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Canada goose crop damage abatement in South Dakota

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Abstract: Canada geese (*Branta canadensis*) can cause considerable damage to crops during summer when geese are flightless. We evaluated the effectiveness of a program designed to alleviate crop damage on soybeans by Canada geese in South Dakota, USA. The applications of electric fences, feeding stations, and propane cannons reduced the area of crop damage by 90% in 2006 and 80% in 2007, but the timing was important. Fields where abatement practices were applied early in the growing season had less damage than fields where they were applied later. Abatement practices that were properly applied as soon as damage started and that were maintained throughout the growing season were effective at reducing damage to soybeans by Canada geese.

Key words: abatement, *Branta canadensis*, Canada goose, crop damage, electric fence, human–wildlife conflicts, South Dakota, molt, soybean

Many Canada goose (*Branta canadensis*) populations have increased over the last 4 decades, and Canada geese are considered a nuisance in many areas (Conover and Chasko 1985), including agricultural areas where they can cause considerable crop damage (Schaible et al. 2005). While damage to crops by geese has been difficult to quantify, surveys of agricultural producers indicate that it may be severe in some areas (Heinrich and Craven 1987, Conover and Decker 1991), resulting in substantial economic losses. Various abatement techniques have been used to reduce crop damage by migrating Canada geese. Chemicals sprayed on vegetation have been tested (Conover 1985, Cummings et al. 1991, 1992, 1995), but have seen little agricultural use because of high cost or ineffectiveness. Hazing geese from fields using sonic deterrents, such as propane exploders or shell crackers, or the use of visual deterrents, such as mylar flags and reflective tape, or human effigies all reduced goose numbers in some fields (Heinrich and Craven 1990). However, most of this research has been conducted on geese that had the ability to fly, with little research having been conducted on abatement of crop damage by flightless geese (Nelson and Oetting 1998).

Geese are flightless in early summer when adults are molting and young geese have not yet attained the ability to fly. Crop damage by Canada geese is especially intense during this brood-rearing and molting period when goslings have high energy demands for growth, and breeding females need to replenish lost reserves after egg-laying and incubation (Raveling 1979, Alisauskas and Ankney 1992). In addition, molting geese have increased energy demands because of feather production. Adult geese exhibit a synchronous molt, which renders them flightless for a period of about 25 days (Bellrose 1980). The flightless period is often the most problematic for agricultural producers because it coincides with early crop growth and the limited mobility of geese results in greater persistence at foraging in crop fields.

South Dakota Game, Fish and Parks (SDGFP) instituted a program in 1996 to reduce crop damage caused by Canada geese. This program costs roughly $250,000 per year and is funded by a $5 surcharge on all hunting licenses sold in South Dakota. Any agricultural producer that filed a complaint of goose damage was eligible to receive abatement assistance by SDGFP. Complaints of goose damage in South Dakota have been reported on corn, wheat, oats, alfalfa, and sorghum (Gigliotti 2007), but in South Dakota >90% of the crop damage occurs in soybeans fields (Schaible et al. 2005). Soybean damage continues well into the growing season (Schaible et al. 2005) and can result in financial losses to farmers. Here, we evaluate the

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effectiveness of the SDGFP program in reducing the area of soybean fields that received damage by Canada geese.

Study area

The study was conducted in McCook, Minnehaha, Miner, Lake, Moody, Brookings and Kingsbury counties in eastern South Dakota, USA (Figure 1). These counties are located within the Prairie Pothole Region, which is characterized by numerous small depressions left by retreating glaciers and is mostly devoid of drainage networks. Current land use is dominated by agriculture. The soil is Chernozem and is productive for row crops, predominantly soybeans, corn, and wheat. The area's climate is classified as humid continental and the average annual precipitation ranges from 53 to 61 cm (Hogan 1991).

Methods

We compared the area of damage (m^2) in fields where SDGFP abatement practices were applied to reference fields (no abatement) to determine the effectiveness of the SDGFP damage-reduction program. For all abatement fields, SDGFP personnel decided on the types of abatement practices that were applied. In some abatement fields, electric fences were used in conjunction with feeding stations; the latter were intended to lure geese away from crops and provide an alternative source of food. Electric fences consisted of 1 piece of 1.27-cm-wide white polytape installed 10 cm from the ground on polyethylene posts between the water and the field. Fences were energized by solar units or deep cycle batteries. Fences were removed in late August after geese had attained the ability to fly. Feeding sites consisted of an area where shelled corn was dumped on a mowed site adjacent to the same wetland where geese were causing damage. Corn was replenished as needed. Single-bang propane canons were used when geese had the ability to fly. Particularly problematic geese were sometimes shot; however, this occurred infrequently.

