REP 1993-030

White plastic flags repel snow geese (*Chen caerulescens*)

J. R. Mason*[‡], L. Clark* and N. J. Bean[†]

*USDA/Animal and Plant Health Inspection Service, Denver Wildlife Research Center, c/o Monell Chemical Senses Center, 3500 Market Street, Philadelphia, PA 19104–3308 and [†]Department of Psychology, Vassar College, Poughkeepsie, NY 12601, USA

The effectiveness of white flags as visual repellents to snow geese (*Chen caerulescens*) was evaluated. Twelve fields, each 10.12 ha (25 acres) in area, with snow goose damage, were located and proximity was used to create six pairs. Within each pair, one field was selected randomly for treatment (one white plastic flag per acre) and the other served as a control. At 7-day intervals for 5½ weeks, mean vegetation length and mean percentage vegetative cover were estimated for all fields. The results showed that grazing damage was significantly reduced in fields with flags. It is concluded that white plastic flags may be an economical and effective method of reducing snow goose damage.

Keywords: Crop damage; goose; flagging; visual repellent

Populations of greater snow geese (*Chen caerulescens atlantica*) have increased in recent years throughout the eastern United States (Gauthier and Bedard, 1991). As a result, crop depredations occur more frequently on migration and wintering areas along the East Coast (Anonymous, 1981). Unlike Canada geese (*Branta canadensis*), which cause damage to crops in the fall (autumn) (Heinrich and Craven, 1990), damage by snow geese is most severe in late February and early March during premigratory fattening (Ankney, 1977). Rye, winter wheat, and grass turf are severely grazed, compromising the principal reasons for planting these crops, i.e. nitrogen fixation, and protection of soil from wind erosion (J. Paterson, Soil Specialist, Rutgers Cooperative Extension, personal communication). In addition, geese are a vector for the transmission of agriculturally important pathogens and parasites (e.g. soybean cyst nematode; J. K. Springer, Nematode Specialist, Rutgers Cooperative Extension, personal communication), and even farmers without substantial goose damage to crops express concern over visits by flocks to their fields.

Chemical repellents such as methyl anthranilate may become available for goose damage control (Cummings *et al.*, 1991), but no substance currently is registered with the US Environmental Protection Agency for this pupose. Existing legal strategies include hunting and harassment, planting unattractive cover crops and lure crops (Owen, 1978, 1990; Gauthier and Bedard, 1991) and using auditory and visual repellents (Conover and Chasko, 1985; Knittle and Porter, 1988; Heinrich and Craven, 1990).

[‡]To whom correspondence should be addressed

We evaluated the effectiveness of white plastic flags as snow goose visual repellents. White flagging is commonly used in coastal areas of southern New Jersey for this pupose. Although the origin of the practice is obscure, we suspect that it is related to the use of black flagging and silver/red Mylar streamers as waterfowl repellents (Timm, 1983; Knittle and Porter, 1988; Heinrich and Craven, 1990; Summers and Hillman, 1990).

Materials and methods

Study sites

Twelve fields, each 10.12 ha (25 acres) in area, were selected in Cumberland and Salem counties, New Jersey, USA (*Figure 1*). This field size is common for New Jersey, a state where the average farm size is only 99 acres (Bureau of Census, 1987). Selection was based on a variety of agronomic factors, including planting date, crop and barriers to the wind. Rye (*Secale cereale*) was planted in ten fields and winter wheat (*Triticum aestivum*) was planted in the other two. Landowner reports and our own observations between 1985 and 1991 indicated that the 12 test fields consistently experienced severe grazing damage by snow geese. All were being grazed by snow geese just before the present test, and flocks of > 5000 birds were observed on all fields ≤ 8 days before our experiment. It is perhaps noteworthy that although adjoining and nearby fields were planted with rye and winter wheat, landowners reported that damage was usually greatest in the fields selected for study.

