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Survey of Twig-Inhabiting Coleoptera in Louisiana, USA

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Abstract

Twigs are an understudied habitat utilized by many beetle species. Samples of twigs were collected in all six Level III Ecoregions in Louisiana during April and May 2013. The twigs were maintained in emergence chambers from which 942 specimens of adult Coleoptera were obtained, representing 31 families, 111 genera, and 128 species. Beetle richness and composition were not significantly different among ecoregions. Three species collected represent **new state records**: *Pseudochoragus nitens* (LeConte) (Anthribidae); *Dryotribus mimeticus* Horn (Curculionidae); and *Narthecius grandiceps* LeConte (Laemophloeidae). Four non-native species, all Curculionidae, were collected: *Cyrtepistomus castaneus* (Roelofs) (Entiminae); *Cnestus mutilatus* (Blandford) (Scolytinae); *Xylosandrus crassiusculus* (Motschulsky) (Scolytinae); and *Xylosandrus germanus* (Blandford) (Scolytinae).

Key Words: emergence chamber, beetles, fine woody debris, saproxylic, species richness

Of what use are twigs
but to sweep up litter
of fallen petals?
-Yosa Buson (translated by Harry Behn)

Twigs are more than a potential eye hazard to a hiker, convenient kindling, or the bane of a suburbanite's lawn. Recent studies have revealed that twigs and fine woody debris (FWD) are overlooked habitats that support a rich beetle fauna. A review of community-level surveys of North American Coleoptera collected from FWD (up to 64 mm diameter) listed 83 species (Ferro *et al.* 2009). Collection of beetles emergent from mixed hardwood FWD (25–70 mm diameter) in Great Smoky Mountains National Park resulted in 1,544 specimens representing 162 species (Ferro *et al.* 2012). Two studies in Louisiana of twigs (14 ± 5 mm diameter) from *Quercus falcata* Michaux (southern red oak, Fagaceae) resulted in the collection of 414 beetles representing 35 species (Ferro *et al.* 2009) and 39 beetles representing 21 species (Ferro and Gimmel 2014).

Woody debris of all sizes is an important habitat for many insects, especially Coleoptera (see review in Ferro *et al.* 2012). Woody debris is generally divided into two size classes based on diameter: coarse and fine. There are no standardized size definitions. Commonly, the lower limit of coarse woody debris (CWD) falls between a diameter of 25–75 mm (Harmon *et al.* 1986), anything smaller is considered FWD. Ferro *et al.* (2012) defined FWD as woody debris with 25–70 mm diameter and originating from trees. Ferro *et al.* (2009) and Ferro and Gimmel (2014) consistently used the term "twigs" to refer to woody debris originating from trees that fell below 25 mm diameter. In an effort to provide consistency, the terms CWD, FWD, and twig will be used in this study as defined above.

The purpose of this exploratory study was to survey the beetle diversity within twigs throughout various habitats in the state of Louisiana and further develop the list of beetles that utilize the twig habitat. A secondary purpose was to investigate the community structure of twig-inhabiting beetles among Louisiana ecoregions.

Material and Methods

North America is divided into a hierarchical arrangement of ecoregions based on shared biotic and abiotic characteristics (CEC 1997). Louisiana contains two Level I, three Level II, and six Level III Ecoregions (CEC 2006; Daigle *et al*. 2006) (Table 1; Fig. 1). In an effort to thoroughly survey twig beetle fauna within Louisiana, samples were taken at each of the six Level III Ecoregions of the state (Table 2). Specific sample sites were chosen based on presence of forest cover and availability of fine woody debris.

Samples consisted of dead twigs from hardwood trees, <25 mm diameter and broken into <40 cm lengths. An effort was made to collect twigs from a wide variety of tree species and circumstances, *e.g*., touching the ground, hanging above the ground, attached to tree, dry, moist, little decay, heavy decay. Twigs were collected during April and May 2013 and immediately placed into emergence chambers (see Ferro and Carlton 2011 for design). An April–May collection time in Louisiana ensured that the twigs contained living beetles presumably ready for a spring emergence. An average of 180 twigs were placed in each emergence chamber. A total of 36 samples were taken at 19 locations, where each Level III Ecoregion was represented by at least three locations (Table 2).

