

# Successful Use of Alarm and Alert Calls to Reduce Emerging Crop Damage by Resident Canada Geese near Horicon Marsh, Wisconsin

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**ABSTRACT:** Increased populations of resident Canada geese create major crop loss problems for farmers, especially in areas that become traditional sites for brood-rearing. Such sites concentrate geese and goslings in locations where food is abundant and flightless adults and young find escape safety on adjacent lakes or rivers. Emerging corn, winter wheat, and soybeans are favorite foods, and these sustain extensive crop damage when near water and brood-rearing sites. From 16 May to 28 August 2007, alarm and alert call playbacks from GooseBuster call units were used with and without other scare reinforcement to assess efficacy of different methods at reducing crop damage at multiple sites near Horicon Marsh, Wisconsin. Test sites were recommended by USDA APHIS Wildlife Services personnel as being sites with heaviest early summer crop damage reported in prior years. Criteria for success were based upon geese/hours/month or geese/hours/week of field use before and after treatment, using frequent counts of geese on properties, weekly farmer interviews, and dropping counts in fields to estimate number and number of hours geese were present. Crop damage assessment by USDA compared current year to prior years' assessment, or used visible signs of damage and extent. On-demand use of call units, coupled with firing screamer and banger shells, was found to be the most effective method for inducing long-term crop avoidance. Crop damage reduction was very successful, ranging from a 94.3% reduction at one site (17 bushels lost in 2007 versus 297 bushels in 2006), to several fields declared to have "no significant goose damage in 2007" by USDA crop evaluation personnel. Goose hours/month on the largest field data collection decreased from >36,000 to <200 geese/hour/month, a 99.45% reduction. No sign of habituation to reinforced "on-demand" alarm call use was found over the course of the 100 days of the study.

**KEY WORDS:** alarm call playback, biosonics, bird damage, *Branta canadensis*, Canada goose, crop damage reduction, hazing

Proc. 23<sup>rd</sup> Vertebr. Pest Conf. (R. M. Timm and M. B. Madon, Eds.)  
Published at Univ. of Calif., Davis. 2008. Pp. 74-79.

## INTRODUCTION

Expanding resident Canada goose (*Branta canadensis*) populations have led to increased human/goose conflicts in business and municipal parks, and increased damage to rural and suburban agricultural crops (Knittle and Porter 1988). These geese are difficult to displace and keep away. Short, highly-fertilized grass near ponds and parks (Whitford 2002), and young corn or soybeans near gosling brooding areas, attract geese to these environs. Most non-lethal Canada goose dispersal techniques have provided limited long-term success in these settings. A summary of control techniques was published by Smith et al. (1999). Live trapping and relocation or euthanasia programs provide some reduction in local problem areas (Cooper and Keefe 1997). Castelli and Sleggs (2000) reported on the efficacy of border collies at dispersing nuisance geese. Recently, Blackwell et al. (2002) tested lasers on this species for dispersal potential, and VerCauteren and Marks (2004) tested potential for use of nicarbazin as a fertility-inhibiting drug for giant Canada geese (*B. c. maxima*) in Green Bay, WI. Unpublished results of a continuing study at Bay Beach Wildlife Sanctuary, Green Bay, WI, have found hand-held, high-intensity spotlights effective at reducing night roosting geese on ponds there (T. W. Baumann, Bay Beach Wildlife Sanctuary, Green Bay, WI, pers. commun.). Yet, these works fail to address increasing problems of emergent crop damage resulting from large congregations of resident geese/goslings (hereafter, "geese") at rural agricultural sites that have become traditional brood-rearing and molting sites. Zicus (1981) reported molt migrations of resident giant Canada geese from Wisconsin to James Bay, Canada. Yet, Mercer (1999), Mott and Timbrook (1988), and Conover and

Chasko (1985) all reported that large numbers of giant Canada geese congregate near large bodies of water in the central and eastern U.S. when molting. White and Combs (2004) reported high levels of site fidelity for molting and brood rearing by resident Canada geese, leading to annual reuse of specific sites by large concentrations of geese and increased nuisance goose and crop damage problems. This research attempts to address these problems.

