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An Annotated Checklist of Wisconsin Handsome Fungus Beetles (Coleoptera: Endomychidae)

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AN ANNOTATED CHECKLIST OF WISCONSIN HANDSOME FUNGUS BEETLES (COLEOPTERA: ENDOMYCHIDAE)

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ABSTRACT

The first comprehensive survey of Wisconsin Endomychidae was initiated in 1998. Throughout Wisconsin sampling sites were selected based on habitat type and sampling history. Wisconsin endomychids were hand collected from fungi and under tree bark; successful trapping methods included cantharidin-baited pitfall traps, flight intercept traps, and Lindgren funnel traps. Examination of literature records, museum and private collections, and field research yielded 10 species, three of which are new state records. Two dubious records, *Epipocus unicolor* Horn and *Stenotarsus hispidus* (Herbst), could not be confirmed. Wisconsin distribution, along with relevant collecting techniques and natural history information, are summarized.

Endomychidae, handsome fungus beetles, is a moderately large family with 1,300 species in about 120 genera worldwide (Strohecker 1986, Lawrence 1991). There are 22 genera and 46 species known to occur in the United States with the majority occurring in the eastern and southeastern regions (Skelley and Leschen 2002). As their common name implies, endomychids can be attractively colored and are typically mycophagous, feeding on a wide variety of fungal types from spores and hyphae of microfungi to large Basidiomycetes (Lawrence 1991, Skelley and Leschen 2002). Some species are rather fungal host specific, such as *Endomychus biguttatus* Say associated with *Schizophyllum commune* Fries (Leschen and Carlton 1988), *Lycoperdina ferruginea* LeConte with puffball fungi in the genera *Lycoperdon* and *Calvatia* (Pakaluk 1984), and *Xenomycetes laversi* Hatch with *Paxillus atrotomentosus* (Batsch ex. Fr.) Fries (Johnson 1986). *Holoparamecus caularum* (Aubé), *Holoparamecus depressus* Curtis, *Holoparamecus* singularis (Beck), *Holoparamecus ragusae* Reitter, *Mycetaea subterranea* (Fabricius), and *Trochoideus desjardinsi* Guerin have been collected in association with stored products, usually feeding on mold (Hinton 1945, Aitken 1975, Bousquet 1990).

Aphorista morosa LeConte has been found in association with a yellow plasmodium of a slime mold (Myxomycetes) (Lawrence 1991). While some endomychid species occur in termite, ant, and bee nests, little is known about their biology (Lawrence 1991, Yanega and Leschen 1994, Skelley and Burgess 1995). Young (1984, 1989) observed four North American species of Endomychidae: *Aphorista vittata* (Fabricius), *Danae testacea* (Ziegler), *L. ferruginea,* and *Xenomycetes morrisoni* Horn, orienting to filter paper baited with cantharidin, a defensive compound produced by most meloid and some oedemerid beetles. The role of cantharidin in endomychid biology is unknown but one conjecture is cantharidin may mimic other terpenoid compounds in nature, such as terpenoid fungal metabolites that may assist the beetles in locating fungal hosts (Young 1984).

Regardless of the relative abundance and fascinating fungal associations of Endomychidae, natural history and distribution data for species of the western

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Great Lakes region of North America are scarce. Several general beetle reviews and catalogs including endomychids have been conducted for individual states or subdivisions: Dury (1902) for Cincinnati, Ohio; Blatchley (1910) for Indiana; Peck and Thomas(1998) for Florida; or regions: Leng (1920) for North America North of Mexico; Hatch (1961) for the Pacific Northwest; Campbell (1991) for Canada; Downie and Arnett (1996) for the Northeastern United States; Shockley and McHugh (2003) for the Great Smoky Mountains National Park. Also, there are a few endomychid specific catalogs of North America: LeConte (1854); Crotch (1873) for the United States; Wickham (1894) for Ontario and Quebec; Strohecker (1986) for America North of Mexico; Arriaga-Varela et al. (2007) for Mexico; and Majka (2007) for the Maritime Provinces of Canada.

In Wisconsin, Rauterberg (1885) recorded a portion of the Coleoptera of Wisconsin collected, "in the vicinity of Milwaukee", including some endomychid species with brief notes on their abundance (common, rare, or very rare) and how specimens were collected. Wickham (1895) provided a list of Coleoptera from the southern shore of Lake Superior; however, the list did not include endomychid species from Wisconsin. Until the present study, no comprehensive studies of Wisconsin Endomychidae diversity, life histories, and distributions have been conducted.

MATERIALS AND METHODS

This survey was initiated in 1998 as part of an undergraduate independent study by the senior author and was continued along with a graduate study of Nitidulidae and Kateretidae of Wisconsin (Price and Young 2006). Colleagues conducting separate insect faunal surveys have and continue to contribute endomychid data. Our paper summarizes data through 2007.

