

Effects of prescribed fire on small mammals inhabiting Spotsylvania Court House Battlefield

By Cheryl Tanner and Gregg Kneipp

Introduction

The primary objective of prescribed burning at Fredericksburg and Spotsylvania County Battlefields Memorial National Military Park (Virginia) is to protect and preserve its cultural resources. Prescribed burning accomplishes this objective by controlling woody vegetation on earthworks and in fields and promoting the growth of native grasses, which are an essential element of the historical scenes. Native grass species include broomsedge (*Andropogon virginicus*), purpletop (*Tridens flavus*), little bluestem (*Schizachyrium scoparium*), poverty grass (*Danthonia spicata*), purple love grass (*Eragrostis spectabilis*), Indian grass (*Sorghastrum nutans*), and switch grass (*Panicum virgatum*). Burning maintains the historical view of the battlefields by suppressing forest succession and invasion of exotic vegetation. Other objectives of prescribed burning are reducing hazardous fuel accumulations around developed areas and along the park boundary, thereby reducing the potential for fire damage to park resources and adjacent lands and minimizing risks to employees, residents, and visitors.

Many studies have examined the effects of fire on small mammals but few have included the eastern harvest mouse (*Reithrodontomys humulius*; fig. 1, page 42), an abundant inhabitant of the fields in the park. The western harvest mouse (*R. megalotis*) and the meadow vole (*Microtus pennsylvanicus*; fig. 2, page 42), however, have received greater attention. Fire-related mortality among both *R. humulius* and *R. megalotis* adults has been documented as has that of nesting *R. megalotis*, which are particularly susceptible because of immobility (Erwin and Stasiak 1979). We assumed similarities between both species of harvest mouse. The extent of mortality depends upon the seasonal timing and intensity of the fire (Smith 2000; USDA Forest Service 2002). When nestlings are present, immobile *R. megalotis* pups suffer high mortality (Erwin and Stasiak 1979) because their nests are aboveground (Linzey 1998). Adult small

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mammals, including meadow voles and western harvest mice, often seek refuge in underground burrows to escape the heat of the fire. However, sometimes they cannot outrun or otherwise escape the heat and flames (Smith 2000; USDA Forest Service 2002; U.S. Geological Survey 2006). Western harvest mice generally remain in the habitat after the burn or quickly recolonize (U.S. Geological Survey 2006). Meadow voles, however, quickly vacate the burned area because of lack of cover and food. Moreover, peak densities of *M. pennsylvanicus* are not achieved until vegetation has regenerated enough to provide sufficient habitat requirements, typically two to five years after burning (Murphy et al. 2006; USDA Forest Service 2002; U.S. Geological Survey 2006). Though mortality is occasionally documented, the greatest impact to population densities of grassland small mammals is attributed not to direct mortality from the





Figure 1. An eastern harvest mouse is released after capture into the charred remains of its habitat at the McCoull House site in Spotsylvania Court House Battlefield.

NPS/CHERYL TANNER



Figure 2. Seeing a meadow vole, the species most affected by the prescribed fires at Fredericksburg and Spotsylvania National Military Park, has been a rare occurrence since prescribed burning began in 2004.

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fire but to the relatively short-term (but significant) impact of habitat modification (USDA Forest Service 2002; U.S. Geological Survey 2006). The burning of vegetation removes the vital cover required for predator avoidance, destroys thick grasses through which small mammals construct their “runways” or travel corridors and build their nests, and affects food supplies.

Natural Resource Manager Gregg Kneipp began the use of prescribed grassland fires in Spotsylvania Court House Battlefield—one of four major battlefields preserved in the park—in February 2004. In accordance with the National Park Service’s Inventory and Monitoring Program, investigators coincidentally initiated a mammal inventory two days after the first annual burn. Under a cooperative agreement between Frostburg State University (Maryland) and the National Park Service, graduate students conducted the inventory over the next two years, which included several trapping sessions in the burned fields. However, because neither of these efforts focused on how the fire affected movement and mortality of the park’s grassland residents, Kneipp initiated a pilot study before the third annual burn, which occurred on 28 April 2006 (fig. 3). The purpose of the pilot study was to investigate the effects of fire on small mammals. The small mammals under investigation in this study were species that had been discovered during previous research in these fields.

Though protecting and preserving cultural resources is the primary objective, knowing about the mortality and migration patterns of small mammals between open fields and forested areas during prescribed burns will provide valuable information concerning the ongoing management of these open fields. Using these research results park managers will be able to modify management practices for the benefit of both the cultural and natural resources in the park.

