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Effects of Turf Rolling and Soil Aeration on Rodent Populations

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Abstract: Rodent populations at airports can cause human safety issues by attracting raptors which increases the risk of raptor-aircraft strikes. Various methods can be used to reduce rodent numbers, including trapping, poisoning, and habitat manipulation. Burrow disruption by turf rolling and soil aeration is a potential habitat manipulation method that could potentially reduce the carrying capacity for rodents. We tested this method at Kansas City International Airport, Missouri. We monitored the rodent populations in a control (untreated) area and in a nearby treated area where the turf was rolled and the soil aerated. We used grids of live traps to determine rodent abundance in the two areas. Unfortunately, the turf rolling and aeration did not reduce the rodent population, as we recorded 14-15 rodent captures per 100 trap-nights on both areas. We caution, however, that this was a very preliminary assessment, and the method could be further investigated for its potential to reduce rodent populations.

Key Words: airport, burrows, management, *Microtus*, rodent, soil aeration, wildlife damage

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INTRODUCTION

Worldwide, rodents are a major vertebrate pest group because of their impacts on human society (Witmer and Singleton 2010). Much effort has been, and continues to be, expended to reduce rodent numbers and damage (Witmer 2007, Witmer and Singleton 2010). Rodents are implicated in many types of damage, including crop and tree damage, structural property, wire and cable damage, disease transmission, and significant predation on native species of animals and plants on islands to which rodents have been accidentally introduced (Angel et al. 2009, Witmer and Singleton 2010). Damage can be especially severe when population densities are high (Witmer and Proulx 2010). At the same time, rodents have many important ecological roles and most species are not major pests (Witmer and Singleton 2010). Some of the roles include soil mixing and aeration, seed and spore dispersal, influences on plant species composition and abundance, and serving as a prey base for many predatory vertebrates.

Bird strikes are an increasing problem in the United States (Dolbeer and Wright 2009) and it is important to address the risks and ways to reduce them (Blackwell et al. 2009). Airports often provide good year-round habitat for rodent populations. Rodents at airports can cause damage directly by their gnawing and burrowing activities. Perhaps the most serious hazard posed by a sizeable rodent population at airports, however, is the indirect hazard of attracting foraging raptors with an associated raptor-aircraft strike hazard (e.g., Barras and Seamans 2002, Blackwell and Wright 2006). Raptors pose one of the most hazardous groups of birds at the airports (Cleary et al. 2002). Unfortunately, many activities at airports result in good habitat for rodents (e.g., allowing tall grass in an effort to reduce loafing habitat for flocking birds) or reduced predation of rodents (e.g., perch removal, bird hazing, carnivore-proof perimeter fencing, and raptor and carnivore capture and relocation; see discussion by Barras and Seamans (2002)). Clearly, it is important to know which rodent species occur at the airport and to have a good understanding of their biology, population dynamics, and ecology along with their relationships to damage, land uses, and human activities.

Rodents are commonly controlled by the use of rodenticides and traps (Hygnstrom et al. 1994, Witmer and Singleton 2010). In some situations, these methods cannot be used because of social or legal concerns, potential environmental or non-target animal concerns, or because they are not cost effective over a large area (Witmer 2011). In that case, it may be possible to modify the environment somewhat so that it is less supportive of high densities of rodents. For example, certain crops are less supportive of rodents and livestock grazing may reduce forage and compact soil, disrupting burrow systems (Moser and Witmer 2000, Witmer 2011). Another way of disrupting burrows is by plowing or disking. This has been used to reduce rabbit populations in Australia (Williams et al. 1995) and to slow ground squirrel reinvasion of areas in California previously treated with rodenticides (Gilson and Salmon 1990). Burrows are a valuable resource and their disruption reduces the value of the area to rodents along with reducing re-invasion rates (e.g., Witmer et al. 1996). Of course, physical disruption of burrows may also result in direct mortality of some of the rodents occupying those burrows.

In this study, we assessed the impact of turf rolling and aeration on rodents at the Kansas City International Airport (KCI). We evaluated this because using a tractor-drawn soil aerator is much less disruptive of landscapes than plowing or disking. We hypothesized that this habitat manipulation would reduce rodent populations. If rodent populations were substantially reduced, this would provide an additional method, albeit indirect, of reducing raptor use of airports with a subsequent reduction in raptor-aircraft strikes.

Figure 1. The Toro Deep Tine soil compactor and aerator. Note the long tines.

METHODS

USDA APHIS Wildlife Services (WS) conducted two weeks of rodent surveys as part of a study to determine the efficacy of turf aeration in reducing rodent populations on the KCI airfield. The project started when the KCI Wildlife Liaison, Bob Johnson, KCI Airport Operations, requested USDA National Wildlife Research Center (NWRC) assistance to determine if aeration could be used as an alternative to zinc phosphide for rodent control. NWRC was consulted on study design and protocol, but the surveys were conducted by KCI's on-site WS biologist to save the cost of having an NWRC scientist travel to Kansas City, MO, from Fort Collins, CO. The hypothesis was that the turf roller and soil aerator would reduce rodent numbers by causing significant burrow disruption. The first step was to find a soil aerator that would penetrate the soil deep enough to cause significant burrow disruption. No pull-behind types were suitable, but Bob Johnson found a piece of equipment made by the Toro Company (Bloomington, MN) that could penetrate the soil to a depth of up to 15 inches (37.5 cm). The Toro Company was contacted, and after a meeting with the KCI and WS staff, agreed to loan KCI their "Deep Tine" soil aerator (Figure 1) and a tractor for only the cost of a set of aerator tines ($253.16).