South Dakota Game, Fish and Parks began receiving reports of goose damage when crops began growing, typically in late April, and reports continued through July. Abatement practices were always applied within 1 week of the complaint being filed, and nearly all complaint fields were used for the study. Only fields with resident geese were included in the study. The few fields that were not used had complaints filed early in the growing season and involved geese that were migrating

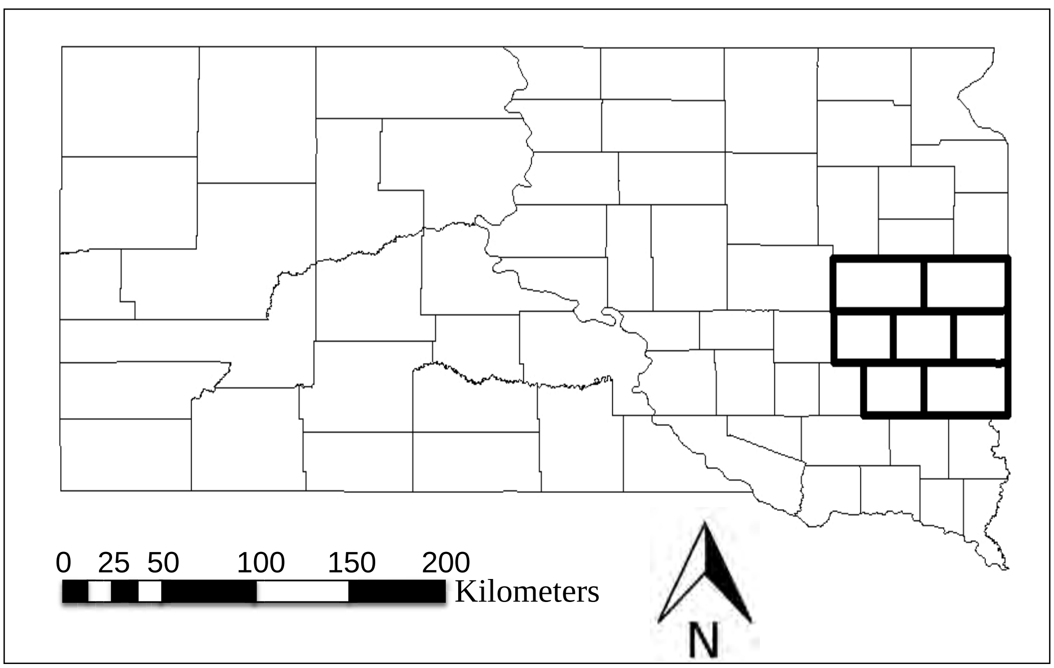

Figure 1. Map of South Dakota counties. Bolded counties indicate location of study area, 2006–2007.

through the area. We considered geese to be residents if they were nesting in the area. No data was collected during spring or fall migration. Reference fields were those in which landowners filed complaints but agreed to forgo abatement in return for monetary compensation for damage. Compensation for damage in place of abatement was offered to every landowner who filed a complaint. If landowners declined this offer, their fields became abatement fields. If they accepted, their fields became reference fields. We assumed that any differences between landowners accepting compensation and landowners accepting abatement did not have a substantial effect on the results. We also assumed that reference fields and abatement fields are similar.

We measured areas of crop damage by walking the perimeter of the damaged area with a global positioning system unit (Garmin GPS 12), which recorded the area of damage (m^2). Measuring area this way results in errors of <5% for most areas >500 m^2 (Webster and Cardina 1997). Most areas we measured were >500 m^2. We included all areas for which plants were foraged by geese, regardless of degree of damage. Geese caused nearly all crop damage. The ground near all damaged areas was littered with goose feces, and geese could commonly be seen foraging in the damaged areas. During 2006, the damage measurements were taken in early August. However, in many damaged fields, soybeans recovered enough that it was difficult to determine the area of initial damage. Therefore, in 2007, we attempted to take measurements as soon as damage had stopped and the extent of damage was clear. Damage was initially measured when the complaint was filed. Fields were then checked throughout the growing season and remeasured if damage had continued. When multiple measurements of the same field were taken, the largest area of damage measured was used for analysis because it represented the total area of damage. We measured 43 abatement fields and 13 reference fields in 2006 and 47 abatement fields and 16 reference fields in 2007.