Methods

Sherman live traps were deployed at regular intervals (10 m [33']) in grids (3 m x 15m [9.8' x 49']) in two fields (McCoull House and Upton) for eight days before and eight days after the burn to monitor mortality and movement. Grid formations were used to facilitate calculations of population parameters (i.e., abundance, density, and movement distances), which are based on area. By contrast, transects do not allow for such accurate calculations because of their lack of effective area. However, traps were also placed in two transects 10 meters apart in the surrounding forest edges to document movement out of the field and into the adjacent forests. Traps were baited with a mixture of peanut butter, bird seed, and oats and checked at least once per day, depending on weather and capture trends. Before release, captured individuals were marked for recognition upon recapture. The

demographic variables of age, sex, reproductive status, and weight of these mammals were recorded as was trap location for each capture in an attempt to measure movement distances.

Results

The only species of small mammal captured in fields during the 2006 study was the eastern harvest mouse. These animals were documented both before and after the burns in both fields but never in the forest edges, which indicates no movement out of the habitat. Data were insufficient to analyze pre- and post-movement distances, which would have been useful in determining how far species were forced to travel in order to find the resources necessary for their survival after habitat alteration. If mortality occurred, it was low, at least among non-nesting individuals. Because eastern harvest mice build their nests of grass aboveground, any young in these nests could have perished. Partially charred empty nests (fig. 4, page 44) were found after the fires, which indicate that they were either empty before the fire or exposed and depredated afterwards. Half of the mobile individuals caught before the burn were also caught after the burn in both fields (after/before: 4/8 and 1/2), indicating survival. Evidence of survival was also documented by 16 captures of new individuals in both fields after the burns, presumably in search of food in the absence or reduction of their normal forage. Upon release from capture, some harvest mice were observed entering underground burrows, which is likely how they survived the fire. Other factors that may have contributed to survival include the patchiness and relatively low intensity of the



Figure 3. A member of the prescribed-burn team, Rocky Schroeder (Prince William Forest Park), ignites the McCoull House site in Spotsylvania Court House Battlefield. NPS/GREGG KNEIPP



burn. Harvest mice were also documented after the Upton burns in previous years, which suggests that the population has survived three fires. Because very little fire research has addressed the effects on eastern harvest mice, this is valuable information.

Meadow voles weigh about 70g (2.5 oz) and require heavy cover and thick grasses for runway construction (Linzey 1998). Only two meadow voles were captured (in different fields) during the inventory of February 2004. The individuals were trapped on day 3 and day 8 after this first annual burn. Subsequent trapping in these particular fields has documented no meadow voles since that time. The presence of at least one vole in each burned field in 2004, the presence of elaborate and heavily used runway systems observable immediately after the 2004

fire, and the absence of the species ever since suggests that meadow voles were present and most likely abundant before the fire. These data suggest a reluctance of the species to return. Capture of one individual in a small, unburned portion of the 2006 McCoull House site, together with the absence of the species

in burned areas, suggest that the annual removal of vegetation by fire most likely prevents the meadow vole population from rebounding in these fields. By contrast, eastern harvest mice, which are much smaller (average adult is 11g [0.4 oz]) and do not depend on runways, are less affected. The lone meadow vole from the unburned McCoull site may indicate either a very small remnant population from before the burns or the attempted return of the species to the fields. However, the latter does not seem likely due to the recent annual elimination of their habitat.

The white-footed mouse (*Peromyscus leucopus*; fig. 5) was the only species found in the forest edges. Fewer individuals were captured after the burn than before (3/10 and 6/12); however, because none were caught in the burned fields, mortality is not suspected. In addition, many traps in the forest edge were habitually closed by raccoons, thereby preventing entry by mice. On a side note, traps on the forest edge led to the unexpected but exciting incidental capture of a southern flying squirrel (*Glaucomys volans*), the first to be documented in the park.