Emergence chambers were taken to Feliciana Preserve (West Feliciana Parish, Louisiana) and placed outdoors in a shaded, tree-covered area. Beetles were allowed to emerge until 5 September 2013 (4–5 months) when all specimens were collected. Propylene glycol was used as a killing and preserving agent. Adult Coleoptera were pinned or point-mounted as needed and labeled. Identification to the lowest taxon level possible (typically species) was performed with the appropriate taxonomic literature and/or comparison with authoritatively identified reference specimens. All other macroinvertebrates were retained, labeled, and preserved in 90% ethanol. Specimens are deposited in the Louisiana State Arthropod Museum, Louisiana State University, Baton Rouge, Louisiana.

Statistical comparisons of the community of twig-inhabiting beetles were performed in R (R Core Team 2015) with *adonis* in the *vegan* package (Okanen *et al.* 2005). Ecoregion, mean annual temperature, annual precipitation, thermal line, and hydric soil rating (US Geological Survey 1998) were used as predictor variables for community differences. Total richness was estimated using Chao-1 (Chao 1984).

Table 1. Level I–III Ecoregions in Louisiana (CEC 2006). Numbers in parentheses correspond to Level III Ecoregion designations from Daigle *et al*. (2006).

8.0 Eastern Temperate Forests
8.3 Southeastern USA Plains
8.3.5 (65) Southeastern Plains
8.3.6 (74) Mississippi Valley Loess Plains
8.3.7 (35) South Central Plains
8.5 Mississippi Alluvial And Southeast USA Coastal Plains
8.5.2 (73) Mississippi Alluvial Plain
8.5.3 (75) Southern Coastal Plain
9.0 Great Plains
9.5 Texas-Louisiana Coastal Plain
9.5.1 (34) Western Gulf Coastal Plain

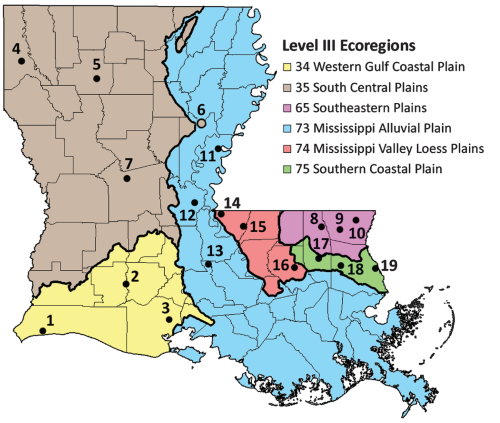


Fig. 1. Level III Ecoregions in Louisiana and collection locations. See Table 2 for location information.

Results

In total, 942 specimens of adult Coleoptera were obtained, representing 31 families, 111 genera, and 128 species (or lowest taxonomic unit when species could not be determined) (Table 3; Appendix 1). Despite the size of this study with 36 samples at 19 locations (6,400+ twigs), few species were recovered in abundance. Fifteen species (12%) were represented by 10 or more specimens, 56 (44%) were singletons, 70 (55%) were collected from only a single ecoregion, 10 (8%) were collected from five or more ecoregions, and 64 (50%) were collected from only one sample.

No significant differences in taxon richness among ecoregions and no significant differences among communities based on any of the predictor variables were found ($p > 0.05$). Community sampling was not saturated for any ecoregion (data not shown). Chao-1 estimated a total richness of 228 species.

Discussion

Eleven species collected during this study overlapped with previous studies (Ferro *et al.* 2009; Ferro and Gimmel 2014), bringing the total number of twig-inhabiting beetle species in Louisiana to 167. Chao-1 estimated a total richness of 228 species, showing that the sampling in this study only found 64% of the expected number of beetles. Finding that more species are expected was not surprising as it is often the case in studies with (what turned out to be) relatively small sampling. However, the rarified dispersion of species among the samples in this study was surprising. It is in contrast to the high overlap of species among twig bundles reported by Ferro *et al*. (2009), which suggested a diverse but predictable community of beetles was associated with twigs. Despite this contrast, the lack of community differences among the various predictor variables within Level III Ecoregions suggests that twig communities are homogeneous and that twigs in the broad sense are a uniform resource that are home to a specific guild of beetles. However, high species richness implies that variations within the twig habitat (*e.g*., tree species, age, position,

Table 2. Localities and dates of twig collections. # = number on map (Fig. 1); numbers in parentheses correspond to Level III Ecoregion designations from Daigle *et al*. (2006) (Table 1); (x2) = two samples taken from single location.

