DISTRIBUTION, SEASONAL OCCURRENCE AND CONSERVATION STATUS OF *DROMOCHORUS PRUININA* (CASEY) IN MISSOURI

Ted C. MacRae[1] and Christopher R. Brown[2]

ABSTRACT

Dromochorus pruinina (Casey) (Coleoptera: Carabidae: Cicindelitae) is a flightless tiger beetle known from Missouri until now by a single collection of six individuals in 1975 at "Johnson Co., 10 mi [16 km] W Warrensburg on County Rd DD" in west-central Missouri. In 2005, *D. pruinina* was encountered at Knob Noster State Park, Johnson Co. during a broader survey of tiger beetles in west-central and southwestern Missouri. In 2006 and 2008, pitfall traps and direct observations were used at multiple sites in west-central Missouri to more precisely delimit its geographical distribution within the state. Adults were encountered at a total of five sites, all located along a 4-km stretch of County Rd DD in Knob Noster State Park. In the 2006 survey, 38 individuals were encountered in pitfall traps or by direct observation at four sites, and in the 2008 survey eight individuals were encountered by direct observation only at two of the previous sites and one new site. Dates of occurrence ranged from 23 June to 22 July, with adults most active during late afternoon and early evening. These surveys suggest that *D. pruinina* has a highly restricted geographical range in Missouri, occurring only on sparsely vegetated red clay exposures in a small area of Johnson Co. and disjunct from the main population in the central and southern Great Plains by a distance of 120 km. The highly restricted and disjunct occurrence of this species in the state, its limited dispersive capabilities, and the low incidence of individuals observed all suggest that *D. pruinina* is highly vulnerable to extirpation within Missouri. Because of this, it has been listed as a species of conservation concern by the Missouri Department of Conservation (MDC) with a status of "S1" (critically imperiled). Additional conservation measures should be considered to augment the existing population and prevent its extirpation.

INTRODUCTION

A faunal survey of tiger beetles in Missouri is currently being conducted by the first (TCM) and second (CRB) authors (MacRae & Brown 2001). To date, 24 species have been recorded from the state, including the previously unrecorded *Cylindera* (s. str.) *celeripes* (LeConte) in loess hilltop prairie remnants in northwestern Missouri (MacRae and Brown, unpublished data) and a vagrant occurrence of *Cicindela* (*Cicindelidia*)

[1] Monsanto Company, 700 Chesterfield Parkway West, Chesterfield, MO 63017, U.S.A.
[2] Monsanto Company, 800 N. Lindbergh Blvd., Creve Coeur, MO 63141, U.S.A.

trifasciata ascendens LeConte in southeastern Missouri (Brown & MacRae 2005a). Several of these species are of potential conservation concern in Missouri due to restricted geographical occurrence in the state. One of these species is *Dromochorus pruinina* (Casey), a flightless species associated with sparsely vegetated grasslands, roadside slopes, and disturbed areas in the central and southern Great Plains (Pearson et al. 2006). Until now its occurrence in Missouri has been poorly understood. Prior to 2005, only seven Missouri specimens were known (deposited in the private collection of Ronald L. Huber, Bloomington, MN). One specimen labeled "Columbia, Mo., 27 June 1938, T. E. Birkett" is considered mislabeled; however, the remaining six specimens, labeled "Johnson Co., 10 mi [16 km] W Warrensburg on Co. Rd. DD, June 26, 1975, B. Cutler" are considered to represent a valid Missouri record.

