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EVALUATION OF THREE DAMAGE ABATEMENT TECHNIQUES FOR CANADA GEESE

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Canada geese (*Branta canadensis*) frequently cause unacceptable losses to agricultural crops (Hunt 1984). Depredation control has been an important aspect of waterfowl management near Horicon National Wildlife

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Refuge (HNWR) for 28 years (Hunt and Bell 1973), yet available abatement techniques are insufficient to prevent unacceptable levels of damage according to area farmers (Heinrich and Craven, unpubl. data).

Traditionally, farmers in the Horicon area have relied on propane exploders (gas cannons), scare flags, shell crackers, hunters, and some form of financial compensation to cope with Canada goose depredations Hunt 1984). However, as pointed out above, the varied abatement techniques are not entirely satisfactory. Thus, there is a constant need to evaluate new abatement technology.

A substantial increase in the goose flock during the early 1980's aggravated the damage problem and focused renewed attention on abatement techniques. Horicon area farmers strongly expressed their need for new methods to protect their crops in an extensive postal survey (Heinrich and Craven, unpubl. data). Thus, in 1985 the Wisconsin Department of Natural Resources (WDNR) contracted with the University of Wisconsin-Madison Department of Wildlife Ecology (UWWE) to evaluate several new abatement techniques for Canada geese. Three techniques were assessed; mylar flagging, human effigies (scarecrows), and a commercial sonic deterrent. Each technique has been used in other areas for avian damage abatement (Besser 1985, Woronecki and Dolbeer 1985), yet none of the 3 had been evaluated as a Canada goose abatement technique. Our objectives for each technique were to evaluate; (1) abatement potential; (2) material cost and labor requirements and; (3) acceptance by cooperating farmers.

STUDY AREA

The study area was located in Waupun township, Fond du Lac county, Wisconsin, at the north-west corner of HNWR. The topography is level to gently rolling, with no location more than 0.8 km from a road. The area is primarily agricultural land and the common crops are corn, alfalfa, and winter wheat. Farmers in Waupun township filed the largest number of agricultural goose complaints for 1981-1985 in the HNWR area (R. Birger, USFWS, pers. commun.). Peak fall goose counts for HNWR were 172,000 in 1986 and 236,250 in 1987 (WDNR surveys).

METHODS

We established a 58 km road transect in the study area (Fig. 1). All fields visible from the road were included in the study. Cumulative field area was 2,176 ha in 1986 and 2,936 ha in 1987. Differences were due to normal agricultural rotations.

Belling (1985) demonstrated that the distance between night roost and feeding site was an important variable in feeding site selection by Canada geese. Thus, the driving route was laid out 4.8-8.0 km from the HNWR roost impoundments, to minimize any effect based on distance.

The fall migration of Mississippi Valley Population (MVP) Canada geese through the Horicon area results in the highest seasonal level of damage complaints (Hunt 1984). Data were collected for 7 weeks each fall, starting 10 days after the arrival of the geese, in each of the study years (27 September-17 November, 1986 and 22 September-9 November, 1987).

Canada geese typically feed twice daily, during early morning and evening (Raveling et al. 1972, Zicus 1976, Reed et al. 1977). The transect length was set to allow the entire route to be covered within each feeding period. The route was driven twice each day, in the morning beginning 30 minutes after sunrise and in the evening, back calculating the starting time from 30 minutes before sunset. Direction of travel was reversed on alternate days. The transect was completed 93 times in 1986 and 86 times in 1987. Fog and/or rain precluded observations on 19 occasions.

All fields on both sides of the transect were mapped by; (1) crop type; (2) size and; (3) presence/type of abatement device. Each time the route was driven, changes in these categories were recorded for all fields. Also, if any geese were present in the field at the time of observation, a "sighting" was recorded for that field.