#	Parish	Location	Latitude	Longitude	Date
(34) 1	Cameron	Pevito Woods Sanctuary (x2)	N 29.7576°	W 93.6029°	20 April 2013
2	Jefferson Davis	Jennings (x2)	N 30.2376°	W 92.6338°	20 April 2013
3	Vermilion	Palmetto SP (x2)	N 29.8662°	W 92.1337	20 April 2013
(35) 4	Bossier	Bayless Estate	N 32.4496°	W 93.8510°	11 May 2013
5	Bienville	Big Cypress SP (x2)	N 32.2552°	W 92.9758°	12 May 2013
6	Catahoula	Sicily Island WMA	N 31.8118°	W 91.7642°	14 April 2013
		Sicily Island WMA	N 31.8064°	W 91.7729°	14 April 2013
7	Rapides	Kincaid Recreation Area (x2)	N 31.2672°	W 92.6234°	11 May 2013
(65) 8	Tangipahoa	Sandy Hollow WMA	N 30.8016°	W 90.3773°	4 April 2013
		Sandy Hollow WMA	N 30.8013°	W 90.3800°	4 April 2013
9	Washington	Bogue Chitto SP	N 30.7803°	W 90.1480°	4 April 2013
		Bogue Chitto SP	N 30.7796°	W 90.1429°	4 April 2013
10	Washington	7 k W Bogalusa (x2)	N 30.8569°	W 89.9639°	4 April 2013
(73) 11	Concordia	Bayou Cocodrie NWR (x2)	N 31.5638°	W 91.5601°	5 May 2013
12	Avoyelles	Pomme de Terre WMA (x2)	N 31.0280°	W 91.8406°	14 April 2013
13	Iberville	Sherburne WMA	N 30.4193°	W 91.6508°	14 April 2013
		Sherburne WMA	N 30.4248°	W 91.6732°	14 April 2013
(74) 14	West Feliciana	Tunica Hills WMA	N 30.9377°	W 91.5087°	4 May 2013
		Tunica Hills WMA	N 30.9322°	W 91.5196°	4 May 2013
15	West Feliciana	Feliciana Preserve	N 30.7946°	W 91.2537°	4 May 2013
		Feliciana Preserve	N 30.7956°	W 91.2566°	4 May 2013
16	Livingston	Tickfaw SP (x2)	N 30.3827°	W 90.6483°	4 May 2013
(75) 17	Tangipahoa	East of Hammond (x2)	N 30.5175°	W 90.3733°	4 April 2013
18	Covington	Fairview Riverside SP	N 30.4111°	W 90.1440°	4 April 2013
19	St. Tammany	Honey Island WMA	N 30.3741°	W 89.6740°	4 April 2013
		Honey Island WMA	N 30.3879°	W 89.6800°	4 April 2013

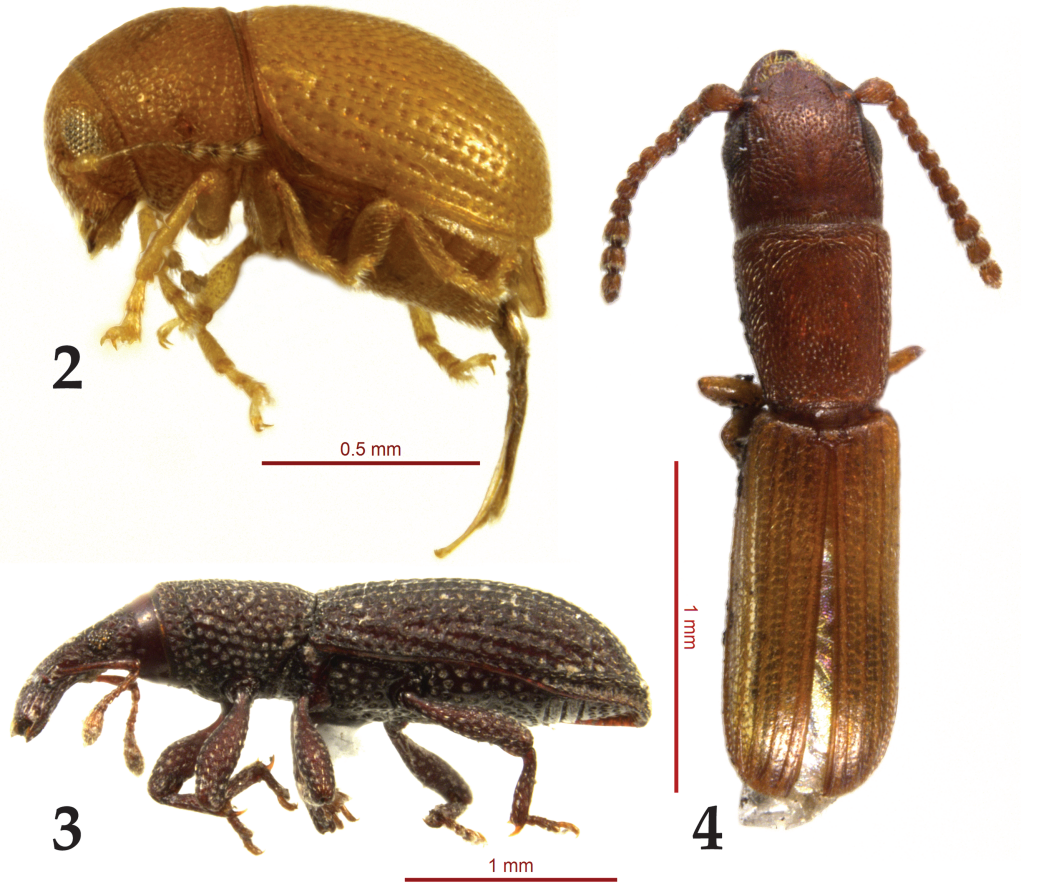
Table 3. Taxon richness by ecoregion. Numbers in parentheses correspond to Level III Ecoregion designations from Daigle *et al*. (2006) (Table 1).

