REPORT:

A survey for American burying beetles in Southwest Missouri.

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ABSTRACT

Carrion beetles (Family Silphidae) were surveyed at 25 sites in southwestern Missouri during June and July of 2001. At each site, 4-12 pitfall traps baited with carrion were open for 2-4 nights. Total effort was 538 trap-nights, with average effort equal to 21.5 trap-nights per site. Seven species of silphids were recovered, including *Nicrophorus marginatus, Nicrophorus orbicollis, Nicrophorus tomentosus, Oiceoptoma inaequale, Oiceoptoma novaboracense, Necrophila americana, and Necrodes surinamensis.* Average species number per site was 3.82 (range 0-7). Average trapping success of all silphids at sites was 2.84 individuals per trap-night (range 0-12.5). The most abundant and widespread species were *Necrophila americana* and *Nicrophorus marginatus,* which occurred at 87% and 75% of sites, respectively. The endangered American burying beetle (*Nicrophorus americanus*) was not recovered in this survey.

INTRODUCTION

The American burying beetle, *Nicrophorus americanus*, was placed on the U.S. federal endangered species list in August 1989. This species was recorded historically from at least 35 states in the eastern and central United States, as well as along the southern portions of the eastern Canadian provinces. Currently, it is known to exist in isolated colonies in at least six states: Arkansas, Kansas, Nebraska, Oklahoma, South Dakota, and Rhode Island (Backlund and Marone 1997, Bedick et al. 1999). Populations proximate to southwest Missouri are in west-central Arkansas and east-central Oklahoma (Lomolino et al 1995), and 3 counties west of the Missouri border, in the Chautauqua Hills regions of southeastern Kansas (Guarisco 1997, Miller and McDonald 1997).

Historically, *Nicrophorus americanus* has been recorded in 13 counties in Missouri (Simpson 1991). The last recorded capture apparently occurred either in Newton county in the mid-1970's (Simpson 1991) or in Jasper County in 1982 (USFWS 1991). The present survey was concentrated in southwest Missouri because of the relatively close proximity of extant populations in bordering states. All trap sites were within the Osage Plains and Ozark Natural Divisions (Springfield Plateau and Elk River sections) of Missouri (Nelson 1987).

METHODS

Fieldwork was carried out by two SMSU students; Mr. Robert Brown and Mr. Kevin Freeman (Figure 1a). We sought to capture American burying beetles and other carrion beetles using baited pitfall traps. The traps were polyethylene dairy tubs, 7 inches deep and 6 inches in diameter (#81128 U.S. Plastics Corporation, Lima, OH). Each trap was baited with a single dead mouse. Mice (frozen) were purchased in lots of 100 (Perfect Pets, Inc., Belleville, MI). Each mouse was wrapped in an "envelope" of nylon window screen, which was suspended over the middle of the pitfall container with a bamboo skewer (Figure 1b). The hanging screen packets were a convenient way to isolate the bait from the beetles while allowing the scent of decay to disperse from the trap. Before each trapping trip, a suitable number of such packets were made and stored in a sealed cartridge box for 2-3 days to ripen (Figure 1c). The cartridge box had a rubber gasket that helped reduce stench while storing and transporting the ripened baits.

Each container was buried with the lip flush with the surface of the ground (Figure 1d). The opening of the trap was shielded with a 1-foot square piece plywood cover (Figure 1e). The corners of the cover rested on earth or rocks to leave a gap of approximately 1 inch above the lip of the container, so as to allow beetle entry. The cover prevented beetles from flying out of the trap and shielded the traps from sun and rain. Approximately 2 inches of soil was placed inside the container so as to allow captured beetles to burrow and to protect them from desiccation (Figure 1f).

Suspension of the bait within a screen envelope at the opening of the trap is a different approach than used previously. Previous workers advise placing the bait in a screen-top container at the bottom of the trap (Kozel 1990, USFWS 1991). We feel that suspending the bait above the trap facilitates dispersal of the scent, while accomplishing the purpose of isolating the bait from the beetles. Enclosing the bait within a screen envelope is economical, facilitates compact storage of the baits, and the packets can be discarded when the bait becomes unusable.