At the onset of this survey, literature records, and museum and private collections were examined to determine which endomychid species had previously been collected in Wisconsin. The following institutional collections were reviewed for Wisconsin records: Field Museum of Natural History (FMNH), Milwaukee Public Museum (MPMC), and University of Wisconsin-Madison Insect Research Collection (WIRC). Several private collections were also examined.

Field survey work focused on historically under-sampled regions and unique Wisconsin habitats, e.g., oak savanna and hemlock forest. A variety of trapping methods were used to collect endomychids, including cantharidin-baited jar traps (Fig. 1) partially buried into the soil, blacklight traps, flight intercept traps, Lindgren funnel traps, and Malaise traps. The following endomychid species were consistantly attracted to cantharidin-baited traps in Wisconsin: *A. vittata*, *D. testacea*, and *L. ferruginea* (Young 1984, 1989). In addition to trapping, endomychids were hand-collected, mainly from fungi and wood. Specimens were also obtained from sweep net and leaf litter samples.

The following surveys in conjunction with the WIRC also provided Wisconsin specimen records: Wisconsin Department of Natural Resources (WDNR) projects, Hemlock Draw (The Nature Conservancy) and Quincy Bluff (State Natural Area) Surveys, Fort McCoy inventory project, and Necedah National Wildlife Refuge inventory project. Specimen data were entered into the relational biodiversity database software, BIOTA™ (Colwell 1996). Voucher specimens have been deposited in the WIRC and additional specimens reside in the personal collections of the contributors to this study.

RESULTS

This survey yielded 10 Wisconsin species in nine genera of Endomychidae and an additional two dubiously recorded species in two genera. Three species represent new state records not having previously been recorded from the state

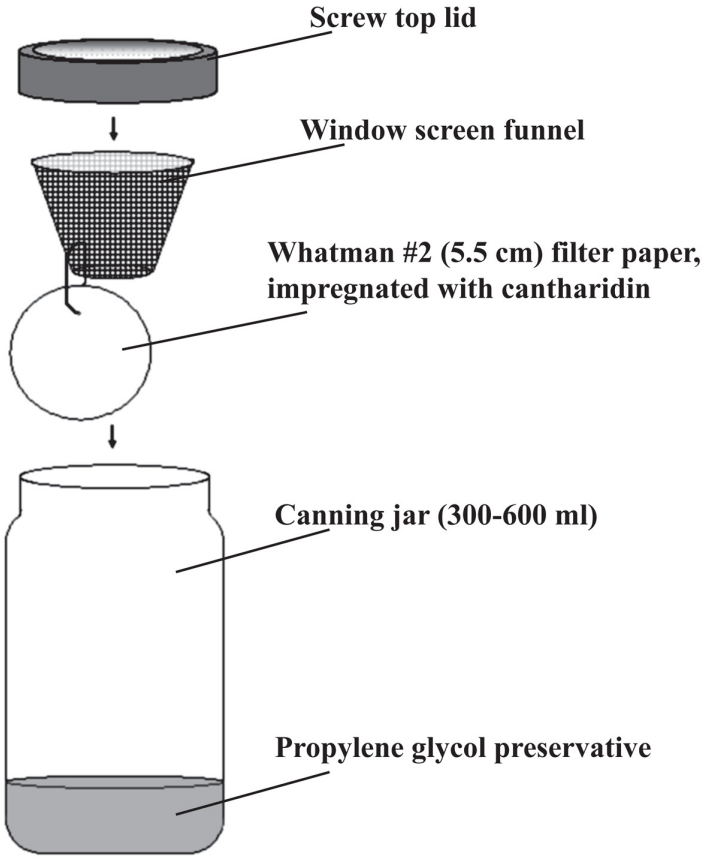

Figure 1. Disarticulated cantharidin-baited jar trap.

in the literature. The arrangement of subfamilies follows the phylogeny proposed by Tomaszewska (2000), with genera and species listed in alphabetical order.

A website has been developed for Wisconsin endomychids. It includes images, distribution maps, and general information for each species. In addition, links are provided to other Wisconsin insect faunal surveys. The website can be accessed at the following address: <http://entomology.wisc.edu/~mbprice/wibeetles/Price/Endo%20Intro.htm>.

For each endomychid species profile, the total number of specimens examined (this number includes specimens with and without ecological data), whether the species is newly reported in Wisconsin, natural history, specific number of species collected in a particular collection event, temporal and Wisconsin geographic distributional records are documented. Species previously recorded in the literature from Wisconsin are followed by the relevant literature reference(s). To simplify county associations, Wisconsin has been divided into nine, 8-county regions (Fig. 2; after Kriska and Young 2002, Hilsenhoff 1995). Life history, phenological, and trapping information pertain solely to adult and larval Wisconsin endomychid records and have been extracted directly from