Ecoregion	# families	# genera	# species
Western Gulf Coastal Plains (34)	19	37	39
South Central Plains (35)	17	40	42
Southeastern Plains (65)	16	34	34
Mississippi Alluvial Plains (73)	15	38	46
Mississippi Valley Loess Plains (74)	16	37	41
Southern Central Plain (75)	17	36	40
Total	**31**	**111**	**128**

season of death) result in a wide variety of niches, and the life of a dead twig is more dynamic than anticipated.

It is important to note that the lack of significant differences in species richness or community composition among Level III Ecoregions may be influenced by the relatively small study size and inability to saturate sampling. Additionally, this and previous studies (Ferro *et al.* 2009; Ferro and Gimmel 2014) are biased for species that overwinter in twigs. However, even if these limitations were overcome, the necessary fast life cycle and vagility of most twig-inhabiting beetles may result in a more or less homogenous community at scales greater than Level III Ecoregions as seen by Ferro *et al.* (2009). Additionally, aggregation of twigs to a single location for emergence may have influenced what species emerged, but that seems unlikely due to the overall taxonomic diversity observed.

Three species collected represent **new state records**. *Pseudochoragus nitens* (LeConte) (Anthribidae) (Fig. 2) was previously known only from Massachusetts and Latimer Co., Oklahoma, where it was collected by beating dead hickory branches (Valentine 1991). *Dryotribus mimeticus* Horn (Curculionidae) (Fig. 3) has a wide distribution, but is only reported from Florida and South Carolina in the USA and associated with driftwood along beaches (Anderson 2002). *Narthecius grandiceps* LeConte (Laemophloeidae) (Fig. 4) has only been reported from Pennsylvania, Florida, and Latimer Co., Oklahoma. It is a suspected predator of Scolytinae (Curculionidae) and has been collected from sweetgum and red oak (Thomas 1993). Additionally, four non-native species, all Curculionidae, were collected: *Cyrtepistomus castaneus* (Roelofs) (Entiminae); *Cnestus mutilatus* (Blandford) (Scolytinae); *Xylosandrus crassiusculus* (Motschulsky) (Scolytinae); and *Xylosandrus germanus* (Blandford)



Figs. 2–4. Species of new Louisiana state records. **2)** *Pseudochoragus nitens*; **3)** *Dryotribus mimeticus* Horn; **4)** *Narthecius grandiceps*.

(Scolytinae). The scolytines are invasive species in the USA. *Cnestus mutilatus* was reported damaging plastic gas cans in Louisiana, presumably mistaking the container for desirable habitat (Carlton and Bayless 2011).

Twigs are a convenient study system—they are inexpensive to obtain, abundant, and easily collected, transported, and stored. Furthermore, they provide substrates in which beetles may be "reared" in the field, and their transportability allows for easy field manipulation to investigate the ecology of twig-inhabiting beetles. The high species richness and multiple guilds that twigs harbor indicate that they may be useful for 1) utilitarian studies (ecological indicators, impact, restoration) as well as being 2) a worthy study system unto themselves (fun). More general exploratory studies and surveys are needed to better flesh out the total diversity of beetles in twigs. However, the findings of this research make it apparent that ecological studies attempting to discover statistically meaningful differences will have to be either much larger or more specific in focus.