Trapping was carried out at 25 sites. These sites were located mainly within State Conservation Areas or Natural Areas managed by the Missouri Department of Conservation or The Nature Conservancy (Figure 2, Table 1). Sites were classified as grassland, woodland or edge (i.e. the boundary of grassland and woodland). From 2-12 traps (average 7.7) were placed

at each site, separated from one another by 60 – 100 meters. Traps were generally placed and baited in the afternoon and left open for 2-5 nights in succession. The traps were then uncovered and checked for the presence of *N. americanus.* Other beetle species present were collected and stored in 95% ethanol for later curation and identification. At sites #1-4, only vouchers of each species trapped were collected. At sites #5-21, all silphid beetles trapped were collected.

Collections were brought to SMSU and the beetles were cleaned of soil by spraying each specimen with a water jet and brushing with a small paintbrush. Identification of beetles was made by comparison with keys and figures in Ratcliffe (1996). Voucher specimens were deposited with the University of Nebraska State Museum.

RESULTS

Trapping was carried out at 25 sites in 10 counties between June 2 and July 14 (Table 1). Total trapping effort amounted to 538 trap nights (number of traps set, minus number of traps disturbed, times number of nights open). No American burying beetles were captured. However, we trapped 610 silphids of seven species. At least one species was present at 24 of the 25 sites. In order of numerical abundance, these were: *Nicrophorus marginatus, Necrophila americana, Necrodes surinamensis, Nicrophorus orbicollis, Nicrophorus tomentosus, Oiceoptoma inaequale,* and *Oiceoptoma novaboracense* (Table 2). The number of species captured per site ranged from 0-7 (average 3.8). The number of beetles captured per site ranged from 0-90 (average 29). Trapping success (beetles/trap-night) ranged from 0-12.5 (average 2.8). Trapping success rate declined somewhat with increasing number of nights that the traps were open. However, this trend was not statistically significant (Figure 3).

DISCUSSION

The last extensive survey for *Nicrophorus americanus* in Missouri was carried out in 1990 and 1991 and also failed to locate this species (Simpson 1991). Total trapping effort in that study was 919 trap-nights and 782 individual silphids were captured. Trapping was carried out by citizen volunteers and localities were distributed in 26 counties, a broader geographic area than the present study.

American burying beetles appear to be habitat generalists (Lomolino et al. 1995). Recent collections in Oklahoma and Arkansas have generally been from level areas with relatively loose, well-drained soils, and a well-formed litter layer of previous years' vegetation. The sites are located in several ecoregions (EPA Level III), including the Arkansas Valley, the Central Oklahoma/Texas Plain, the western Ouachita Mountains, and the southwestern edge of the Boston Mountains. Habitats in these regions include oak-pine and oak-hickory woodlands, open fields and grasslands, and transition zones (Creighton et al. 1993, Lomolino et al. 1995). Habitats of recently discovered colonies in the Loess Hills region of Nebraska and the Chatauqua Hills in Kansas generally consist of grazed grassland, forest edge and scrubland (Bedick et al. 1999, Guarisco 1997). Ratcliffe (1996) felt that carrion availability and relatively undisturbed habitat might be more important factors determining distribution than the type of vegetation or soil structure.

The seasonal activity of adult *N. americanus* generally begins in the spring after nighttime temperatures have reached at least 15 ^{o}C (Bedick et al. 1999). In Nebraska, adult beetles fly from mid-May to early August, with peaks of trapping success in early June and mid July. The former peak was attributed to the emergence of overwintered adults and the later peak to the emergence of new adults (Bedick et al. 1999). In Oklahoma and Arkansas, adults were trapped throughout the summer and early fall (Lomolino et al. 1995).

Lomolino and Creighton (1995) suggested that, although *N. americanus* forage widely and are found in a variety of habitats, viable populations in Arkansas and Oklahoma might be limited to sites having deep, loose soils and surface litter, particularly mature forests. These authors found that breeding pairs placed in forest were more successful in burying prey and produced more offspring than pairs placed in grassland. On the other hand, populations of *N. americanus* in Nebraska, South Dakota, and Kansas do not appear to be associated with extensive forest (Bedick et al. 1999, Backlund et al 1997, Guarisco 1997).

