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EVALUATION OF ELECTRONIC FRIGHTENING DEVICES AS WHITE-TAILED DEER DETERRENTS

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ABSTRACT: The authors evaluated the effectiveness of the motion-activated Usonic Sentry (with and without strobe), motion-activated Yard Gard, and Electronic Guard for deterring white-tailed deer (*Odocoileus virginianus*) from preferred feeding areas from February to April 1996. Two four-week experiments were conducted, monitoring deer use (number of intrusions and corn consumption) at eight feeding stations in a 2,200 ha fenced facility in northern Ohio with high deer densities ($\geq$38/km^2). During these experiments, one of the devices was positioned at each of four sites. The mean ($\pm$ SE, $\underline{n}$ = 4) daily number of deer intrusions at feeding stations during treatment (96.5 $\pm$ 12.6-169.0 $\pm$ 22.0) was similar ($\underline{P} \geq 0.13$) to or greater ($\underline{P} \leq 0.04$) than the mean daily number of deer intrusions during pre- or post-treatment (109.8 $\pm$ 15.6-148.8 $\pm$ 21.4). Corn consumption declined ($\underline{P} \leq 0.05$) only at stations with Usonic Sentrys without strobes for one week. It was concluded that the electronic frightening devices tested were generally ineffective in deterring white-tailed deer from preferred feeding areas.

KEY WORDS: acoustic deterrents, Electronic Guard, frightening devices, *Odocoileus virginianus*, sound, strobe lights, ultrasound, Usonic Sentry, white-tailed deer, wildlife damage management, Yard Gard

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White-tailed deer populations in the United States have increased dramatically in recent years. Ungulate damage to agricultural and ornamental crops is increasing concurrently (Dolbeer et al. 1995). Farmers and agricultural and wildlife agencies have ranked deer as causing more crop damage overall than any other group of wildlife (Conover and Decker 1991; Wywialowski and Beach 1992). Direct removal of deer can reduce the potential for conflict; however, such removals are often controversial, particularly in urban areas. Effective nonlethal techniques are needed to reduce deer damage to agricultural and ornamental crops.

Acoustic frightening devices have been recommended for deterring deer from desired areas (Craven and Hygnstrom 1994); however, previous studies have met with mixed success. Belant et al. (1996) evaluated the effectiveness of propane exploders as white-tailed deer deterrents. They determined that motion-activated exploders were more effective than exploders that fired at regular intervals, probably because deer were unable to habituate to them as readily. Curtis et al. (1995) concluded that the Super Yard Gard ultrasonic device was ineffective as a deer deterrent. However, ultrasound from Super Yard Gards in their study was emitted at regular intervals rather than activated by movements of deer.

The objective of this study was to compare the effectiveness of three electronic frightening devices: motion-activated Usonic Sentry, motion-activated Yard Gard, and Electronic Guard for deterring white-tailed deer from preferred feeding sites. The goal was to develop a technique for reducing deer depredation of agricultural crops, winter livestock food supplies (e.g., stacked hay), and ornamental plantings.

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STUDY AREA

This study was conducted during February to April 1996 at the National Aeronautic and Space Administration Plum Brook Station (PBS), Erie County, Ohio. The 2,200 ha facility is enclosed by a 2.4 m high chain-link fence with barbed-wire outriggers. Habitat within PBS differed from the surrounding agricultural area and consisted of canopy-dogwood (*Cornus* spp.) (39%), grasslands (31%), open woodlands (15%), and mixed hardwood forests (11%) (Rose and Harder 1985). During winter 1995-1996, PBS had an estimated minimum white-tailed deer population of 825 ($\geq$38/km^2) based on a helicopter facility over the entire facility (P. Ruble, Ohio Div. Wildl.).