In 2003, efforts were initiated to reconfirm the occurrence of this species in Missouri. CRB made two visits to Johnson Co. during June and July in an effort to find the 1975 collection site and search suitable habitats in its vicinity for the occurrence of *D. pruinina*. The species was not encountered during either of those visits; however, it was noted that County Rd DD runs east of Warrensbug (rather than west) in or near Knob Noster State Park. In 2005, County Rd DD in Knob Noster State Park was included in a broader survey of remnant glade and prairie habitats throughout west-central and southwestern Missouri that targeted several tiger beetle species, including *D. pruinina* (Brown & MacRae 2005b). On 15 July, CRB encountered three adult *D. pruinina* on sparsely vegetated red clay exposures 1.6 km W State Hwy 23 on County Rd DD in Knob Noster State Park. The species was not found in any other area included in that survey. Based on that finding, targeted surveys were conducted in west-central Missouri in 2006 and 2008 to more precisely delimit the geographical distribution of *D. pruinina*. The 2006 survey utilized pitfall traps and direct observations in roadside habitats near the 2005 site and in more distant localities in Henry, Jackson, Johnson, and Pettis Counties, while the 2008 survey focused on Knob Noster State Park and immediately adjacent areas to delimit the occurrence of *D. pruinina* in and around the park. We report details and results of those surveys here.

METHODS & MATERIALS

In 2006, roadside habitats at 16 sites in Henry, Jackson, Johnson, and Pettis Counties were surveyed by direct observation and pitfall traps (Table 1, Fig. 1). An area extending approximately 50 miles west from Sedalia to just east of Kansas City and approximately 25 miles south from just north of Knob Noster State Park to Clinton was surveyed. Six of the selected sites were close to the 2005 site, while the remaining ten were distributed in more distant areas along roadsides containing apparently suitable habitat. This included sparsely vegetated clay or rocky clay substrates, especially those where natural features (e.g., rock outcrops) formed likely runways that could be used to assist in directing beetles into the traps. Survey activities were initiated 25 June and concluded 22 July to coincide with the presumed adult activity period for the species. A total of 52 traps were placed at the sites and checked every 5–9 days during the survey period. Direct observations were also made whenever traps were placed or checked to monitor for the presence of active adults. At least two and up to seven pitfall traps were placed at each site (Table 1), with the number placed intended to provide adequate sampling of apparently suitable habitat. Pitfall traps consisted of two nested 225-mL plastic drink cups buried in the ground, and with the inner cup rim lying flush with the ground. The inner cup was filled with ~75 mL (about one-third full) of ~1:1 mixture of ethylene glycol and water to serve as a killing agent and preservative. Plastic dinner plates (~23 cm diameter) were suspended ~2–4 cm over the traps using three 9-cm long galvanized nails pushed completely through the plate margin and into the ground to shield traps from rain and prevent desiccation of trap contents. A marking flag was placed near each trap to facilitate relocation during subsequent visits. For monitoring, trap contents were transferred into a collection container, and the trap was reassembled and the ethylene glycol/water mixture replenished. Trap contents were processed in the laboratory by rinsing with tap water over a 30-mesh sieve and transferring into a white tray, then sorting through the trap contents. *Dromochorus pruinina* specimens were transferred to 70% ethyl alcohol

Table 1. Missouri sites surveyed for *Dromochorus pruinina* during 2006, with site #, county, locality description, GPS coordinates, elevation, and number of pitfall traps placed.