0261–2194/93/07/0497–04

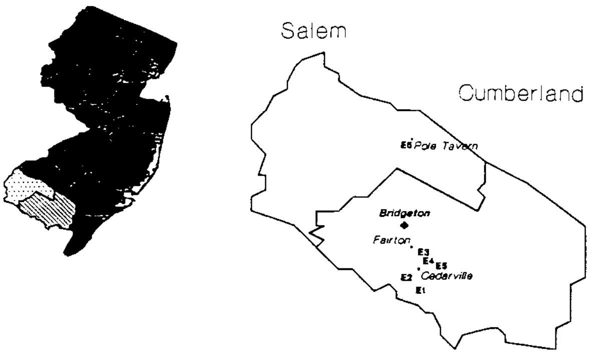

Figure 1. (Left) Map of New Jersey, showing the positions of Salem and Cumberland Counties; (right) map of Salem and Cumberland Counties, showing approximate geographical locations of flagged and control field pairs (E1–E6)

Procedure

Proximity was used to assign the 12 fields to six pairs. Within pairs, one field was randomly assigned to the treatment condition and the other to the control (the same crop type was planted in both). For each treated field, 25 rectangular white flags were constructed from plastic garbage bags (Acme Brand Large Kitchen Garbage Bags, dimensions 77 × 154 cm) stapled widthwise to 1.2 m lengths of wooden lathe. One flag was positioned in the centre of each acre (2.47 flags ha^{-1}) to create a grid, in accordance with published recommendations for the use of black plastic flags (Timm, 1983). The flags stood approximately 0.9 m high. No large flags were placed in control fields, although the corners of each were marked with small (5 cm × 5 cm) yellow survey flags on 0.25 m lengths of wire. These yellow markers facilitated sampling (see below), and had no apparent effect on snow goose behaviour. To minimize the possibility that observer disturbance while treatments were being set up would differentially affect the geese, the same amount of time was spent at control fields as at experimental fields on the day that the flags were positioned.

Testing began on the day after the last day of the snow goose hunting season (7 February 1992), and continued until the first of the 12 fields was ploughed under (11 March 1992). No other damage management technique was employed at any treated or control field during the course of the trial.

All fields were visited six times at ~7-day intervals throughout the test. During visits to each field, leaf lengths and total percentage coverage were recorded at each of 12 sampling plots, each 1 m^2 in area. This number of sampling plots was selected on the basis of preliminary observations showing that variance around running averages became asymptotic at this point. Leaf length and percentage coverage were selected because these measures are important to farmers as indicators of protection from erosion.

For tested fields, sampling plots were situated within six randomly selected quadrats (two plots per quadrat, ~90 m apart) out of the possible 16 quadrats (defined as areas marked in each corner by one of the white flags). Although the same quadrats served for sampling throughout the test, new sampling plots within quadrats were selected randomly (the wood frame sample plot was tossed over the shoulder to determine location) during each visit. For control fields, 12 sampling plots were selected pseudorandomly at each visit during a walk through the field. At the outset, the observer used the small yellow corner flags to locate the approximate centre of the field. From the centre point, a compass direction was chosen randomly and the observer walked 90 m. At that point, the wooden sampling frame was tossed, and observations recorded. Next, another compass direction was randomly selected, another 90 m walked, the grid was thrown, and a second set of observations was recorded. This procedure was repeated until 12 plots were sampled. Sampling visits to all experimental and control fields were approximately 40 minutes in duration.

The control sampling regime differed from sampling in treated fields because we did not wish to place any visual markers within the control fields that might affect the behaviour of geese. Even the small yellow flags placed at the corners of control fields appeared to have locally repellent effects on foraging geese (i.e. vegetative length and percentage coverage appeared to be greater within 0.5–1.5 m of these flags).

To estimate length of vegetation, 12 leaves at each sampling plot were selected pseudorandomly by the observer with his eyes closed, and measured to the nearest 0.25 cm. As for number of plots, this number of leaves was selected because the variance around the running mean became asymptotic at this point. After measurement of vegetative lengths, mean percentage coverage within the sampling grid was visually estimated (0–25, 25–50, 50–75, 75–100%). The number of geese present at the beginning of each visit was estimated by block counting (Meanley, 1965), and the number of fresh goose droppings and goose tracks within the sampling plots was recorded.

