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# Scarab Beetles (Coleoptera: Scarabaeidae) in the Dung of Native Arkansas Mammals

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Running Title: Scarab Beetles in the Dung of Native Arkansas Mammals

## Abstract

Dung beetles are important ecological components of natural ecosystems. One primary activity is the fragmentation and recycling of animal dung. Little is known about the ecological impact of beetles associated with the dung of mammals native to Arkansas. We surveyed the dung of native mammals within Arkansas to determine the species and distributional patterns associated with dung. We searched and collected beetles *in situ* from the dung or nests of native mammalian species within Arkansas. We also set simple pitfall traps using dung of various native Arkansas mammals as bait. Most of the beetles collected were common dung beetles. However, we collected a new state record, *Ataenius cylindrus*, in dung of white-tailed deer, *Odocoileus virginianus*, and we provide the first report of dung beetles in the dung of river otter, *Lontra canadensis*.

## Introduction

Dung beetles (Scarabaeidae: Scarabadeinae and Aphodiinae) are important ecological components of natural ecosystems (Nichols et al. 2008). One primary result of the activity of these beetles is the fragmentation and recycling of animal dung. A recent study in Arkansas primarily focused on the fragmentation of dung of exotic animals (i.e., domestic cattle, Fiene et al. 2011). That study also supplied additional statewide natural history data on scarab species and a current list of known dung beetle species occurring in Arkansas. However, limited studies have been conducted determining the distribution of dung beetle fauna of native mammals. Little is known about the ecological impact or habits in Arkansas of beetles found in the dung of native mammals. The majority of previous research in Arkansas has either focused on the beetle fauna associated with a particular mammal (e.g. Ozark pocket gopher, *Geomys bursarius ozarkensis*, Kovarik et al. 2008) or a particular habitat (e.g. karst

habitat, Slay et al. 2012). As a first step in understanding these ecological relationships, we surveyed the dung of select native mammals within Arkansas to determine the species and distributional patterns associated with native dung.

## Methods

We employed two types of methods to collect dung beetles: (1) sifting through *in situ* dung and collecting the beetles and (2) setting pitfall traps in habitat baited with native mammalian dung. Most of our survey occurred in forested areas and pastures of southern Arkansas, although we also include observations from northern Arkansas.

We examined various habitats to search for dung beetles *in situ*, and to locate areas in which to set pitfall traps. The habitats were chosen based on knowledge of presence of mammals, either from previous sightings or from trace evidence (i.e., dung, tracks, nests). Areas that showed high levels of mammalian activity were selected. Particular attention was paid to areas that contained elevated amounts of mammal excrement, which were found closest to the nesting sites of these mammals, usually in areas of mixed deciduous-pine bottomland. These criteria were met most consistently by habitats of white-tailed deer, *Odocoileus virginianus*, raccoon, *Procyon lotor*, and swamp rabbit, *Sylvilagus aquaticus*, whose high population density also made them ideal contributors of excrement. This study was conducted from November 2011 to September 2012, with most of the work conducted in the summer months of 2012. The average temperature for the summer months at the time the areas were examined was 21.6°C in morning and 29.4°C in afternoon.

Identification of dung to species was made by comparison with Elbroch (2003). We sifted dung by hand, collected beetles, and preserved them in 70% ethanol. Collected dung was then used as bait for a series of pitfall traps, which were placed in areas of

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concentrated mammal activity. Traps were constructed from 473 ml (16 oz) plastic drinking cups placed so that the rim was flush with the ground. A malleable wire was used to suspend a sample of dung in a piece of tack cloth over the cup. The cup contained a solution of water, detergent (to lower surface tension and cause the beetles to sink), and table salt (to kill and help preserve the beetles). Traps were allowed to sit for 3-5 days. Beetles were then collected and placed in a 70% ethanol solution for preservation. Beetles were identified by PE Skelley and subsequently deposited in the Florida State Collection of Arthropods at the Florida Department of Agriculture.

### Results

A total of 11 species of dung beetles were collected from 4 species of native mammals by either *in situ* searching or pitfall trapping.

*Ataenius cylindrus* Horn: 22 July 2012, *in situ* white-tailed deer dung, Drew County (N33°35.569', W -91°49.120'), 1 specimen, JBK. *Ataenius cylindrus* is a new state record. However, as it has been collected from nearby Tennessee, Mississippi, Louisiana, and Texas (Cartwright 1974), its discovery in southern Arkansas is not surprising. This species has been collected from dry cow dung and under dry excrement on the ground (Woodruff 1973, Cartwright 1974, Stebnicka 2007). This is the first report of this species being collected from deer dung.