WS conducted pretreatment rodent surveys the week of June 6, 2011 on an area of the airfield of about 20 acres. The study area was divided into one treatment and one control plot with each being about 10 ac in size. On each plot, we placed a 10 by 10 grid of Sherman live traps (Sherman Traps, Tallahassee, FL) with about 10 m between traps. The traps were baited with a small ball of oat meal and peanut butter and a small slice of apple. Traps were set in the afternoon and checked the next morning. The trap grids were operated for 4 consecutive nights. After recording rodent captures each morning, the rodents were released nearby, hence, recaptures are assumed to have occurred. The trap grids were again operated as before (with the exceptions noted below) during the week of June 27, 2011. This was about 2 weeks after the soil aerator was used on the treatment plot. We compared captures per night on the treatment and control plots, using a t-test. We also presented the total captures in the standardized format of captures per 100 trap-nights. Finally, because some traps were found to be sprung in the morning without containing a rodent, we made an adjustment for trap availability (Nelson and Clark 1973).

Table 1. Depth of aerator holes (n = 93) in two inch increments, with percentage of holes in each depth range.

Depth Range, inches (cm)	No. Holes in Depth Range	Percentage of Holes in Depth Range
0-2 (0-5)	1	1.1
2-4 (5-10)	38	40.9
4-6 (10-15)	36	38.7
6-8 (15-20)	14	15.1

RESULTS AND DISCUSSION

In the week of trapping before turf rolling and soil aeration, only 1 prairie vole (*Microtus ochrogaster*) was captured in the control plot and 11 were captured in what was to be the treatment plot. Aeration took place on June 15-16 on the treatment plot. Several adjustments had to be made to the soil aerator to keep the penetration deeper than 5 in (12.5 cm), and the operator finally gave up, fearing damage to the equipment. Samples of 93 holes revealed an average depth of 4.7 in (11.7 cm), with 9.5 in (23.8 cm) being the deepest and 1.9 in (4.8 cm) the shallowest of the holes surveyed (Table 1). Because vole burrows are generally quite shallow (e.g., 4 in or 10 cm), we decided to proceed with the study.

Unfortunately, the day after aeration was completed, KCI field maintenance staff filled in a low spot on the airfield that was located in the treatment plot. Approximately 20% of the area was covered with dirt. This disturbance probably affected the potential pre- and post-treatment comparison on the survey plot, but data were still available from the post-treatment comparison of the treatment and control plots. Rodent numbers increased from the pre-treatment to the post-treatment surveys on both plots, which was to be expected as population recruitment was occurring because of births. In the control (non-aerated) plot, 55 rodents were captured in 400 trap-nights compared to 49 in 340 trap-nights in the treatment plot (Figure 2). The actual calculation with the adjustment of captures for sprung traps on the control plot was 55 captures divided by $400-(16\times.5) = 55/392 = .14$ captures per adjusted trap-night or 14 captures per 100 adjusted trap-nights. The ad-

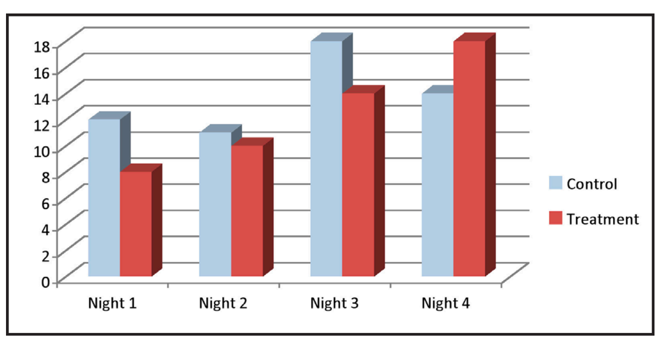

Figure 2. Post-treatment rodent captures per night on control and treatment plots.

justment for the treatment plot was 49 captures divided by 332-(11×.5) = 49/326.5 = .15 captures per adjusted trap-night or 15 captures per 100 adjusted trap-nights. There was no significant difference in the numbers of rodents captured nightly on the treatment plot versus the control plot ($t = 0.66$, $P = 0.555$).

This study did not demonstrate a reduction in rodent population as a result of turf rolling and aeration. However, we caution that our study was not replicated and, additionally, the treatment (soil rolling and aeration) was only applied once. It is possible that repeated soil rolling and aeration events might have a greater effect on rodent populations over time. Alternatively, it could be that the impact of the soil rolling and aeration is not intense enough to adversely affect the burrow systems or to directly kill rodents. For example, Salmon et al. (1987) showed that disking to a depth of 30 cm did not reduce ground squirrel re-invasion rates, but disking to a greater depth of 45 cm did reduce re-invasion rates (Gilson and Salmon 1990). Nonetheless, further investigation of the potential to reduce rodent populations by soil rolling and aeration may be warranted if current methods are not effective or if their use is curtailed.

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