Area of damage was compared among abatement and reference fields using ANOVA. Regression was used to predict area of damage in abatement fields by Julian date of application of abatement practices in 2006 and 2007. The area of damage variable was square root transformed ($\chi^{0.5}$) for all analyses to improve normality. All data analyses were conducted in JMP 7.0.2 (JMP, version 7.02, SAS Institute, Cary, N.C., 2007).

Results

Mean area of crop damage in abatement fields was smaller than in reference fields in 2006 ($F_{1,54}$ = 38.89, P < 0.001) and 2007 ($F_{1,61}$ = 28.19, P < 0.001). Area of damage in 2006 was 0.10 $\pm$ 0.03 ha (mean $\pm$ SE) for abatement fields, 1.02 $\pm$ 0.24 ha for reference fields, and in 2007 area of damage was 0.30 $\pm$ 0.09 ha for abatement fields and 1.55 $\pm$ 0.46 ha for reference fields. We saw evidence of goose foraging after abatement practices were installed in 14 of 47 abatement fields in 2007. Geese continued to forage in 15 of 16 reference fields after complaints had been filed. We measured crop damage at different times during the growing season each year; thus, we could not make a comparison of damage between years. Date of application of abatement practices was positively related to area of damage in 2006 (R^2 = 0.16, P = 0.004) and 2007 (R^2 = 0.34, P < 0.001; Figure 2), indicating greater effectiveness at reducing crop damage with earlier application of abatement practices.

Discussion

The SDGFP program was effective at reducing the area of crop damage caused by Canada geese, especially if abatement practices were applied as soon as damage started. Fields with a substantial amount of damage at the end of the growing season typically had a large amount of damage when abatement practices were initially applied. Although some fields received additional damage after practices were applied, the amount of additional damage was typically small. Fields that received additional damage often did so because of an inoperable fence or because geese had gained the ability to fly immediately after the molt and were flying over fences. In both cases, additional damage was minor because inoperable fences were usually repaired within a week, and goose foraging after molt quickly shifted from soybeans to other food sources. Further, damage done after the application of abatement practices often was on the same areas that were previously damaged and did not result in an increase in the area of damage.

Similar research in 2003 in South Dakota found no difference in the amount of damage between abatement and non-abatement fields (Schaible et al. 2005). In the 2003 study, crop damage was measured in all crop fields, not just in soybean fields as in the current study. Type of crop should have little effect on the effectiveness of abatement practices because similar abatement practices are applied in all fields. Reasons for the different results between the 2 studies remain unknown.

Other studies have evaluated techniques for the abatement of goose crop damage. Applying chemicals to crops can deter geese but has seen limited use, possibly because of high cost (Conover 1985, Cummings et al. 1995). Many techniques are intended to frighten geese (Heinrich and Craven 1990, Gilsdorf et al. 2002). While frightening devices can reduce crop damage, geese often habituate to them (Heinrich and Craven 1990), making them less effective over time (Summers and Hillman 1990). Habituation is particularly problematic with flightless geese because limited mobility prevents geese from traveling to other food sources. Most crop damage by geese in South Dakota occurs during the flightless period, and electric fences were effective at deterring flightless geese. Geese do not become habituated to electric fences because electric fences are a physical barrier that provide a negative stimulus (McKillop and Sibly 1988). Feeding sites were sometimes used in conjunction with fences when there was not enough natural food in the areas where geese had damaged soybeans in past years. Feeding sites increased the effectiveness of the fences. However, some geese still fed on soybeans, even when alternative food from the feeding site was available. Because geese show site fidelity (Anderson et al. 1992), feeding sites may actually increase the number of geese that return to that area each year, perpetuating the need for management of goose problems in that area. Propane canons were used prior to or after the molt, often for >1 week, which was sufficient to deter geese.

