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FINAL REPORT: QA-1485--PART A

AN EVALUATION OF GEOTEXTILE BARRIERS TO PREVENT ACCESS THROUGH HOLES BY WILD NORWAY RATS AND HOUSE MICE

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CITATION AND ABSTRACT

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The commensal rats and mice have amazing adaptability, are well equipped to gnaw and claw through materials, and can make use of a wide array for foods and resources. They also have a high reproductive capability and can achieve high densities. As a result, rodents cause significant damage to human and natural resources in all parts of the world. Effective barriers can prevent or reduce their access to resources, providing economic relief to humans and protection to natural resources. In this study, we tested the effectiveness of a geotextile (metal fiber) material ("Xcluder Fill Material") as a barrier to prevent wild-caught commensal rodents from accessing preferred foods on the other side of a barrier. The barrier material used in this study was highly effective in preventing access to valued food resources by both wild Norway rats and wild house mice. The barrier material is easily installed, allowing home owners, food producers, and personnel of other industries to readily make use of them. We recommend that future trials be conducted in real world settings. Those trials should not only evaluate effectiveness, but also the durability of the barriers over time.

INTRODUCTION

Originally from Asia and parts of the Middle East, Norway rats (*Rattus norvegicus*) and house mice (*Mus musculus*) have followed humans around the world and are now found worldwide (Long 2003). In many situations they live in a close commensal relationship with humans, but on many tropical islands and on portions of some continents, they are free-ranging and do not need the food and shelter provided incidentally by humans. Invasive rats and mice pose a threat to the native flora and fauna of islands (Burbidge and Morris 2002, Witmer et al. 2006, Witmer et al. 2007) and can cause significant damage to agricultural commodities and property (Long 2003, Timm 1994a, 1994b). Most seabirds that nest on islands have not evolved to deal with predation and are very vulnerable to introduced rodents (Moors and Atkinson 1984). House mice are very prolific and populations have irrupted periodically to cause "plagues" in places such as Australia and Hawaii (Long 2003). The Study Director had conducted a site visit to Pennsylvania where house mice were posing a serious threat to the poultry industry, both by consuming and contaminating chicken feed and by the transmission of the bacterial disease, Salmonella. Despite the use of a variety of rodenticides by the poultry growers, problems with mice persist. Norway rats cause the same types of problems at many dairies and livestock feedlots where food and cover are abundant. The abilities of rodents to climb, jump, gnaw, and squeeze through small openings poses a formidable challenge.

More effective tools are needed to reduce rodent populations and the damage they cause (Witmer et al. 1995, Witmer and Jojola 2006). Effective barriers would help reduce or eliminate rodent problems in and around buildings. Effective barriers could reduce the likelihood of transmission of rodent-borne diseases such as hantavirus (Hopkins 2002). If the barriers were affordable and durable, they could also be used in other applications such as to reduce burrowing on large grassy areas such as in agricultural settings and at airports (Witmer and Fantinato 2003), or reduce damage to insulation in buildings (Hygnstrom 1995). Unfortunately, the abilities of rats and mice, including their very sharp, ever-growing incisors, make it very difficult to prevent their access to vulnerable resources (Baker et al. 1994). Nonetheless, Bourne (1998) noted that the development of new and affordable building materials can greatly help prevent incursion by rodents. The objective of this study is to test the ability of at least two types of metallic barrier materials to deter rodent access. We tested one barrier material (geo-textile containing metal fibers) in pen trials to evaluate its ability to prevent access by wild Norway rats and wild house mice. The animals were motivated to gain access to the other side of the barrier by the use of preferred food items. This study was conducted under the approved NWRC Project: Development and assessment of methods and strategies to monitor and manage invasive mammalian vertebrate species with emphasis on rodents.

METHODS

Free-ranging house mice and Norway rats, live-trapped near Fort Collins CO, were maintained in individual plastic shoebox cages (mice) within a room of the Animal Research Building (ARB) or metal rack cages (rats) in an outdoor rodent building (ORB) at NWRC as per SOP AC/CO 005.00 (mice) and SOP AC/CO 011.01 (rats). The mice and rats were provided with commercial laboratory rat chow and water *ad libitum*. Each cage had a den box, a piece of cardboard or chew stick for gnawing, and cotton (mice) or burlap (rats) for bedding material. The mice and rats were quarantined for two weeks before the trial began. The mice and rats were weighed and sexed before the start of the trial.

On day 1, 10 caged mice and 10 caged rats were randomly assigned to the barrier treatment group with each group having 5 males and 5 females. An additional 10 mice and 10 rats were assigned as controls. All rodents continued to receive rodent chow and water throughout the trial. Prior to addition of the individual treatment rodent, a barrier wall was placed in each treatment cage. The walls were constructed of wood and held in place by screws (rat cages) or wood dowels (mice cages). Each of the 10 rat cage walls had a circular hole of 2 ½ inch diameter drilled through it; the mouse cages had 1 ¼ inch holes. The wall was positioned about 1/3 of the way from one end of the cage, and hence, 2/3 of the way from the other end of the cage. The larger area of the cage had the den box, rodent chow and the water bottle.

