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Reese J. Worthington
Luther College

Kirk J. Larsen
Luther College

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Worthington and Larsen: An Annotated Checklist of Scarab Beetles (Coleoptera: Scarabaeida

An Annotated Checklist of Scarab Beetles (Coleoptera: Scarabaeidae) from Northeastern Iowa

Reese J. Worthington[1] and Kirk J. Larsen[1*]

Abstract

A survey of scarab beetles (Coleoptera: Scarabaeidae) was conducted during 2009 in the geographically distinct area of Winneshiek and Allamakee counties in extreme Northeast Iowa. Four plant communities distributed among 10 locations, including tallgrass prairie, mixed grassland and forest, oak-hickory forest, and pasture were sampled during 2009 using black light traps, banana-beer traps, rodent burrow pitfalls, manure-baited pitfalls, and gleaning. Additionally, previous specimen records were examined. Forty-nine scarab species were documented for Winneshiek and Allamakee counties, including five species not previously reported in Iowa. Mixed grassland and forest habitat contained the greatest scarab species richness (n=31); black light trapping yielded the greatest number of individual beetles and collected the most species.

Scarabaeidae contains approximately 27,800 known species worldwide (Ratcliffe and Paulsen 2008). In North America, Scarabaeidae is comprised of 125 genera and 1,700 species (Ratcliffe and Paulsen 2008). In the Upper Midwest, several surveys of scarab beetles have documented their diversity. Blatchley (1910) surveyed the Coleoptera of Indiana and included a comprehensive list of scarabs. Dawson (1922) catalogued the scarabs of Nebraska, then Ratcliffe (1991) and Ratcliffe and Paulsen (2008) expanded on Dawson's catalogue of Nebraska scarabaeid beetles. Helgesen and Post (1967) surveyed the saprophagous scarabs of North Dakota, which was followed by a survey of phytophagous scarabs and trogids in North Dakota (Lago et al. 1979). Kriska and Young (2002) surveyed the Scarabaeoidea of Wisconsin. Although surveys have been conducted in other states in the Midwest, no comprehensive survey of scarabaeids has yet been published for Iowa.

Extreme northeastern Iowa is a geologically distinct area of the state characterized by scenic limestone bluffs and deep-cut valleys with cold-water streams. As part of the Paleozoic Plateau ecoregion this area was not affected by the most recent glaciation (Prior 1991, Griffith et al. 1994). This area is also located in the transition zone between the eastern deciduous forest and prairie (Davis 1977). It is comprised of several distinct plant communities including tallgrass prairie, mixed grassland and forest (primarily oak savanna), oak-hickory forest, and grazed pasture land (Mutel 2008). Due to these characteristics of northeastern Iowa, the insect communities present in this area are fairly distinct and less studied as compared with the rest of the state. For example, 25 state record species of ground beetles (Coleoptera: Carabidae) alone have been recently documented in this area of the state (Purrington and Larsen 1997, Purrington et al. 2000, Larsen and Purrington 2009).

Scarabaeid beetles have been used as an indicator group for monitoring influences of habitat modifications (Rice and Riley 2000). Therefore, having a

[1]Department of Biology, Luther College, 700 College Drive, Decorah, IA 52101, USA.
[*]Corresponding author: Kirk Larsen, (e-mail: larsenkj@luther.edu).

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list of current scarab beetle diversity can serve as a baseline for future studies. In 2009, we conducted a field survey of scarabaeid beetles in four different habitat types at 10 different locations in Winneshiek and Allamakee counties in extreme northeastern Iowa. In addition, we examined existing collection records. The objective of this study was to catalog the scarabaeid beetles of Winneshiek and Allamakee counties.

Materials and Methods

Adult scarab beetles were collected from May to October 2009 at 10 locations in northeastern Iowa (Table 1). Collection sites were classified by dominant vegetation type and past land use (Katovich et al. 1998). *Tallgrass prairie* was land that had not been grazed or pastured within the last five years and had an established original or planted native prairie plant community. *Oak-hickory forest* had at least 60% composition of oak or hickory trees. Oak-hickory forest sites are located on west-southwest dry, mesic slopes (Mutel 2008). *Mixed grassland and forest* habitat were sites that had at least 40% composition of grassland (primarily federal conservation reserve program or CRP plantings) along with mixed forest. *Pasture* was any site that was currently being grazed by livestock or had been grazed in the last five years.

