
<sup>3</sup> <i>Lasioglossum (Lasioglossum) forbesii</i> (Robertson, 1890)					x			5-10	S	S
<i>Lasioglossum (Lasioglossum) leucozonium</i> (Schrank, 1781)*	x	x	x	x	x	x		5-10	S	S
<i>Lasioglossum (Lasioglossum) paraforbesii</i> McGinley, 1986	x		x	x	x	x	x	4-10	S	S
<i>Lasioglossum (Lasioglossum) zonulum</i> (Smith, 1848)*	x		x	x	x	x	x	4-10	S	S
<i>Lasioglossum (Sphecodogastra) texanum</i> (Cresson, 1872)						x		4-12	S	S
<i>Sphecodes antenmariae</i> Robertson, 1891						x		6-9	[S]	P
<i>Sphecodes atlantis</i> Mitchell, 1956								5-9	[S]	P
<i>Sphecodes banksii</i> Lovell, 1909						x		4-9	[S]	P
<i>Sphecodes clematidis</i> Robertson, 1897	x	x				x		5-10	[S]	P
<i>Sphecodes confertus</i> Say, 1837	x	x				x		3-8	[S]	P
<i>Sphecodes coronus</i> Mitchell, 1956	x	x	x	x		x	x	6-9	[S]	P
<i>Sphecodes cressonii</i> (Robertson, 1903)	x	x	x	x		x	x	1, 4-9	[S]	P
<i>Sphecodes davisii</i> Robertson, 1897	x	x	x	x	x	x	x	5-10	[S]	P
<i>Sphecodes dichrous</i> Smith, 1853	x	x	x	x	x	x	x	4-9	[S]	P
<i>Sphecodes heraclei</i> Robertson, 1897								3-11	[S]	P
<i>Sphecodes illinoensis</i> (Robertson, 1903)						x		5-10	[S]	P
<i>Sphecodes johnsonii</i> Lovell, 1909					x			8-10	[S]	P
<i>Sphecodes levis</i> Lovell and Cockerell, 1907					x			5-8	[S]	P
<i>Sphecodes mandibularis</i> Cresson, 1872	x				x	x	x	5-8	[S]	P
<i>Sphecodes minor</i> Robertson, 1898						x	x	3-9	[S]	P

Oenothera

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST	SOCIALITY	HOST
<i>Sphcodes prosporus</i> Lovell and Cockerell, 1907	x	x	x	x		x	x	5-9	[S]	P	
<i>Sphcodes ranunculi</i> Robertson, 1897				x			x	4-7	[S]	P	
<i>Sphcodes solonis</i> Graenicher, 1911	x		x					5-8	[S]	P	
<i>Sphcodes townesi</i> Mitchell, 1956							x	5-9	[S]	P	
<b>Megachilidae</b>											
<i>Anthidium (Anthidium) manicatum</i> (Linnaeus, 1758)*	x		x				x	6-10	C	S	
<i>Ashmeadiella (Ashmeadiella) bucconis</i> (Say, 1837)	x					x	x	5-8	C	S	
<i>Coelioxys (Boreocoelioxys) banksi</i> Crawford, 1914							x	4-9	[C]	P	<i>Megachile</i>
<i>Coelioxys (Boreocoelioxys) funeraria</i> Smith, 1854	x	x				x		5-9	[C]	P	
<i>Coelioxys (Boreocoelioxys) moesta</i> Cresson, 1864	x	x	x				x	5-9	[C]	P	<i>Megachile</i>
<i>Coelioxys (Boreocoelioxys) octodentata</i> Say, 1824	x	x	x			x	x	5-10	[C]	P	
<i>Coelioxys (Boreocoelioxys) porterae</i> Cockerell, 1900	x	x					x	6-9	[C]	P	<i>Megachile</i>
<i>Coelioxys (Boreocoelioxys) rufitarsis</i> Smith, 1854	x	x	x	x		x	x	4-10	[C]	P	<i>Megachile</i>
<i>Coelioxys (Boreocoelioxys) sayi</i> Robertson, 1897	x	x					x	3-10	[C]	P	<i>Megachile</i>
<sup>5</sup> <i>Coelioxys (Coelioxys) immaculata</i> Cockerell, 1912							x	3-7	[C]	P	
<i>Coelioxys (Coelioxys) sodalis</i> Cresson, 1878	x		x				x	4-9	[C]	P	<i>Megachile</i>
<i>Coelioxys (Cytocoelioxys) modesta</i> Smith, 1854	x	x				x	x	6-8	[C]	P	<i>Megachile</i>
<i>Coelioxys (Synocoelioxys) alternata</i> Say, 1837	x	x	x				x	6-10	[C]	P	<i>Megachile</i>
<i>Dianthidium (Dianthidium) simile</i> (Cresson, 1864)	x		x				x	7-9	C	S	
<i>Heriades (Neotrypetes) carinatus</i> Cresson, 1864	x	x	x	x		x	x	4-9	C	S	
<i>Heriades (Neotrypetes) variolosus</i> (Cresson, 1872)								4-9	C	S	
<i>Hoplitis (Alcidamea) pilosifrons</i> (Cresson, 1864)	x	x	x	x		x	x	4-7	P	S	
<i>Hoplitis (Alcidamea) producta</i> (Cresson, 1864)	x	x	x	x		x	x	4-7	P	S	
<i>Hoplitis (Alcidamea) truncata</i> (Cresson, 1878)	x	x	x			x	x	4-8	P	S	
<i>Hoplitis (Monumetha) albifrons</i> (Kirby, 1837)	x	x					x	5-8	P	S	
<i>Hoplitis (Monumetha) spoliata</i> (Provancher, 1888)	x		x			x	x	4-8	P	S	
<i>Megachile (Callomegachile) sculpturalis</i> Smith, 1853*							x	6-9	C	S	
<i>Megachile (Chelostomoides) campanulae</i> (Robertson, 1903)	x							2-11	C	S	
<i>Megachile (Chelostomoides) rugifrons</i> (Smith, 1854)							x	4-7	C	S	