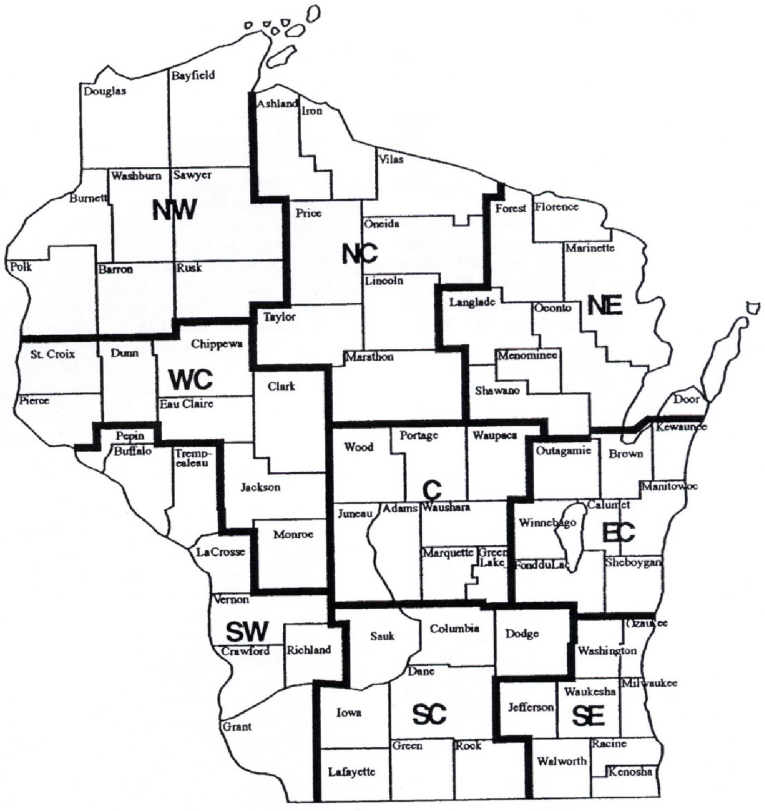

Figure 2. Regional divisions (nine, 8-county areas) of Wisconsin (after Kriska and Young 2002, Hilsenhoff 1995).

labels accompanying specimens. Thus, in reporting plant and fungal associations, we report the data as indicated by specimen labels only. In some cases the above mentioned are recorded by Latin binomial and author, e.g., under the bark of *Populus grandidentata* Michaux, while in other cases a common vernacular is used, e.g., on puffball fungus. Many species are active at night when they can be readily collected with a flashlight or headlamp. Those collected during the day were typically found in host fungi beneath bark of dead trees or within moist decaying woody material in which fungi were common. Many phenologies are likely artifacts of sampling activity. We still lack sound natural history information for some species in Wisconsin.

LEIESTINAE Thomson, 1863

***Phymaphora pulchella* Newman. NEW STATE RECORD.** (81 Wisconsin specimens examined). Adult specimen collection data included the following: beneath bark of less than a year old cut log (possibly maple) (5 specimens), under loose bark (8 specimens) under bark of standing dead *P. grandidentata* abundant with fungus (3 specimens), beneath paper birch bark (2 specimens), under bark of pine (2 specimens), under oak bark (5 specimens), in fungus on

fallen tree (1 specimen), and in damp tree-hole litter (3 specimens). We also obtained adult specimens with the following trapping methods: flight intercept traps baited with cantharidin (2 specimens) (bait presumably incidental in this case), Malaise trap (1 specimen), unbaited Lindgren funnel traps (35 specimens), as well as, Lindgren funnels baited with cantharidin only (3 specimens), ipsdienol only (4 specimens), both cantharidin and ipsdienol (2 specimens), ethanol (1 specimen), banana and fermenting brown sugar (3 specimens) (all baits presently considered incidental). Aspen and birch dominant forest, mixed conifer-hardwood forest, one-year-old hardwood cut-site, oak and pine forest, beech-dominated northern mesic forest, aspen, oak, Jack pine forest, *Pinus resinosa* Aiton plantation, oak savanna, southern mesic forest, and northern (wet) mesic forests were observed collection sites. Specimens were active from March to October. Most specimens were collected under bark of fallen trees (25 specimens) and with Lindgren funnel traps (48 specimens): **NW:** Douglas, Sawyer; **NE**: Florence, Forest, Marinette, Menominee; **WC:** Jackson, Monroe; **C:** Marquette, Wood; **SC:** Dane, Dodge, Sauk; **SE:** Racine.

***Rhanidea unicolor* (Ziegler).** (31 Wisconsin specimens examined). Rauterberg (1885) obtained this species with sweep-net and considered it rare. We collected adults beneath bark of a dead log snag near a *Lasius* Fabricius**,** ant colony (3 specimens), beneath bark of a log (possibly maple cut less than a year prior) (10 specimens), and in leaf litter (2 specimens). We also obtained adult specimens with the following trapping methods: flight intercept trap (1 specimen), unbaited Lindgren funnel traps (11 specimens), as well as, Lindgren funnel traps baited with banana and fermenting brown sugar (2 specimens) and ipsdienol (2 specimens) (baits considered incidental). Sandy oak barrens, southern mesic hardwood forest, oak savanna and plantation with *P. resinosa*, *Pinus strobus* Linnaeus, and *Picea* species were observed collection sites. Specimens were active from April to October. Most specimens were collected under bark of fallen trees (13 specimens) and with Lindgren funnel traps (15 specimens): **NE:** Shawano; **SW:** Grant, Richland; **SC:** Columbia, Dane, Green, Sauk.