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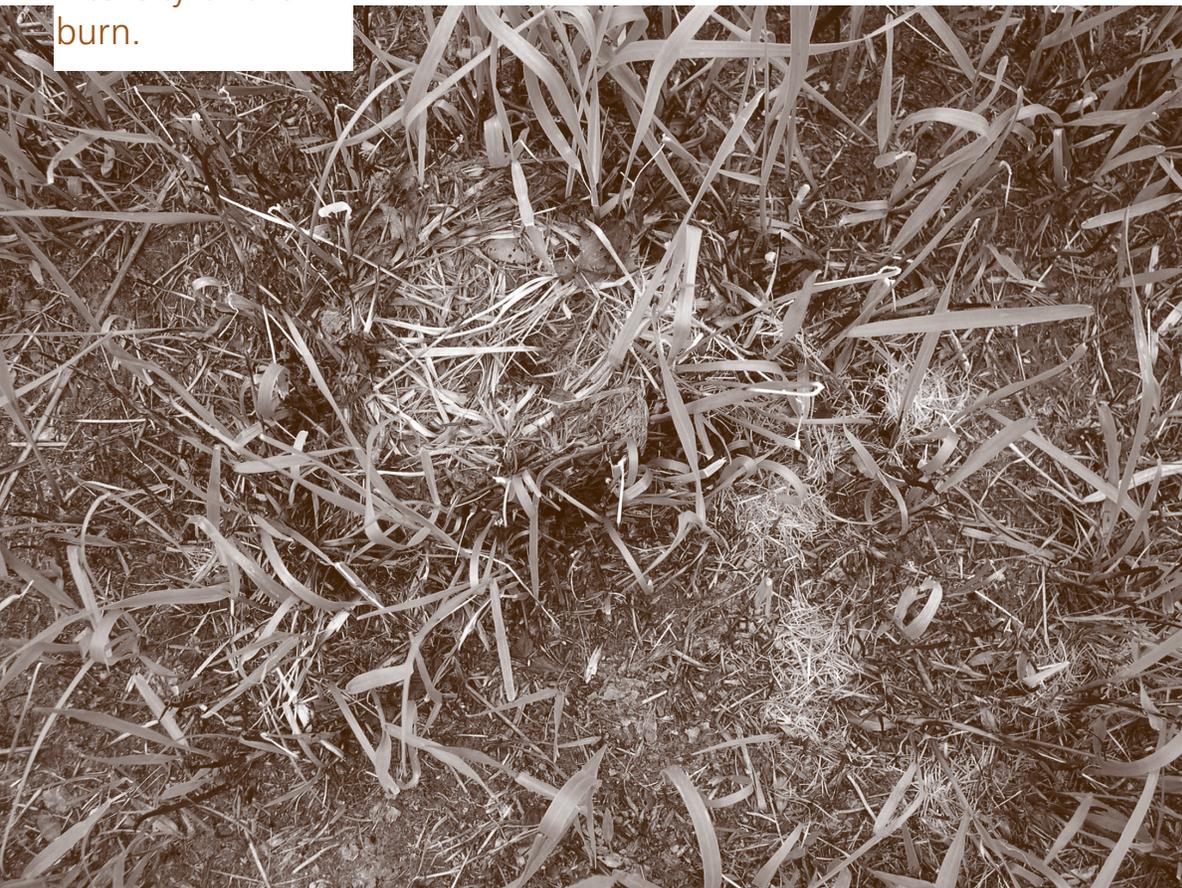


Figure 4. Several weeks after the 2006 prescribed burn, investigators located the partially charred remains of an eastern harvest mouse nest. NPS/CHERYL TANNER

Conclusions

In summary, the eastern harvest mouse population survived the fires and remained in its habitat. The meadow vole population disappeared after the first annual burn and has yet to recover three years later, probably as a result of persistent habitat modification. Forest-dwelling, white-footed mice seem unaffected by the grassland fires. Plans are to continue monitoring the effects of fire on small mammals during subsequent prescribed burns in order to elucidate any trends. Once fire has reduced woody vegetation in the fields, which is the primary objective, a two-to-three-year rotation in

prescribed fire management will be implemented to reduce the effects on meadow voles. In the rotation, some fields would be burned in any given year while other contiguous fields would not. Hence, the unburned fields may provide the habitat necessary to sustain the local population; that is, voles from the burned fields could potentially relocate to the unburned areas that have had time to partially regenerate the cover necessary for survival.

Future research suggestions

Because insufficient capture data precluded the ability to statistically analyze movement distances before and after the fires, we suggest conducting a similar study over a longer period of time. We cannot determine movement distances without a sufficient number of individual recaptures. Also, the question arises as to where meadow voles go after the fire. A radiotelemetry study could determine movement patterns and refugia used after the loss of their habitat.

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Figure 5. White-footed mouse. NPS/CHERYL TANNER

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