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST SOCIALITY	HOST
<i>Megachile (Eutricharax) rotundata</i> (Fabricius, 1793)*		x	x		x	x	x	6-9	C	S
<i>Megachile (Leptorachis) petulans</i> Cresson, 1878						x	x	5-9	C	S
<i>Megachile (Litomegachile) brevis</i> Say, 1837	x	x		x		x	x	3-12	C	S
<i>Megachile (Litomegachile) mendica</i> Cresson, 1878	x	x	x	x	x	x	x	5-10	C	S
<i>Megachile (Litomegachile) texana</i> Cresson, 1878	x	x	x	x	x	x	x	6-8	S <sup>1</sup>	S
<i>Megachile (Megachile) centuncularis</i> (Linnaeus, 1758)*	x	x	x	x	x	x	x	5-9	C	S
<i>Megachile (Megachile) inermis</i> Provancher, 1888	x	x	x				x	6-9	C	S
<i>Megachile (Megachile) montivaga</i> Cresson, 1878	x	x	x	x	x	x	x	4-9	C	S
<i>Megachile (Megachile) relativa</i> Cresson, 1878	x	x	x	x	x	x	x	5-10	C	S
<i>Megachile (Megachiloidea) dakotensis</i> Mitchell, 1926								7-8	C	S
<i>Megachile (Sayapis) inimica sayi</i> Cresson, 1872	x	x	x	x	x	x	x	7-9	C	S
<i>Megachile (Sayapis) pugnata</i> Say, 1837	x	x	x	x	x	x	x	6-9	C	S
<sup>5</sup> <i>Megachile (Xanthosarus) addenda</i> Cresson, 1878					x	x		4-10	S	S
<i>Megachile (Xanthosarus) fortis</i> Cresson, 1872	x					x		7-8	C	S
<i>Megachile (Xanthosarus) frigida</i> Smith, 1853	x	x	x	x		x	x	6-9	C	S
<i>Megachile (Xanthosarus) gemula</i> Cresson, 1878	x	x	x	x	x	x	x	4-8	C	S
<i>Megachile (Xanthosarus) latimanus</i> Say, 1823	x	x	x	x	x	x	x	5-10	C	S
<i>Megachile (Xanthosarus) melanophæa</i> Smith, 1853	x	x	x	x	x	x	x	5-8	C	S
<i>Osmia (Diceratomia) conjuncta</i> Cresson, 1864				x				4-7	C <sup>1</sup>	S
<i>Osmia (Helicosmia) caerulea</i> (Linnaeus, 1758)*				x				3-8	C	S
<i>Osmia (Helicosmia) georgica</i> Cresson, 1878					x	x		3-6 (8)	C	S
<i>Osmia (Melanosmia) albiventris</i> Cresson, 1864	x	x	x	x	x	x	x	5-7	C	S
<i>Osmia (Melanosmia) atriventris</i> Cresson, 1864	x	x	x	x	x	x	x	4-7	C	S
<i>Osmia (Melanosmia) bucephala</i> Cresson, 1864	x	x		x			x	4-6	C	S
<i>Osmia (Melanosmia) collinsiae</i> Robertson, 1905	x							4-6	C	S
<i>Osmia (Melanosmia) distincta</i> Cresson, 1864		x	x	x	x	x	x	5-6	C	S
<i>Osmia (Melanosmia) inermis</i> (Zetterstedt, 1838)	x							5-7	C	S
<i>Osmia (Melanosmia) inspergens</i> Lovell and Cockerell, 1907			x				x	5-6	C	S
<i>Osmia (Melanosmia) proxima</i> Cresson, 1864	x	x	x	x	x	x	x	5-8	C	S

Ericaceae

Table 2. Continued

SPECIES	NW	NF	FT	LM	CS	SW	SE	SEASON (Not WI specific)	NEST	SOCIALITY	HOST
<i>Osmia (Melanosmia) pumila</i> Cresson, 1864	x	x	x	x	x	x	x	4-7	C	S	S
<i>Osmia (Melanosmia) similima</i> Smith, 1853	x	x	x	x	x	x	x	5-8	C	S	S
<i>Osmia (Melanosmia) tersula</i> Cockerell, 1912	x	x	x	x	x	x	x	5-7	C	S	S
<i>Osmia (Melanosmia) virga</i> Sandhouse, 1939	x	x	x	x	x	x	x	4-7	C	S	Ericaceae
<i>Osmia (Osmia) lignaria</i> Say, 1837	x	x	x	x	x	x	x	2-6	C	S	S
<i>Paranthidium (Paranthidium) jugatorium</i> (Say, 1824)	x	x	x	x	x	x	x	7-9	S	S	S
<i>Stelis (Stelis) coarctatus</i> Crawford, 1916				x				6-8	[C]	P	Megachilidae
<i>Stelis (Stelis) foederalis</i> Smith, 1854				x				5-7	[C]	P	Megachilidae
<i>Stelis (Stelis) labiata</i> (Provancher, 1888)				x				4-8	[C]	P	Megachilidae
<i>Stelis (Stelis) lateralis</i> Cresson, 1864				x				3-7	[C]	P	Megachilidae
<i>Stelis (Stelis) nitida</i> Cresson, 1878								6-7	[C]	P	Megachilidae
<i>Stelis (Stelis) permaculata</i> Cockerell, 1898			x					7-8	[C]	P	Megachilidae
<i>Stelis (Stelis) submarginata</i> Cresson, 1878				x				7	[C]	P	Megachilidae
<i>Trachusa (Heteranthidium) zebrata</i> (Cresson, 1872)	x	x	x	x	x	x	x	8-10	S	S	S
<b>Melittidae</b>											
<i>Macropis (Macropis) ciliata</i> Patton, 1880							x	5-9	S	S	<i>Lysimachia</i>
<i>Macropis (Macropis) nuda</i> (Provancher, 1882)							x	6-8	S	S	<i>Lysimachia</i>
<b>Total Number of Species</b>	<b>166</b>	<b>125</b>	<b>129</b>	<b>221</b>	<b>95</b>	<b>224</b>	<b>228</b>				
<b>Number of Counties in region</b>	<b>7</b>	<b>12</b>	<b>8</b>	<b>7</b>	<b>9</b>	<b>16</b>	<b>13</b>				

<sup>1</sup>This name has been applied to several species related to *L. viridatum*, and specimens may be misidentified as *Lasioglossum paradimirandum* or other similar species. Additional taxonomic analysis is needed to resolve taxonomic uncertainties in this group (J. Gibbs, pers. comm.).

<sup>2</sup>Records of *L. oblongum* need to be checked as many could pertain to *L. planatum* (Lovell), reinstated as a valid species based on integrative taxonomic work by J. Gibbs. He has confirmed that both true *oblongum* and *planatum* occur in Wisconsin.

<sup>3</sup>Records of *L. pilosum* need to be checked as these could include other closely related species such as *L. succinipenne*, recently confirmed to occur in Wisconsin as a result of integrative taxonomic work by J. Gibbs.

<sup>4</sup>Removed from synonymy with *L. oblongum* based on integrative taxonomic work by J. Gibbs.

<sup>5</sup>Hannah Gaines and Michael Arduser, pers. comm.

<sup>6</sup>Graenicher's (1935) records of *C. aestivalis* Patton pertain to this species (Stephen, 1954).

S<sup>7</sup>Cells constructed of leaves as in related cavity-nesting, leaf-cutting *Megachile*.

C<sup>8</sup>Reportedly nests in snail shells.

Wisconsin during August 2006 (Spring Green Preserve in Sauk County, Avoca Prairie in Iowa County, and Buena Vista Marsh in Portage County). Most (5) specimens were collected on *Solidago* sp. and one individual was collected from *Centaurea biebersteinii* (DC). The distribution of *A. placata* was poorly understood prior to LaBerge's (1967) revision of subgenus *Callandrena* due to confusion by most previous workers with the very similar *Andrena simplex* Smith (= *solidaginis* Robertson).

***Andrena (Cnemidandrena) peckhami* Cockerell, 1902.** A scarce composite specialist collected (2 specimens) on *Solidago* by ATW along the Bonita Grade in the Chequamegon-Nicolet National Forest in Oconto County on 17 August 2005. Also present in museum collections from Buffalo, Burnett, Pierce, and St. Croix Counties in western Wisconsin.

***Andrena (Euandrena) nigrihirta* (Ashmead, 1890).** The only recent Wisconsin specimen of *A. nigrihirta* was collected by Marshall in June 1967 at Lake Namekagon in Bayfield County (IRCW). Originally described by Graenicher (1911), this northern bee species ranges from Alberta to Nova Scotia and the New England states and has been collected from Michigan, Minnesota, and Ontario.

***Andrena (Melandrena) barbara* Bouseman and LaBerge, 1979.** This is a "southeastern" species at the edge of its range. A single specimen was collected in Grant County in southwestern Wisconsin by M. Wolf on 15 June 2006 at a weedy wayside. Very similar to *Andrena perplexa* Smith (= *viburnella* Graenicher) and certain other *Melandrena*, this species might have been overlooked or misidentified by earlier authors.

***Andrena (Parandrena) wellesleyana* Robertson, 1897.** This sandbar willow specialist is known in Wisconsin only from an undated Dane County specimen in the IRCW.