ENDOMYCHINAE Leach, 1815

***Endomychus biguttatus* Say.** (118 Wisconsin specimens examined). Rauterberg (1885) obtained this species on young branches of aspen and with sweep-net, and considered the species common. Wisconsin was included in the distribution recorded by Downie and Arnett, Jr. (1996). Adult specimen collection data included the following ecological notations: beneath bark of shagbark hickory snag (1 specimen), beneath bark of *P. grandidentata* (1 specimen), on pine bark (1 specimen), under bark (1 specimen), under fleshy shelf fungus (1 specimen), crawling on fallen tree (18 specimens), on tree with fungus (2 specimens), on small fungus on stick (3 specimens), feeding on fungus on large tooth aspen (4 specimens), on shelf fungus on fallen *Populus* tree (1 specimen), near sap flow (1 specimen), under leaf litter (1 specimen), in damp tree hole litter at base of tree (1 specimen), and on low vegetation (1 specimen). Ten specimens, including mating pairs, were collected in early September on bark of a fallen tree. One immobile adult specimen was collected at the tip of an *Onosmodium molle* Michaux inflorescence (1800 h, 80˚F sunny). In April, a larva was collected under bark of a newly cut hardwood. We also obtained adult specimens with the following trapping methods: flight intercept traps (21 specimens), light trap (2 specimens), banana trap (1 specimen), Malaise traps (13 specimens), jug trap (1 specimen), unbaited Lindgren funnel traps (9 specimens), Lindgren funnel traps baited with banana and fermenting brown sugar (3 specimens), and Lindgren funnel traps baited with ipsdienol only (1 specimen) and Lindgren funnel traps baited with cantharidin and ipsdienol (4 specimens) (all baits presently considered incidental). Habitat types included northern (wet and dry) mesic forest,

one-year-old hardwood cut site, dry lime prairie, southern (wet) mesic hardwood forest, oak/pine forest, oak savanna, *Pinus banksiana* Lambert barrens near lightning struck *Quercus* spp. snag, and sandy oak barrens. Specimens were active from March to December with the majority collected between July and September. Most specimens were collected on or under bark of fallen trees (32 specimens) and with flight intercept traps (21 specimens) and Lindgren funnel traps (17 specimens): **NW:** Bayfield, Polk; **NC:** Vilas; **NE:** Door, Florence, Forest, Marinette, Shawano; **WC:** Monroe; **C:** Marquette, Waupaca, Wood; **EC:** Fond du Lac; **SW:** Crawford, Grant, Richland; **SC:** Dane, Dodge, Green, Lafayette, Rock, Sauk; **SE:** Jefferson, Ozaukee, Racine, Waukesha.

STENOTARSINAE Gorham, 1873

***Danae testacea* (Ziegler).** (>2,000 Wisconsin specimens examined). Rauterberg (1885) collected this species (listed as *Mycetina testacea* LeConte) under the bark of old logs and considered it rare. Young (1984) obtained this species with cantharidin-baited traps. Ecological data associated with our adult specimens included the following: under logs (2 specimens), in leaf litter near fallen tree near fleshy white fungus (6 specimens), in wet moldy leaf litter near fallen tree (3 specimens), leaf litter near fallen tree (8 specimens) and a single specimen was collected at night on leaf of small herbaceous plant. We also obtained adults with the following trapping methods: cantharidin-baited pitfall traps (>1,800 specimens), unbaited (31 specimens) and cantharidin-baited (4 specimens) flight intercept traps, human dung/malt/molasses pitfall traps (6 specimens) (this bait likely incidental), gilled fungus baited pitfall trap (1 specimen), Malaise trap (1 specimen), Lindgren funnel trap baited with ipsdienol (1 specimen), and water-filled pan trap (2 specimens). Collection sites included aspen and birch dominant forest, northern mesic forest (dry), hardwood forest adjacent to lime prairie, southern mesic hardwood forest (dry), oak forest near flood plain, pine and oak forest, sandy oak barrens, and *P. resinosa* stand. Specimens were active from March to December. The majority of specimens were collected from pitfall traps baited with cantharidin: **NW:** Douglas; **NE:** Florence, Marinette, Shawano; **WC:** Eau Claire, Jackson, Monroe; **C:** Adams, Marquette, Waupaca, Waushara, Wood; **SW:** Grant, Richland, Trempealeau; **SC:** Dane, Green, Iowa, Lafayette, Sauk; **SE:** Jefferson, Ozaukee, Racine, Walworth.