Five collecting techniques were used including black light traps (BioQuip universal black light trap, Model 2851A), banana-beer traps, cow manure-baited pitfall traps, rodent burrow pitfall traps, and diurnal flower and foliage gleaning. Rodent burrow pitfall traps were set in five vacant burrows of the plains pocket gopher, *Geomys bursarius* (Shaw, 1800) for one week exposures each month (Skelley and Gordon 2001). Gleaning (hand collecting of observed live beetles) occurred from foliage, flowers, decaying logs, and anthills for two hours each month at each site. Each of the 10 sites was sampled using all techniques once each month.

In addition to field collecting, all scarab beetle specimens in the research insect collection of the Hoslett Museum of Natural History at Luther College that had been collected prior to this survey were included in the survey if collected in Winneshiek or Allamakee counties. There were a total of 104 previously collected specimens examined from the Luther College collection, which equated to 6.3% of the total specimens examined in the survey. Other collections that contained specimens from counties pertinent to the study were not examined. Adult scarab beetles were identified to species by the authors or with the assistance of Dr. Matt Paulsen or Dr. Brett Ratcliffe (both University of Nebraska-Lincoln) and given standardized names using keys presented in Luginbill and Painter (1953) and Ratcliffe and Paulsen (2008). Voucher specimens of all species are housed in the research insect collection in the Hoslett Museum of Natural History, Department of Biology, Luther College, Decorah, Iowa.

Results

Overall, 1,653 scarabs representing 49 different species were found during this survey. These included 44 of the 136 documented species of scarabs from Iowa (Ed Freese, personal communication), while five species have not been previously reported in Iowa and are apparent state records.

Mixed grassland and forest habitat contained 31 of the 49 scarab species found in Allamakee and Winneshiek counties. Black lights captured 28 species and 78% (n=1,292) of the 1,653 specimens examined during the 2009 survey, whereas banana-beer baited traps and rodent burrow pitfall trapping together yielded only five species and 41 beetles. Manure-baited pitfalls yielded 12 species and 109 beetles, while rodent burrow pitfalls trapped only three species and 25 beetles. New state records are indicated in boldface. Subfamilies and tribes are arranged phylogenetically based on Ratcliffe and Paulsen (2008) while scientific names are arranged alphabetically.

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Table 1. Locations of scarab beetle collections during the 2009 field survey (*) and other locations of scarab collections in Allamakee and Winneshiek County, Iowa, along with brief site descriptions.

Site Name	Lat/Long Coordinates	County	Owner/Manager	Site description
Aikman Prairie	43.324°N, 91.810°W	Winneshiek	Luther College	2-ha mixed grassland and forest habitat
Anderson Prairie*	43.315°N, 91.800°W	Winneshiek	Luther College	10.1-ha tallgrass prairie planting
Cardinal Marsh*	43.332°N, 92.074°W	Winneshiek	Iowa Department of Natural Resources	471.4–ha mixed grassland and forest habitat
Chattahoochie Park	43.316°N, 91.817°W	Winneshiek	Winneshiek County Conservation Board	riparian floodplain forest
Chipera Prairie*	43.130°N, 92.007°W	Winneshiek	Winneshiek County Conservation Board	36.4-ha mostly native tallgrass prairie, mixed forest habitat
Coon Creek	43.329°N, 91.639°W	Winneshiek	Iowa Department of Natural Resources	mixed grassland and forest habitat
Decorah Community Prairie	43.300°N, 91.803°W	Winneshiek	Decorah Parks and Recreation	tallgrass prairie planting
Effigy Mounds	43.099°N, 91.184°W	Allamakee	National Park Service	mixed grassland and oak-hickory forest
Eichinger*	43.257°N, 91.895°W	Winneshiek	Eichinger family	6.0-ha pastureland habitat
Enos*	43.272°N, 91.921°W	Winneshiek	Enos family	8.0-ha pastureland habitat
Gateway Prairie	43.316°N, 91.812°W	Winneshiek	Luther College	15-ha tallgrass prairie planting
Heritage Valley	43.375°N, 91.585°W	Allamakee	Iowa Natural Heritage Foundation	mixed grassland and forest habitat
Hickory Ridge Woods*	43.319°N, 91.799°W	Winneshiek	Luther College	33.6-ha oak-hickory forest and oak woodland
Jewell	43.321°N, 91.826°W	Winneshiek	Jewell family farm	15-ha pastureland
Kraus*	43.358°N, 91.699°W	Winneshiek	Kraus family farms	62.7-ha pastureland and mixed grassland and forest habitat

Table 1. Continued.