***Andrena (Scaphandrena) arabis* Robertson, 1897.** Represented by 3 specimens from Dane and Sauk Counties (IRCW). A Brassicaceae visitor, this species also has been recorded from Illinois, Indiana, and Michigan.

***Andrena (Tylandrena) wilmattae* Cockerell, 1906.** Two specimens of this poorly known Wisconsin species were collected from Dane and Trempealeau Counties (IRCW). The species is known to occur in all five nearby states (Illinois, Indiana, Iowa, Michigan, and Minnesota).

#### Apidae

***Bombus (Pyrobombus) frigidus* Smith, 1854.** Specimens believed to be *B. frigidus* were caught at Thunder Lake State Wildlife Area in Oneida County on 11 June 2006 and 10 June 2007 by ATW. The color pattern of these bees resembles typical *B. (Pyrobombus) vagans* (Smith) and *B. (Pyrobombus) sandersoni* (Franklin) but the metasoma is orange-tipped. Studies of DNA sequences are in progress and should diagnose the status of this population with respect to *B. sandersoni* and other similar species. The Thunder Lake area is surrounded by extensive boreal forest, including some of the best areas of open lowland conifers in north central Wisconsin. Individuals were visiting patches of *Trifolium repens* (L.) in 2006 and *Rubus* sp. along a refuge road during 2007. Other than an unconfirmed report from Maine this would be the only known record of this northern and western montane species from the eastern United States.

***Bombus (Bombus) affinis* Cresson, 1863; *Bombus (Bombus) terricola* Kirby, 1837.**

Represented in collections from numerous Wisconsin localities but not found during 2005-07 by ATW and others, although one *B. affinis* was photographed by I. Loser in Dane County in 2006 (<http://bugguide.net/node/view/80951>). Recent records are of interest due to documented declines in these

species and their parasite *Bombus ashtoni* (Cresson) (National Research Council 2007, Colla and Packer 2008, Grixti et al. 2009).

***Bombus (Psithyrus) ashtoni* (Cresson, 1864).** Widely represented in historical collections from Wisconsin, but we have seen no recent (post-2000) records from Wisconsin or anywhere else in eastern North America. A social parasite of the declining *B. affinis* (Cresson) and *B. terricola* (Kirby), this species is at least as vulnerable as its hosts and deserves the same or greater conservation concern. The most recent records of this species known to us are five queens collected in Wasilla, Matanuska-Susitna Borough, Alaska by L. Revet during 19-25 May 2003 (AMNH collection, det. by JSA).

***Bombus (Thoracobombus) pensylvanicus* (DeGeer, 1773); *Bombus (Psithyrus) variabilis* (Cresson, 1872).**

*Bombus pensylvanicus* (DeGeer) and its social parasite *B. variabilis* (Cresson) were not detected in our study and seem to have declined across the northern edge of their range (Colla and Packer, 2008). All historical specimens of *B. pensylvanicus* examined except one (an IRCW specimen with missing locality data) were found in the MPM collection. The MPM collection localities reveal a mainly southern or western distribution in Wisconsin: Dodge, Grant, Milwaukee, Pierce, St. Croix, Vernon, and Waushara Counties. *B. variabilis* is widely represented in historical collections, especially from the Central Sands Region and southern Wisconsin. Medler and Carney (1963) report specimens from Dane, Columbia, Grant, Iowa, Sauk, and Waushara Counties, and MPM specimens were collected in Portage and Burnett Counties.

***Epeoloides pilosula* Cresson, 1878.** Historical records of this cleptoparasite of *Macropis* species are from southern and western Wisconsin (Burnett, Dane, Douglas, Grant, Pierce, St. Croix, and Vernon Counties). Since 1960 *E. pilosula* has been found only in Nova Scotia (Sheffield et al. 2004; see also Ascher 2005) and recently Connecticut (Wagner and Ascher 2008).

***Epeolus ainsliei* Crawford 1932.** Collected on 25 July 2006 by ATW at Spring Green Preserve in Sauk County. This is another prairie species, new for the eastern USA *sensu* Mitchell (1962). It was known previously from Iowa and elsewhere in the Great Plains from Alberta and Manitoba to Texas. The Spring Green specimen was collected over a sandy area in association with potential *Colletes* hosts (*C. americanus* and *C. susannae*).

***Neolarra vigilans* (Cockerell, 1895).** Three specimens in the IRCW, collected by P. Gruber in a flight-intercept trap at the Spring Green Preserve in Sauk County between 24 July and 2 August 2000, were identified by JSA as *N. vigilans*. This is the first record of tribe Neolarrini for the eastern USA outside of the southeast, where the genus is known only from Georgia and Tennessee, and is the first records of *N. vigilans* for the eastern USA (Shanks 1977). *Perdita gerhardi* (Viereck), a likely host species, was collected by Gruber at the same time at the Spring Green Preserve. These species are well-matched in size, but definitive host associations will require rearing from excavated nests. *N. vigilans* must have different hosts elsewhere in its wide range as *P. gerhardi* does not occur in the southwestern USA and northern Mexico where *N. vigilans* occurs. Spring Green Preserve is a 409 ha (1,011 acre) state natural area commonly referred to as the "Wisconsin Desert". Located in the unglaciated southwestern part of Wisconsin, it features dry prairie, open sand blowouts, and a number of rare invertebrate species (Meyer 2003).

***Nomada armatella* Cockerell, 1903.** Two male specimens were collected on 22 May 2005 near Old Highway 64 in Oconto County.

***Nomada australis* Mitchell, 1962.** This cleptoparasite on *Agapostemon* is represented in Wisconsin by a single specimen collected in Shawano County during August 2002 (IRCW), an unusually late date for this species. No records

have been documented from adjacent states, but this primarily eastern and southern species also has been collected in Indiana.

***Nomada graenicheri* Cockerell, 1905.** Known with certainty only from Wisconsin and Ontario. Museum specimens from Wisconsin (all undated) were collected from Buffalo, Burnett, Pierce, St. Croix, and Washburn Counties (MPM).

***Nomada hydrophylli* Swenk, 1915.** A presumed cleptoparasite of vernal *Andrena*, *N. hydrophylli* was collected by ATW and J. Watson in Brown County. Not found in historical Wisconsin museum collections or from nearby states except Illinois.

***Nomada illinoensis* Robertson, 1900.** This widespread cleptoparasite of *Andrena* is documented in Wisconsin by 10 specimens collected in late spring/early summer (April – June) between 1920 and 1953 (IRCW). Localities include Door, Dane, Washington, and Iron Counties.

***Nomada imbricata* Smith, 1854.** Represented in Wisconsin by 3 specimens (IRCW) collected during April by Medler in Washington County (1952) and during May in Dane County (Fye in 1953 and Kriska in 1993). A widespread eastern North American cleptoparasite of *Andrena* (*Melandrena*) species, *N. imbricata* also occurs in Illinois, Indiana, and Michigan.

***Nomada lehighensis* Cockerell, 1903.** The single Wisconsin specimen of this eastern North American cleptoparasite of *Andrena* was collected by R.E. Fye during June 1952 in Bayfield County (IRCW). The species also is documented from Illinois, Indiana, and Michigan.

***Nomada luteoloides* Robertson, 1895.** A species not previously reported for Wisconsin, collected by J. Watson 16 June 2005 at Dunbar Barrens State Natural Area in Marinette County (northeastern Wisconsin) in a white bowl trap. Dunbar Barrens State Natural Area is an open barrens dominated by low growing woody plants like *Vaccinium* sp. and grasses. *N. luteoloides* is a common and widespread cleptoparasite of *Andrena* (*Melandrena*). JSA identified 18 additional specimens from the IRCW collection dating back to 1902. The most recent of these included collections from Dane (1996), Racine (2000), and Wood (2004) Counties.