Site #	County	Locality descriptor	GPS	Traps
1	Pettis	12.5 km N US Hwy 50 (Sedalia) on US Hwy 65	38°48'39"N, 93°13'33"W	6
2	Pettis	8.6 km W US Hwy 65 (Sedalia) on US Hwy 50	38°44'44"N, 93°20'04"W	6
3	Johnson	Perry Conservation Area 0.6 km W Dunksburg on CR NE1000	38°53'59"N, 93°30'24"W	2
4	Johnson	4.5 km N US Hwy 50 on State Hwy 23	38°48'03"N, 93°32'58"W	7
5	Johnson	2.2. km S US Hwy 50 on State Hwy 23	38°45'04"N, 93°34'33"W	2
6	Johnson	Knob Noster State Park, 0.2 km N County Rd DD on State Hwy 23 (north)	38°44’38”N, 93°34’37”W	3
7	Johnson	Knob Noster State Park, 0.6 km W State Hwy 23 on County Rd DD (north)	38°44'34"N, 93°35'07"W	3
8	Johnson	Knob Noster State Park , 1.6 km W State Hwy 23 on County Rd DD (north)	38°44'29"N, 93°35'47"W	3
9	Johnson	Knob Noster State Park, 3.2 km W State Hwy 23 on County Rd DD (north)	38°44'32"N, 93°36'56"W	2
10	Johnson	Knob Noster State Park , 2.5 km W State Hwy 23 on County Rd DD (north)	38°44'33"N, 93°37'08"W	3
11	Johnson	Knob Noster State Park, 3.8 km W State Hwy 23 on County Rd DD (north)	38°44’33”N, 93°37’20”W	2
12	Johnson	4.8 km W State Hwy 23 on County Rd Y	38°41'01"N, 93°37'00"W	4
13	Johnson	Kearn Conservation Area Jct CR SE650 & CR SE1221	38°39'30"N, 93°31'19"W	3
14	Henry	4.0 km WNW Clinton on State Hwy 7	38°23'24"N, 93°49'03"W	3
15	Henry	25.9 km WNW Clinton on State Hwy 7	38°28'52"N, 94°01'48"W	3
16	Jackson	9.3 km SSW Pleasant Hill on State Hwy 7	38°42'40"N, 94°18'03"W´	2

