EFFECTIVENESS OF A PERCEIVED SOLID BARRIER AS AN EXCLUSION FENCE TO PREVENT WHITE-TAILED DEER DAMAGE

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Abstract: We hypothesized that a visually solid barrier of cloth would provide an effective exclusion fence for free ranging white-tailed deer (*Odocoileus virginianus*). Three plots consisting of 2, 10 m x 10 m squares were established in pastures. Data were collected daily for consumption of corn provided (2.27 kg) and events recorded by infrared game monitors. Following construction of the burlap fence at 1.7 m height, corn consumption decreased (0.07 ± 0.01 kg/day, $P < .001$). The number of Infrared monitor events recorded also decreased within the enclosures (2.13 ± 0.04 events/day, $P < .001$) compared to controls (46.0 ± 2.2 events/day). During the second stage of the experiment, two of the three plots were reestablished 45 days later. Fence heights began at 65 cm and were raised 15 cm each 5 days, until reaching 1.7 m. At 1.7 m, corn consumption decreased by 30% (1.56 ± 0.23 kg/day, $P < .01$). The number of infrared monitor-recorded events was also lower at fence heights >65 cm ($P < .03$). Results indicate that a visually solid barrier has potential to be an effective exclusion fence.

Key words: barrier, burlap fence exclosure, exclusion, fence, white-tailed deer

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INTRODUCTION

Permanent fencing to create an exclosure as a means of reducing deer damage is well documented. Many exclosures were based on modifications of a typical electric fence utilized for livestock including: two-wire outrigger (Scott and Townsend 1985, Howard 1991), 7-wire strand vertical (Palmer et al. 1985, Craven and Hygnstrom 1994), slanted fences (Craven and Hygnstrom 1994), electric polytape (Owens et al. 1995) and double offset fencing (Fitzwater 1972, Palmer et al. 1985, Craven and Hygnstrom 1994). While exhibiting varying degrees of effectiveness, virtually all electric fences are highly subject to short-circuiting due to weed growth, snowdrifts and lightning (Porter 1983, Craven and Hygnstrom 1994). Chain link fences (Bashore and Bellis 1982) and woven wire fencing (Nolte 1999) greater than 2.4 m in height are effective but tend to be cost prohibitive and require extensive maintenance.

Herd-oriented animals respect a barrier that appears visually substantial (Grandin 1993). The use of barrier fences that are or appear solid has been used extensively to capitalize and exploit this behavioral characteristic in livestock species (Grandin and Deesing 1998), commercially

raised red deer (Whittington and Chamove 1995), reindeer and several African species (Kilgour 1971, Fowler 1978, Grandin 1980). If herd-oriented animals respect solid barriers because of their inability to see perceived threats from outside the perimeter, then the reverse could also be true. The inability to visually inspect for potential threats due to a fence that appears solid may act as a deterrent to prevent animals from entering an area. Therefore, the purpose of this experiment was to determine if a visually solid barrier of cloth could prove an effective exclusion fence. Additionally, we examined the effects of intentionally conditioning deer to jump the cloth fence.

METHODS

Phase I. The study was conducted on the 1,215 ha wildlife refuge area encompassing the Berry College campus in Northwest Georgia from 29 January - 15 March, 2002. Deer population in the refuge area was estimated at 1 deer per 4 ha (J. Beardon, Georgia Department of Natural Resources, personal communication). Three plots were established approximately 1.5 km apart. Each plot was located within 100 m of a paved road. Two plots were located in improved pastures maintained for livestock grazing consisting of perennial fescue (*Festuca arundinacea*) and bermuda (*Cynodon spp.*) respectively. The third plot of perennial bermuda was utilized for hay production.

Each plot consisted of 2, 10 m x 10 m adjacent squares to serve as treatment and control sites. Corner posts were erected for each square and an additional post was placed between corner posts on one side of each square to facilitate attachment of the infrared game monitors at a height of 1 m (Trail Timer® Plus 500, St. Paul, MN). Use of similar systems was reported to be effective in decreasing the chances of small mammals and birds from activating the monitors (Jacobson et al. 1997, Henke 1997). These monitors record an event when sufficient infrared heat is detected within a projected beam path, to a maximum distance of 18.2 m. The monitors used in this study have a 1-minute delay following each recorded event, thus reducing the number of recorded events that would result from continuously breaking the infrared beams path. The infrared monitors were used to evaluate the degree of activity and not to determine deer numbers. Feed stations were constructed within the center of each plot by placing a plastic tray (42x43x10 cm) on a single layer of cinder blocks and securing the tray by driving steel rods in the ground around the perimeter.

Each day, between 1100 h and 1300 h, 2.27 kg of #2 dent, cracked corn (Purina Inc.®, St. Louis, MO) was provided at each feed station after recording consumption level from the previous 24-hr period. The number of events recorded by the infrared monitors for the previous 24-hr period was also collected.

