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NOTES

HABITAT PREFERENCE OF THE ENDANGERED AMERICAN BURYING BEETLE (*NICROPHORUS AMERICANUS*) IN OKLAHOMA

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The American burying beetle, *Nicrophorus americanus* (Coleoptera: Silphidae), was formerly widespread over much of eastern North America (Peck and Kaulbars, 1987). During the past several decades, unknown factors have contributed to a precipitous decline in the range and abundance of the species. Currently, it is known only from Block Island, on the coast of Rhode Island, central Nebraska, eastern Oklahoma and from western Arkansas (Anderson, 1982a; U.S. Fish and Wildlife Service, 1991; Ratcliffe and Jameson, 1992; unpubl. data). As a result of this decline, *N. americanus* was listed by the Department of the Interior as an endangered species in July 1989 (Federal Register 54:29652-29655).

Nicrophorus americanus, the largest member of its genus in North America, feeds on carrion both as an adult and as a larva. As with all members of the genus, extended biparental care is provided to the young. Much of what is known about the natural history and habitat preferences of this beetle has been gathered from the Block Island population (Kozol et al., 1988; Kozol, in litt.). However, it is not known whether habitat preferences shown on Block Island are characteristic of extant populations on the mainland.

During the summer of 1991, a previously unknown population of *N. americanus* was discovered on the Cherokee Wildlife Management Area/Camp Gruber in Muskogee and Cherokee counties in northeastern Oklahoma. Because this population occurred in a relatively undisturbed area, it provided an excellent opportunity to assess habitat usage of a mainland population.

The Cherokee Wildlife Management Area occurs on the western edge of the Ozark uplift and consists of a mosaic of grasslands, oak-hickory,

and bottomland forests (Kuchler, 1964; Rice and Penfound, 1959; Rice, 1965). Dominant grasses in the grassland included *Andropogon virginicus*, *Aristida* sp., *Sporobolus* sp., and several species of *Panicum*. The most common trees in the oak-hickory included *Quercus stellata*, *Q. marilandica*, *Carya texana*, and *Ulmus alata*. The dominant trees in the bottomland forest areas were *U. americana*, *Platanus occidentalis*, *Betula nigra*, *Carya illinoensis*, and *Quercus* spp.

Surveys were done at 13 sites between 10 July 1991 and 4 October 1991. Each survey was conducted by placing six pitfall traps approximately 20 m apart along a transect line. Traps were baited with decaying chicken. Of the 13 survey sites, 11 were in oak-hickory forest and 2 were in bottomland forest. Traps were used for 214 trap-nights at oak-hickory sites with 75 captures of *N. americanus*; 12 trap-nights in two bottomland sites resulted in 3 captures. For these general surveys, no difference could be shown in the numbers of beetles captured per trap-night between the two habitat types ($G = 0.55$, $P > 0.05$).

Study plots were also established in each of the three habitat types: two plots each in grassland and bottomland forest areas, and one plot in an oak-hickory forest. None of the study plots had been sampled previously, but all the plots were located near areas where previous surveys for *N. americanus* had been successful.

Each study plot consisted of 16 pitfall traps arranged in a 4 × 4 grid, with traps 50 m apart. During a two-day and two-night sampling period, each pitfall trap was baited with decaying chicken. Traps were checked each morning, and any *N. americanus* captured were marked by clipping out a small triangle from the end of one

TABLE 1—Total number of captures of *N. americanus* for each study plot. Each plot was trapped during two time-periods in 1991, with a total for the two periods of 64 trap-nights per plot.

Site	Initiation date	Number captured
Grassland 1	21 August, 7 September	28
Grassland 2	29 August, 17 September	24
Oak-hickory	29 August, 7 September	40
Bottomland 1	21 August, 7 September	10
Bottomland 2	29 August, 17 September	0

elytron. Recaptures were not included in the analyses. Each study plot was sampled twice during August and September 1991. For statistical analyses, the number of captures were pooled within each habitat type.

The number of *N. americanus* captured differed significantly among the five study plots (Table 1; $G = 65.14$, $P < 0.001$, $d.f. = 4$). Relatively more *N. americanus* were captured in oak-hickory forest than grassland ($G = 4.09$, $P < 0.05$, $d.f. = 1$) or bottomland forest ($G = 45.94$, $P < 0.001$, $d.f. = 1$). Furthermore, higher numbers were captured in grassland than in bottomland forest ($G = 31.17$, $P < 0.001$, $d.f. = 1$). The absence of statistical significance between oak-hickory and bottomland forests during the general survey may be due in part to the variation in habitat quality among survey sites and the relatively few bottomland forest sites surveyed.