METHODS

The authors evaluated the motion-activated Yard Gard (Weitech, Inc., Sisters, Oregon), motion-activated Usonic Sentry (Medlinc of Colorado, Grand Junction), and Electronic Guard (Pocatello Supply Depot, Pocatello, Idaho). All devices were used according to manufacturer specifications. Yard Gards, marketed to deter mammals from desired areas, were evaluated at the medium frequency setting (20 to 28 KHz, 114 dB at 1 m). When activated, the Yard Gard emitted ultrasound for about 7 seconds. Usonic Sentrys were designed to deter mammals by using multiple units to create a perimeter of ultrasound around the area being protected. Usonic Sentrys operated at 23 to 35 KHz with sound pressure of 160 dB at 1 m, and emitted sound for 8 to 18 seconds when activated. During one experiment, a white strobe light (140,000 candlepower [cp], flash rate = 120/min) was connected to the top of each Usonic Sentry. Electronic Guards were equipped with a 1.4 KHz modulating (15 to 20 modulations/minute) siren with 116 dB output at 1 m. Electronic Guards also contained a white strobe light (70,000 cp, flash rate = 60/minute) and were equipped with a photocell such that they were operative during night only. Timers activated the devices for about 7 to 10 seconds at 6 to 7 minute intervals.

Feeding Experiments

During January 1996, eight deer feeding stations were established located ≥1 km apart using whole-kernel corn placed in two adjacent 1.2 m long cattle feed troughs. A plastic snow fence (1.5 m high) was erected on three sides of a 5 x 5 m area such that feed troughs were located inside the fenced areas about 1 m from the back. Corn was added to feed troughs as necessary to maintain a constant food supply and the weight of corn added was recorded (Belant et al. 1997). An infrared monitoring device (TrailMasterR, Goodson and Assoc., Inc., Lenexa, Kansas) was installed 60 cm above ground at each opening to record the number of deer intrusions and avoid recording nontarget species (e.g., raccoons [*Procyon lotor*], fox squirrels [*Sciurus niger*]).

Experiment 1. Four feeding stations were selected randomly to each receive a Usonic Sentry without strobe. The remaining four stations received a Yard Gard. Each device was attached to a post about 1.2 m above ground and centrally located within the fenced area on the back side. Motion sensors were positioned such that any deer that approached the feeding stations would activate the device 1 to 3 m prior to being detected by the infrared device.

Using the TrailMasters, the daily number of deer intrusions at each feeding station was monitored until the number of intrusions did not increase for one week. The experiment consisted of a one-week pretreatment (beginning February 9), two-week treatment, and one-week post-treatment period. The appearance of each feeding station was identical among periods except that frightening devices were activated during treatment only.

The authors divided the daily values recorded by the infrared monitors by two to determine the number of deer entering each feeding station. The mean daily number of intrusions/week for each station was calculated. Analysis of variance (ANOVA) with repeated measures (weeks) (SAS Inst., Inc. 1988) was used to compare the mean number of deer intrusions and mean amount of corn consumed (kg) by week for each device. Data were log-transformed prior to analyses because of heterogeneity of variances (Zar 1984). If main effects were significant ($P \leq 0.05$), Tukey tests were used to determine which means differed.

Experiment 2. This experiment was initiated one week after the conclusion of Experiment 1. Electronic Guards and Usonic Sentrys with strobes were placed at the sites which previously contained Usonic Sentrys without strobes and Yard Gards, respectively.

The experimental design and statistical analyses were similar to those described for Experiment 1. However, to determine whether the strobe lights modified deer use of feeding stations, the percent of movements that occurred during night (sunset to sunrise) were calculated, and the authors analyzed these movements across weeks by frightening device using repeated-measures ANOVA on log-transformed data.

RESULTS

Experiment 1

There were no differences in the mean daily number of deer intrusions among weeks for the Yard Gard (96.5 ± 12.6-109.8 ± 15.6) ($F = 0.51$; 3,9 df; $P = 0.6852$) or Usonic Sentry (105.3 ± 18.6-132.0 ± 23.6) ($F = 2.48$; 3,9 df; $P = 0.1272$) (Figure 1). There was a difference in corn consumption among weeks, however, for the Yard Gard and Usonic Sentry ($F = 26.31$-26.98; 3,9 df; $P < 0.0001$). Corn consumption decreased ($P < 0.05$) from pre-treatment (4.8 ± 1.0 kg) to week 1 treatment (1.5 ± 0.9) for stations with Usonic Sentrys, but not with Yard Gards (6.5 ± 1.4-2.3 ± 0.8) ($P > 0.05$). For both devices, the amount of corn consumed then increased (≥17.3 ± 2.5) ($P < 0.05$) during week 2 treatment and remained constant ($P > 0.05$) through post-treatment.