If geese were found to be present on 3 out of 5 sequential observations the field was defined as "in use" by Canada geese. Experimental fields and control fields were assigned among fields "in use". Experimental fields were randomly selected to receive one of the 3 abatement treatments; (1) mylar flags; (2) human effigies or; (3) sonic deterrents. We obtained landowner permission to place and maintain abatement devices and requested that they not disturb the control fields even if damage occurred.

Mylar flags

The mylar flags used were 15.0 cm X 1.5 m strips, red on one side and silver on the other, attached to 1.7 m wooden stakes and deployed at a rate of 10 per 4 ha of treatment. Mylar flags were used to successfully reduce goldfinch (Carduelis tristis) damage in sunflower fields by Woronecki and Dolbeer (1985).

Human effigies

The human effigies used were 2.6 m x 0.6 m, cut from 1.2 cm exterior plywood and "dressed" in orange rainsuits as described by Perry (1985). Two 5.0 cm black eyespots and a 10 cm mouth slit were painted on each side of the enlarged white head (Fig. 2). Effigies were deployed at a rate of 1 per 4 ha, as recommended by Perry (1985). In fields >4 ha additional effigies were placed at right angles to each other to minimize a potential limitation of the two-dimensional design.

Sonic deterrents

The commercial sonic deterrents used were Model AVA-2 Av-Alarms@. Although Av-Alarms@ have been used to protect a variety of crops from small birds (McCracken 1972, Palmer 1976, and Besser 1985), their use for waterfowl abatement has not been described. We used the 3 speaker AVA-2 units placed at a 1.5 m height on steel "T" posts. The pulse and interval timers were set on medium, resulting in a 10 second sound pulse and a 5 minute interval between activations. Volume controls were set on "loud". One unit was deployed per 4 ha of treatment field, well within the effective limits of the device (Holcomb 1976).

Experimental design

The treatment fields were each paired with a matched control field. The pairs were matched by; (1) field size; (2) crop type and; (3) date the field met the "in use" criterion. Field size and crop type had been shown to be important variables in feeding site selection by Belling (1985). "In use" dates were utilized due to the extreme fluctuations in goose numbers in the HNWR area during the fall MVP migration. The transect observer continued to gather data on all fields on the route, and was not informed of these control/treatment pairings (blind design). In 1986, 24 pairs of treatment/control fields were established and 22 pairs were created in 1987. Data were transformed into rates of observation (# of sightings/ # of observations) and a paired t test procedure was applied to each treatment group, to evaluate for treatment effect.

Horicon area farmers believe that more goose use of a field will result in more damage (Heinrich and Craven, unpubl. data.). Thus, this study was designed to determine whether the desired treatment effect occurred (fewer goose sightings in protected fields than in paired control fields). We assumed that a significant treatment effect would indicate that the technique was effective in decreasing crop damage. We did not validate this assumption by field assessment of actual crop yields. Since no goose sightings would indicate a high probability of no damage, the relative frequency of no sightings/observation was recorded for all abatement and control field pairs.

Canada goose damage abatement in the HNWR area is a cooperative effort between the WDNR, the United States Department of Agriculture-Animal Damage Control (USDA-ADC), and the area farmers; the agencies provide the abatement materials and the farmers provide the labor. We recognized that a new abatement technique would not be effective if it was not used, and we assumed that a technique that was perceived to work would be more likely to be used. Thus, landowner perceptions on abatement success were requested by telephone interview after each study season. We asked each farmer to characterize the particular abatement device we had placed on their farm. Further, requests for the new techniques were monitored through USDA-ADC. If a study technique decreased goose use AND convinced farmers of its efficacy we judged it to be "effective abatement".

Though a significant treatment effect and subsequent acceptance by farmers could define an effective new abatement technique, evidence of rapid habituation would indicate that the technique might not remain useful in the field. We believed that a significant reduction in treatment effect within a study year, or between study years, would suggest the development of habituation. Therefore, we examined the field data for evidence of within-year and between-year changes in treatment effect.