*Ateuchus histeroides* Weber: 15-23 September 2012, raccoon dung, pitfall trap, Drew County, Lake Monticello (N33°35.570', W -91°49.125'), 1 specimen, JBK. *Ateuchus histeroides* is predominantly collected at light traps or under cow dung; however it has also been collected from various other food sources (Young 2007). It is a woodland species, and has been collected from dung of many woodland mammals (Ratcliffe and Paulson 2008). In Arkansas, this species has been collected from a trap baited with carrion of woodland vole, *Microtus pinetorum* (Fiene et al. 2011). It has also been identified in droppings of woodrat, *Neotoma* sp., and woodchuck, *Marmota monax*, in Ohio (Woodruff 1973).

*Blackburneus stercorosus* (Melsheimer): 1 June 2012, *in situ* white-tailed deer dung, Drew County (N33°35.570', W -91°49.126'), 2 specimens, JBK. *Blackburneus stercorosus* habits are not completely known, however specimens have been taken from

small mammal and cow dung (Gordon and Skelley 2007). In fact, only a single specimen was collected from cow dung during a study in northeastern Arkansas (Fiene et al. 2011). The species is found in woodlands in Texas (Fincher et al. 1986); specimens collected in our study were collected in woodlands.

*Copris minutus* (Drury): 29 March 2012, *in situ* swamp rabbit latrine, Drew County, Lake Monticello, 1 specimen, JBK. 2 December 2011, *in situ* raccoon dung, Union County, ca. 11 km WNW El Dorado, 1 specimen, MBC. 15-23 September 2012, raccoon dung pitfall trap, Drew County, Lake Monticello (N33°35.570', W -91°49.125'), 1 specimen, JBK. *Copris minutus* primarily feeds on cow dung (Woodruff 1973). It has been taken from traps baited with raccoon dung previously (Fincher et al. 1970). This is the first report of this species feeding on swamp rabbit dung.

*Irrasinus stupidus* (Horn): 15 February 2012, *in situ* white-tailed deer dung, Union County, vic. El Dorado, 0.5 km S junction US 63 and Grady Bell Road, 1 specimen, MBC. This species is closely associated with deer dung (Gordon 1983). *Irrasinus stupidus* primarily feeds on shaded deer dung (Gordon and Skelley 2007), but has been known to feed on cow and horse dung as well (Woodruff 1973).

*Onthophagus hecate hecate* (Panzer): 2 December 2011, *in situ* raccoon dung, Union County, ca. 11 km WNW El Dorado, 1 specimen, MBC. 1 November 2011, *in situ* river otter, *Lontra canadensis*, dung, Drew County, SW of Dermott, Seven Devils Swamp (N33°24.353', W -90°33.712'), JBK. 1 June 2012, *in situ* raccoon dung, Drew County, (N33°35.232', W -91°49.416'), 3 specimens, JBK. 1-4 June 2012, raccoon dung pitfall trap, Drew County (N33°24.572', W -90°49.123'), 10 specimens, JBK. 1 June 2012, *in situ* white-tailed deer dung, Drew County (N33°35.570', W -91°49.126'), 2 specimens, JBK. 1-6 June 2012, raccoon dung pitfall trap, Drew County (N33°35.570', W -91°49.125'), 13 specimens, JBK. 9 June 2012, *in situ* raccoon dung, Drew County (N33°35.562', W -91°49.132'), 11 specimens, JBK. 9-12 June 2012, raccoon dung pitfall trap, Drew county (N33°35.570', W -91°49.125'), 17 specimens, JBK. 22-26 July 2012, raccoon dung pitfall trap, Drew County (N33°35.570', W -91°49.125'), 1 specimen, JBK. 15-23 September 2012, raccoon dung pitfall trap, Drew County, Lake Monticello (N33°35.570', W -91°49.125'), 3 specimens, JBK. *Onthophagus hecate* is

a widespread generalist beetle, being previously collected from various types of dung, rotting fruit, carrion, light traps, and woodrat nests (Howden and Cartwright 1963). This is the first report of a scarab beetle being collected from river otter dung. Since this species of beetle is a generalist, this dung source is probably not necessary for this species to persist.

*Onthophagus pennsylvanicus* Harold: 1 June 2012, *in situ* raccoon dung, Drew County, (N33°35.232', W -91°49.423'), 3 specimens, JBK. 1 June 2012, *in situ* white-tailed deer dung, Drew County (N33°35.570', W -91°49.126'), 2 specimens, JBK. 1-6 June 2012, raccoon dung pitfall trap, Drew County (N33°35.570', W -91°49.125'), 1 specimen, JBK. 15-23 September 2012, raccoon dung pitfall trap, Drew County, Lake Monticello (N33°35.570', W -91°49.125'), 1 specimen, JBK. 15-23 September 2012, swamp rabbit dung pitfall trap, Drew County, Lake Monticello (N33°35.570', W -91°49.125'), 1 specimen, JBK. *Onthophagus pennsylvanicus* is a widespread generalist beetle with varied adult food habits (Howden and Cartwright 1963).