Following a preconditioning period, data were collected for 10-days to establish baseline activity. A single strand of high tensile wire was then attached to the corner posts of one of the 10 m squares of each plot. Two layers of 1.8 m width, 10 oz treated burlap (Dayton Bag & Burlap Co., Dayton, OH) were secured to the high tensile wire using wire ties resulting in an average height of 1.7 m. The other square at each site served as a control. Corn consumption and infrared monitor recorded events were collected for 30-days using the previously described procedure.

The analysis of variance procedure of SPSS 11.5 (SPSS 2002) was used to determine differences in corn consumption and deer activity by treatment, across periods. A significance threshold level of 95% confidence was utilized for all analyses.

Phase II. Two of the three plots were re-established for the second phase of the experiment conducted 24 April – 22 June, 2002. A preconditioning period was followed by a 5-day data collection period to establish a baseline level of activity. Burlap fences were erected at a height of 65 cm and raised 15 cm each 5 days until reaching a height of 1.7 m. Corn was provided, and data for consumption and events recorded from infrared monitors were collected as previously described.

The paired T-test analysis procedure of SPSS 11.5 (SPSS 2002) was used to determine differences in corn consumption and deer activity by treatments, within fence height periods. A significance threshold level of 95% confidence was utilized for all analyses.

RESULTS

During *Phase I* the presence of the burlap fence had a significant impact on corn consumption by white-tailed deer (Figure 1). During the baseline period, deer consumed virtually all corn provided at treatment (2.25 ± 0.02 kg/day) and control (2.27 ± 0.00 kg/day) feeders. Activity of deer, as determined by the infrared monitors, varied among feeders within each plot in a non-systematic manner (Figure 2). However, no differences (P = .069) were noted between the control and treatment feeders across the three plots.

Figure 1. Average daily corn consumption by white-tailed deer during baseline and burlap fence treatment periods across plot locations.

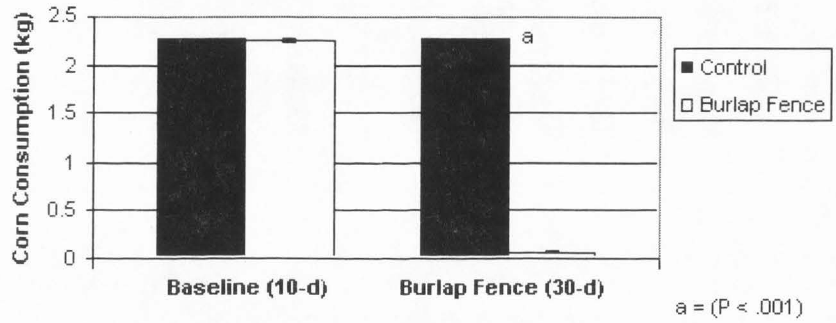
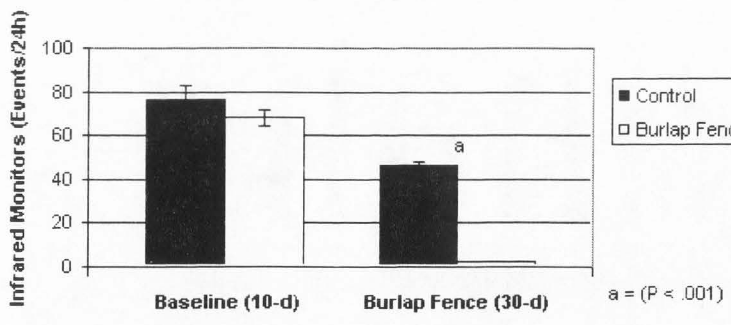


Figure 2. Average daily recorded infrared monitor events of white-tailed deer during baseline and burlap fence treatment periods across plot locations.



Once the burlap fence was erected, deer continued to consume all corn provided (2.27 ± 0.00 kg/day) at control feeders during the 30-day period. Corn consumption within

the burlap enclosures decreased to near negligible levels (0.07 ± 0.01 kg/day, $P < .001$). Small amounts of corn consumed were attributed to sparrows utilizing the feeders. This was confirmed by both visual observation and the appearance of pecked areas in the corn provided. Similarly, infrared monitor events recorded were lower at treatment sites (2.13 ± 0.04 events/24 hr, $P < .001$) compared to respective controls (45.96 ± 2.24 events/24 hr). While the infrared monitors do not record actual numbers of deer, they do provide an indication of activity level of animals with sufficient size to result in the recording of an event. It should be noted that the infrared monitor events presented are artificially inflated by a factor of two recorded events. Upon activation of the unit or the clearing of data recorded, monitors begin recording events starting at 1 observation. The second artificial recorded event was obtained during collection of data for each 24-hour period by intentionally triggering the monitor by blocking the beam and using our infrared detected body heat to induce recording of an event. This protocol was followed to ensure that the monitors were correctly functioning.

Figure 3. Average daily corn consumption by white-tailed deer with increasing height of burlap fence at 5-day intervals.