Within-year effect was investigated using the first 14 and last 14 observations of each treatment field as paired data sets (n = 22). A significant reduction in treatment effect between the first and last week of abatement would have suggested rapid habituation to the technique.

To test for between-year effect we divided the data into control, mylar flag, human effigy, and sonic deterrent subsets. We first compared the frequency of goose sightings in control fields between 1986 and 1987 to determine if there was any over-riding between-year effect present to confound the individual analysis of between-year effect by treatment type. This was considered to be a plausible concern in that a 40% increase in peak numbers of geese (WDNR census) occurred between 1986 to 1987. Further, 1987 was the earliest harvest in 10 years whereas 1986 was a normal harvest year (J. Phanta, University of Wisconsin-Extension, pers. commun.). A two-sample t test was used to compare goose sightings in the study fields between the two years. A significant reduction in treatment effect between years would have suggested habituation to the technique. Preliminary data analysis justified pooling data for the two study years.

RESULTS

Treatment efficacy

Geese were present in the 46 control fields on 35% of the transect observations, and all three experimental abatement techniques caused significant reductions in the expected rate of observation as recorded in paired control fields (Table 1). Geese were observed in the 24 fields with mylar flags on 4% of the observations, significantly less than in paired control fields (t = 4.55, 23 df, P = .0001). Geese were sighted in the 16 human effigy fields on 3% of the transect observations fewer than in paired control fields (t = 5.39, 15 df, P = .0001) Only 3 Av-Alarms@ were available, resulting in a small sample size (n = 6). Geese were observed in fields with Av-Alarms@ on 3% of the observations, less than in paired control fields (t = 2.77, 5 df, P = .0187).

Cooperators' perceptions

When cooperating farmers were asked for their opinion, they were offered 3 response categories; (1) fully successful; (2) helped reduce damage or; (3) not successful. Their perceptions of success were mostly consistent with the field data (Table 1). Nineteen of 24 cooperating farmers agreed that mylar flags were "fully successful". The remaining five said mylar flags "helped reduce damage". Five of 16 cooperating farmers said that human effigies were "fully successful" and the remaining 11 all felt that the effigies "helped reduce damage". However, only 1 of the 6 farmers felt that Av-Alarms@ had "helped reduce damage". The remaining 5 all said that the Av-Alarms@ were "not successful". Requests for mylar flags and human effigies have become common at the local Wisconsin Wildlife Damage Program (WWDP) office since 1986 (USDA-ADC, agency records).

Habituation

We could not detect a within-year (habituation) effect for mylar flags ($\underline{t}$ = 1.25, 21 df, $\underline{P}$ = .1164), human effigies ($\underline{t}$ = 1.92, 14 df, $\underline{P}$ = .0755), or Av-Alarms@ ($\underline{t}$ = .60, 5 df, $\underline{P}$ = .2880) (Table 1).

Geese were present in the control fields on 36% of the transect observations in 1986 and 33% in 1987, and these rates of observation did not differ between years ($\underline{t}$ = .45, 44 df, $\underline{P}$ = .6564). Thus, we did not detect any over-riding between-year effect to confound the individual analysis of between-year effect by treatment type. We could not detect a between-year effect for mylar fields ($\underline{U}$ = 64,79; $\underline{P}$ = .6851), or human effigy fields ($\underline{t}$ = -1.05, 14 df, $\underline{P}$ = .2680). The between-year tests for Av-Alarm treatment fields could not be implemented due to the small sample size (n = 2) in 1987.

DISCUSSION

We placed each experimental abatement device in an attempt to make an "in use" field less attractive to geese. However, in our experience, once geese landed in a field it immediately became far more attractive to additional geese. Thus, if any geese landed in a "protected" field, subsequent site selection would be simultaneously effected by the abatement device and the presence of geese. This would confound any analysis based on numbers of geese observed. Thus, we judged geese/no geese to be the appropriate unit of analysis for the evaluation of these experimental abatement techniques.