Site Name	Lat/Long Coordinates	County	Owner/Manager	Site description
Lake Meyer*	43.175°N, 91.906°W	Winneshiek	Winneshiek County Conservation Board	64.7-ha mixed grassland and forest
Larsen	43.307°N, 91.799°W	Winneshiek	Larsen family	suburban home
Lindeman Pond	43.317°N, 91.806°W	Winneshiek	Luther College	mixed grassland and forest habitat surrounding 0.5-ha pond
Lionberger Preserve*	43.334°N, 91.871°W	Winneshiek	Luther College	74-ha mixed grassland and forest habitat
Luther College campus	43.312°N, 91.804°W	Winneshiek	Luther College	oak savanna college campus
Malanaphy Springs	43.350°N, 91.835°W	Winneshiek	Iowa Department of Natural Resources	state preserve, oak-hickory forest
Prairie Song*	43.480°N, 91.521°W	Allamakee	Osterholm family	39.6-ha mixed grassland and forest habitat
Roslien Woods	43.326°N, 91.820°W	Winneshiek	Luther College	mixed grassland and forest habitat
Sordahl	43.287°N, 91.794°W	Winneshiek	Tex Sordahl	suburban home
Twin Springs	43.295°N, 91.817°W	Winneshiek	Decorah Parks and Recreation	city park, oak-hickory forest
US-52 Roadside	43.362°N, 91.814°W	Winneshiek	Iowa Department of Transportation	grassland right of way along US-52
Yellow River	43.171°N, 91.243°W	Allamakee	Iowa Department of Natural Resources	state forest, oak-hickory forest

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SCARABAEIDAE

Aphodiinae

Aphodiini

Aphodius bicolor Say, 1823. [8 specimens examined]. Wickham (1911). Adult specimens were collected in pitfall traps and by gleaning in dog feces. One specimen was collected in oak-hickory forest habitat and seven specimens were collected in the Decorah area. Specimens were collected from 26 June to 10 September. Sites include: Hickory Ridge Woods and Larsen residence in Decorah.

Aphodius concavus Say, 1823. [25 specimens examined]. Wickham (1911). Adult specimens were collected by gleaning, using pitfall traps, black light traps, and rodent burrow pitfall traps. Twenty-three specimens were collected from tallgrass prairie habitat, one specimen was collected in mixed grassland and forest habitat, and one specimen was collected in a grassland habitat. Specimens were collected from 3 June to 6 August. Sites include: Anderson Prairie, Chipera Prairie, Gateway Prairie, and US-52 Roadside.

Aphodius distinctus (Müller, 1776). [1 specimen examined]. Wickham (1911). An adult specimen was collected by gleaning in a mixed grassland and forest habitat. 6 October. Site: Lindeman Pond.

Aphodius erraticus (Linnaeus, 1758). [1 specimen examined]. Ratcliffe (1991). An adult specimen was collected by gleaning in a mixed hardwood forest habitat. 7 July. Site: Twin Springs.

Aphodius granarius (Linnaeus, 1767). [26 specimens examined]. Putnam (1876). Adult specimens were collected by gleaning and manure-baited pitfall trapping. One specimen was collected in a mixed forest and grassland habitat and 25 specimens were collected in pasture habitat with actively grazing cattle or sheep. Specimens were collected from 15 June to 6 July. Sites include: Cardinal Marsh, Eichinger, and Jewell farms.

***Aphodius haemorrhoidalis* (Linnaeus, 1758). NEW STATE RECORD.** [1 specimen examined]. An adult specimen was collected by R.J. Worthington using manure-baited pitfall traps in an actively grazed pasture habitat. 6 July 2009. Site: Enos.

***Aphodius kirni* Cartwright, 1944. NEW STATE RECORD.** [5 specimens examined]. Adult specimens were collected by R.J. Worthington black light trapping and rodent burrow pitfall trapping. Four specimens were collected in a tallgrass prairie habitat and one specimen was collected in a mixed grassland and forest habitat. Specimens were collected from 12 June to 29 June. Sites include: Anderson Prairie and Cardinal Marsh.

***Aphodius lentus* Horn, 1870. NEW STATE RECORD.** [5 specimens examined]. Adult specimens were collected by R.J. Worthington using black light trapping and pitfall traps. Two specimens were collected in tallgrass prairie habitat and three specimens were collected in a mixed grassland and forest habitat. Specimens were collected from 2 June to 29 June 2009. Sites include: Anderson Prairie, Cardinal Marsh, and Chipera Prairie.

***Aphodius magnificens* Robinson, 1940. NEW STATE RECORD.** [1 specimen examined]. An adult specimen was collected by R.J. Worthington gleaning in a tallgrass prairie habitat. 21 September 2009. Site: Anderson Prairie.