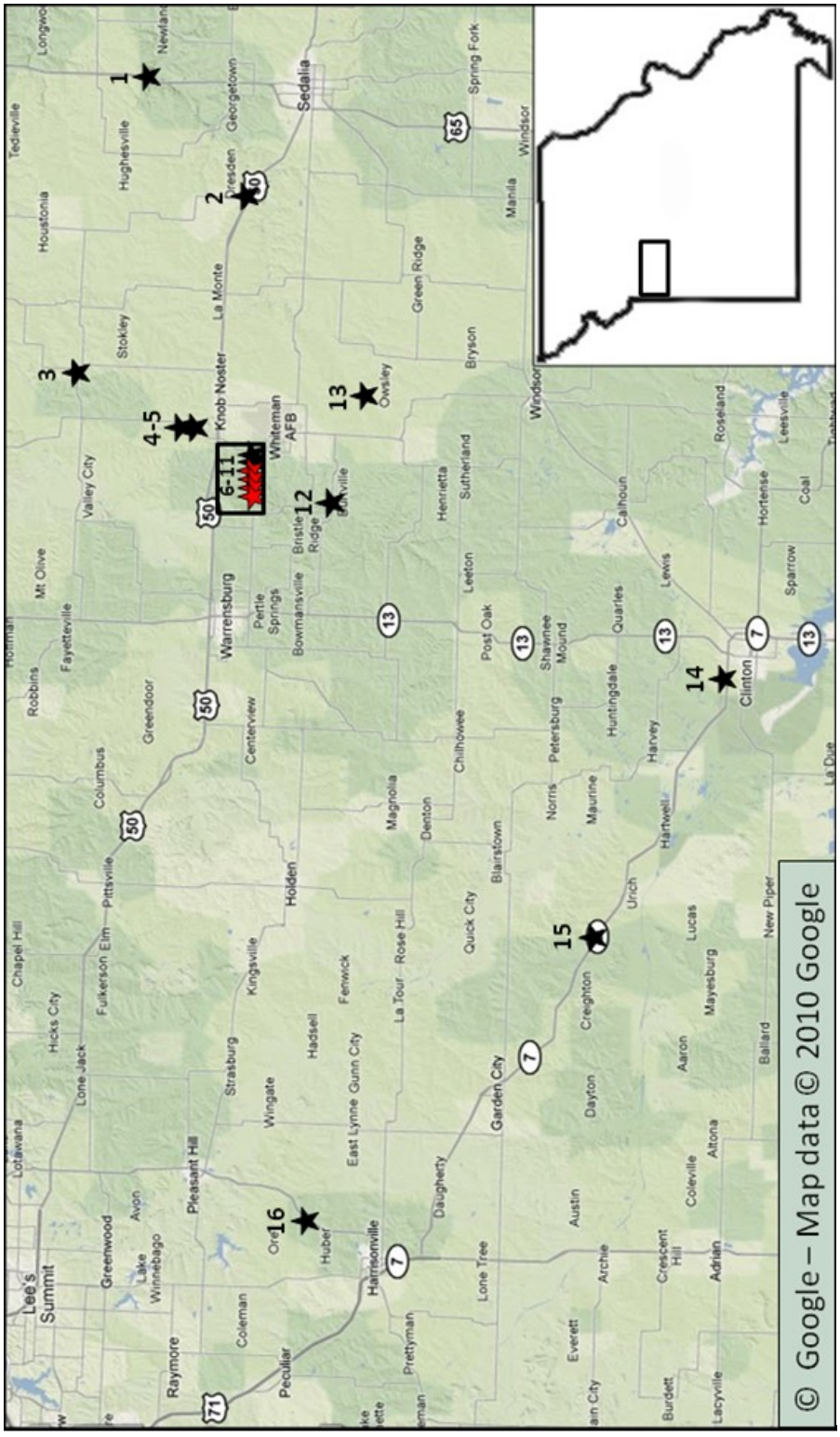

Figure 1. 2006 survey sites in west-central Missouri (see Table 1 for key to numbers). Red stars indicate sites where *Dromochorus pruinina* was observed. Black box on inset map of Missouri denotes main map area. Black box on main map denotes 2008 survey area (see Fig. 2).

Table 2. Missouri sites surveyed for *Dromochorus pruinina* during 2008, with site #, county, locality description, GPS coordinates, elevation, and number of pitfall traps placed.

Site #	County	Locality descriptor	GPS	Traps
1	Johnson	0.3 km W State Hwy 23 on 75NE 0.5 km S US Hwy 50	38°46'54"N, 93°34'11"W	7
2	Johnson	1.1 km W State Hwy 23 on 75NE 0.5 km S US Hwy 50	38°45'58"N, 93°34'42"W	4
3	Johnson	Knob Noster State Park, 1.6 km W State Hwy 23 on County Rd DD (south)	38°44'30"N, 93°35'44"W	5
4*	Johnson	Knob Noster State Park, 1.6 km W State Hwy 23 on County Rd DD (north)	38°44'29"N, 93°35'47"W	0
5	Johnson	Knob Noster State Park, 0.2 km N County Rd DD on SE751	38°44'37"N, 93°36'15"W	5
6	Johnson	Knob Noster State Park, 3.4 km W State Hwy 23 on County Rd DD (south)	38°44'30"N, 93°36'52"W	9
7*	Johnson	Knob Noster State Park, 3.2 – 3.8 km W State Hwy 23 on County Rd DD (north)	38°44'32"N, 93°36'56"W	0
8	Johnson	Knob Noster State Park, 1.6 km N County Rd DD on SE591	38°45'18"N, 93°37'41"W	4
9	Johnson	Knob Noster State Park, Equestrian Camp, 0.4 km S County Rd DD	38°44'20"N, 93°35'41"W	3
10	Johnson	Knob Noster State Park, 0.3 km W State Hwy 23 on SE10	38°45'09"N, 93°34'42"W	5
11	Johnson	Knob Noster State Park, 0.8 km S US Hwy 50 on State Hwy 23	38°45'40"N, 93°34'08"W	5
12	Johnson	1.6 km S US Hwy 50 on State Hwy 23 Jct NE901	38°45'24"N, 93°34'32"W	3

* Sites 4 and 7 were included as controls sites known to support *D. pruinina* and surveyed by direct observation only.