A pre-conditioning trial had been conducted to identify several highly preferred foods to use as lures in the trial. Lure foods tested included small slices of orange, apple, melon, banana, green bean, potato, cucumber, cheese, hot dog, and chocolate/peanut candy bar. We also tested pelleted dog food and small balls of oatmeal mixed with peanut butter; the latter is a standard bait used in both live and snap traps in rodent field studies. Foods were added three at a time and monitored for several days before a new group of three foods were tested. The lure foods most preferred by Norway rats were peanut butter-oatmeal balls and apple and cheese slices. The lure foods most preferred by house mice were peanut butter-oatmeal balls and hot dog and cheese slices. Consequently, we used these as lure foods in the barrier study. Treatment animals were fed these foods for several days before the trial was started. The lure foods were placed each day on the smaller side of the cage wall so that the rodent would have to go through the hole in the wall to access the preferred foods. Almost always, the preferred foods were eaten over night and were completely gone when the cages were checked the next morning. The amount of rodent chow placed on the larger side of the cage was also reduced to 4 pellets per day per rat and 2 pellets per day per mouse so that the rodents would be a little more hungry and more inclined to try to gain access to the preferred foods on the smaller side of the cage once the barriers were inserted. The rodent pellets were not replenished unless the current ones had been mostly eaten.

On the afternoon of the start of the barrier trial, a tight wad of the geotextile barrier material (marketed as "Xcluder Fill Material"; Global Materials Technologies, Inc., Palantine, IL) was inserted tightly into the wall hole of each treatment cage while the rodent was in its den box (See Figures 1 and 2). Half of the wads were inserted from the left side and half from the right side of the walls (i.e., 5 from the front-side and 5 from the backside). This was because in a real world setting, one would not know from which side the rodent might approach the inserted barrier. Fresh lure food was added to the now blocked side of the cage. It was replenished every other day so that the food odors would remain a strong enticement for the rodent to get to the preferred foods on the other side of the barrier.

Each barrier was examined each day and recorded as: 1) no visible damage, 2) slight damage but not breached, 3) moderate damage but not breached, and 4) breached. The trial continued for 7 days for the rats and 5 days for the house mice. If the hole barrier was breached on any day, the trial ended immediately for that animal.

At the end of the trial for each animal, the hole barrier was removed after fresh preferred food had been added to the smaller side of the cage. This was to assure that the animals would readily go through the now unblocked hole and consume the lure foods.

All rodents used in the study were euthanized with CO_2 and incinerated at the end of the study. However, we first examined each rodent to see if there was any blood evident or injuries or abrasions from trying to remove the barrier material.

Figure 1. Hole barrier set-up for rats.

Figure 2. Hole barrier set-up for mice.

RESULTS AND DISCUSSION

Norway rats. None of the 10 blocked holes were breached during the 7-day trial. Only one rat tugged at the barrier material and removed some of the geotextile material (See Figure 3). Interestingly, it appeared that the rat used the material for bedding in its den box. After the hole barriers were removed, all 10 rats passed through the now open wall holes and consumed the lure food during the first night. No signs of injury were noted on any of the treatment rats. All 10 control rats survived the study period, consumed preferred foods daily, and exhibited no injuries.

House mice. None of the 10 blocked holes were breached during the 5-day trial. There was only very slight shredding of the geotextile material by 3 mice (See Figure 4). After the hole barriers were removed, all 10 mice passed through the now open wall holes and consumed the lure food during the first night. No signs of injury were noted on any of the treatment mice. All 10 control mice survived the study period, consumed preferred foods daily, and exhibited no injuries.

Figure 2. Maximum damage to a hole barrier by a rat.

Figure 4. Maximum damage to a hole barrier by a house mouse.

CONCLUSIONS

The commensal rats and mice have amazing adaptability, are well equipped to gnaw and claw through materials, and can make use of a wide array for foods and resources. They also have a high reproductive capability and can achieve high densities. As a result, rodents cause significant damage to human and natural resources in all parts of the world. Effective barriers can prevent or reduce their access to resources, providing economic relieve to humans and protection to natural resources. The barriers constructed of geotextile materials used in this study were highly effective in preventing access to valued food resources by both wild Norway rats and wild house mice. The barrier material is easily installed, allowing home owners, food producers, and personnel of other industries to readily make use of them. We recommend that future trials be conducted in real world settings and over longer periods of time. Those trials should not only evaluate effectiveness, but also the durability (e.g., weathering effects) of the barriers over time.

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