Aphodius prodromus (Brahm, 1790). [3 specimens examined]. Gordon and Skelley (2007). Adult specimens were collected by gleaning. One specimen was collected in a mixed hardwood forest habitat, one specimen was collected in a tallgrass prairie habitat, and one specimen was collected in a mixed grassland and forest habitat. Specimens were collected from 30 September to 6 October. Sites include: Twin Springs, Anderson Prairie, and Lindeman Pond.

The Great Lakes Entomologist, Vol. 43, No. 1 [2010], Art. 7

Aphodius rusicola Melsheimer, 1846. [120 specimens examined]. Wickham (1911). Adult specimens were collected by pitfall trapping, black light trapping, and manure-baited pitfall trapping. Three specimens were collected in a tallgrass prairie habitat, six specimens were collected in oak-hickory forest habitat, 86 specimens were collected in a mixed grassland and forest habitat, and 25 specimens were collected in actively grazed pasture habitat. Specimens were collected from 2 June to 11 August. Sites include: Anderson Prairie, Hickory Ridge Woods, Chipera Prairie, Kraus, Prairie Song, Lionberger Preserve, Eichinger, Enos, Cardinal Marsh, and Lake Meyer.

Aphodius stercorosus Melsheimer, 1846. [133 specimens examined]. Wickham (1911). Adult specimens were collected by black light trapping. One specimen was collected in tallgrass prairie habitat, one specimen was collected from oak-hickory forest habitat, 99 specimens were collected in mixed grassland and forest habitat, and 32 specimens were collected in actively grazed pasture habitat. Specimens were collected from 23 June to 11 August. Sites include: Anderson Prairie, Chipera Prairie, Eichinger, Enos, Hickory Ridge Woods, Kraus, Lionberger Preserve, and Prairie Song.

Dialytes truncatus (Melsheimer, 1846). [11 specimens examined]. Stebnicka (1994). Specimens were collected using manure-baited pitfall traps and black light traps. Four specimens were collected in an oak-hickory forest habitat and seven specimens were collected in a mixed grassland and forest habitat. Specimens were collected from 10 July to 9 September. Sites include: Hickory Ridge Woods, Lake Meyer, Lionberger Preserve, and Prairie Song.

EUPARIINI

Ataenius abditus (Haldeman, 1848). [48 specimens examined]. Putnam (1876). Adult specimens were collected using black light trapping. All specimens were collected in mixed grassland and forest habitat. Specimens were collected from 23 June to 29 June. Sites include: Cardinal Marsh, Chipera Prairie, Lake Meyer, and Lionberger Preserve.

Ataenius gracilis (Melsheimer, 1846). [231 specimens examined]. Wickham (1911). Adult specimens were collected using black light traps and manure-baited pitfall traps. Eighty-eight specimens were collected in mixed grassland and forest habitat and 143 specimens were collected in actively grazed pasture habitat. Specimens were collected from 23 June to 3 August. Sites include: Cardinal Marsh, Chipera Prairie, Eichinger, Enos, Kraus, Lake Meyer, Lionberger Preserve, and Prairie Song.

Ataenius spretulus (Haldeman, 1848). [538 specimens examined]. Cartwright (1974). Adult specimens were collected using pitfall traps, black light traps, and manure-baited pitfall traps. One specimen was collected from tallgrass prairie habitat, one specimen was collected from oak-hickory forest habitat, 490 specimens were collected from mixed grassland and forest habitat, and 46 specimens were collected from actively grazed pasture habitat. Specimens were collected from 23 June to 15 September. Sites include: Cardinal Marsh, Chipera Prairie, Eichinger, Enos, Gateway Prairie, Hickory Ridge Woods, Kraus, Lake Meyer, Lionberger Preserve, and Prairie Song.

Ataenius strigatus (Say, 1823). [10 specimens examined]. Wickham (1911). Adult specimens were collected using black light traps. Three specimens were collected from a mixed grassland and forest habitat and seven specimens were collected from an actively grazed pasture habitat. Specimens were collected from 26 June to 3 August. Sites include: Chipera Prairie and Enos.

https://scholar.valpo.edu/tgle/vol43/iss1/7
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SCARABAEINAE

Onthophagini

Onthophagus hecate (Panzer 1794). [155 specimens examined]. Putnam (1876). Specimens were collected by gleaning, using pitfall traps, and manure-baited pitfall traps. Sixty-nine specimens were collected in tallgrass prairie habitat, four specimens were collected in a grassland habitat, 45 specimens were collected in a mixed grassland and forest habitat, 19 specimens were collected in actively grazed pasture habitat, six specimens were collected in an oak-hickory forest habitat, and 12 specimens were collected in the Decorah area by gleaning in dog feces. Specimens were collected from 2 June to 24 September. Sites include: Anderson Prairie, Chipera Prairie, Eichinger, Enos, Gateway Prairie, Heritage Valley, Hickory Ridge Woods, Kraus, Lake Meyer, Larsen, Lionberger Preserve, Prairie Song, and US 52 roadside.