Complete descriptions from sonographic studies of call form, duration, and frequency of alarm and alert calls and associated behaviors of giant Canada geese have been published (Whitford 1987, 1998). Preliminary research using alarm calls for Canada goose dispersal have shown mixed results (Whitford 1987, Mott and Timbrook 1988, Aguilera et al. 1991). To date, only one study of the use of alarm and alert call playback reports a long-term success at resident goose dispersal and also shows promise of preventing re-colonization of areas after resident geese dispersal, removal by transplanting, or lethal methods (Whitford 2003). No large-scale published studies exist investigating efficacy of alarm and alert calls for either preventing spring-emerging crop damage by resident Canada geese or removing geese from water/wastewater treatment facilities. To address these areas, initial study plans were to use alarm/alert call playback on areas of young winter wheat adjacent to the Beaver Dam River, Lowell, WI. These fields were recommended as test sites by USDA APHIS Wildlife Services personnel, based on past heavy winter wheat loss from resident geese there. That plan was modified when the wheat rapidly grew beyond goose-preferred height due to the combination of early warm weather and delayed gosling hatching. USDA personnel identified other sites that had histories of heavy emerging crop losses

to high concentrations of molting/brood-rearing resident Canada geese. The study changed to testing efficacy of alarm and alert calls at reducing emerging soybean, corn, and alfalfa damage from geese at long-term brood-rearing and molt sites in Dodge County, WI. Preliminary counts indicated >200 geese within 0.5 km of each study site before project inception.

Goals were to: 1) test efficacy of GooseBuster unit alarm/alert call playback at reducing crop damage, using set times of play and no other reinforcement; 2) test call units when reinforced with human harassment and/or screamer/banger shells; 3) determine when or if habituation occurred with each study method; 4) determine whether call and reinforcement techniques would be successful at study site 3 when the majority were to be carried out by resident farmers, instead of wildlife specialists—a real-world test of efficacy for crop protection.

My hypothesis, based on prior research (Whitford 2003), was that playback of alarm/alert calls would make resident geese apprehensive and easier to displace via human and other harassment at the study sites. If successful, the technique would offer a new and more effective means to reduce goose crop damage and fecal contamination problems.

## METHODS

GooseBuster call playback units used in this study were provided by Bird-X Inc. (Chicago, IL), along with 5-watt “Solpan” 33 × 33-cm solar panels (Model 1009, ICP Global Technologies, Montreal, Quebec, Canada) and 24-hour DC timers (FM/1 series, Grasslin Controls Corp., Mahwah, NJ). All units were powered by 14-volt Werker deep cycle marine batteries from Batteries Plus (Madison, WI). Playback units had 3 internal timer settings, “test,” “short,” and “long,” providing call playback at randomized times within base intervals of 1-3, 5-10, or 10-20 mins, respectively. The volume controls for all units were set to make call playback consistent with natural goose alarm call and alert call volumes.

Alarm and alert call playback used digitized forms of calls recorded from captive giant Canada geese live trapped at Rochester, MN for my dissertation research (Whitford 1987). Original calls were copied and digitally elongated and/or compressed 0.01-0.05 sec and were re-recorded onto microchips to produce varied call frequency and duration series that geese would perceive as produced by different individuals. Temporal and frequency changes create the impression that different individuals are giving alarm or alert calls (Whitford 1987). Call units play up to 4 different call series, mixes of varied alarm and/or alert calls, in randomized sequence, one series via each of 4 dispersed speakers, each time playback is initiated. These call and unit modifications are thought to enhance goose response and reduce/delay habituation to the calls (Whitford 2003).