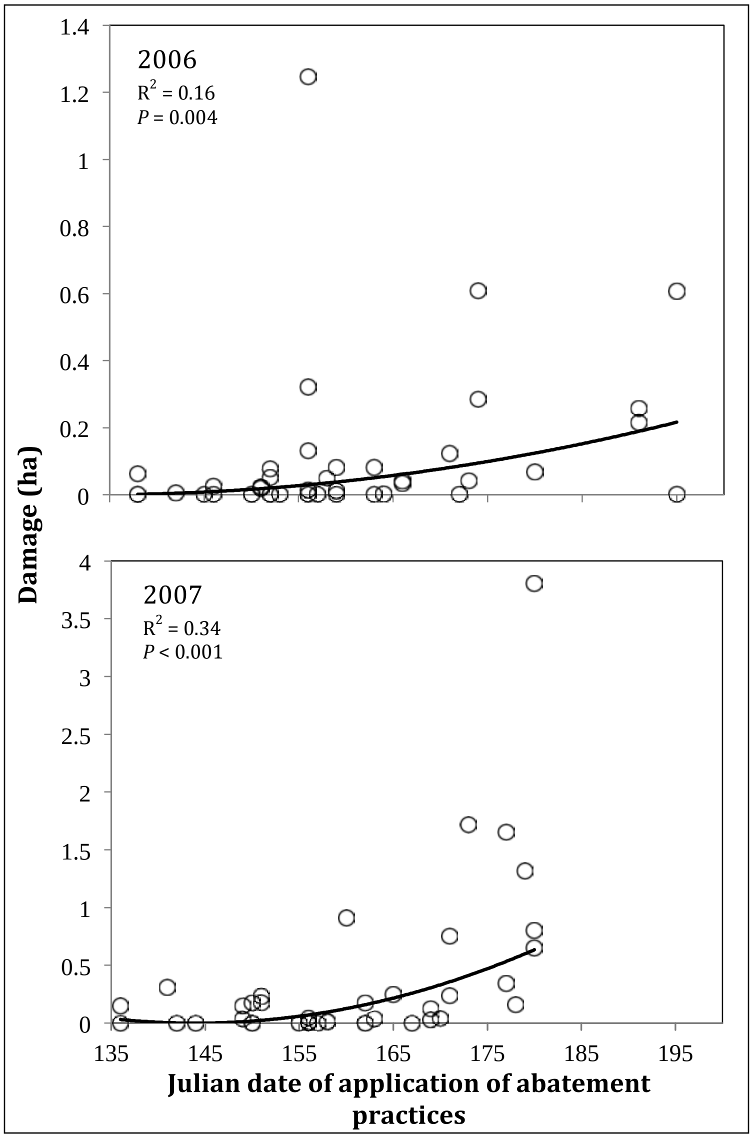

Figure 2. Relationship between Julian date of application of abatement practices and area of damage by Canada geese in South Dakota, 2006–2007. Square-root regression lines are shown.

Willingness to accept compensation by landowners may have been partly determined by the time of year in which the complaint was filed. When complaints were filed late in the growing season, there may not have been enough time for soybeans to recover once damage stopped. These landowners may have been more likely to accept compensation than landowners with damage earlier in the growing season. We do not believe that this had a substantial affect on the results. Because no abatement was applied, the date of the complaint did not affect goose foraging.

It is possible that abatement practices resulted in a shift in the location of goose damage in some areas. When abatement practices were applied to a field, geese may have moved to different fields where no abatement practices had been installed (Radtke 2008). Because most damage went unreported, abatement practices may not have reduced damage substantially, but simply caused a shift in the location of damage. Neighboring landowners sometimes filed complaints, but it is unknown whether these new complaints were the result of recent abatement activities in neighboring fields or if damage was occurring previous to abatement in neighboring fields. The availability of additional food near an abatement field likely contributed to the effectiveness of the SDGFP program. If additional food is readily available, abatement practices likely are more effective. However, geese may have been more persistent at accessing an abatement field if few other food sources were available (Summers and Hillman 1990).

Despite the effectiveness of the SDGFP program, most damaged fields went unreported. In talking with producers, we discovered several reasons why damaged areas may have gone unreported. Some agricultural producers were not aware of the goose damage that was occurring. Other producers were unaware of the SDGFP program. Still other producers indicated that damage earlier in the year was minimal, and they decided not to file a complaint until damage became more substantial.

To keep crop damage to a minimum, agricultural producers and managers should remain vigilant of crops that are subject to damage. Agricultural producers should act immediately when damage starts and regardless of the techniques used, managers must revisit sites for basic maintenance and to ensure that geese have not continued to damage crops.

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