LYCOPERDININAE Redtenbacher, 1844

***Aphorista vittata* (Fabricius).** (226 Wisconsin specimens examined). Rauterberg (1885) reported this species as "somewhat common" and Wisconsin was included in the distribution recorded by Strohecker (1986) and Downie and Arnett, Jr. (1996). We collected one adult specimen on a sandy dirt road at the edge of woods and a mating pair was collected in June. We obtained most adults with cantharidin-baited pitfall traps (222 specimens); a single specimen was recovered from a banana trap. Collection sites included northern mesic forest, dry lime prairie, red pine plantation, and oak savanna. Specimens were active from May to August: **NW:** Douglas; **NE:** Florence, Marinette; **WC:** Jackson, Monroe; **C:** Adams, Wood; **SW:** Grant; **SC:** Sauk.

***Lycoperdina ferruginea* LeConte.** (>450 Wisconsin specimens examined). Rauterberg (1885) obtained this species under the bark of old logs and considered it rare. Ackerman and Shenefelt (1973) conducted a general survey of insects associated with macro-fruiting bodies of forest fungi in Wisconsin and recorded *L. ferruginea* associated with the puffball fungi, *Lycoperdon perlatum* Persoon and *Morganella pyriformis* (Schaeffer: Persoon) Krüger and Kreisel (=*Lycoperdon pyriforme* Schaeffer: Persoon). Young (1984) collected this species from cantharidin-baited traps in Wisconsin. We collected adult and larval specimens under and in fruiting bodies of puffball fungi (>50 specimens) of the

above-mentioned species and *Calvatia* species. Larvae were observed from March to April and from September to October in association with puffball fungi. Ecological data associated with our adults include the following: sweep-net (1 specimen), on *Geomys bursarius* (Shaw) pushup (1 specimen), under log (1 specimen), and in leaf litter near fallen tree (12 specimens). We also obtained adults with the following trapping methods: cantharidin-baited pitfall traps (>350 specimens), cantharidin-baited flight intercept traps (3 specimens), human dung/malt/molasses pitfall trap (1 specimen) (this bait likely incidental), and barrier-pitfall trap near mammal burrow entrance (1 specimen). Collection sites included disturbed grassland, oak savanna, northern mesic forest (dry, old growth), dry sand prairie, edge of lake, old growth hemlock forest, red pine plantation, hardwood forest adjacent to a saw mill, sandy oak barrens, and southern mesic hardwood forest. Specimens were active from March to November with the majority of adults from pitfall traps baited with cantharidin: **NW:** Barron, Burnett; **NC:** Oneida, Vilas; **NE:** Florence, Forest, Marinette, Menominee, Shawano; **WC:** Eau Claire, Jackson, Monroe; **C:** Adams, Juneau, Marquette, Waupaca, Wood; **EC:** Manitowoc, Sheboygan; **SW:** Grant, LaCrosse, Richland; **SC:** Columbia, Dane, Dodge, Green, Iowa, Lafayette, Sauk; **SE:** Jefferson, Kenosha, Ozaukee, Walworth, Waukesha.

***Mycetina perpulchra* (Newman).** (107 Wisconsin specimens examined). Rauterberg (1885) collected this species under the bark of old logs and considered it rare. Ecological data from adults we collected included the following: on Agaricales fungi (2 specimens), on fungus of downed rotting tree at night (1 specimen), on shelf fungus of decaying tree stump (6 specimens), and in leaf litter (3 specimens). Nine specimens were collected mating on stump covered with fungus in June. We also obtained adults with the following trapping methods: unbaited flight intercept traps (52 specimens), flight intercept traps baited with cantharidin (4 specimens), black light (1 specimen), Malaise traps (4 specimens), and a variety of baited Lindgren funnel traps: ipsdienol (4 specimens), banana and fermenting brown sugar (1 specimen), and ethanol (1 specimen); and unbaited Malaise trap (1 specimen). In all cases, including cantharidin, the bait is presently considered to be incidental and not indicative of a definitive association. Most specimens were collected with the flight intercept traps (56 specimens). Collection sites included aspen and birch dominant forest, northern mesic hardwood forest (dry, wet, old growth, and beech dominated), southern mesic hardwood forest, oak savanna, pine barrens, sandy oak barrens, oak and pine barrens, in ring of declining *P. resinosa*, and plantation with *P. resinosa*, *P. strobus*, and *Picea* species. Specimens were active from April to October: **NW:** Bayfield, Douglas, Polk; **NC:** Ashland, Marathon, Vilas; **NE:** Florence, Marinette, Menominee; **WC:** Eau Claire, Jackson, Monroe; **C:** Juneau, Waupaca, Wood; **SW:** Grant, LaCrosse, Richland, Trempealeau; **SC:** Columbia, Dane, Green, Lafayette, Sauk.