The oak-hickory habitats preferred by American burying beetles in Oklahoma contrast sharply with the type of habitat in which the beetle is found in Rhode Island. On Block Island, *N. americanus* is most common in areas with deep soil and light agricultural activity. These habitats are not natural, however. The natural vegetation of Block Island has been altered during the past 200 years from hardwood forest to post-agricultural maritime scrub, mowed fields, and grazed pastures (U.S. Fish and Wildlife Service, 1991). The oak-hickory habitat in which we found the beetles to be most abundant is probably more typical of the habitat in which the beetle occurred prior to its decline. Walker (1957) provided one of the few published accounts of the habitat associated with the occurrence of *N. americanus*. He captured nine beetles in a deciduous forest located on the floodplain of a small creek in Tennessee. The site was described as being "parklike" with

little undergrowth. This is not unlike the understory conditions found in Oklahoma upland forests. Our bottomland sites, by contrast, tended to have a fairly dense undergrowth of small trees and bushes.

Among other North American species of *Nicrophorus* that occur in Oklahoma, *N. marginatus* is found in meadows and prairie areas, while *N. orbicollis*, *N. sayi*, and *N. pustulatus* occur in forests (Anderson, 1982b; J. C. Creighton, unpubl. data). In contrast, *N. tomentosus* is present in a variety of habitat types. *N. americanus* may be more similar to *N. tomentosus* in breadth of habitat preferences than to other species of *Nicrophorus* in Oklahoma. Biotic and abiotic factors that influence the distribution of *N. americanus* are currently under investigation.

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NEST AND NEST-SITE CHARACTERISTICS OF A WESTERN POPULATION OF FOX SPARROW (*PASSERELLA ILIACA*)

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Relatively little is known about nesting and breeding habits of the fox sparrow due to its secretive nature on the breeding grounds (Linsdale, 1928; Austin, 1968; Threlfall and Blacquiére, 1982). Accounts of fox sparrow nests describe materials used, species of plant the nest was found in or under, and general characteristics of the habitat in the area, but do not give nest measurements or describe vegetation immediately surrounding the nest-site (Austin, 1968; Threlfall and Blacquiére, 1982). Bendire (1889) and Pierce (1921) each gave measurements of a single representative nest for some subspecies, while Mailliard (1921) reported the ranges of measurements of 14 nests from a single population at Lake Tahoe, California. Herein we provide measurements of 23 fox sparrow nests as well as descriptions of physical and vegetative characteristics associated with 25 nest-sites from a single population. These data, viewed as phenotypic extensions with possible effects on fitness (as argued in Dawkins, 1982; Lent, 1992), add to the growing body of information about individual and geographic variation in this species (Linsdale, 1928; Swarth, 1920; Zink, 1986, in press).

Fox sparrows were studied from late May to early July 1989 in Sequoia National Forest, 7.5 km west of Hume, Fresno County, California (36°48'N, 118°59'W, altitude 1,950 m). The study site is at the boundary between two fox sparrow subspecies (*P. i. stephensi* and *P. i. megarhyncha*) interconnected by clinal variation (Zink, 1986); therefore, we do not assign a subspecies to the population we studied. Habitat at the study site

consists of mostly chaparral (the most abundant species are listed in Table 1) and also some mixed coniferous forest including giant sequoia (*Sequoiadendron giganteum*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), and sugar pine (*Pinus lambertiana*).

Nests were located by observing adults and by walking through patches of vegetation while attempting to flush incubating or brooding adults. Nest and nest-site characteristics were measured after the nest was no longer active. Using a metric ruler, we measured nest size, height of nest (distance from bottom of nest to ground), height of nest plant (plant nest was placed in or under), distance from top of nest to top of nest plant, and distance from side of nest to nearest edge of nest plant. We calculated relative distance from top of nest plant by dividing distance from top of nest plant by nest plant height and relative distance from side of nest plant by dividing distance from side of nest by diameter of nest plant. We measured nest concealment by standing at edges of nest plants and then estimating, to the nearest 25%, percent of nest visible from top and any sides of the nest plant without moving any branches.

Nest-site choice may be affected by surrounding habitat as well as by physical characteristics within the immediate vicinity of the nest (Martin and Roper, 1988; Zamora, 1990). Therefore, we visually estimated percent of shrubby vegetation occupied by each plant species within circles centered on the nest and having radii of 0.5 and 4.0 m. In addition, presence and number of conif-