***Nomada perplexa* Cresson, 1863.** The only Wisconsin record since 1953 was collected by Robert Murphy during June 2005 in Waupaca County. Four older specimens (1931-1953) are present in IRCW from April-June in Dane and Washington Counties.

***Nomada rubicunda* Olivier, 1811.** Represented by three specimens (IRCW) all collected during June. Localities include Peninsula State Park in Door County (1956), Ft. McCoy in Monroe County (1997), and Kettle Moraine State Forest in Waukesha County (2001). Also found in Indiana, Michigan, and Minnesota, this species is believed to be a cleptoparasite of *Agapostemon*. In New York State, where rarely collected, it seems to be associated with sandy habitats such as the Albany Pinebush.

***Nomada wisconsinensis* Graenicher, 1911.** Recent specimens of this geographically restricted species have been collected at Ft. McCoy in Monroe County (J. Maxwell, June 1997) and in the southern Kettle Moraine Forest of Waukesha County (Craig Brabant, June 2001). This cleptoparasite, first described by Graenicher, also is known from Illinois, Michigan, and Minnesota.

***Nomada xanthura* Cockerell, 1908.** Not collected in Wisconsin since 1933, when it was found near Madison. Two specimens (IRCW) also were collected in 1928 by Granovsky in Door County. All Wisconsin specimens were collected during the month of May. This cleptoparasite of *Andrena* is known from Illinois and also from Nova Scotia to New York and New England. *N. xanthura* may be a senior synonym of *N. inepta* Mitchell, 1962, as these two nominal species are separated on the basis of a mere color difference; the yellow tergal maculations

of *N. xanthura* are more extensive (S. Droege, pers. comm.). *N. inepta* has, in turn, been associated as the male (junior synonym) of *N. gracilis* Cresson, 1863, using DNA barcodes, (Sheffield et al. 2009). Further comparative studies of these three nominal taxa, of other nominally valid North American species including *N. composita* Mitchell, 1962, *N. detrita* Mitchell, 1962, *N. mendica* Mitchell, 1962, and *N. ochlerata* Mitchell, 1962, and of the European *N. flava* Panzer (similarity of this species to *N. xanthura* was noted by M. Schwarz pers. comm.), are required to resolve numerous remaining taxonomic difficulties in this group.

***Xylocopa (Xylocopoides) virginica virginica* (Linnaeus, 1771).** The common eastern carpenter bee is known in Wisconsin from only two specimens collected in 1923 (no date) near Racine (IRCW). The species is now known from all of the eastern United States (Vermont records were confirmed by L. Richardson pers. comm.).

### Colletidae

***Colletes aberrans* Cockerell, 1897; *C. albescens* Cresson, 1868; *C. andreusi* Cockerell, 1906; *C. susannae* Swenk, 1925; *C. wilmattae* Cockerell, 1904.** These Great Plains species reach their eastern range limits in Iowa, Illinois, Wisconsin, Minnesota, and Michigan. All of the specimens are present in the Milwaukee Public Museum (MPM) collection, while *C. aberrans* also is present in the IRCW and ATW collected *C. susannae* on 23 July 2006 at Spring Green Preserve.

***Colletes consors mesocopus* Swenk, 1907; *C. impunctatus lacustris* Swenk, 1906.** Both species are boreal bees reaching the southern edges of their eastern ranges in Wisconsin. All older specimens are found in the MPM Collection. ATW and students collected recent specimens of *C. c. mesocopus* on 17 June 2005 and 29 June 2006 at Toft Point State Natural Area in Door County.

***Colletes nudus* Robertson, 1898.** This southern species is not present in historical Wisconsin collections but was found visiting *Spiraea* by ATW at Avoca Prairie in Iowa County on 23 July 2006.

***Hylaeus (Prosopis) nelumbonis* (Robertson, 1890).** Collected from Dane County (IRCW) and found by ATW on 23 July 2006 at Avoca Prairie in Iowa County, where it was visiting *Eupatorium maculatum* (L.). Water lilies (Nymphaeales) were present in floodplain wetlands within 500 m of this site.

### Halictidae

***Dufourea marginata* (Cresson, 1878).** Sunflower specialist collected at *Helianthus* on 29 August 2006 by ATW at Avoca Prairie (Iowa Co). Also present in MPM collection (Polk and St. Croix Counties).

***Dufourea monardae* (Viereck, 1924).** Specialist on *Monarda*. Collected in Brown County by ATW and present in IRCW (specimen from Dane Co). This *Monarda* specialist is best known from the Upper Midwest (including Michigan, Illinois, Indiana) and southern Ontario, but was collected by JSA on 10 Aug 2008 near Elmira in Chemung County, New York, a new state record and significant range extension.

***Dufourea novaeangliae* (Robertson, 1897).** Specimens from western Wisconsin are present in IRCW and MPM collections. This is a *Pontederia* specialist at the NW edge of its range in Wisconsin.

***Lasioglossum (Dialictus) bruneri* (Crawford, 1902); *Lasioglossum (Dialictus) coreopsis* (Robertson, 1902); *Lasioglossum (Dialictus) nymphaearum* (Robertson, 1895); *Lasioglossum (Dialictus) paradmirandum* (Knerer and Atwood, 1966); *Lasioglossum (Evylaeus) swenki* (Crawford, 1906).** These 5 species were added to the state list by the Wisconsin Department of Natural Resources' Prairie Invertebrate Survey during the



mid-1990's. All were found in native prairie remnants in southern Wisconsin, and all are known from grasslands in at least one of the nearby states (Illinois, Indiana, Michigan, or Minnesota).

***Lasioglossum (Dialictus) atlanticum* (Mitchell, 1960).** Recent specimens collected by ATW and colleagues in Brown, Iowa, and Grant Counties were identified by J. Gibbs as *L. atlanticum*. Many specimens labeled as *L. admirandum* in historic collections actually pertain to this species.

***Lasioglossum (Dialictus) divergens* (Lovell, 1905).** ATW observed and collected specimens in suburban Green Bay in Brown County on 1 July 2006; the bees were visiting *Lysimachia ciliata* (L.) and *Dalea purpurea* (Vent.). Also collected on *Rubus* spp. in Forest County on 11 June 2005.

***Lasioglossum (Dialictus) dreisbachi* (Mitchell, 1960).** This rare northern species was collected by ATW in a bowl trap in an oak woods in Brown County on 25 May 2005 and later identified by J. Gibbs. Also known from Minnesota, Michigan, and New York.

***Lasioglossum (Dialictus) ellisiae* (Sandhouse, 1924).** The single Wisconsin specimen was collected at Spring Green Prairie (Sauk County) in July 2006 by ATW and later identified by J. Gibbs. This species was synonymized with *L. tegulare* by Mitchell (1960) but was recently resurrected by Gibbs (2009).

***Lasioglossum (Dialictus) hartii* (Robertson, 1892).** A rarely collected species from the southeastern and central United States is represented by a single undated specimen from Vernon County in MPM collection.

***Lasioglossum (Dialictus) hemimelas* (Cockerell, 1901).** This rarely collected species previously known only from New Mexico and Colorado. The single Wisconsin specimen was collected on 24 May 2005 from Oconto County by ATW and later identified by J. Gibbs.

***Lasioglossum (Dialictus) illinoense* (Robertson, 1892).** A single specimen was collected by M. Wolf on 7 July 2006 near Eau Claire and later identified by J. Gibbs. This species is widely distributed in eastern North America.

***Lasioglossum (Dialictus) obscurum* (Robertson, 1892).** The only 2 Wisconsin specimens are from Dane County (Medler, July 1952) and Grant County (no date). This species is scarce but widespread in the eastern U.S., including records from Illinois, Indiana, Michigan, and Minnesota.