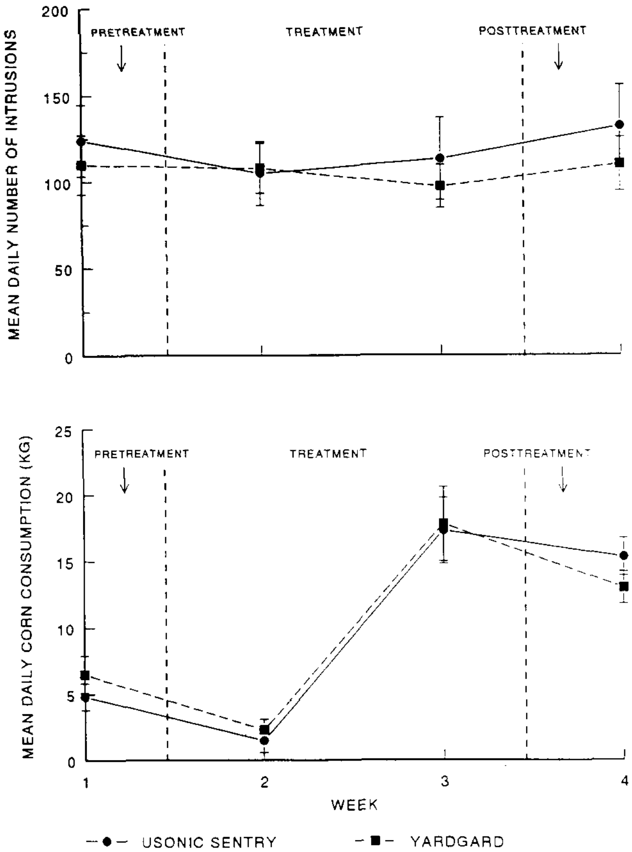

Figure 1. Mean daily number of white-tailed deer intrusions and mean daily corn consumption at sites with Usonic Sentry or Yard Gard by week, Plum Brook Station, Erie County, Ohio, February to March 1996. Capped vertical lines represent 1 standard error.

Experiment 2

Mean daily number of deer intrusions differed among weeks for the Usonic Sentry with strobe ($F = 4.52$; 3,9 df; $P = 0.0340$) and the Electronic Guard ($F = 4.11$; 3,9 df; $P = 0.0430$) (Figure 2). For the Usonic Sentry and Electronic Guard, the respective mean daily number of intrusions increased from pre-treatment (124.0 ± 13.5 and 148.8 ± 21.4) through treatment (140.0 ± 12.6 and 169.0 ± 22.0) then declined during post-treatment (103.5 ± 9.8 and 131.0 ± 13.9). The mean percent of intrusions during night at feeding stations with Usonic Sentrys increased (F = 4.79; 3,9 df; P = 0.0292) from pre-treatment through treatment. For stations with Electronic Guards, the mean percent of intrusions at night was similar (F = 2.71; 3,9 df; P = 0.1077) among weeks. Corn consumption differed (F = 3.87-5.18; 3,9 df; $P \leq 0.0497$) among weeks at stations with Usonic Sentrys or Electronic Guards. Corn consumption generally was greater during treatment than during pre-treatment or post-treatment periods.

DISCUSSION

The initial (one week) reduction in corn consumption after Usonic Sentrys (without strobes) were activated was probably because deer were affected by the novel stimulus. Nonetheless, habituation to devices occurred rapidly (<1 week) for deer intrusions into feeding sites. In addition, strobe lights on Usonic Sentrys did not further reduce deer use of sites or alter movements by time of day. Motion-activated Yard Gards were ineffective in reducing deer movements and corn consumption at feeding stations, even during week 1 of treatment. Curtis et al. (1995) reported systematically-activated Super Yard Gard ultrasonic devices were ineffective in deterring white-tailed deer from bait sites. The increase in consumption of corn at all feeding stations observed during the first experiment was likely a consequence of a 15 cm snowfall during week 2 treatment which reduced relative availability of alternate food. Also, this study was conducted when alternate food was least available (winter and early spring); thus, overall effectiveness of the devices tested may have been reduced relative to other times of year.