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Appendix 1

List of taxa and number of specimens collected from each ecoregion. Ecoregion designations are taken from Daigle *et al*. (2006) (Table 1).

#	Species	Level III Ecoregion					
		34	35	65	73	74	75
Anthribidae							
1	*Choragus harrisii* LeConte					1	
2	*Euparius paganus* Gyllenhal		1				
3	*Eusphyrus walshi* LeConte	1		1	4		
4	*Euxenus punctatus* LeConte			2		1	
5	*Goniocloeus bimaculatus* (Olivier)		1		2		
6	*Piesocorynus mixtus* LeConte	2			1		
7	*Pseudochoragus nitens* (LeConte)	1					
Biphyllidae							
8	*Diplocoelus rudis* (LeConte)		1	2		1	
Bostrichidae							
9	*Lichenophanes bicornis* (Weber)	1	1				
Buprestidae							
10	*Acmaeodera tubulus* (Fabricius)		1				
11	*Actenodes acornis* (Say)						1
12	*Agrilaxia flavimana* (Gory)					2	
13	*Agrilus obsoletoguttatus* Gory	1	1		1	2	
14	*Chrysobothris scitula* Gory					2	
15	*Chrysobothris sexsignata* (Say)					1	
16	*Xenorhipis brendeli* LeConte		2				1
Carabidae							
17	*Mioptachys flavicauda* (Say)	1	1	2		2	1
Cerambycidae							
18	*Astylopsis sexguttata* (Say)				5		
19	*Curius dentatus* Newman		2				
20	*Ecyrus dasycerus* (Say)	9	2	3	8	1	
21	*Eupogonius pauper* LeConte	1	1				
22	*Leptostylopsis planidorsus* (LeConte)	2	1				
23	*Leptostylus transversus* (Gyllenhal)	1	2				
24	*Lepturges angulatus* (LeConte)				3		
25	*Lycochoriolaus lateralis* (Olivier)			1			
26	*Methia necydalea* (Fabricius)		1				
27	*Sternidius mimeticus* (Casey)	1	1	1	1		5
28	*Sternidius misellus* (LeConte)				3		7
29	*Sternidius punctatus* Haldeman				1		
30	*Strangalia famelica* Newman			1			
Cerylonidae							
31	*Philothermus glabriculus* LeConte			1			
Ciidae							
32	*Orthocis longulus* Dury				1		
33	*Orthocis punctatus* (Mellie)	1				2	
34	*Orthocis transversatus* (Kraus)		1		1		
Cleridae							
35	*Chariessa pilosa* (Forster)				1		
36	*Cymatodera wolcotti* Barr	1					
37	*Neorthopleura thoracica* (Say)				1		
Corylophidae							
38	*Arthrolips* sp.		1		1		
39	*Clypastraea lunata* (LeConte)					2	
40	*Holopsis* sp.	1		1	2	1	
Cupedidae							
41	*Tenomerga cinerea* (Say)			1			
Curculionidae							
42	*Acalles clavatus* (Say)	2	1		2		3

Continued on next page

Appendix 1. Continued.