Analysis

Mean vegetation length and percentage coverage were calculated for each field on each sampling date. Because we did not consider our observations to be independent, two-factor repeated measures analyses of variance (ANOVA; Keppel, 1973) were used to evaluate the data. Similarly, goose numbers were assessed in a two-factor repeated measures ANOVA. Tukey post-hoc tests (Winer, 1962) were used to isolate significant differences ($p < 0.05$) among means. Because neither faeces nor tracks were observed frequently, these measures were not statistically assessed and are not presented here.

Results

There were significant differences in mean vegetation length ($F = 3.6$; 5,25 d.f.; $p < 0.013$) and mean coverage ($F = 7.9$; 5,25 d.f.; $p < 0.0003$) among sampling dates. Both increased during the course of the trial. However, there were significant interactions between sampling dates and treatment condition for both mean length ($F = 7.4$; 5,25 d.f.; $p < 0.0004$) and mean coverage ($F = 4.4$; 5,25 d.f.; $p < 0.005$). Although length and coverage were relatively greater in control fields on the first sampling date, the opposite was true by the end of the test period (*Figures 2* and *3*, respectively).

Geese were observed in control fields significantly more often than experimental fields ($F = 41.2$; 1,5 d.f.; $p < 0.0004$). Birds were seen on at least two dates in each control field, but only once in only one flagged field (*Figure 4*). The size of flocks observed in control fields ranged from 5000 to > 15 000 birds. On the one occasion that a flock was observed in a flagged field, 500 birds were observed in several quadrats on one border of the field. Presumably, these birds moved into these quadrats from an adjoining field where > 10 000 birds were grazing.

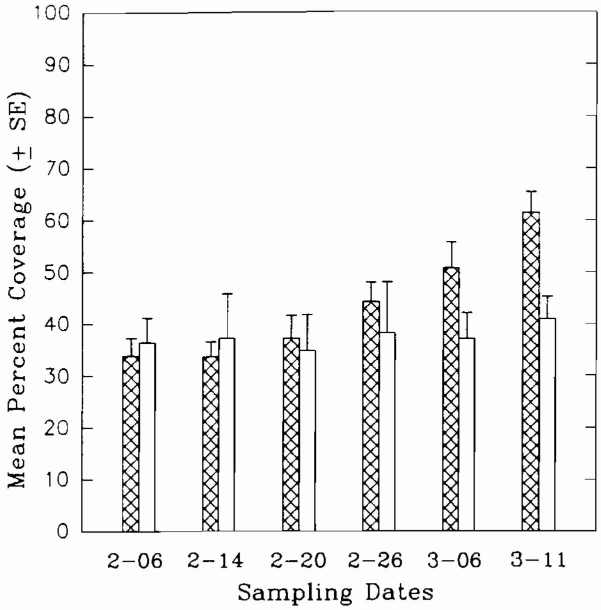

Figure 3. Mean percentage vegetation coverage recorded during six sampling visits to (⊠) flagged plots or (□) control plots. Capped vertical bars represent standard errors of the means

Discussion and management implications

Black plastic flags and Mylar streamers are recommended as waterfowl repellents (Timm, 1983; Knittle and Porter, 1988; Summers and Hillman, 1990). To our knowledge, however, only Mylar has demonstrated utility (e.g. Heinrich and Craven, 1990). The test described here thus provides the first data to support the use of plastic flags as grazing deterrents.

We believe that these results are intriguing. First, white flags conferred significant protection in the absence of other damage control techniques. Second, large flocks of geese (5–15 000 birds) had been grazing in treated fields regularly for 6–8 weeks before the experiment, but stopped once the flags were positioned. Finally, significant control was achieved at low cost, approximately US\$0.80 per unit. A comparable Mylar flag costs nearly 50% more (US\$1.20 per unit; Heinrich and Craven, 1990). We speculate that combining the use of flags with other deterrent strategies (e.g. propane cannons, harassment) would further enhance control (Knittle and Porter, 1988; Heinrich and Craven, 1990).