Onthophagus orpheus canadensis (Fabricius, 1801). [10 specimens examined]. Howden and Cartwright (1963). Specimens were collected by gleaning, pitfall traps, and manure-baited pitfall traps. One specimen was collected in a mixed floodplain forest habitat, two specimens were collected in a tallgrass prairie habitat, three specimens were collected from the Decorah area, one specimen was collected from a mixed grassland and forest habitat, and three specimens were collected from an oak-hickory forest habitat. Specimens were collected from 11 June to 22 September. Sites include: Anderson Prairie, Chattahoochie Park, Hickory Ridge Woods, Larsen, Luther College campus, and Prairie Song.

Coprini

Copris fricator (Fabricius, 1787). [25 specimens examined]. Putnam (1876). Specimens were collected using pitfall traps, gleaning, black light traps, and manure-baited pitfall traps. Eleven specimens were collected from tallgrass prairie habitat, 13 specimens were collected from mixed grassland and forest habitats, and one specimen was collected from oak-hickory forest habitat. Specimens were collected from 29 May to 8 September. Sites include: Aikman Prairie, Anderson Prairie, Effigy Mounds National Monument, Heritage Valley, Hickory Ridge Woods, Lionberger Preserve, and Prairie Song.

Phanaeini

Phanaeus vindex MacLeay, 1819. [9 specimens examined]. Wickham (1911). Specimens were collected by gleaning and pitfall trapping. Seven specimens were collected in tallgrass prairie habitat and two specimens were collected in a mixed grassland and forest habitat. Specimens were collected from 5 June to 5 September. Sites include: Anderson Prairie, Decorah Community Prairie, Effigy Mounds National Monument, and Heritage Valley.

Canthonini

Canthon pilularius (Linnaeus, 1758). [8 specimens examined]. Wickham (1911). Adult specimens were collected by gleaning. Four specimens were collected from a tallgrass prairie habitat and four specimens were collected from the Decorah area. Specimens were collected from 8 June to 19 June. Sites included: Effigy Mounds National Monument and Luther College campus.

Canthon viridis (Palisot de Beauvois, 1805). [4 specimens examined]. Wickham (1911). Specimens were collected by pitfall trapping and gleaning. All four specimens were collected from tallgrass prairie habitats. Specimens were collected from 2 to 25 June. Sites include: Aikman Prairie, Anderson Prairie, and Gateway Prairie.

MELOLONTHINAE

DIPLOTAXINI

Diplotaxis harperi Blanchard, 1851. [57 specimens examined]. Wickham (1911). Specimens were collected using black light traps, manure-baited pitfall traps, and banana-beer traps. One specimen was collected in tallgrass prairie habitat, 10 specimens were collected in oak-hickory forest habitat, and 46 specimens collected from mixed grassland and forest habitat. Specimens were collected from 12 June to 15 September. Sites include: Anderson Prairie, Cardinal Marsh, Hickory Ridge Woods, Lake Meyer, Lionberger Preserve, and Prairie Song.

HOPLIINI

***Hoplia laticollis* LeConte, 1856. NEW STATE RECORD.** [1 specimen examined]. Specimen was collected by P. Kraus gleaning in an actively grazed pasture habitat. Specimen was collected on 14 June 2009. Site: Kraus.

MACRODACTYLINI

Dichelonyx linearis (Gyllenhal, 1817). [2 specimens examined]. Wickham (1911). Specimens were collected using black light traps. Both specimens were collected in a mixed grassland and forest habitat. Specimens were collected from 19 June to 24 June. Sites include: Heritage Valley and Lake Meyer.

Dichelonyx subvittata (LeConte, 1856). [34 specimens examined]. Wickham (1911). Specimens were collected by gleaning and black light trapping. One specimen was collected in tallgrass prairie habitat, eight specimens were collected in oak-hickory forest habitat, three specimens were collected in a mixed hardwood forest habitat, two specimens were collected in the Decorah area, and 20 specimens were collected in a mixed grassland and forest habitat. Specimens were collected from 2 June to 24 June. Sites include: Malanaphy Springs, Luther College Campus, Anderson Prairie, Hickory Ridge Woods, Coon Creek, Lionberger Preserve, and Lake Meyer.