Mylar flags

The mylar flag treatment was quick, easy, and inexpensive. Each flag cost $0.30 and each stake $0.90, for a material cost of $3.00/ha. The flags were made and applied with a pair of scissors, a hand saw, and a hammer. One person can make and install the flags on a 4 ha field in 45 minutes (Table 1).

Mylar flags significantly reduced the rate of observation in both study years, throughout the damage season. Further, there were no goose sightings in 13 of the 24 fields protected by mylar flags, with no paired control fields recording no sightings.

We considered any "protected field" in which the rate of observation exceeded its paired control field to be a "total failure". In both fields in which mylar flags totally failed, the geese landed behind hillocks that obscured the nearest flags. In one 8 ha corn stubble field we recorded goose sightings 23 of 59 observations after placement of mylar flags. The field had an unusual degree of topographic relief for the area, with many hillocks partially blocking both wind and line-of-sight. Any observation of geese in a protected field was considered a "failure". We observed mylar flag failures in an additional 9 instances and in each case the flags were motionless due to lack of wind. In no cases were geese observed to land within a 4 ha area in which they could see a flag in motion.

Once on the ground, geese would walk to within 20 m of a flag in motion, and within 1 m of the flag when not in motion. It appeared that the abatement value of mylar flags was dependent on line-of-sight and wind, and substantially limited to geese in flight.

Human effigies

The human effigies were also quick and easy to place in a field. Total cost per completed effigy was $12.00 (plus $2.50 for one steel T post), for a material cost of $3.80/ha. A hammer, circular saw, saber saw, and electric drill were required for construction and a post driver and pliers for installation. Though it took about 30 minutes to make one effigy, it could be placed in a 4 ha field in 10 minutes.

Human effigies significantly reduced goose use in both study years, throughout the damage season. In fields ≤8 ha with no pronounced low spots and all field edges defined by a physical boundary such as a road, woven wire fence, or wood lot (n = 6) there were no goose sightings after the human effigies were in place, with no paired control field recording no sightings. Total failures (as defined above) occurred twice. In one case, the geese landed behind a hillock that obscured the effigy, in the other geese landed in an adjoining field and walked into the protected field. Subsequent to both occurrences, geese were observed to walk up to and feed at the base of the human effigies. The abatement value of human effigies was limited to geese in flight. Despite this limitation, 15% use was the highest recorded on an effigy protected field in either study year, as compared to 51% average use of the effigy control fields.

Sonic deterrents

The Av-Alarm@ unit itself was easy and quick to set up and operate, however the 12 V automotive battery required to power the device was somewhat difficult to transport. The batteries did not require recharging during 5 weeks of use. The Av-Alarm@ unit for a 4 ha field could be installed in 15 minutes with a post driver and pliers.

Retail price on the Av-Alarm@ AVA-2 is $289.00. Batteries were $40.00 each and steel T posts cost $2.50, for a material cost of $82.50/ha. If the company's advertised 3 year life span is used, the amortized cost would be $27.50/ha/year.

While the cost of Av-Alarm@ treatments was the highest of the three techniques we investigated, we did not judge it to be prohibitive as compared to potential losses. Av-Alarms@ significantly reduced goose sightings in protected fields throughout the damage season. There were no goose sightings in Av-Alarm@ fields in 2 of 6 protected fields, with no control fields recording no sightings. Av-Alarm@ efficacy was not effected by topography. Wind decreased the effective area and allowed geese to land in a "protected field" in 2 instances observed by cooperating farmers.