***Lasioglossum (Dialictus) perpunctatum* (Ellis, 1913).** Collected by ATW near Lake Michigan at Kingfisher Farm in Manitowoc County (30 July 2005) on *Rudbeckia hirta* (L.) and *Argentina anserina* (L.) Rydab. and on 29 June 2006 on *Potentilla* at Ridges Sanctuary in Door County.

***Lasioglossum (Dialictus) rohweri* (Ellis, 1915).** Collected by R. Howe at Solon Springs in Douglas County on 2 June 2005 in white bowl trap. Also collected on *Penstemon digitalis* (Nutt. ex Sims) at UWGB prairie restoration in Brown County on 20 June 2005, at Kingfisher Farm in Manitowoc County on 30 July 2005, at Dunbar State Natural Area in Marinette County on 30 May 2005, Buena Vista Wildlife Area in Portage County, Lower Wisconsin River Wildlife Area in Grant County on 1 July 2005, Scuppernong Prairie in Waukesha County on 2 July 2006, Navarino State Wildlife area in Shawano County on 9 July 2006, and in Minoqua in Oneida County on 20 July 2005 (all by ATW). Identified by S. Droege. Likely overlooked by early workers due to great similarity to certain other *Dialictus* species, especially *L. lineatulum* and *L. versatum* (Robertson, 1902).

***Lasioglossum (Dialictus) sagax* (Sandhouse, 1924).** Newly recorded from eastern North America based on Wisconsin specimens collected by ATW at Kingfisher Farm in Manitowoc County on 30 July 2005 and on Ridges Road in Door County on 29 June 2006. Specimens were identified by J. Gibbs. Previously known only from Colorado.

***Lasioglossum (Dialictus) subviridatum* (Cockerell, 1938).** Newly recorded from the United States based on Wisconsin specimen collected by ATW at the Lower Wisconsin River State Wildlife Area in Grant County on 1 July 2005. Specimen was identified by J. Gibbs. Previously recorded only from Saskatchewan.

***Lasioglossum (Dialictus) succinipenne* (Ellis, 1913).** Easily confused with *L. pilosum* and therefore underrecorded. Specimens of this western species were collected in Brown, Dane, Door and Grant Counties by UW-Green Bay scientists in June and July 2005-06 and identified by J. Gibbs. Previously recorded only from Colorado.

***Lasioglossum (Evyllaesus) nelumbonis* (Robertson, 1890).** Single specimen collected on *Eupatorium maculatum* L. flowers by ATW at Avoca Prairie on 23 July 2006. Water lilies (Nymphaeales) were present in nearby floodplain wetlands. Specimens from Pierce and Walworth Counties also are present in MPM collection.

***Lasioglossum (Hemihalictus) lustrans* (Cockerell, 1897).** Known in Wisconsin from 9 specimens collected at Ft. McCoy (Monroe County) in July 1997. Also documented from Michigan, Indiana, and other localities from New Mexico to North Dakota and along the Atlantic Coast north to Delaware.

***Lasioglossum (Lasioglossum) forbesii* (Robertson, 1890).** Collected recently by Hannah Gaines in Wood County during research on bees of cranberry bogs and identified by M. Arduser. An eastern species ranging from Wisconsin to New York and south to Oklahoma and North Carolina. Historical records from far beyond this area are misidentifications of related species (see McGinley 1986).

***Lasioglossum (Sphecodogastra) texanum* (Cresson, 1872).** A nocturnal bee specialist on *Oenothera* represented in Wisconsin collections examined by a single IRCW specimen. McGinley (2003) recorded this species from Pierce County (Prescott) and from Wood County (Port Edwards).

***Sphecodes antennariae* Robertson, 1891.** Eastern species represented in Wisconsin by one record in MPM collection (Vernon County); also documented from Illinois, Michigan, and Indiana.

***Sphecodes atlantis* Mitchell, 1956.** Collected on *Solidago* by M. Wolf at Red Arrow Park Marinette County on 17 August 2006. This tiny cleptoparasite also is known from Illinois, Michigan, and Minnesota.

***Sphecodes johnsonii* Lovell, 1909.** The only Wisconsin specimens were collected during September 1961 in Dane County and more recently near Plainfield in 2003, also during September (IRCW). This eastern North American cleptoparasite is known from Michigan but not other nearby states. The undescribed male has recently been discovered by JSA among collections from coastal New York and Massachusetts (the latter collected by G. I. Stage). It is similar to *S. davisii* Robertson, but the metasoma is entirely black, not partly red.

***Sphecodes townesi* Mitchell, 1956.** Known from a single Wisconsin specimen collected at Abrahams Woods State Natural Area in Green County during June 2000 (IRCW). Also recorded in Michigan, but unrecorded from other nearby states.

***Sphecodes levis* Lovell and Cockerell, 1907.** A single specimen was collected by ATW along a sandy road in Marinette County at Dunbar State Natural Area on 30 May 2005. Also known from Michigan and Minnesota.

***Sphecodes banksii* Lovell, 1909.** Only Wisconsin specimen collected by ATW at Spring Green Preserve (Sauk County). Documented from Indiana, Michigan, and Minnesota.

***Sphecodes solonis* Graenicher, 1911.** A northern species described from Solon Springs in Douglas County (Graenicher 1911). Historic collections

also have been recorded from Clark County (AMNH). Most recent Wisconsin collection was in 1978 near Clam Lake in Ashland County. Also known from Minnesota.

### Megachilidae

***Anthidium (Anthidium) manicatum (Linnaeus, 1758)***. Exotic species new to Wisconsin. Found in Dodge County (Beaver Dam, 28 August 2006 on mint by ATW) and Dane County (Madison, 14 October 2005 by Schmidt and 28 September 2005 on *Lavandula* sp. by Mader). This species has rapidly expanded its range in the midwestern USA having been found in Ohio and Michigan (Miller et al., 2002), and subsequently in Illinois (Tonietto and Ascher, 2009) in addition to Wisconsin.

***Coelioxys (Coelioxys) immaculata Cockerell, 1912***. A male and female of this cleptoparasite of *Megachile addenda* were collected recently in Wood County by Hannah Gaines as part of her research on bees of cranberry bogs; identified by M. Arduser.

***Dianthidium (Dianthidium) simile (Cresson, 1864)***. A scarce, localized species collected by M. Wolf near Eau Claire in Eau Claire County on 7 July 2006 and two days later by ATW at Navarino State Wildlife Area in Shawano County. Specimens from western Wisconsin also are in MPM collection.

***Hoplitis (Monumetha) albifrons albifrons (Kirby, 1837)***. Boreal subspecies poorly documented in eastern USA. Historical records are from widely distributed localities throughout the state (e.g., Milwaukee, Monroe, Door, Douglas Counties) in MPM and IRCW collections. No recent collections.

***Megachile (Chelostomoides) rugifrons (Smith, 1854)***. Uncommon species represented in Wisconsin by only two specimens (Dane County, Oconto County) in IRCW collection. Also known from Illinois, Indiana, Iowa, and Michigan.

***Megachile (Callomegachile) sculpturalis Smith 1853***. Exotic species of East Asian origin new to the state. Collected in Milwaukee County September 2004 by S. Sullivan Borkin on butterfly bush (*Buddleia* sp.). Also photographed by I. Loser at Cross Plains in 2007 ([www.bugguide.net](http://www.bugguide.net)). We have now seen records from nearly all of the eastern United States including Illinois (Tonietto and Ascher, 2009).