The Electronic Guard was developed originally to reduce coyote predation on livestock (Linhart 1984; Linhart et al. 1992). Livestock producers and fruit growers have reportedly also used Electronic Guards to reduce damage to haystacks and orchards caused by deer and elk (U.S. Dep. Agric. 1995). Data from this study do not support reductions in deer use of preferred feeding areas. The only other quantified study evaluating sonic devices as deer deterrents involved propane exploders (Belant et al. 1996). Belant et al. (1996) determined that motion-activated propane exploders were more effective (up to six weeks) than exploders fired at regular intervals (effective for about two days), probably because deer were unable to habituate to them as readily.

Because none of the sonic or ultrasonic devices tested reduced deer use of feeding sites for >1 week, it is unlikely these devices used alone would deter deer from other preferred food (e.g., agricultural crops, ornamental trees and shrubs). The lack of negative reinforcement associated with the frightening devices tested probably allowed deer to habituate more rapidly than if additional negative stimuli (e.g., pyrotechnics or shooting with a gun to frighten or kill) were provided. As with other vertebrate deterrents, incorporation of multiple techniques in an integrated approach is generally more effective than use of individual techniques.

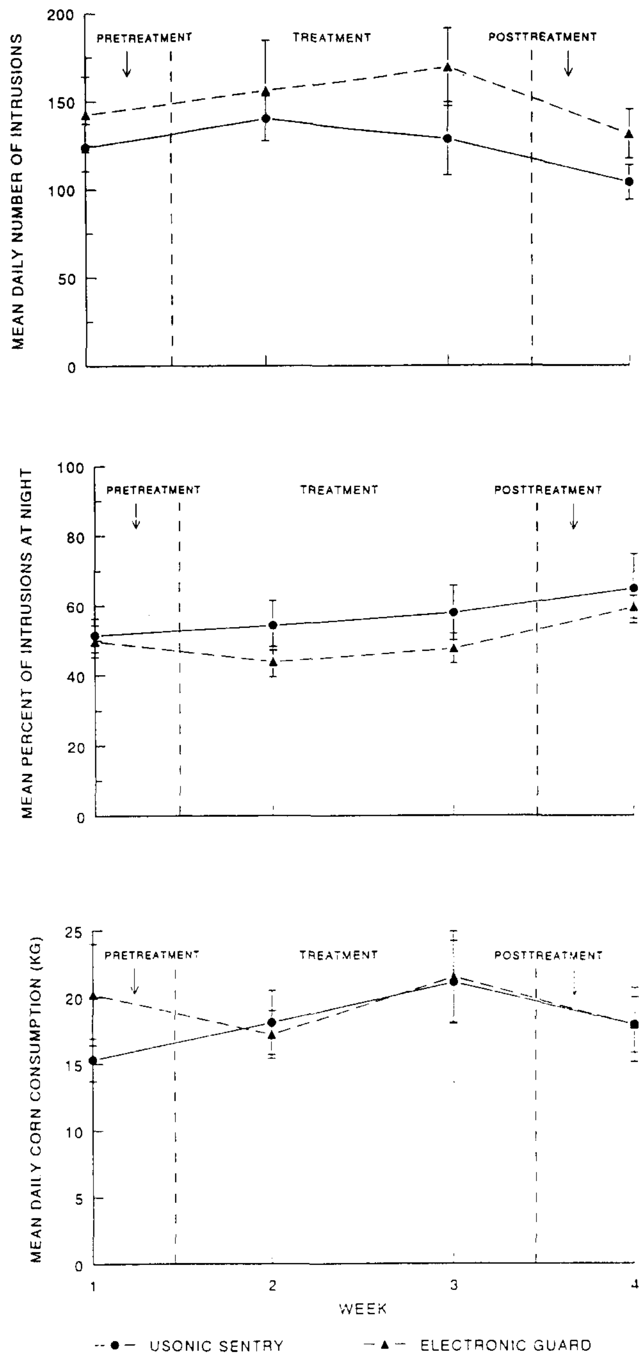

Figure 2. Mean daily number of white-tailed deer intrusions, mean percent of intrusions at night (sunset to sunrise), and mean daily corn consumption at sites with Usonic Sentry (with strobe) or Electronic Guard by week, Plum Brook Station, Erie County, Ohio, March to April 1996. Capped vertical lines represent 1 standard error.

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