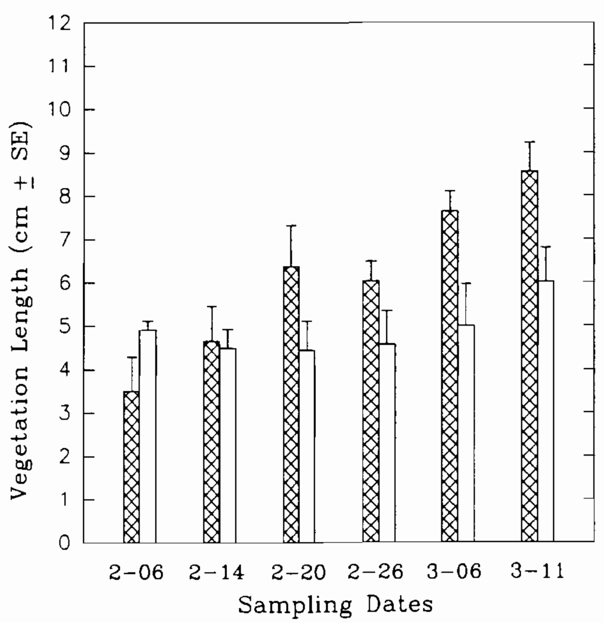

Figure 2. Mean vegetation length recorded during six sampling visits to (⊠) flagged plots or (□) control plots. Capped vertical bars represent standard errors of the means

Although factors underlying the repellency of flags remain obscure, several plausible explanations can be offered. Aperiodic flashes of visible light (e.g. Taylor and Kirby, 1990) and the noise of the flags blowing in the wind could frighten geese. If these were the only factors, however, then the apparent lack of habituation (e.g. Davis, 1974) by geese over the 5½ weeks of our test and during other similar tests with Mylar (Heinrich and Craven, 1990) is remarkable; usually, neophobic responses diminish more rapidly. Even more curious is the effectiveness of flags as a control strategy, when white flags, white rag decoys, and white kites are used throughout the hunting season to attract geese. Although our data cannot resolve this dilemma, flagging might be repellent because of the regular pattern in which it is laid out (decoys, of course, are clumped). In addition, our flags were shiny whereas rag decoys, flags and attractor kites are dull. Finally, because both white and black flags may be effective (Knittle and Porter, 1988), it could be that the answer lies, at least in part, with cues other than visible light. Many, if not most,

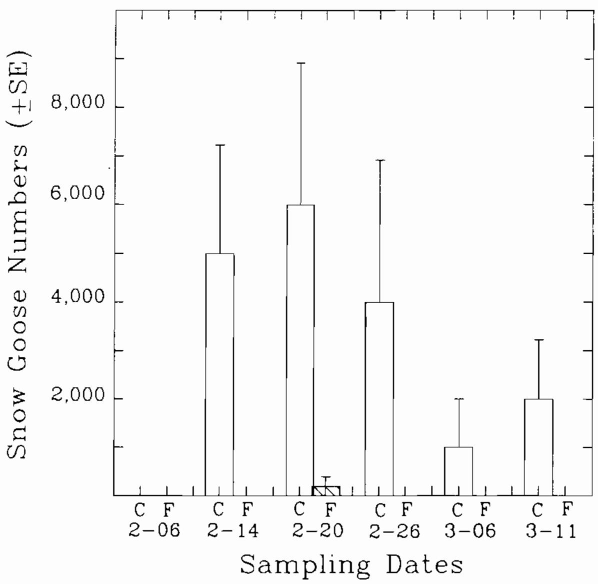

Figure 4. Mean numbers of geese observed at the beginning of each sampling visit to (C) control fields or (F) flagged fields. Capped vertical bars represent standard errors of the means

birds see ultraviolet light (Kreithen and Eisner, 1978; Goldsmith, Collins and Licht, 1981; Parrish, Benjamin and Smith, 1981). Perhaps ultraviolet reflectance from the flags is a salient cue.

White flagging may be a useful tool to control snow goose damage in locations other than agricultural fields, particularly when other readily accessible feeding sites are available nearby. For example, flagging could disperse geese in marshes where excessive grazing has substantial negative impacts (e.g. Iacobelli and Jefferies, 1991). We plan a test of this possibility, as well as a comparative evaluation of white flags, black flags and Mylar streamers.