Cooperators' perceptions

The mylar flags impressed farmers as "a great flag" before they ever used them, and subsequent experience reinforced the initial reaction. Initially, cooperators felt that the human effigies were "ridiculous" and would "never do the job". However, after a season of experience they concluded that the effigies were a useful abatement technique. Av-Alarms@ were also initially viewed as a technique that would "never do the job". After a season of personal observations, cooperating farmers still felt that Av-Alarms@ were "not successful", even though field data indicated a statistically significant reduction in goose use. Farmers also said that Av-Alarms@ were "too noisy". Their general comments suggested a lack of faith in this highly technological approach to Canada goose damage abatement.

Habituation

The field data did not provide any evidence of within-year or between-year effect (habituation) and the data for the 2 years were pooled for subsequent analysis. However, our experience with propane exploders suggests that habituation would be likely to occur if any of these techniques were to be deployed at a saturation level.

Summary

Mylar flags, human effigies, or Av-Alarms® each significantly reduced the rate of observation in protected fields and resulted in many fields with no goose sightings at all. Farmers agreed that mylar flags and human effigies were either fully successful or at least helpful, and acted on that belief by subsequently requesting those techniques from USDA-ADC. Thus, we judged both mylar flags and human effigies to be "effective abatement". Av-Alarms® reduced the rate of observation yet were rated as unsuccessful by cooperating farmers. However, the small Av-Alarm® sample size (n = 6) may have effected both measures of efficacy. (Table 1.)

MANAGEMENT IMPLICATIONS

Mylar flags (10 per 4 ha) and human effigies (1 per 4 ha) are effective abatement techniques for Canada geese in corn, winter wheat, and alfalfa. Av-Alarms® (1 per

4 ha) are effective abatement (they reduce goose use), but are not convincing to landowners.

Mylar flags should be considered as an abatement recommendation in any size field, for any crop type and topography that allows the geese to see the flags as they approach to land. The efficacy of mylar flags is dependent on wind, however the material is so light that any wind will suffice, only complete calm results in a motionless flag.

Human effigies should be recommended for fields with defined physical barrier boundaries, especially for such fields ≤8 ha. Human effigies would not be effective in large fields with unprotected contiguous areas and no perimeter barrier. The effigies would also not be effective if the topography had sufficient relief to block line-of-sight contact with the effigy.

Av-Alarms@ could be recommended for Canada goose damage abatement, but public acceptance may be a problem. Further, Av-Alarms@ were the most expensive of the techniques we assessed, thus their use might be more appropriate to; (1) settings where alternate abatement devices are prohibited such as urban golf courses; (2) depredation of crops with a high unit value or; (3) field situations in which all other abatement efforts have failed.

In our study fields, we placed only one type of device per field, and we left it exactly as originally placed. Our experience with Canada geese at Horicon marsh suggests that alternating or combining techniques would be even more effective.

Habituation may occur if these techniques are used over a longer period of time or at higher densities (Davis 1974). However, habituation was not observed within or between years in this study. At this point, three effective new abatement techniques are available to help resolve the long-standing Canada goose crop damage problem near HNWR and elsewhere.

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Table 1. Mylar flags, human effigies, and Av-Alarms@ as techniques for Canada goose damage abatement near HNWR.

Technique	Effect[a]	within[b]	Between[c]	Cost[d]	Time[e]	Perception[f]
Mylar flags	yes	no	no	$ 3.00	11 min.	fully succ.
Human effigy	yes	no	no	$ 3.80	10 min.	helped red.
Av-Alarm@	yes	no		$27.50	4 min.	not succ.

a Effectiveness; one-tailed paired t tests.

b Within-year change in effectiveness; one-tailed paired t tests.

c Between-year change in effectiveness; two-tailed two-sample t tests. 1987 Av-Alarm@ sample (n = 2) too small to perform test.

d Cost/1 ha treatment.

e Time to deploy/1 ha treatment.

f Telephone survey of farmers who used the technique; the response the majority choose among; (1) fully successful; (2) helped reduce damage and; (3) not successful.