MYCETAEINAE Jacquelin du Val, 1857

***Mycetaea subterranea* (Fabricius).** Rauterberg (1888) collected this species with a sweep-net and considered it rare. Pellitteri and Boush (1983) recovered a single specimen in June from a feed mill in southern Wisconsin: **SC:** Dane.

ANAMORPHINAE Strohecker, 1953

***Symbiotes duryi* Blatchley. NEW STATE RECORD.** (9 Wisconsin specimens examined). We collected adults with unbaited (1 specimen) and cantharidin-baited (1 specimen) flight intercept traps and non-baited Lindgren funnel traps (2 specimens) and Lindgren funnel traps baited with either banana and fermenting brown sugar (3 specimens) or cantharidin (2 specimens). At

this time, all baits are considered to be incidental. Collection sites included dry mesic hardwood forest, northern wet mesic forest, aspen, oak, and jack pine forest, and sandy oak barrens. Specimens were active from May to September: **NW:** Washburn; **NE:** Marinette; **C:** Marquette; **SW:** LaCrosse, Richland; **SC:** Sauk; **SE:** Milwaukee.

***Symbiotes gibberosus* (Lucas). NEW STATE RECORD**. (11 Wisconsin specimens examined). We recovered adults from flight intercept trap (1 specimen) and Lindgren funnel traps (2 specimens) baited with cantharidin and ipsdienol in woods adjacent to Lake Michigan. As with *S. duryi*, the small number of specimens provides no compelling evidence to suggest a chemical association. In Madison, eight specimens were collected in June with no additional ecological data. Specimens were active from May to August: **SC:** Dane; **SE:** Milwaukee.

The following species represent dubious historical records. No Wisconsin specimens were obtained during the current survey nor were any of Rauterberg's specimens bearing these names discovered. Both are almost certainly in error.

STENOTARSINAE Gorham, 1873

***Stenotarsus hispidus* (Herbst).** Rauterberg (1885) recorded this species from sweep netting and considered it very rare. *Stenotarsus hispidus* has been reported to occur in southern Indiana and Ohio thus making its presence in Wisconsin slightly plausible; however, this species is more southern in its distribution within North America (Dury 1902, Blatchley 1910).

EPIPOCINAE Gorham, 1873

***Epipocus unicolor* Horn.** Rauterberg (1885) obtained this species in autumn in fungus and considered it common. Verified records indicate this species is more southwestern in distribution within North America (Strohecker 1986).

DISCUSSION

In addition to the two dubious records noted above, the distributional ranges of several additional endomychid species may extend into Wisconsin. A listing of these follows, along with the state(s) and provinces from which they are currently known in closest proximity to Wisconsin: *Bystus ulkei* (Crotch) (Indiana), *Clemmus minor* (Crotch) (Indiana, Illinois), *Epipocus punctatus* LeConte (Indiana, Illinois), *Hadromychus chandleri* Bousquet and Leschen (Ontario, Quebec), and *Symbiotes impressus* Dury (Ohio) (Blatchley 1910, Strohecker 1986, Downie and Arnett, Jr. 1996, Bousquet and Leschen 2002). Except for *H. chandleri*, these species are more southern in distribution and should any of them extend into Wisconsin they would be expected to occur only in the southern-most portion of the state. *H. chandleri* ranges from Nova Scotia to southern Ontario and may be restricted to northeastern North America. Natural history information for this species is limited. Two specimens were collected with a flight intercept trap in a red spruce forest and one specimen was collected by shifting a "conifer log" (Bousquet and Leschen 2002). If this endomychid prefers northern wet forests and boreal forest types with species of white and black spruce and other conifers, it could possibly occur in northern Wisconsin.

Within Wisconsin it appears most endomychid species are generally distributed throughout the state in a variety of forested habitats. Several species may show some interesting distribution patterns but sampling bias might also account, at least in part, for the results seen thus far. With 200+ specimens examined, *A. vittata* may be considered fairly common, yet it is known from only

nine of Wisconsin's 72 counties. *M. perpulchra* is fairly widespread throughout the state but lacks records in the east-central and southeastern regions of the state. *R. unicolor* has been more commonly collected in the southwestern and south-central regions of the state. Although *S. duryi* is widely distributed throughout the state, it is known from only seven counties. Knowing more about endomychid fungal host specificity and the distributions of preferred fungal hosts would add greatly to such discussions.

The two introduced species, *M. subterranea* and *S. gibberosus*, have the fewest county records. Perhaps not surprisingly, both were collected within the vicinity of fairly large cities in the southeastern and south-central parts of Wisconsin.

Although several trapping methods were used to sample endomychids, cantharidin-baited pitfall traps dwarfed all other methods for species known to orient to the compound. More than 1,000 specimens of *D. testacea* were collected with this method. *A. vittata* and *L. ferruginea* were rarely or never collected at flight intercept traps or Lindgren funnel traps, hence pitfall traps baited with cantharidin were a necessary means for collecting these species. While *E. biguttatus and M. perpulchra* were commonly collected with flight intercept and Lindgren funnel traps, *P. pulchella* and *R. unicolor* were commonly collected with mainly Lindgren funnel traps. An awareness of most successful trapping methods for particular species can aid with future studies that monitor habitat management practices and species diversity, especially for forested habitats.