There are several reasons to expect that the American burying beetle will eventually be rediscovered in Missouri. Surveys efforts in Missouri have not been extensive. Although the adult beetles are strong fliers and can range up to 6 km during foraging, most recaptures of individual beetles took place within 0.5 kilometers of the point of initial capture (Bedick et al. 1999). Thus, localized and low-density colonies might easily be overlooked by surveys unless the number of traps used is large and geographic coverage is complete (Carlton and Rothwein

1998). Finally, even if the American burying beetle was or is currently extirpated in Missouri, recolonization from nearby populations is an ongoing possibility.

Reintroduction of American burying beetles is a possible conservation strategy (USFWS 1991, Amaral et al. 1997, Keeney and Horn 1998). A recent genetic study of five *N. americanus* populations, collected from South Dakota, Nebraska, Oklahoma, Arkansas, and Rhode Island, found no diagnostic alleles for any of the five populations examined (Szalanski et al. 2000). This evidence indicates that reintroduction of the American burying beetle to Missouri from another locality would probably not jeopardize the genetic makeup of any undiscovered local populations. Nonetheless, more survey work seems advisable before undertaking any reintroduction effort.

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Table 1. Site descriptions, trapping effort, and trapping results.

Site id number	County	Sites	Habitat	Trapping dates	Traps set	Traps disturbed	Nights	Trap nights (TN)	*Necrodes surinamensis*	*Necrophila americana*	*Nicrophorus marginatus*	*Nicrophorus orbicollis*	*Nicrophorus tomentosus*	*Oiceoptoma inaequale*	*Oiceoptoma novaboracense*	Total beetles (TB)	Species captured	Trap success (TB/TN)
1	Barton	Buffalo Wallow Prairie	edge	6/2-5	10	3	3	21	(+)	(+)	(+)	0	(+)	(+)	(+)	*	6	-
2	Barton	Dorris Creek	grassland	6/2-5	10	0	3	30	(+)	(+)	(+)	0	(+)	(+)	(+)	*	6	-
3	Barton	Pa Sole	wetland	6/2-5	12	0	3	36	(+)	(+)	(+)	0	(+)	(+)	(+)	*	6	-
4	Barton	Treaty Line	grassland	6/2-5	10	1	3	27	(+)	(+)	(+)	0	(+)	(+)	(+)	*	6	-
5	Bates	Settle's Ford	grassland	7/12-14	6	1	2	10	0	36	2	14	2	0	0	54	4	5.4
6	Cass	Amarugia Highlands	old field	7/12-14	4	0	2	8	0	31	0	3	0	0	0	34	2	4.3
7	Cass	Dorsett Hill Prairie	edge	7/12-14	6	0	2	12	0	1	0	0	0	0	0	1	1	0.1
8	Cass	James R. Harter	grassland	7/11-13	6	0	2	12	0	9	4	1	1	0	0	15	4	1.3
9	Cass	Anderson Farm	woodland	7/12-14	4	0	2	8	0	2	0	2	0	0	0	4	2	0.5
10	Cedar	Mo-Ko Prairie	grassland	6/22-24	10	2	2	16	1	4	13	0	5	2	0	25	5	1.6
11	Cedar	Sky Prairie	grassland	6/22-24	10	0	2	20	3	5	3	2	5	1	1	20	7	1.0
12	Dade	Niawathe Prairie	grassland	6/8-13	10	0	5	50	0	4	19	0	1	9	3	36	5	0.7
13	Dade	Stony Point Prairie	grassland	6/8-13	10	0	5	50	0	5	18	0	1	34	3	61	5	1.2
14	Henry	Urich C.A.	edge	7/11-13	6	0	2	12	0	1	1	12	0	0	0	14	3	1.2
15	Lawrence	Kickapoo Prairie	edge	6/14-18	10	0	4	40	0	1	7	4	6	6	3	27	6	0.7
16	Lawrence	Mount Vernon Prairie	grassland	6/29-7/2	10	2	3	24	0	10	17	0	5	1	0	33	4	1.4
17	Lawrence	Robert E. Talbot	grassland	6/14-18	10	0	4	40	0	0	5	0	2	1	0	8	3	0.2
18	McDonald	Huckleberry Ridge	woodland	8/17-19	6	5	2	2	0	0	0	25	0	0	0	25	1	12.5
19	McDonald	Powell Tower Site	woodland	8/17-19	2	0	2	4	0	12	0	38	0	0	0	50	2	12.5
20	Newton	Diamond Grove Prairie	grassland	6/9-14	10	0	5	50	0	0	0	0	0	0	0	0	0	0.0
21	Newton	Fort Crowder	woodland	6/9-14	8	4	5	20	0	10	1	0	5	24	30	70	5	3.5
22	St. Clair	Birdsong	woodland	7/11-13	5	0	2	10	0	1	0	13	0	0	0	14	2	1.4
23	St. Clair	Taberville Prairie	grassland	7/11-13	6	0	2	12	32	6	51	1	0	0	0	90	4	7.5
24	St. Clair	Wah-Kon-Tah Prairie	grassland	6/22-24	6	0	2	12	1	2	19	0	0	1	0	23	4	1.9
25	Vernon	Gama Grass Prairie	grassland	7/12-14	6	0	2	12	0	3	2	1	0	0	0	6	3	0.5
				sum	**193**	**18**	**71**	**538**	**37**	**143**	**162**	**116**	**33**	**79**	**40**	**610**		
* no counts made at sites 1-4				**average**	**7.7**	**0.7**	**2.8**	**21.5**	**1.8**	**6.8**	**7.7**	**4.6**	**1.6**	**3.8**	**1.9**	**29.0**	**3.8**	**2.8**