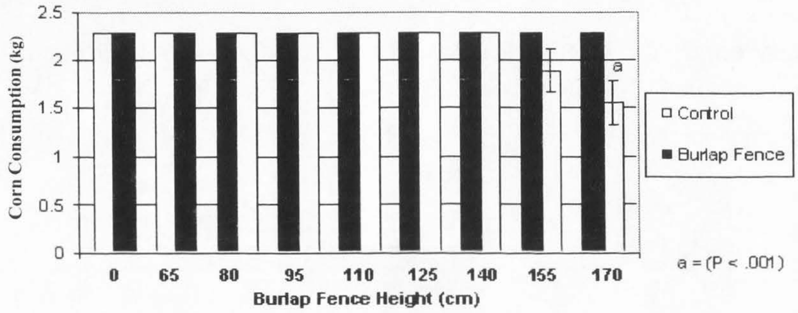
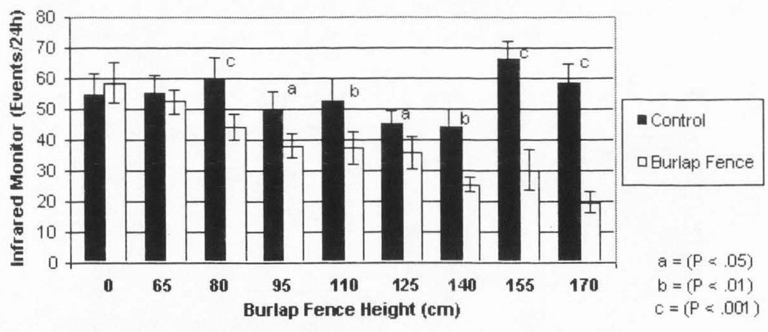


Figure 4. Average daily recorded infrared monitor events of white-tailed deer with increasing height of burlap fence at 5-day intervals.



Corn consumption decreased during Phase II, by 30% (1.56 ± 0.23 kg/day, $P < .01$) compared to control plots at a fence height of 1.7 m (Figure 3). From a height of 80 cm – 1.7 m, the number of events recorded by the infrared monitors within the enclosures decreased ($P < .03$). Once the fence reached the 1.7 m height, the difference in recorded events within the burlap enclosures (19.5 ± 3.51 events/24 hr,

$P < .001$) and control plots (58.5 ± 6.15 events/24 hr) was more pronounced (Figure 4).

DISCUSSION

Limited effectiveness of many types of physical barriers may be related to innate deer behavior. Deer prefer to go under or through fences versus jumping over structures (Palmer et al. 1985). The burlap fence design was not secured at ground level. While deer certainly could gain access by moving under the burlap, this did not occur, likely due to their inability to visually inspect the area on the other side of the fence for potential danger. Wind may also have increased the effectiveness of the enclosure. Air movement was readily expressed as constant and inconsistent motion of the burlap fence. Deer feeding at control feeders were most frequently observed facing the enclosure and often exhibiting a limited fright response when movement of the fence occurred. It was also observed that extensive trampling of the ground occurred on the side of control feed stations farthest away from the burlap fence at all plots, suggesting deer preferred to maintain visual contact with the fence.

It has been reported that as area of exclosure increases control of deer is reduced (Owen et al. 1995, Nolte 1999). The use of electrified polytape fencing was more effective at deterring deer at plot sizes of 101 m^2 as compared to those of up to 0.41 ha (Owen et al. 1995). However, in that study the fence averaged 75.6% control, within the 10 m^2 plots, with decreasing effectiveness over three replications. Plots used in the burlap fence study were of similar size (100 m^2) with 100% effectiveness as measured by corn consumption and infrared monitor recorded events over the 30-day period.

The ability of deer to rapidly become conditioned to various stimuli is well documented. Numerous methodologies including human and animal-based repellants (El Hani and Conover 1998, Mason 1998), hot sauce and bitter flavors (El Hani and Conover 1998), acoustic methods, propane cannons (Belant et al. 1996), ultrasonic whistles (Belant et al. 1998) and fence enclosures (Owen et al. 1995) have all been reported to have diminished effectiveness over time. Due to the initial success of the burlap fence as an exclosure, the second phase of this experiment was intended to accelerate the learning curve by intentionally conditioning deer to transverse the burlap fence. As fence height reached the 1.7 m level, consumption of corn and events recorded by the infrared monitor decreased. It is unfortunate that the fence height could not be further increased because this was the maximum width of the burlap. Regardless, the decrease in consumption and recorded events is highly encouraging regarding the potential use of this type of fence as a means to exclude deer.

Based on the results of this study, the use of an artificial solid barrier appears to hold promise as a means to exclude deer. Anecdotal evidence from local individuals adopting this concept further supports our findings. Results of this study warrant further examination to determine the effectiveness of cloth fences on larger plots of land, as well as evaluation of different types of material to determine cost and durability relationships.

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