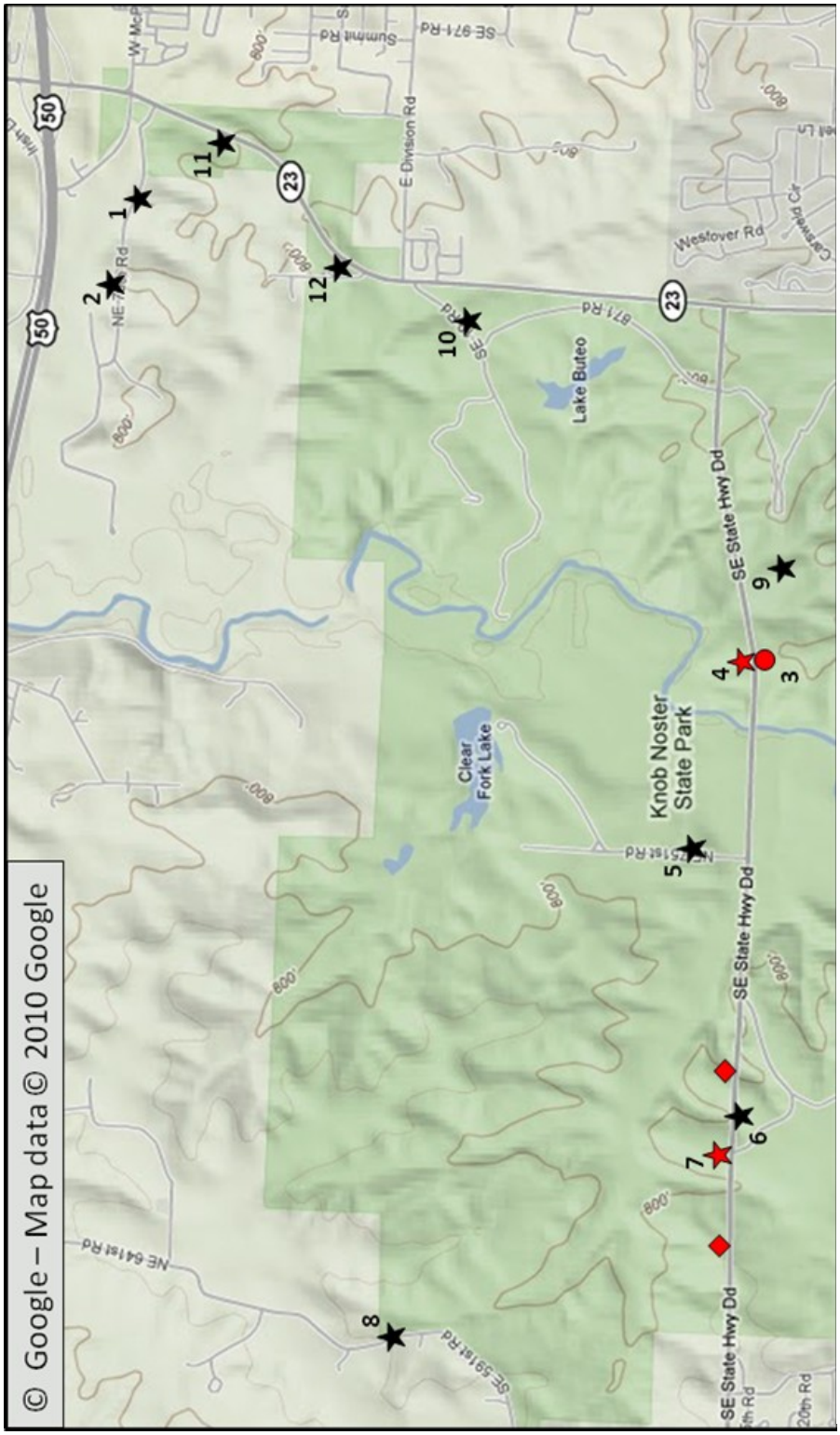

Figure 2. 2008 survey sites (see Table 2 for key to numbers). Red numbered markers indicate sites where *Dromochorus pruinina* was observed in 2008 only (circle) and 2006 also (stars). Unnumbered markers (red diamonds) indicate 2006 sites where *D. pruinina* was also observed.

for storage until mounting on insect pins and labeling. Voucher specimens were retained from all sites where the beetle was observed and are deposited in the authors' collections.