***Megachile (Eutricharaea) rotundata (Fabricius 1793)***. Accidentally introduced to North America from the Old World and now a very important managed pollinator of alfalfa. Found between June and late August 2006 at numerous localities, including Chippewa, Columbia, Dodge, Grant, Portage, LaCrosse, and Oconto Counties during 2006.

***Megachile (Leptorachis) petulans Cresson, 1878***. Known from 3 specimens in IRCW collection, 2 from Dane County in 1931 (July and August) and a third, undated specimen, from Vernon County. Widespread species also recorded from Illinois, Indiana, and Iowa.

***Megachile (Xanthosarus) addenda Cresson, 1878***. Recently added to the Wisconsin list based on collections by Hannah Gaines as part of research on bees of cranberry bogs. Identified by M. Arduser.

***Osmia (Melanosmia) albiventris Cresson, 1864***. Numerous specimens from widely distributed localities are present in MPM and IRCW collections, but no recent collections are known. We have seen few recent specimens from anywhere in eastern North America and suspect that this species has declined.

***Osmia (Melanosmia) collinsiae Robertson 1905***. A single specimen collected in Douglas County near Solon Springs on 2 June 2005 by R. Howe in a blue bowl trap.

***Osmia (Melanosmia) inermis* (Zetterstedt, 1838).** The only Wisconsin specimen was collected by Medler in May 1952 near Spooner in Washburn County (IRCW). This Holarctic species has been documented from Michigan but no other adjacent state. Known to favor *Vaccinium*.

***Osmia (Helicosmia) georgica* Cresson 1878.** One collected on *Senecio* sp. along a roadside in Iowa County on 3 June 2006 (ATW) is the only Wisconsin record of this southern species.

***Osmia (Melanosmia) proxima* Cresson, 1864.** Northern species represented by numerous specimens in MPM and IRCW collections, but no recent collections by ATW and others.

***Osmia (Melanosmia) tersula* Cockerell, 1912.** Northern and western montane species found also in Michigan and Minnesota. Only Wisconsin records are specimens in IRCW collection from far northern counties.

***Stelis (Stelis) coarctatus* Crawford, 1916.** Not found in Wisconsin since July 1903, when Graenicher collected a single specimen near Milwaukee (Milwaukee Public Museum). A cleptoparasite of Megachilidae, also recorded from Indiana, Iowa, Michigan, and Minnesota.

***Stelis (Stelis) foederalis* Smith, 1854.** Only state records are MPM and IRCW specimens from Milwaukee and Door Counties. Known from Illinois, Michigan, and Minnesota.

***Stelis (Stelis) labiata* Provancher, 1888).** Uncommon, collected by ATW at Toft Point in Door County on 29 June 2006. Only other Wisconsin record is an IRCW specimen with no precise locality data. Documented from Illinois, Indiana, and Michigan.

***Stelis (Stelis) permaculata* Cockerell, 1898.** Only documented specimen is at the American Museum of Natural History, collected on July 23, 1919 in Worden Township, Clark County. This rarely detected cleptoparasite is known from Illinois but no other adjacent state.

***Trachusa (Heteranthidium) zebra* (Cresson, 1872).** Wisconsin is the type locality of *Anthidium (Protanthidium) chippewaense* Graenicher, 1910, a junior synonym of *T. zebra*. We have seen no recent records from the state. This species occurs in the Western and Central United States, but only locally in the Midwest including Minnesota and Michigan.

#### Melittidae

***Macropis (Macropis) ciliata* Patton, 1880.** Recorded from Pierce, St. Croix, and Vernon Counties in MPM collection. Now rare, this species has also been recorded from Illinois.

#### DISCUSSION

Our list of Wisconsin bee species provides a useful baseline for future studies, although the relatively large number of new records collected since 2005 suggests that much remains to be discovered about the Wisconsin bee fauna. The number of species (Table 2) represented in collections is highest for southern Wisconsin (Southeastern and Southwestern regions) and the Lake Michigan Coastal region, not surprising given that the homes of major collectors are located there (Milwaukee, Madison, Green Bay). With the possible exception of Northwestern Wisconsin (NW), the extensive areas of natural and semi-natural habitats in northern Wisconsin appear to be relatively under-sampled. The most poorly represented geographic area on our list is the Central Sands (CS) region. Although covering only nine counties, this region includes large areas of potentially important bee habitats in Adams, Columbia, Green Lake, Jackson, Juneau, Marquette, Portage, Waushara, and Wood Counties. These areas should be high priorities for future field surveys, although new records

can be expected from all regions in the state. The Wisconsin bee fauna includes several assemblages of species with similar ecological or geographic affinities, representing important elements of the native bee fauna that should be recognized by conservation strategies.

**Boreal bees.** Several bee species are primarily associated with boreal habitats, reaching their southern limits in Wisconsin. These species are more or less restricted to the northern and eastern portions of the state, where the cooling effects of Lake Superior and Lake Michigan result in low average summer temperatures compared with other parts of the state (Graenicher 1935). Similar conditions also occur extensively in northern Michigan and Minnesota. Northern species are generally well represented in the flora and associated bee fauna (e.g., *Bombus borealis*) from eastern Wisconsin south to northeastern Illinois (see Pearson 1933), although truly boreal species reach only northern Minnesota, the Upper Peninsula of Michigan, and northern Wisconsin. At Solon Springs in northwestern Wisconsin (Douglas County), Graenicher recorded several characteristically boreal bees in 1909 (Graenicher 1911), including *Colletes impunctatus lacustris* and *Sphecodes solonis* (type locality). Our recent record of *B. frigidus* in north-central Wisconsin represents another example of a boreal bee species that is restricted to sites of appropriate northern habitat and microclimate.

**Western bees.** A remarkable assemblage of bee species with western or prairie affinities reaches its northern or eastern limits in unglaciated portions of western Wisconsin, extending northward through the St. Croix and Mississippi Valleys. Species characteristic of the Great Plains but generally absent from forested eastern North America include *Colletes aberrans* and *C. albescens*, and *Anthophora walshii*, and its probable cleptoparasite *Xeromelecta interrupta*. Of these, *Anthophora walshii* is interesting for its disjunct occurrence as far east as coastal New England.

**Sand specialist bees.** Several bee species that nest exclusively in sand or visit host plants restricted to sand occur in southeastern and central Wisconsin, especially along the Wisconsin River. Sand specialists include *Dianthidium (Dianthidium) simile* (O'Brien 2008), *Lasioglossum (Dialictus) vierecki*, and probably several *Perdita* and *Colletes* that serve as hosts of cleptoparasitic *Neolarra* and *Epeolus*, respectively.

**Prairie bees.** Collections of new state records by Wisconsin Department of Natural Resources researchers during the 1990's and more recently by ATW and colleagues demonstrate that remnant prairies and barrens in Wisconsin harbor many remnant populations of native bees, especially among sweat bees of the genus *Lasioglossum*. The WDNR collections have not been completely analyzed and are likely to provide additional new findings. Native grasslands and barrens clearly should be a high priority for bee conservation in Wisconsin.

**Oligolectic bees.** Oligolectic bees (Table 2) have specific ecological needs that must be considered when sampling bees and assessing their conservation needs and utility as pollinators. Graenicher's work and that of Robertson in southern Illinois provide a solid foundation for understanding oligolecty among Wisconsin bee species, but require updating based on subsequent studies. *Physalis* specialists include *Colletes latitarsis* and *Perdita halictoides* (recorded by Graenicher as *P. maura*). Visitors of aquatic plants in Wisconsin include two species that are poorly studied but seem to have some degree of association with Nymphaeaceae: *Hylaeus nelumbonis* and *Lasioglossum (Evylaeus) nelumbonis*. *Dufourea novaeangliae* requires the aquatic pickerelweed, *Pontederia cordata*. L. *Lasioglossum (Sphecodogastra) texanum* is a nocturnal oligolecte of *Oenothera* (Kerfoot 1967). All *Macropis* species are specialists of *Lysimachia* (Myrsinaceae), from which they collect pollen and floral oils used for food and nest linings (Cane et al. 1983).

