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ABSTRACT

We studied the home ranges and activity patterns of 24 white-tailed deer (Odocoileus virginianus) in southwestern Wisconsin via radio-telemetry and visual observation to determine their response to single-strand electric crop-protection fences. Deer were allowed to establish feeding patterns in alfalfa fields during the spring green-up periods of 1986 and 1987. In mid-April of each year, 7 fences were constructed around selected 7-25 ha alfalfa fields to exclude deer from varying portions of their home ranges. No fences were constructed around alfalfa fields in one area. Fences were built around 50 and 100% of the alfalfa in 2 other areas. Deer movements were monitored in each of the 3 areas.

Preliminary observations indicate that 1) marked and unmarked deer used alfalfa fields extensively from snowmelt to first cutting, 2) deer-use of alfalfa fields by deer decreased significantly ($P<0.05$) after fences were installed in the 50 and 100% treatment areas. Conversely, deer in the 0% treatment area significantly ($P<0.05$) increased their use of alfalfa fields after fences were installed, and 3) home ranges of deer in each of the treatment level areas decreased significantly ($P<0.05$) in size after fences were installed. Deer limited their movements primarily to non-alfalfa areas within their pre-fencing home ranges. These results lend further support for the use of fences in deer damage control.

INTRODUCTION

Crop damage caused by deer (Odocoileus spp.) has increased in many agricultural regions because of growing deer populations. In Wisconsin, the white-tailed deer herd (O. virginianus) has increased to about 1 million and deer damage has been estimated at $36.7 million per year (Wisconsin Department of Agriculture, Trade and Consumer Protection 1984). Various types of deer fences have proven cost-effective in reducing deer damage in orchard, field and specialty crops (Palmer et al. 1985, Craven and Hygnstrom 1986). However, we do not know how deer respond when excluded from established feeding areas and other portions of their home ranges. Critics argue that excluded deer simply move to feed in fields that are unprotected, thereby making fencing a questionable alternative. The objectives of this study were to determine the effects of crop protection fences on home-ranges and activity of white-tailed deer so that conclusions could be made about the overall effectiveness of deer fencing.

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STUDY AREA

The study was conducted at the Badger Army Ammunition Plant (BAAP) in southwestern Wisconsin. The BAAP is a 23km^2 fenced enclosure consisting of mixed agricultural land,

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grasslands, woodlots and ammunition production and storage facilities. Nearly half of the agricultural land is used for high quality alfalfa hay production. The local deer population is estimated at 12 deer/km^2 (Creed et al. 1987), however, helicopter counts indicate that the population in the plant is higher.

METHODS

Twenty-eight deer were captured with baited Clover traps and equipped with battery-powered radio-collars or eartags during January and February of 1986 and 1987. We included 16 additional deer that were radio-equipped by J. W. Herron in a previous study.

Radio-collared deer were located by triangulation, using 2, 13-element, vehicle-mounted antennae and hand held compasses. We recorded the date, time, receiver location, and bearing for each deer in the field. Later, bearings were coordinated and converted into locations on a computer-digitized map, using a program developed by J. R. Cary. Visual observations of marked deer were also recorded.

Deer were located 3-6 times per day from 1 February to 18 April, 1986 and 1 February to 25 April, 1987 (before fencing period). By 12 April of both years, deer had established regular feeding patterns in alfalfa throughout BAAP. On 19-20 April, 1986 and 26-27 April, 1987 we constructed 7 crop-protection fences around selected alfalfa fields to exclude deer from varying portions of their home ranges. Fenced field sizes ranged from 7 to 25 ha. Fences were made of a single-strand of polywire (Visible Grazing Systems, Palmerston North, New Zealand) or glowgard (Live-Wire Products, Brea, CA) and charged with New Zealand-style energizers (Hygnstrom and Craven in press). Twenty-three marked deer were excluded from 100% of their available alfalfa (based on home ranges before fencing). Eleven deer were excluded from 50% of the alfalfa within their home ranges and 17 deer were not excluded from alfalfa to serve as a control group. We continued to locate deer 3-6 times per day after the fences were constructed (after fencing period) until 1 June of 1986 and 1987, when hay harvesting disrupted deer activity.

In this preliminary examination, we selected 8 deer from each of the treatments to provide information about relationships between exclusion levels and changes in home range. Deer were selected based on home range size and location, number of locations and reliability of the data. We analyzed telemetry locations and visual observations with the mean harmonic method of home range analysis (Dixon and Chapman 1980). We generated 95% and 50% isopleths to represent the outer boundaries of home ranges and activity centers, respectively. Changes in home range size and number of locations within alfalfa fields were examined using a 2-way analysis of variance with 2 factors. One factor, time period, included 2 levels: before fencing and after fencing. The other factor, level of alfalfa fencing (treatment), included 3 levels: 100%, 50% and 0%.