Table 2. Silphid beetles recovered at sites 5-25. *Nicrophorus marginatus* was the most numerically abundant species overall. *Necrophila americana* was the most widespread species.

Species	**N beetles**	**N sites**	**beetles/site**	**% sites**
Nicrophorus marginatus	162	18	9.0	72%
Necrophila americana	143	22	6.5	88%
Nicrophorus orbicollis	116	11	10.5	44%
Oiceoptoma inaequale	79	13	6.1	52%
Oiceoptoma novaboracense	40	9	4.4	36%
Necrodes surinamensis	37	8	4.6	32%
Nicrophorus tomentosus	33	14	2.4	56%

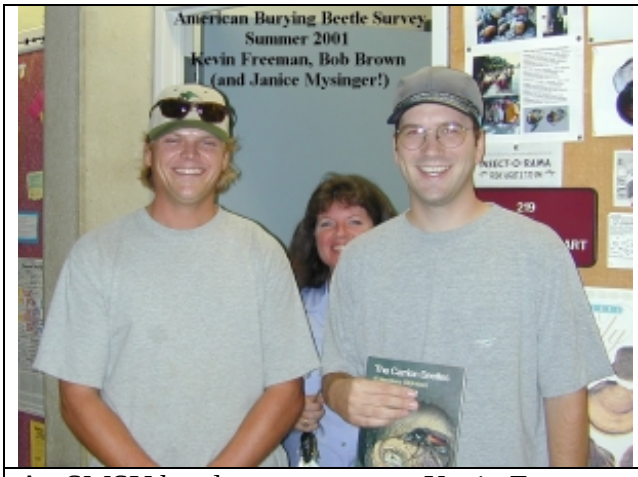
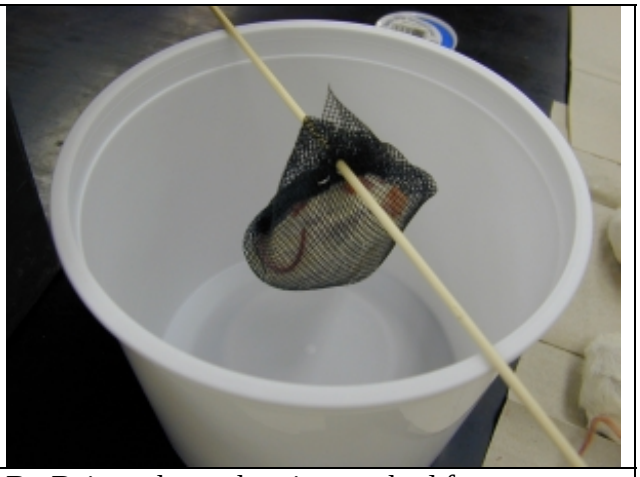
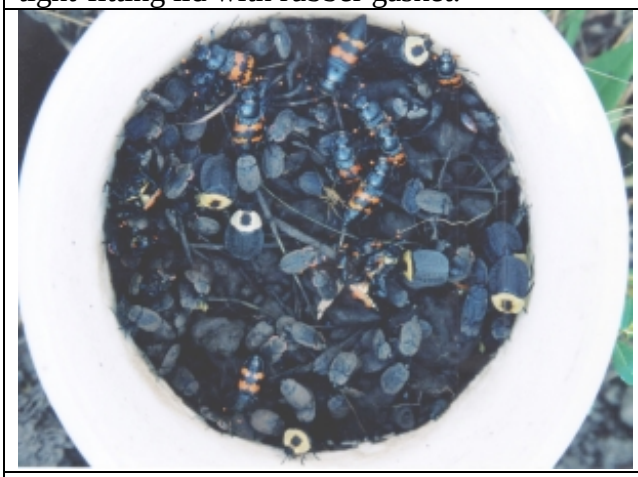
	