A few oligolectic associations proposed by Graenicher (1935, and previous papers) are now regarded as incorrect. *Andrena wheeleri* is now thought to be a polylectic species with some preference for blueberries (*Vaccinium*) rather than an oligolectic of Apiaceae (=Umbelliferae) as indicated by Graenicher (LaBerge 1989). Graenicher recorded the introduced *Melilotus albus* Medik. (as *M. alba* Desv.) (Fabaceae) as the pollen source of *Perdita maculigera maculipennis* Graenicher and hypothesized that it originally collected pollen from native Leguminosae (=Fabaceae). However, this subspecies has subsequently been reported to collect pollen from *Salix* (Salicaceae) (Timberlake 1960; Michener and Ordway 1963), and JSA found a few visiting sandbar willows, *Salix exigua* Nutt. at Cayuga Inlet, Ithaca, New York after examining specimens from that host plant and locality in the Cornell University Insect Collection obtained by the late G.C. Eickwort.

**Parasitic bees.** Parasites may be particularly vulnerable to environmental threats because they require substantial populations of particular host bees for survival. Compounding this problem, many parasitic bee species remain rare in collections, including several Wisconsin species (Table 2); partly for this reason the taxonomy and identification of genera such as *Nomada* and *Sphcodes* requires much additional work. In addition to being worthy of conservation status in their own right, cleptoparasites can serve as indicators of healthy populations of their host bees.

**Seasonality of bees in Wisconsin.** The earliest seasonal flight records of bees noted by Graenicher (1935) from the Milwaukee area were of *Andrena frigida* (as *A. cockerelli*), a willow specialist, and *Osmia lignaria*, a regular polylectic of willows, collected on 31 March 1903 from staminate flowers of the earliest-blooming willow, *Salix discolor* (Muhl.). Willows (*Salix* spp.) typically are in flower by mid-April in northeastern Wisconsin according to recent phenology records by G. Fewless (pers. comm., University of Wisconsin-Green Bay Herbarium, Green Bay, WI). Data from Ithaca, NY from 1996-2003 (Ascher, unpublished) indicate that *Colletes inaequalis* emerges there in the last week in March simultaneous with or slightly before *A. frigida*, although Graenicher (1935) did not record *C. inaequalis* until April.

Late-occurring species like *Andrena asteris*, *A. canadensis*, *A. hirticincta*, and *Pseudopanurgus andreoides*, *P. nebrascensis*, and *P. rudbeckiae* are associated with fall-flowering species of Asteraceae. The flight periods of these autumnal bees, like those associated with early spring flowers, may be compressed into very short windows of time in northern Wisconsin due to early or late onset of cold conditions.

**Comparison with other states.** JSA has compiled a comprehensive list of published and many additional unpublished bee distributions for nearby states (and elsewhere), including records cited by Mitchell (1960, 1962) and subsequent revisions (see above). These state lists incorporate published records by Pearson (1933) from the Chicago area, Robertson (1929, updated by Marlin and LaBerge 2001) from southern Illinois, Evans (1986) from southeastern Michigan, and Tuell et al. (2009) from Michigan. According to this compilation, nine species on our Wisconsin list (*Bombus frigidus*, *Colletes andrewsi*, *Neolarra vigilans*, *Nomada xanthura*, *Stelis submarginata*, *Lasioglossum planatum*, *L. sagax*, *L. succinipenne*, and *L. subviridatum*) have not been recorded in any of the adjacent states of Minnesota, Michigan, Iowa, and Illinois, or from nearby Indiana (Table 3). The *Lasioglossum* (*Dialictus*) have been underrecorded due to inadequate knowledge of their taxonomy and identification. The ranges of most of the other species are centered in the Great Plains west of Wisconsin or in the boreal region to the north, including the northern Great Lakes.

At least 130 species are recorded from Illinois but not Wisconsin, including a large number of "southern" species recorded at Carlinville (Marlin and LaBerge 2001) and other sites in southern Illinois. A larger proportion

**Table 3.** Comparison of the documented bee fauna in Wisconsin with species lists from nearby states compiled by Ascher and colleagues. These records are online at [www.discoverlife.org](http://www.discoverlife.org) as part of the “AMNH\_BEES” database.

State	Total Species	Recorded in WI	Not in WI	% Shared with WI
Illinois	417	285	132	68.3
Indiana	388	285	103	73.5
Iowa	204	169	35	82.8
Michigan	404	325	79	80.4
Minnesota	325	277	48	85.2
All 5 states	577	381	191	66.0

of species (> 80%) listed for Iowa, Michigan, and Minnesota also are found in Wisconsin. According to this analysis, Wisconsin’s bee fauna is most similar to that of Minnesota, reflecting shared northern elements and limited southern elements in these faunas.

**Changes in the Wisconsin bee fauna over time.** The bees of Wisconsin are important in broader context due to the historical contributions by S. Graenicher. Early research on Wisconsin’s bee fauna was rife with new discoveries, although several species from the state have been subsequently recognized as junior synonyms (Table 4). Graenicher described 20 species from specimens collected at Milwaukee and elsewhere in Wisconsin. Other authors also described new bee species from Wisconsin specimens collected by Graenicher, naming in his honor a *Halictus sensu lato* (Ellis 1914; now a junior synonym of *Lasioglossum pictum* (Crawford)) an *Andrena* (Cockerell 1902; now a junior synonym of *Andrena helianthi* Robertson), and a *Nomada* (Cockerell 1905).

By 1935 Graenicher already had recognized significant changes in the bee fauna and host plants compared with his collections from earlier decades. He began his treatise on Wisconsin bees with the following observation (p. 285): “Much of the information presented in this article was obtained in Milwaukee, Wisconsin, around the beginning and in the early part of the present century. In the meanwhile Milwaukee, the largest city of the state, has grown far beyond its former limits, thereby bringing about considerable changes in the biota of the surrounding territory. This statement applies especially to the various plant communities with which the bees were associated. In other words, this article deals to quite an extent with conditions as they were found years ago.”

Graenicher (p. 300) described *Epeoloides pilosula* as “comparatively common at Milwaukee” and noted that it, “has been found in western Wisconsin all along the St. Croix and Mississippi Rivers, together with *M. morsei* [= *Macropis nuda*] (along the St. Croix) and *M. ciliata* Patton (along the Mississippi).” Despite the former abundance and wide distribution of *Epeoloides* in Wisconsin and elsewhere in eastern North America, representatives of this genus (and its tribe, Osirini) were not recorded anywhere in North America since 1960 until two males were collected in Nova Scotia, Canada in 2002 (Sheffield et al. 2004; see also Ascher 2005) and a few specimens were subsequently collected in Connecticut in 2006 (Wagner and Ascher 2008). Relict populations may persist in Wisconsin and should be looked for wherever its *Macropis* hosts and their *Lysimachia* host plants still occur.

Several bumble bee species have declined alarmingly in the past decade across the eastern USA including Wisconsin (see above), most notably species of subgenus *Bombus* (*B. terricola* and especially *B. affinis*) and their obligate

**Table 4.** Bee species described from Wisconsin and their current status. In addition to taxa described by Graenicher, the table includes a misidentification and a nomen nudum by Graenicher, and one Ellis species and two Cockerell species described from Graenicher's material and named for him. Species indicated with an asterisk (\*) were described from Milwaukee.