In 2008, 12 sites in and immediately adjacent to Knob Noster State Park, including two sites where the beetle was observed in previous years and ten new sites selected based on proximity and similarity of habitat to known sites, were surveyed by direct observation and pitfall traps (Table 2, Fig. 2). Survey activities were initiated 22 June and concluded 12 July, with 3–9 pitfall traps placed at each site for a total of 60 traps at the 12 sites (Table 2). Pitfall trap design, site selection, frequency of monitoring, supplementation by direct observation, and processing of collected specimens was as described above.

RESULTS & DISCUSSION

Dromochorus pruinina adults (Fig. 3) were encountered at a total of five sites, including four of 16 sites surveyed in 2006 (all on County Rd DD in Knob Noster State Park, Johnson Co.) (Table 3, Fig. 1) and three of 12 sites surveyed in 2008 (two previously known sites, plus one additional site on County Rd DD) (Table 3, Fig. 2). A total of 38 individuals were encountered in 2006 by pitfall traps or by direct observation, while only eight individuals were encountered in 2008, all by direct observation. The species was not encountered at any survey site located outside of Knob Noster State Park in either survey year, and at sites within the park the beetle was confined to a 4-km stretch of County Rd DD between State Hwy 23 and the western boundary of the park. The apparent absence of the species at nearby sites within and immediately adjacent to the Park with apparently suitable habitat is puzzling. During the course of these surveys, the great majority of adults were encountered during late afternoon and early evening hours until just prior to sunset, and dates of adult occurrence in the study ranged from 23 June to 22 July.

The results of this survey suggest that *D. pruinina* is restricted in Missouri to roadside habitats along a 4-km stretch of County Rd DD west of State Hwy 23 in Knob Noster State Park, Johnson Co., where it inhabits sparsely vegetated red clay exposures (Fig. 4). We speculate

Table 3. Missouri sites where *Dromochorus pruinina* was observed during 2006 and 2008, with site name, date, # observed (direct or trapped), and voucher number and collection deposited (CRBC = Christopher R. Brown personal collection; TCMC = Ted C. MacRae personal collection).

Site	Date	# Observed	Vouchers
1.6 km W State Hwy 23 on County Rd DD (north)	30.vi.2006 01.vii.2006 13.vii.2006 22.vii.2006	6 direct 3 direct 3 trapped 1 trapped	– 3 TCMC 3 CRBC 1 CRBC
1.6 km W State Hwy 23 on County Rd DD (south)	23.vi.2008	1 direct	–
3.2 km W State Hwy 23 on County Rd DD (north)	30.vi.2006 01.vii.2006 08.vii.2006 22.vii.2006 23.vi.2008 06.vii.2008 12.vii.2008	2 direct 1 direct 2 trapped 1 trapped 1 direct 2 direct 1 direct	– 1 TCMC 2 TCMC 1 CRBC – – –
3.5 km W State Hwy 23 on County Rd DD (north)	30.vi.2006 08.vii.2006 13.vii.2006	5 direct 12-15 direct 1 trapped	– 9 TCMC 1 CRBC
3.8 km W State Hwy 23 on County Rd DD (north)	30.vi.2006 08.vii.2006 13.vii.2006 23.vi.2008 12.vii.2008	1 direct 2 pitfall 1 pitfall 1 direct 1 direct	– 2 TCMC 1 CRBC – –