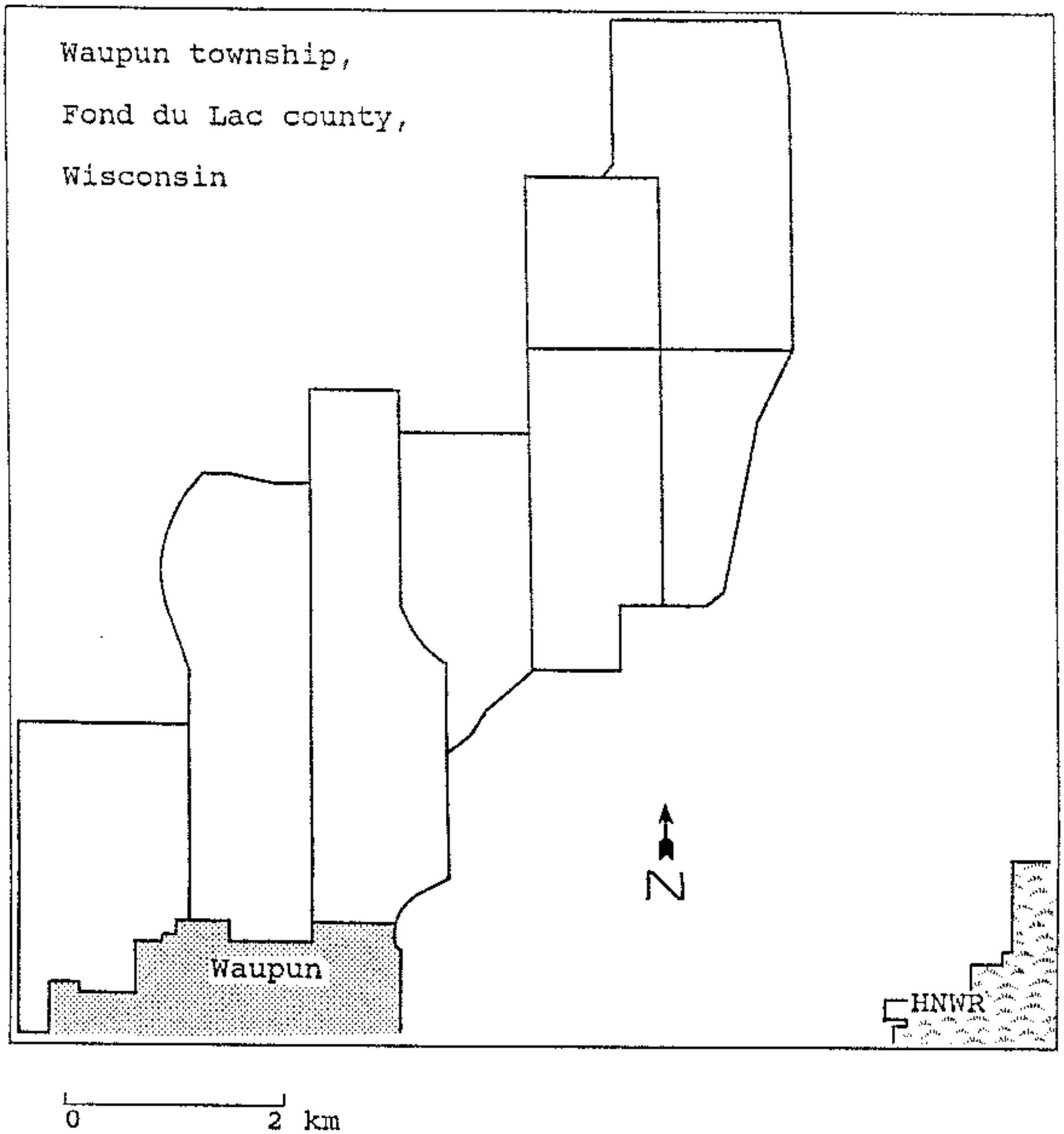

Fig. 1. Road transect near Horicon National Wildlife Refuge, 1986-1987.