The only previously published list of Wisconsin Endomychidae was over 100 years ago (Rauterberg 1885). The most recent catalog of Endomychidae of America North of Mexico (Strohecker 1986) listed but a single species of Endomychidae from Wisconsin. This updated list of Wisconsin endomychid species along with newly documented associations (e.g., habitat, fungal, floral) offers a new and fairly complete baseline reference point upon which future ecological monitoring, behavioral, insect-fungus interaction, and other studies might build. This survey complements the growing list of Wisconsin faunal surveys of Coleoptera in progress: Anobiidae, Cantharidae, Cleridae, Lycidae, Meloidae; or completed (Pyrochroidae: Young 1998; Scarabaeoidea: Kriska and Young 2002; Histeridae: Gruber 2003; Mordellidae: Lisberg and Young 2003; Tenebrionidae: Dunford and Young 2004; Silphidae: Katovich, *et al*. 2005; and Nitidulidae and Kateretidae: Price and Young 2006) in an effort to better understand the "state of the state's" biodiversity. Such studies provide a long overdue baseline of the Wisconsin beetle fauna and improve our position to evaluate the effects of such major ecosystem perturbations as habitat fragmentation and loss, land use changes, climate change, and impacts of invasive species.

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LITERATURE CITED

Ackerman, J. K., and R. D. Shenefelt. 1973. Organisms, especially insects associated with wood rotting higher fungi (Basidiomycetes) in Wisconsin forests. Wisc. Acad. Sci., Arts Letters. 61: 185-206.

Aitken, A. D. 1975. Insect travellers I. Coleoptera. Tech. Bull., Ministry of Agriculture, Fisheries and Food. 31:i-xvi + 191pp.

Arriaga-Varela, E., K. W. Tomaszewska, and J. L. Navarrete-Heredia. 2007. A synopsis of the Endomychidae (Coleoptera: Cucujoidea) of Mexico. Zootaxa 1594: 1-38.

Blatchley, W. S. 1910. The Coleoptera or beetles of Indiana: An illustrated descriptive catalogue of the Coleoptera known to occur in Indiana. Bulletin of the Indiana Department of Geology and Natural Resources 1: 1-1386.

Bousquet, Y. 1990. Beetles associated with stored products in Canada: an identification guide. Research Branch, Agriculture Canada Publication 1837.

Bousquet, Y. and R. A. B. Leschen. 2002. Description of a New Genus and Species of Endomychidae (Coleoptera: Cucujoidea) from Northeastern North America. Coleopt. Bull. 56(2): 291-298.

Campbell, J. M. 1991. Family Endomychidae (Handsome fungus beetles), pp. 237-239. *In* Y. Bousquet (ed.), Checklist of beetles of Canada and Alaska, Ottawa Research Branch, Agriculture Canada.

Colwell, R. K. 1996. BIOTA: The biodiversity database manager. Sinauer Associates, Sunderland, MA.

Crotch, G. R. 1873. Synopsis of the Endomychidae of the United States. Trans. Am. Entomol. Soc. 4: 359-363.

Downie, N. M., and R. H. Arnett, Jr. 1996. The beetles of northeastern North America. Volume 2. Sandhill Crane Press, Gainesville, Florida.

Dunford, J. C., and D. K. Young. 2004. An annotated checklist of Wisconsin Darkling Beetles (Coleoptera: Tenebrionidae) with comparisons to the Western Great Lakes fauna. Trans. Am. Entomol. Soc. 130: 57-76.

Dury, C. 1902. A revised list of the Coleoptera observed near Cincinnati, Ohio, with notes on localities, bibliographical references, and description of new species. J. Cincinnati Soc. Nat. Hist. 20: 107-196.

Gruber, J. P. 2003 Hister beetles of Wisconsin. Available at: <http://entomology.wisc.edu/~young/hbhomage/wishis.html>

Hatch, M. H. 1961. The beetles of the Pacific Northwest, Part III: Pselphidae and Diversicornia I. University of Washington Publication in Biology 16: 1-503.

Hilsenhoff, W. L. 1995. Aquatic Hydrophilidae and Hydraenidae of Wisconsin (Coleoptera). I. Introduction, key to genera of adults, and distribution, habitat, life cycle, and identification of species of *Helophorus* Fabricius, *Hydrochus* Leach, and *Berosus* Leach (Hydrophilidae), and Hydraenidae. Great Lakes Entomol. 28: 25-53.

Hinton, H. E. 1945. A monograph of the beetles associated with stored products. Vol. I. British Museum of Natural History, London.