Macrodactylus subspinosus (Fabricius, 1775). [1 specimen examined]. Wickham (1911). Specimen was collected by gleaning. Specimen was collected on 2 June. Site: Luther College campus.

MELOLONTHINI

Phyllophaga anxia (LeConte, 1850). [2 specimens examined]. Putnam (1876). Specimens were collected by black light trapping in a mixed grassland and forest habitat. Specimens collected on 29 May. Site: Prairie Song.

Phyllophaga balia (Say, 1825). [1 specimen examined]. Wickham (1911). Specimen was collected using black light trapping in an oak-hickory forest habitat. Specimen was collected on 12 June. Site: Hickory Ridge Woods.

Phyllophaga crenulata (Froelich, 1792). [26 specimens examined]. Wickham (1911). Specimens were collected by black light trapping. Three specimens were collected in tallgrass prairie habitat, one specimen was collected in an oak-hickory forest habitat, 21 specimens were collected in a mixed grassland and forest habitat, and one specimen was collected in an actively grazed pasture habitat. Specimens were collected from 10 June to 23 July. Sites include: Anderson Prairie, Chipera Prairie, Hickory Ridge Woods, Kraus, Lake Meyer, Lionberger Preserve, and Prairie Song.

Phyllophaga fusca (Froelich, 1792). [15 specimens examined]. Putnam (1876). Specimens were collected by gleaning and black light trapping. Two specimens were collected in an oak-hickory forest habitat, 11 specimens were collected in a mixed grassland and forest habitat, and two specimens were

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collected in the Decorah area. Specimens were collected from 13 May to 23 June. Sites include: Hickory Ridge Woods, Lionberger Preserve, Luther College campus, and Prairie Song.

Phyllophaga futilis (LeConte, 1850). [38 specimens examined]. Wickham (1911). Specimens were collected by gleaning, pitfall traps, banana-beer traps, and black light traps. Eleven specimens were collected in tallgrass prairie habitat, 20 specimens were collected in a mixed grassland and forest habitat, one specimen was collected in a mixed hardwood forest habitat, and six specimens were collected in an actively grazed pasture habitat. Specimens were collected from 15 May to 10 July. Sites include: Anderson Prairie, Gateway Prairie, Kraus, Lionberger Preserve, Prairie Song, and Yellow River State Forest.

Phyllophaga gracilis (Burmeister, 1855). [1 specimen examined]. Travis (1934). Specimen was collected by black light trapping in a mixed grassland and forest habitat. Specimen was collected 24 June. Site: Lake Meyer.

Phyllophaga ilicis (Knoch, 1801). [3 specimens examined]. Putnam (1876). Specimens were collected using black light traps. One specimen was collected in an oak-hickory forest habitat and two specimens were collected in a mixed grassland and forest habitat. Specimens were collected from 12 June to 23 June. Sites include: Hickory Ridge Woods and Lionberger Preserve.

Phyllophaga implicita (Horn, 1887). [18 specimens examined]. Horn (1887). Specimens were collected by black light traps. Six specimens were collected in an oak-hickory forest habitat and 12 specimens were collected in a mixed grassland and forest habitat. Specimens were collected from 29 May to 24 June. Sites include: Hickory Ridge Woods, Lake Meyer, Lionberger Preserve, and Prairie Song.

Phyllophaga inversa (Horn, 1887). [1 specimen examined]. Wickham (1911). Specimen was collected by black light trapping in a tallgrass prairie habitat. Specimen was collected 10 June. Site: Anderson Prairie.

Phyllophaga rugosa (Melsheimer, 1846). [19 specimens examined]. Wickham (1911). Specimens were collected by black light trapping. Eight specimens were collected in a tallgrass prairie habitat, two specimens were collected in the Decorah area, and nine specimens were collected in a mixed grassland and forest habitat. Specimens were collected from 10 June to 26 June. Sites include: Anderson Prairie, Chipera Prairie, and Lake Meyer.

Phyllophaga tristis (Fabricius, 1781). [3 specimens examined]. Putnam (1876). Specimens were collected by gleaning and pitfall trapping. Two specimens were collected in tallgrass prairie habitat and one specimen was collected in the Decorah area. Specimens were collected from 16 May to 8 June. Sites include: Anderson Prairie and Luther College campus.