#	Species	Level III Ecoregion					
		34	**35**	**65**	**73**	**74**	**75**
43	*Acalles minutissimus* (LeConte)	3		2	9	1	1
44	*Cnestus mutilatus* (Blandford)			22			
45	*Cophes fallax* (LeConte)	2	2		1	2	
46	*Cophes oblongus* (LeConte)			1	1		1
47	*Cophes obtentus* (Herbst)					2	
48	*Cyrtepistomus castaneus* (Roelofs)			1			
49	*Dryophthorus americanus* (Bedel)	2	6	1		5	7
50	*Dryotribus mimeticus* Horn	1					
51	*Hylocurus langstoni* (Blackman)				1		
52	*Hypothenemus eruditus* Westwood	42	2	7	126	85	8
53	*Hypothenemus interstitialus* (Hopkins)	1					
54	*Hypothenemus sersatus* (Eichhoff)		3		4	1	3
55	*Laemosaccus nephele* (Herbst)					1	
56	*Micracis swainei* Blackman				6		
57	*Micracisella nanula* (LeConte)					2	
58	*Phloeotribus texanus* Schaeffer				1		1
59	*Pityophthorus annectens* LeConte		8	5			
60	*Pityophthorus pulicarius* (Zimmermann)		7		1		
61	*Pseudopityophthorus asperulus* (LeConte)	2				26	41
62	*Pseudopityophthorus minutissimus* (Zimmermann)					1	
63	*Thysanoes* cf *pallens* Wood	4	8		9	9	3
64	*Xylosandrus crassiusculus* (Motschulsky)		1				
65	*Xylosandrus germanus* (Blandford)					1	
Elateridae							
66	*Idiotarsus errans* (Horn)						2
67	*Melanotus castanipes* (Paykull)						1
Endomychidae							
68	*Anamorphus waltoni* Blatchley	7				2	
69	*Aphorista vittata* (Fabricius)			2	1		2
70	*Clemmus minor* (Crotch)	1	2	8	23	6	10
71	*Stenotarsus blatchleyi* Walton	1	1				
Eucnemidae							
72	*Adelothyreus dejeani* Bonvouloir				1		
73	*Dromaeolus teres* (Horn)	1	1		1		
74	*Isorhipis nubila* (Bonvouloir)	1			5		
75	*Microrhagus audax* Horn						1
76	*Nematodes atropos* Say						1
Histeridae							
77	*Aeletes simplex* (LeConte)	1	3				
78	*Bacanius* (∼*misellus* LeConte)						1
79	*Bacanius punctiformis* (LeConte)	2		2		3	5
80	*Epierus pulicarius* Erichson		2			1	2
81	*Paromalus seminulum* Erichson						1
82	*Platysoma leconti* Marseul		1				
Laemophloeidae							
83	*Narthecius grandiceps* LeConte						1
Melandryidae							
84	*Microscapha clavicornis* LeConte	11					
Melyridae							
85	*Chaetocoelus setosus* LeConte				1		
Mordellidae							
86	*Glipostenoda ambusta* (LeConte)						2
87	*Mordella* sp.			2			
88	Mordellidae sp.				2		
Nitidulidae							
89	*Stelidota octomaculata* (Say)	1					

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Appendix 1. Continued.

#	Species	Level III Ecoregion					
		34	**35**	**65**	**73**	**74**	**75**
Phalacridae							
90	*Ochrolitus rubens* (LeConte)			1			1
Ptiliidae							
91	*Pteryx* sp.		1			1	
Ptilodactylidae							
92	*Ptilodactyla angustata* Horn						1
Ptinidae							
93	*Caenocara* sp.			1			
94	*Calymmaderus nitidus* (LeConte)				2		1
95	*Cryptorama confusum* White		1			4	
96	*Euceratocerus grandis* White			3			1
97	*Petalium* sp.	1			4	2	1
98	*Priobium sericeum* (Say)				1		
99	*Tricorynus* sp.	1	1	1			
Salpingidae							
100	*Inopeplus immundus* Reitter						1
Silvanidae							
101	*Silvanus muticus* Sharp	1					
Staphylinidae							
102	*Anotylus* sp.		1				
103	Athetini sp.		3	1		4	
104	*Belonuchus rufipennis* (Fabricius)		4		1		
105	*Coproporus* sp.			1			
106	*Dalmosella tenuis* Casey					2	1
107	*Edaphus americanus* Puthz					1	
108	*Euconnus* sp.			1	1		1
109	*Eumicrota* sp.				1		
110	*Eusphalerum* sp.		1				
111	*Hesperus apicialis* (Say)					2	2
112	*Myrmecocephalus cingulatus* (LeConte)			2			
113	*Pycnoglypta fracta* (Casey)		4			1	
114	Scydmaenidae sp.						1
115	*Thinocharis* sp.					1	
116	*Thoracophorus costalis* (Erichson)	8	12	12	10	8	11
117	*Toxidium gammaroides* LeConte	1					
Tenebrionidae							
118	*Isomira pulla* (Melsheimer)					1	
119	*Platydema cyanescens* Laporte and Brullé				1		
120	*Platydema flavipes* (Fabricius)				1		
121	*Platydema ruficorne* (Stürm)		1				
122	*Platydema* sp.				1		
123	*Uloma mentalis* Horn			1			1
Throscidae							
124	*Aulonothroscus convergens* (Horn)	7	8	12	1	13	3
125	Throscidae sp.						1
Zopheridae							
126	*Endeitoma granulata* (Say)	1					
127	*Paha laticollis* (LeConte)					1	
128	*Pycnomerus sulcicollis* (Germar)					1	

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