Johnson, P. J. 1986. A description of the late-instar larva of *Xenomycetes laversi* Hatch (Coleoptera: Endomychidae) with notes on the species' host and distribution. Proc. Entomol. Soc. Wash. 88: 666-672.

Katovich, K., N. L. Kriska, A. H. Williams, and D. K. Young. 2005. Carrion beetles (Coleoptera: Silphidae) of Wisconsin. Great Lakes Entomol. 38: 30-41.

Kriska, N. L., and D. K. Young. 2002. An annotated checklist of Wisconsin Scarabaeoidea (Coleoptera). Insecta Mundi 16: 31-48.

Lawrence, J. F. 1991. Endomychidae (Cucujoidea) (including Merophysiidae, Mycetaeidae), pp. 482-485. *In* F. W. Stehr (ed.) Immature insects. Volume 2. Kendall Hunt, Dubuque, Iowa.

LeConte, J. L. 1954. Synopsis of the Endomychidae of the United States. Proc.Acad. Nat. Sci. Phila. 6: 357-360.

Leng, C. W. 1920. Catalogue of the Coleoptera of America, North of Mexico. John D. Sherman, Jr., Mount Vernon, New York.

Leschen, R. A. B., and C. E. Carlton. 1988. Immature stages of *Endomychus biguttatus* Say (Coleoptera: Endomychidae) with observations on the alimentary canal. J. Kans. Entomol. Soc. 61: 321-327.

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

Majka, C. G. 2007. The Erotylidae and Endomychidae (Coleoptera: Cucujoidea) of the Maritime Provinces of Canada: New records, zoogeography, and observations on beetle-fungi relationships and forest health. Zootaxa 1546: 39-50.

Pakaluk, J. 1984. Natural history and evolution of *Lycoperdina ferruginea* (Coleoptera: Endomychidae) with descriptions of immature stages. Proc. Entomol. Soc. Wash. 86: 312-325.

Peck, S. B., and M. C. Thomas. 1998. A distributional checklist of the beetles (Coleoptera) of Florida. Arthropods of Florida and Neighboring Land Areas 16: 89.

Pellitteri, P., and G. M. Boush. 1983. Stored-product insect pests in feed mills in southern Wisconsin. Wisconsin Academy of Sciences, Arts and Letters 71: 103-112.

Price, M. B., and D. K. Young. 2006. An annotated checklist of Wisconsin sap and short-winged flower beetles (Coleoptera: Nitidulidae, Kateretidae). Insecta Mundi 20: 69-84.

Rauterberg, F. 1885. Coleoptera of Wisconsin. Proc. Nat. Hist. Soc.Wisc. 1885: 48- 62.

Shockley, F.W., and J.V. McHugh. 2003. The Handsome Fungus Beetles (Coleoptera: Endomychidae) of Great Smoky Mountains National Park. Available at: <http://department.caes.uga.edu/entomology/McHugh/GSMNP Endomychids.htm>

Skelley, P. E., and G. R. Burgess. 1995. *Trochoideus desjardinsi* Guérin found in Florida (Endomychidae: Trochoideinae). Coleopt. Bull. 49: 289-291.

Skelley, P. E., and R. A. B. Leschen. 2002. Family 92: Endomychidae, pp. 366-370. *In* R. H. Arnett, Jr., M. C. Thomas, P. E. Skelley, and J. H. Frank (eds.), American beetles, Vol. 2. CRC Press, Boca Raton FL.

Strohecker, H. F. 1986. Catalog of the Coleoptera of America North of Mexico. Family Endomychidae. U. S. Dep. Agric. Agric. Handb. Washington, DC.

Tomaszewska, K. W. 2000. Morphology, phylogeny and classification of adult Endomychidae (Coleoptera: Cucujoidea). Ann. Zool. Wars. 50: 449-558.

Wickham, H. F. 1894. The Endomychidae and Erotylidae of Ontario and Quebec. Can. Entomol. 26: 337-342.

Wickham, H. F. 1895. A list of Coleoptera from the southern shore of Lake Superior. Proc. Davenport Acad.Nat. Sci. 6: 125-169.

Yanega, D., and R. A. B. Leschen. 1994. Beetles associated with bee nests (Hymenoptera: Apidae) in Chiapas, Mexico, with descriptions of the immature stages of *Vanonus balteatus* Werner (Coleoptera: Aderidae, Endomychidae, Meloidae). Coleopt. Bull. 48: 355-360.

Young, D. K. 1984. Field records and observations of insects associated with cantharidin. Great Lakes Entomol. 17: 195-199.

Young, D. K. 1989. Notes on the bionomics of *Xenomycetes morrisoni* Horn (Coleoptera: Endomychidae), another cantharidin-orienting fungus beetle. Pan-Pac. Entomol. 65: 447-448.

Young, D. K. 1998. The fire-colored beetles of Wisconsin (Coleoptera:Pyrochroidae). Available at: <http://entomology.wisc.edu/~young/pyro/wipyroch.html>