of State Hwy 23 in Knob Noster State Park, Johnson Co., where it inhabits sparsely vegetated red clay exposures (Fig. 4). We speculate that the 1975 collection of *D. pruinina* "10 mi [16 km] W of Warrensburg on County Rd DD" in Johnson County represents a mistake in labeling, and that the beetles were actually collected 16 km east of Warrensburg at (or near) the terminus of County Rd DD at State Hwy 23 in Knob Noster State Park. Since the single specimen labeled "Columbia" is suspected of being mislabeled, we regard the 4-km stretch of County Rd DD identified in this study to encompass the only confirmed Missouri population of *D. pruinina*, giving this species the most restricted geographical distribution of any tiger beetle species in Missouri. During the three years of the study (2005, 2006, and 2008), only 49 total individuals were encountered, suggesting that this population is not robust even within its extremely limited distribution.

In the main part of its geographical range across the central and southern Great Plains, populations of *D. pruinina*, while uncommonly encountered, appear to be secure. However, the Missouri population is regarded as critically imperiled because of its highly restricted geographical occurrence, poor dispersive capabilities, and low incidence of individuals. The restricted range of the population makes it vulnerable to extirpation not only through habitat loss and degradation, but also by catastrophic events such as wildfires, and its low density and poor dispersive capabilities compromise its ability to colonize what appear to be suitable habitats in nearby areas. The vulnerability is made even greater by its apparent wide disjunction from other populations. The next easternmost record of this species that we are aware of is an individual photographed at The Prairie Center (just west of Olathe, KS) by Betsy Betros on 19 July 2006 (R. L. Huber, in litt.), a distance of 120 km (75 miles). Such a wide disjunction prevents contact through dispersal and makes loss of genetic diversity due to drift and founder effects an additional concern for this small and restricted population. Another tiger beetle species of highly restricted and disjunct occurrence in central Missouri, *Habroscelimorpha circumpicta johnsonii*, may have already been extirpated due to habitat loss and degradation (Brown and MacRae 2011). Because of its apparent vulnerability, *D. pruinina* is now listed as

Figures 3–4. 3) *Dromochorus pruinina* in west-central Missouri (Knob Noster State Park, 1.6 km W State Hwy 23 on County Rd DD, 30 June 2006). Photo by CRB. 4) Sparsely vegetated clay exposures; habitat for *Dromochorus pruinina* in west-central Missouri (Knob Noster State Park, 3.5 km W State Hwy 23 on County Rd DD, 8 July 2006). Photo by TCM.

a state species of conservation concern with a ranking of "S1" (critically imperiled) – the highest possible ranking (MDC 2010).

Despite concerns about the potential for extirpation, the occurrence of *D. pruinina* within the confines of Knob Noster State Park under the stewardship of the Missouri Department of Natural Resources (MDNR) provides some reason for optimism about the population's long-term prospects. However, it will be incumbent upon MDNR to develop and implement management practices at Knob Noster State Park to ensure that this population remains viable. Much of the park and surrounding environs are heavily forested and, thus, do not provide suitable habitat for the beetle. Prescribed burning has been implemented within portions of the park in recent years to restore the grasslands and more open woodland structure thought to be prevalent in the area prior to European settlement; however, the beetle has been found only in areas where woody growth has been removed completely and continued disturbance (primarily erosion and mowing) has created open clay exposures (i.e., along roadways). It has not been found in the park's restored grasslands, which exhibit high vegetational density and a closed structure rather than the patchwork of barren slopes that characterize the Hwy DD roadsides and which seem to be preferred by the species (Spomer et al. 2008). Thus, at a minimum, land management practices will be needed to maintain existing open clay habitats and prevent their encroachment by woody vegetation. Longer term, the population would benefit greatly from an increase in the amount of available habitat through conversion of adjacent forests/woodlands to grasslands with open structure maintained by mowing, judicious use of fire, selective grazing, and/or other managed disturbance practices.

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