Sericini

Serica sericea (Illiger, 1802). [12 specimens examined]. Wickham (1911). Specimens were collected by pitfall traps, banana-beer traps, black light traps, and rodent burrow pitfall traps. Three specimens were collected in tallgrass prairie habitat, seven specimens were collected in a mixed grassland and forest habitat, and two specimens were collected in an oak-hickory forest habitat. Specimens were collected from 28 May to 10 July. Sites include: Anderson Prairie, Hickory Ridge Woods, Lionberger Preserve, and Prairie Song.

Serica sponsa Dawson, 1919. [4 specimens examined]. Dawson (1919). Specimens were collected by black light trapping. All four specimens were collected in a mixed grassland and forest habitat. Specimens were collected from 23 June to 11 August. Sites include: Lionberger Preserve and Prairie Song.

The Great Lakes Entomologist, Vol. 43, No. 1 [2010], Art. 7

RUTELINAE

RUTELINI

Pelidnota punctata (Linnaeus, 1758). [9 specimens examined]. Putnam (1876). Specimens were collected by gleaning and black light trapping. Five specimens were collected in the Decorah area, two specimens were collected in a mixed grassland and forest habitat, one specimen was collected in actively grazed pasture habitat, and one specimen was collected in oak-hickory forest. Specimens were collected from 8 June to 21 September. Sites include: Hickory Ridge Woods, Kraus, Luther College campus, Prairie Song, and Sordahl.

ANOMALINI

Strigoderma arbicola (Fabricius, 1792). [3 specimens examined]. Putnam (1876). Specimens were collected by gleaning. Two specimens were collected in tallgrass prairie habitat and one specimen was collected in an oak-hickory forest habitat. Specimens were collected from 18 June to 29 June. Sites include: Anderson Prairie and Hickory Ridge Woods.

DYNASTINAE

PENTODONTINI

Aphonus tridentatus (Say, 1823). [3 specimens examined]. Wickham (1911). Adult specimens were collected by gleaning and manure-baited pitfall traps. One specimen was collected in a mixed hardwood forest habitat and two specimens were collected in a mixed grassland and forest habitat. Specimens were collected from 29 June to 6 October. Sites include: Cardinal Marsh and Malanaphy Springs.

Tomarus relictus (Say, 1825). [1 specimen examined]. Wickham (1911). Specimen was collected by black light trapping in a mixed grassland and forest habitat. Specimen was collected on 23 June. Site: Lionberger Preserve.

CETONIINAE

CETONIINI

Euphoria fulgida (Fabricius, 1775). [1 specimen examined]. Wickham (1911). Specimen was collected by gleaning in an actively grazed pasture habitat. Specimen was collected on 9 July. Site: Kraus.

Euphoria inda (Linnaeus, 1758). [13 specimens examined]. Putnam (1876). Specimens were collected by gleaning and manure-baited pitfall traps. Nine specimens were collected in tallgrass prairie habitat, three specimens were collected in the Decorah area, and one specimen was collected in a mixed grassland and forest habitat. Specimens were collected from 31 August to 26 October. Sites include: Anderson Prairie, Chipera Prairie, and Luther College campus.

TRICHIINI

Osmoderma subplanata Casey, 1915. [4 specimens examined]. Howden (1968). Specimens were collected by gleaning and at lights. Specimens were collected from 8 June to 2 September. Sites include: Luther College campus.

Trichiotinus piger (Fabricius, 1775). [3 specimens examined]. Wickham (1911). Specimens were collected by gleaning. One specimen was collected in a tallgrass prairie habitat, one specimen was collected in a mixed hardwood forest habitat, and one specimen was collected in a mixed grassland and forest habitat. Specimens were collected from 2 June to 27 July. Sites include: Coon Creek, Effigy Mounds National Monument, and Roslien Woods.

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Discussion

Oak-Hickory forest and tallgrass prairie are the two most common native habitat types found in Iowa, while pasture land and mixed grassland and forest habitats are products of post-European settlement (Wolf 2004). The prevalence and continuation of oak-hickory forest and tallgrass prairie habitats over an extended period of time has provided beetles the opportunity to adapt to niches in these environments. The mixed grassland and forest habitat had the highest species richness, which can be attributed to the combination of the oak-hickory forest and tallgrass prairie habitat types. The combination of two habitats increased beetle species richness due to the existence of multiple conditions in one area.

Black light trapping collected the most beetles of the five different collecting techniques. The effectiveness of this method was most likely due to the abundance of species that are readily attracted to lights.