Acknowledgements

The authors are grateful to Shepherd Brothers Farms, Inc., Laning Brothers Farms, Inc., Maple Run/Level Acre Farms, Inc., Poplar Brands Farms, Inc., Sorantino Farms, Inc. and Stella Farms, Inc. for the use of their fields. Funding was provided by US Department of Agriculture Cooperative Agreement No. 12-34-41-0040[CA] between the Monell Chemical Senses Center and the Denver Wildlife Research Center (DWRC). All procedures were approved by the DWRC Animal Care and Use Committee. T. Dloehdale, R. A. Dolbeer, E. P. Hill and J. Hupp provided valuable comments on earlier manuscript drafts. H. H. Heinrich of the New Jersey Farm Bureau provided census information on average farm size.

References

Ankney, C.D. (1977) Feeding and digestive organ size in breeding Lesser Snow Geese. *Auk* **94**, 275–282

Anonymous (1981) *A Greater Snow Goose Management Plan.* Can. Wildl. Serv. and U.S. Fish and Wildl. Serv., Atlantic Flyway Council, Quebec, 26 pp

Bureau of Census (1987) *Census of Agriculture, Vol. 1., Geographic Area Series, Part 30, New Jersey State and County Data*, US Department of Commerce, Washington, DC, 60 pp

Conover, M. R. and Chasko, G. G (1985) Nuisance Canada goose problems in the eastern United States. *Wildl. Soc. Bull.* **13**, 228–233

Cummings, J. L., Mason, J. R., Otis, D. L. and Heisterberg, J. L. (1991) Evaluation of dimethyl and methyl anthranilate as a Canada goose repellent on grass. *Wildl. Soc. Bull.* **19**, 184–190

Davis, P. J. (1974) Fundamentals of bird scaring – a laboratory approach. *Ann. Appl. Biol.* **76**, 353–358

Gauthier, G. and Bedard, J. (1991) Experimental tests of the palatability of forage plants in greater snow geese. *J. Appl. Ecol.* **28**, 491–500

Goldsmith, T. H., Collins, J. S. and Licht, S. (1981) A wavelength discrimination function for the hummingbird *Archilochus alexandri. J. Comp. Physiol.* **143**, 103–110

Heinrich, J. W. and Craven, S. R. (1990) Evaluation of three damage abatement techniques for Canada geese. *Wildl. Soc. Bull.* **18**, 405–410

Iacobelli, A. and Jefferies, R. L. (1991) Inverse salinity gradients in coastal marshes and the death of stands of *Salix*: the effects of grubbing by geese. *J. Ecol.* **79**, 61–73

Keppel, G. (1973) *Design and Analysis: A Researcher's Handbook*, p. 198, Prentice-Hall, Englewood Cliffs, New Jersey

Knittle, C. E. and Porter, R. D. (1988) *Waterfowl Damage and Control Methods in Ripening Grain: An Overview.* US Fish and Wildlife Service, Washington, DC, 17 pp

Kreithen, M. L. and Eisner, T. (1978) Ultraviolet light detection by the homing pigeon. *Nature* **272**, 347–348

Meanley, B. (1965) The roosting behavior of the red-winged blackbird in the southern United States. *Wilson Bull.* **77**, 217–228

Owen, M. (1978) Food selection in geese. *Verh. Ornithol. Ges. Bayern* **23**, 169–176

Owen, M. (1990) The damage–conservation interface illustrated by geese. *Ibis* **132**, 238–252

Parrish, J., Benjamin, R. and Smith, R. (1981) Near ultraviolet light reception in the Mallard. *Auk* **98**, 627–628

Summers, R. W. and Hillman, G. (1990) Scaring of brent geese *Branta bernicla* from fields of winter wheat with tape. *Crop Prot.* **9**, 459–462

Taylor, J. P. and Kirby, R. E (1990) Experimental dispersal of wintering Snow and Ross' geese. *Wildl. Soc. Bull.* **18**, 312–319

Timm, R. M. (1983) *Prevention and Control of Wildlife Damage.* University of Nebraska Press, Lincoln, Nebraska, 632 pp

Winer, B. J. 1962. *Statistical Principles in Experimental Design*, McGraw-Hill, New York, 907 pp

Received 17 December 1992
Revised 4 February 1993
Accepted 4 February 1993