*Onthophagus taurus* (Schreber): 3 August 2012, *in situ* white-tailed deer dung, Marion County, vic. Mull, AR St. Hwy. 268E, 1 specimen, MBC. This species is an exotic species that was accidentally introduced into Florida. This species was reported from cow dung at this same site by Fiene et al. (2011). Although this species primarily feeds on exotic dung (e.g. cow and horse dung), some species in the genus are feeding generalists (Howden and Cartwright 1963), so it is not surprising to find this species feeding on deer dung at the same site.

*Onthophagus tuberculifrons* Harold: 2 December 2011, *in situ* raccoon dung, Union County, ca. 11 km WNW El Dorado, 27 specimens, MBC. *Onthophagus tuberculifrons* is a widespread generalist beetle with varied food habits collected most commonly from sandy soils (Howden and Cartwright 1963).

*Oscarinus rusicola* (Melsheimer): 10 May 2012, *in situ* white-tailed deer dung, Union Co., El Dorado, South Arkansas Arboretum, 2 specimens, MBC. 22 July 2012, *in situ* white-tailed deer dung, Drew County (N33°35.569', W -91°49.120'), 4 specimens, JBK. 22-26 July 2012, raccoon dung pitfall trap, Drew County (N33°24.572', W -90°49.123'), 2 specimens, JBK. This species is closely associated with deer dung (Gordon 1983), but is also commonly found on dung of

sheep, cattle, and rodents (Gordon and Skelley 2007, Ratcliffe and Paulson 2008).

*Pseudocanthion perplexus* (LeConte): 1-4 June 2012, raccoon dung pitfall trap, Drew County (N33°24.572', W -90°49.123'), 5 specimens, JBK. 1 June 2012, *in situ* white-tailed deer dung, Drew County (N33°35.570', W -91°49.126'), 1 specimen, JBK. 1-6 June 2012, raccoon dung pitfall trap, Drew County (N33°35.570', W -91°49.125'), 1 specimen, JBK. 9-12 June 2012, raccoon dung pitfall trap, Drew county (N33°35.570', W -91°49.125'), 2 specimens, JBK. Very little is known about the specific biology of this species, but it has been taken from eastern woodrat (*Neotoma floridana*) nests in Florida (Woodruff 1973).

## Discussion

The detection of different genera and species of scarab beetles in native mammalian dung highlights the importance of ecosystem management, including both large and small mammals, in ensuring persistence of populations of beetles. For instance, landscape management regimes focused on large game mammals correlated to higher dung availability to scarab beetles, thereby possibility increasing their abundance (Masis and Marquis 2009). We collected various scarab beetles from dung of both large (e.g. white-tailed deer) and small (e.g. swamp rabbits) mammals, demonstrating that both large and small-sized mammals can provide dung availability for scarab beetles. Furthermore, many scarab beetles also feed on substances other than dung, such as carrion, and have specific preferences for soil types, habitat, and time of activity (Gordon and Skelley 2007). Understanding the complete functioning of scarab beetles in the natural ecosystem goes beyond simple dung availability. The first step in understanding this functioning is cataloguing of diversity and of associations between individual beetle species and host animals. Future studies should be expanded to include collections of dung and carrion from more native mammalian species and different ecoregions of the state.

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Table 1: Scarab beetles collected from dung of various native mammals in Arkansas by *in situ* searching or pitfall traps. Asterisks denote detection.

Species	<i>Procyon lotor</i>		<i>Lontra canadensis</i>	<i>Odocoileus virginianus</i>	<i>Sylvilagus aquaticus</i>	
	<i>in situ</i>	pitfall trap	<i>in situ</i>	<i>in situ</i>	<i>in situ</i>	pitfall trap
<i>Ataenius cylindrus</i> Horn				*		
<i>Ateuchus histeroides</i> Weber		*				
<i>Blackburneus stercorosus</i> (Melsheimer)				*		
<i>Copris minutus</i> (Drury)	*	*			*	
<i>Irrasinus stupidus</i> (Horn)				*		
<i>Onthophagus hecate hecate</i> (Panzer)	*	*	*	*		
<i>Onthophagus pennsylvanicus</i> Harold	*	*		*		*
<i>Onthophagus taurus</i> (Schreber)				*		
<i>Onthophagus tuberculifrons</i> Harold	*					
<i>Oscarinus rusicola</i> (Melsheimer)		*		*		
<i>Pseudocanthion perplexus</i> (LeConte)		*		*		