Status according to Graenicher	Current Status
<i>Andrena Cockerelli</i> Graenicher, 1903*	<i>Andrena (Andrena) frigida</i> Smith, 1853
<i>Andrena Milwaukeeensis</i> Graenicher, 1903*	<i>Andrena (Andrena) milwaukeeensis</i> Graenicher, 1903
<i>Andrena thaspis</i> Graenicher, 1903*	<i>Andrena (Andrena) thaspis</i> Graenicher, 1903
<i>Andrena Graenicheri</i> Cockerell, 1902	<i>Andrena (Callandrena s.l.) helianthi</i> Robertson, 1891 ( <i>helianthi</i> species group)
<i>Andrena [(Pterandrena)] persimilis</i> Graenicher, 1904*	<i>Andrena (Cnemidandrena) canadensis</i> Dalla Torre, 1896 ( <i>nubecula</i> species group)
<i>Andrena nitoides</i> Graenicher, 1911	<i>Andrena (Euandrena) nigrivirga</i> (Ashmead, 1890)
<i>Andrena fragariae</i> Graenicher, 1904*	<i>Andrena (Micrandrena) melanochoa</i> Cockerell, 1898 ( <i>piperi</i> species group)
<i>Trachandrena albofoveata</i> Graenicher, 1903*	<i>Andrena (Scrapteropsis) imitatrix</i> Cresson, 1872 ( <i>imitatrix</i> species group)
<i>Andrena wheeleri</i> Graenicher, 1904*	<i>Andrena (Simandrena) wheeleri</i> Graenicher, 1904
<i>Andrena viburnella</i> Graenicher, 1903*	<i>Andrena (Tylandrena) perplexa</i> Smith, 1853
<i>Perdita maculipennis</i> Graenicher, 1910*	<i>Perdita (Perdita) maculigera maculipennis</i> Graenicher, 1910 ( <i>octomaculata</i> species group)
<i>Perdita citrinella</i> Graenicher, 1910	<i>Perdita (Perdita) perpallida citrinella</i> Graenicher, 1910 ( <i>octomaculata</i> species group)
<i>Perdita pallidipennis</i> Graenicher, 1910	<i>Perdita (Cockerellia) albipennis pallidipennis</i> Graenicher, 1910 <sup>1</sup>
<i>Colletes aestivalis</i> : Graenicher, 1935 (misidentification)	<i>Colletes andreusi</i> Cockerell, 1906 ( <i>aestivalis</i> species group)
<i>Colletes brachyceros</i> Swenk: Graenicher, 1935, nomen nudum	<i>Colletes brevicornis</i> Robertson, 1897 ( <i>willistonii</i> species group)
<i>Colletes vicinialis</i> Graenicher, 1911	<i>Colletes impunctatus lacustris</i> Swenk, 1906 ( <i>impunctatus</i> species group)
<i>Sphécodes solonis</i> Graenicher, 1911	<i>Sphécodes solonis</i> Graenicher, 1911 ( <i>clematidis</i> species group)
<i>Halictus nigro-viridis</i> Graenicher, 1911	<i>LasioGLOSSUM (Dialictus) nigroviride</i> (Graenicher, 1911)
<i>Halictus graenicheri</i> Ellis, 1914	<i>LasioGLOSSUM (Dialictus) pictum</i> (Crawford, 1902)
<i>Anthidium (Protanthidium) Chippewaense</i> Graenicher, 1910	<i>Trachusa (Heteranthidium) zebra</i> (Cresson, 1872) ( <i>zebrata</i> species group)
<i>Nomada cockerelli</i> Graenicher, 1911	<i>Nomada aquilarum</i> Cockerell, 1903 ( <i>roberjeotiana</i> species group)
<i>Nomada (Xanthidium) Graenicheri</i> Cockerell, 1905*	<i>Nomada graenicheri</i> Cockerell, 1905 ( <i>uineta</i> species group) <sup>2</sup>
<i>Nomada (Xanthidium) pseudops</i> Cockerell, 1905	<i>Nomada pseudops</i> Cockerell, 1905 ( <i>ruficornis</i> species group) <sup>3</sup>
<i>Nomada sphaerogaster</i> var a Cockerell, 1905*	<i>Nomada sphaerogaster</i> Cockerell, 1903 ( <i>ruficornis</i> species group) <sup>4</sup>



Table 4. Continued.

Status according to Graenicher	Current Status
<i>Nomada wisconsinensis</i> Graenicher, 1911	<i>Nomada wisconsinensis</i> Graenicher, 1911
<i>Triepeolus oblitteratus</i> Graenicher, 1911	<i>Negana</i> species group <i>Triepeolus oblitteratus</i> Graenicher, 1911 ( <i>simplex</i> species group)

<sup>1</sup>*Perdita pallidipennis* Graenicher, 1910, requires further study, as this may prove to be a subspecies of *Perdita* (*Cockerellia*) *bequaerti* Viereck, 1917, rather than of *P. albipennis* (JSA, new information, based in part on study of specimens collected by R. Jean in Indiana).

<sup>2</sup>This may prove to be a senior synonym of *Nomada besseyi* Swenk, 1913 (S. Droege, pers. comm.).

<sup>3</sup>This may prove to be a junior synonym of *Nomada bethunei* Cockerell, 1903 (S. Droege, pers. comm.).

<sup>4</sup>*Nomada sphaerogaster* is rarely collected and remains poorly known. We have seen no recent material and few historical specimens. Cockerell's var. *alpha* (cited as  $\alpha$  in the original species heading), known only from the unique female type and recognized solely on the basis of slight color differences from the typical form, certainly deserves further study, to confirm that it is indeed conspecific with New Jersey material (specimens can be found at Rutgers University).

social parasite *B. ashtoni*. The effects of pathogens, parasites, parasitoids, and exotic bee competitors on the Wisconsin bee fauna need to be identified and monitored, as do the effects of deer herbivory, fire suppression, and forestry practices on plants visited by bees.

In order to accurately assess changes in Wisconsin's bee fauna more extensive surveys are needed, especially in the western and northern parts of the state. The difficulty of species identification has hindered studies of native bees in Wisconsin and elsewhere. Recently developed online tools such as dynamic maps, identification keys (e.g., [www.discoverlife.org](http://www.discoverlife.org)), image databases such as [www.bugguide.net](http://www.bugguide.net), and integrative taxonomic studies using DNA barcodes and other DNA sequences as diagnostic tools to supplement morphology (e.g., Gibbs 2007, Packer et al. 2008, Sheffield et al. 2009) provide new resources to overcome this challenge and make it easier for non-specialists to contribute useful data on Wisconsin's bees.

Despite the utility of these new tools, there are still major gaps in our knowledge of the bee fauna of Wisconsin and of the eastern North American fauna as a whole, particularly with respect to species delimitation and identification of groups such as *Sphecodes*, *Nomada*, and *Lasioglossum (Dialictus)* for which no revisions exist except Mitchell (1960, 1962). A revision of *Lasioglossum (Dialictus)* is in progress by J. Gibbs. In addition to the described species reported in this paper, we also studied what appear to be multiple undescribed species, including a *Nomada* of the *Gnathias* group with very numerous and dense dark spines at the apex of the female hind tibia (also found elsewhere in the eastern U.S.A. by S. Droege, pers. comm.) and an unusual *Sphecodes* of the *Sphecodium* group. J. Gibbs (pers. comm.) also reported at least two undescribed species of *Lasioglossum*, both collected in 2005-06 by ATW.

In order to effectively quantify changes in populations and distributions, systematic and repeatable methods are needed. We hope that our list will provide a foundation for efforts to better document and conserve Wisconsin's native bee diversity. Based on widespread evidence of declines in well-studied species such steps are timely and might be long overdue.

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