A. SMSU beetle survey crew: Kevin Freeman (left) and Bob Brown (right).	B. Bait package showing method for suspension over pitfall container.
	
C. Military cartridge box used for bait box has tight-fitting lid with rubber gasket.	D. Kevin Freeman checking contents of a pitfall trap.
	
E. Pit trap containing *Nicrophorus marginatus, Necrophila americana, Oiceoptoma inaequale,* and *Oiceoptoma novaboracense*	F. Bob Brown sorting and identifying captures.

Figure 1a-f. See frames for legend.

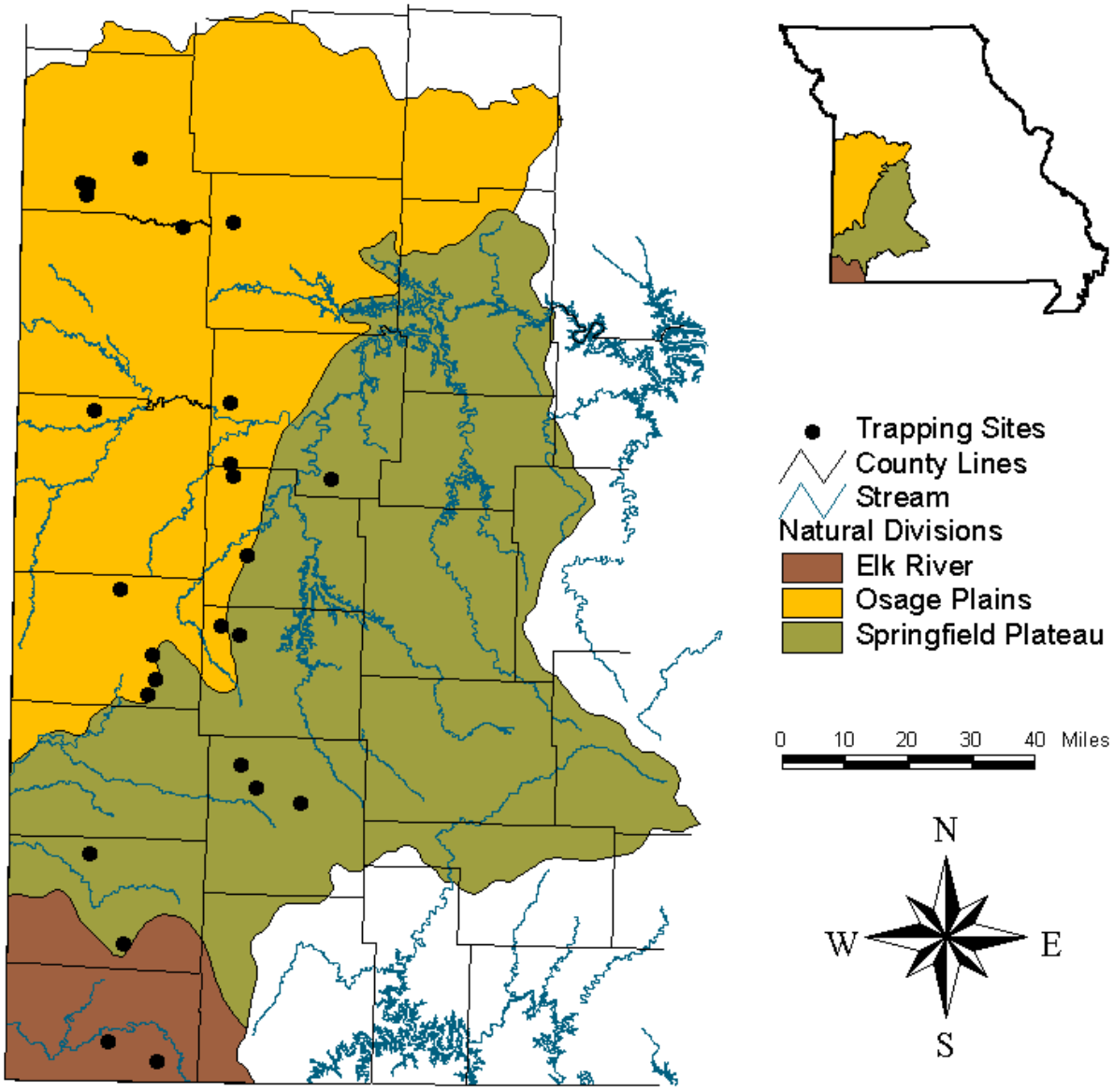


Figure 2. Sites in southwest Missouri that were surveyed for American burying beetles.

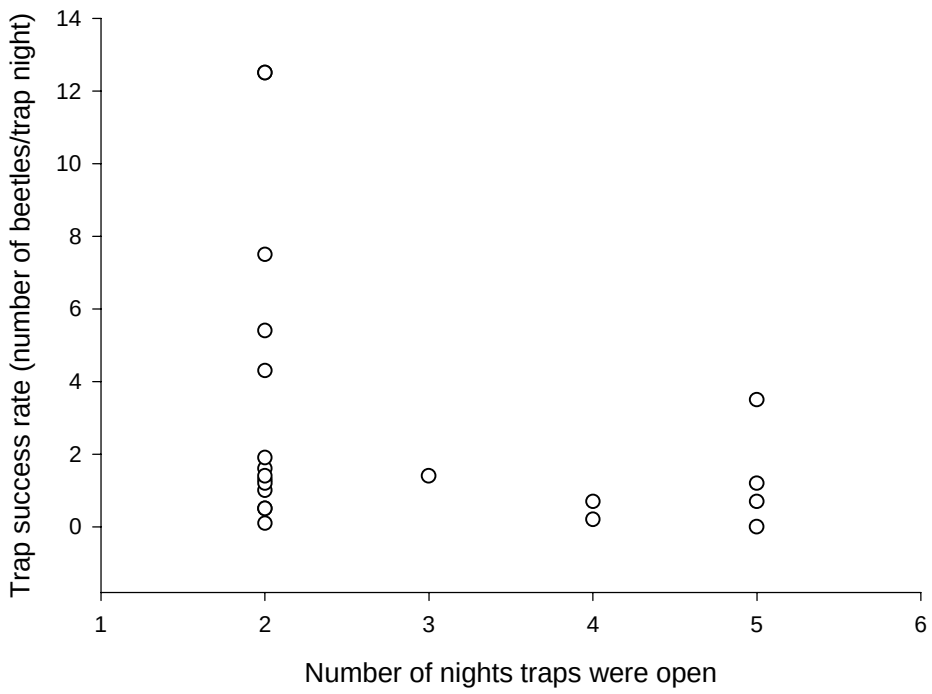


Figure 3: Trapping success at each site versus number of nights that the traps were left open. Trapping success rate (captures per trap night) was not significantly correlated with the number of nights traps were left open (ANOVA, $p = 0.18$).