RESULTS AND DISCUSSION

The 24 deer averaged 24 (Min.-Max. = 13-53) and 14 (Min.-Max. = 0-40) locations in alfalfa fields before and after fences were installed, respectively (Table 1). There was a significant ($P<0.05$) decrease in locations of deer in alfalfa fields from the before and after fencing periods for the 100% and 50% treatment areas (Table 2). We visually observed deer only twice in fenced alfalfa fields after fences were installed. During the same period, there was a significant ($P<0.05$) increase in the number of deer locations in alfalfa fields for the 8 deer that were not fenced out of alfalfa fields. In general, the single-strand electric fences were effective in excluding deer from alfalfa fields. These results are consistent with an earlier study of single-strand electric fences in corn fields (Hygnstrom and Craven in press).

Table 1. Mean percentage of locations in alfalfa fields of 24 radio-equipped deer that were excluded from varying portions of their spring home ranges in southwestern Wisconsin, 1986-1987.

Treatment Level[1/]	Period			
	Before fencing		After fencing	
	$\bar{X}$	Min.-Max.	$\bar{X}$	Min.-Max.
100%	23	(14-29)	5	(0-10)
50%	31	(13-53)	16	(6-40)
0%	20	(14-26)	42	(16-29)

1/ Percentage of alfalfa that was fenced within home ranges of deer.

Home ranges of the 24 deer averaged 338 ha (Min.-Max. = 148-720) and 240 ha (Min.-Max. = 101-426), during the before and after fencing periods, respectively (Table 3). There was a significant ($P<0.05$) decrease in home range size from the before to after fencing periods for all treatment areas (Table 2). Home ranges may have been smaller because deer were excluded from portions of their home ranges. However, other factors probably were involved, since home ranges of 6 of 8 deer in the 0% treatment area were also reduced.

Other factors may include an unequal tracking period (2.0 months before vs. 1.5 months after fences were installed) and an increased availablity of natural foods after the fencing period.

We expected that deer would expand their home ranges through increased food-searching activities after being fenced out of alfalfa fields within their home ranges. However, deer in the 100% and 50% treatment areas restricted their movements primarily to non-alfalfa

Table 2. Abbreviated analysis of variance tables showing the significance of changes in number of deer locations within alfalfa fields and home range size in response to 2 time periods[1/] and 3 treatment levels[2/].

	df	MS	F
Deer Locations Within Alfalfa Fields			
A (Time Period)	1	1,312.52	17.06 [3/]
B (Treatment Level)	2	374.02	4.86
A x B	2	395.90	5.15
Experiment-wise Error	42	76.94	
Home Range Size			
A (Time Period)	1	116,033.33	7.23 [3/]
B (Treatment Level)	2	38,676.57	2.41
A x B	2	9,662.15	0.60
Experiment-wise Error	42	16,049.58	

1/ before and after fencing periods.
2/ percentage of alfalfa (100%, 50% or 0%) that was fenced within home ranges of deer.
3/ significant difference ($P<0.05$).

areas within their pre-fencing home ranges. It appears that the deer were able to access suitable food resources within their pre-fencing home ranges without depending upon alfalfa fields.

CONCLUSIONS

We monitored the movements of 24 deer to determine their responses to crop-protection fences during the spring green-up periods in 1986 and 1987, in southwestern Wisconsin. Home ranges of 2 groups of deer were modified by installing single-strand electric fences around 100% and 50% of the alfalfa fields within their home ranges. A third group was not fenced out of alfalfa fields to serve as a control. Deer avoided fenced fields in the 100% and 50% treatment areas and did not increase their home ranges or move radically in search of other alfalfa fields. These results support the conclusion that crop-protection fences are effective in controlling deer damage. Also, deer that are fenced out of fields are not displaced from their original home ranges and therefore do not cause damage problems in other areas.

Table 3. Mean home range sizes (ha) of 24 radio-equipped deer that were excluded from varying portions of alfalfa located within their spring home ranges in southwestern Wisconsin, 1986-1987.

Treatment Level[1/]	Period			
	Before fencing		After fencing	
	$\bar{X}$	Min.-Max.	$\bar{X}$	Min.-Max.
100%	253	(160-434)	211	(105-421)
50%	389	(179-720)	254	(101-427)
0%	372	(254-483)	254	(101-420)

[1/] Percentage of alfalfa that was fenced within home ranges of deer.

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