This study would have benefited from an examination of pertinent specimens from other colleges and universities, which may have yielded additional species for the area surveyed. Future examinations of other collections' holdings would enhance the accuracy of this survey. Several additional techniques could have been used or modified to maximize both species richness and total beetle abundance in the field survey. Few specimens of Anomalini were collected during this survey, most likely due to the form of the light trap used and the habits of Anomalini when attracted to lights. Anomalini are not usually attracted directly to lights but prefer to remain on vegetation at a distance (P. Lago, pers. comm.). Therefore our use of black light bucket traps without searching nearby vegetation likely reduced the possibility of collecting specimens from Anomalini.

Cremastocheilini also were not collected during this survey. Cremastocheilini leave ant nests in late spring to seek out mates and to locate other ant nests on which to lay their eggs (Alpert 1984). Specific methods suggested for collecting *Cremastocheilus* species consist of placing a board or other flat object on thatch mounds of *Formica* ant nests in the early spring in hopes of catching individuals seeking shelter (B. Ratcliffe, pers. comm.).

Banana-beer traps were used to target Cetoniini, yet few scarab specimens of any species were collected using this method. A method that could have been more productive and increased species diversity and abundance within *Euphoria* (Cetoniini), is a Lindgren funnel system baited with Everclear, a form of grain alcohol (P. Lago, pers. comm.).

Phyllophaga, a genus within Melolonthini, consists of 214 species in the United States and Canada (Evans 2009). One hundred twenty-seven specimens representing 11 *Phyllophaga* species were collected in this study. This genus alone represented 7.68% of the total number of species collected. Iowa has 36 recorded species of *Phyllophaga* and earlier collecting in April and June, especially by black light, may have yielded more species for this genus (Ed Freese, personal communication).

Human and pig feces are known to be more attractive than cow manure to adult dung beetles due to the higher protein and nitrogen content (Hanski and Cambefort 1991). Therefore, it might have been more effective to use human or pig feces instead of cow dung when baiting manure-baited pitfall traps (P. Lago, personal communication). The use of either dung- or malt-bait in rodent burrow pitfall traps may also greatly increase the productivity of trapping (Skelley and Gordon 2001).This survey produced five new state records for Iowa. One specimen of *Aphodius haemorrhoidalis* (Linnaeus) was collected in a manure-baited pitfall trap located in a cattle pasture on 6 July 2009. This

species was introduced into the United States from Europe and has spread to southeastern Canada and the eastern half of the United States westward to the Dakotas, Nebraska, and Kansas, but no specimens had been previously reported from Iowa (Ratcliffe and Paulsen 2008).

The second state record is *Aphodius kirni* Cartwright, with five specimens collected at two locations. Four specimens were collected in a rodent burrow pitfall trap in a tallgrass prairie planting on 12 June 2009. One additional specimen was collected in a mixed grassland/forest interface using a black light trap on 29 June 2009. The range of *A. kirni* is known to extend from southern Manitoba, Wisconsin, and Indiana south to Louisiana, Texas, and New Mexico (Ratcliffe and Paulsen 2008).

The third state record is *Aphodius lentus* Horn, with five specimens collected from three locations. Two specimens were collected in a pitfall trap from a tallgrass prairie planting on 2 June 2009. Three specimens were collected from two mixed grassland/forest tracts using black light traps on 26 and 29 June 2009. *Aphodius lentus* has been sparsely recorded from Massachusetts to Georgia west to Nebraska and Kansas (Ratcliffe and Paulsen 2008).

The fourth state record is *Aphodius magnificens* Robinson, with only one specimen collected throughout the duration of the survey. This specimen was collected from a tallgrass prairie planting by gleaning on 21 September 2009. The range of *A. magnificens* includes Wisconsin, Illinois, Indiana, Minnesota, North Dakota, Nebraska, Kansas, Oklahoma, and Texas. Since this species occurs in Iowa's surrounding states, the likelihood of the species being collected in Iowa was high.

The fifth state record is *Hoplia laticollis* LeConte, with only one specimen collected. The specimen was collected while gleaning on 14 June 2009 from a grazed pasture area that is adjoined by a mixed tree planting of several species of pine and oak. The range of *H. laticollis* is mainly from the Great Plains region from Manitoba and western Ontario in Canada southwest through North and South Dakota, Wyoming, Colorado, and Nebraska to Texas, New Mexico, and Arizona.

This paper documents the presence of 49 species of Scarabaeidae in extreme northeastern Iowa, including five new state records. Mixed grassland and forest habitat had the greatest species richness and beetle abundance. Black light traps collected the greatest number of beetles and species richness of the various collecting techniques.

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