Methods of call playback, harassment, dates of initiation, and intervals between observations varied at each of the 3 study sites selected and are presented with descriptive information for each of the sites. Methods of determining pre-study and study goose populations, crop damage by geese, and goose hours/day/site were consistent for all study sites. Pre-study counts of geese used glassing, walk-

ing and counting all geese visible on the study site and for 0.5 km in all directions for fields, water, and croplands. Few geese could still fly, so all present were assumed to remain on site 24 hr/day, 7 days/week, unless forced to leave by dispersal actions. Total geese observed at each site was multiplied by 168 (number of hours in a week) to estimate pre-study goose hours/week. Later counts were based on daily or alternate-day counts of geese present during 6-hour observation blocks. Weekly interviews of resident farmers and treatment plant personnel about number of geese seen on the study site, where and for how long, were coupled with weekly dropping counts in corn and soybean fields, grass and alfalfa feeding areas, and along water edges where geese rested, to help calculate site use in terms of geese/hours/week. I applied an estimate of 1 goose hour use for every 4 droppings (3 cm or longer) that was found. This is far less feces than an average feeding goose produces (Whitford 2002), and I intentionally used it to produce an inflated estimate of post-treatment numbers/hour of geese presence for the sites, rather than risk underestimating. A large pile of water side “night droppings” was estimated to represent 9 goose hours, since geese rise early to begin feeding. Crop damage estimates were based on direct USDA reports comparing damage on the same fields between prior year and study year for fields, where possible. Fields not enrolled in crop damage programs in prior years had no reports available for direct comparison. I relied then on USDA field personnel’s knowledge of approximate prior losses (gained by assisting these farmers with propane cannons, supplying screamer and banger shells, and/or granting kill permits). Current crop damage estimates used weekly field transects, recording all crop damage with any goose droppings associated with it (deer damage was very common, but tracks and droppings easily identified it).

### Study Site 1

Study site 1 was a 2.1-ha soybean field, 3 km NW of Lowell, WI, with goose access to the Beaver Dam River and an adjacent >150-ha marsh/riverine forest complex. Two call units were placed along the river and marsh edge on 16 May 2007, when cotyledons/leaves of soybeans appeared. Call units were set for “short” (5-10 min) random-time call playback for 2 hrs, then reduced to the “long” (10-20 min) random interval with DC timers set to permit play only 15 mins every-other hour, from 0500-2200, for each unit. No reinforcement of calls by any harassment form was used at this site. Daily 6-hr observation blocks were done 17 May to 31 May.

### Study Site 2

Study site 2 was the Hustisford Sewage Treatment Plant, a 3.4-ha fenced complex with 3 treatment ponds of 2.27 ha total surface area, 1.13 ha of grass (mowed weekly), and a central drainage ditch flowing south to the Rock River, 0.3 km distant. Plant personnel had used exploders, and banger and screamer shells, in past years and had the village apply for a lethal round-up permit for 2008. On my first arrival, 162 geese and goslings were present, and piles of night droppings covered the grass along every pond for 3-4 m from the rip-rapped water edge. Scattered droppings from feeding in grass farther from the water

were in evidence, >20 droppings/m<sup>2</sup>, in random samples at inception. Personnel that tested water from each pond 4 times daily had complained about the droppings, contamination of their clothing, and the smell. Wisconsin DNR had drive-trapped and banded 292 and 228 geese in Hustisford (most at the treatment plant) in July 2006 and 2005, respectively (B. Hill, WI Dept. of Nat. Resources, Horicon, WI, pers. commun.). Ms. Hill further indicated that these efforts were not an attempt to band all the geese in the village. In addition, farm fields to the east between the plant and Rock River, south of Hwy. 60, had heavy crop damage in prior years from >200 geese brood-rearing and molting on the sewage plant property. Another 30-40 geese used the river bank/front yard grasses of this farm daily for resting/brooding areas and access to corn fields along the river, prompting the farmer to request USDA APHIS WS assistance in removing those geese in 2007.

Goose removal efforts began 16 May 2007, with continual call playback on shortest “test” setting from 2 call units placed on opposite sides of the largest pond. No reinforcement, other than walking toward the geese and waving my arms to drive them off the property, was used that day. After 45 mins, the call units were shut off, because 3 nesting geese were discovered just off the property; past work (Whitford 2003) indicated nesting geese habituated to alarm calls if continually exposed to them. Call playback was re-started 5 June using only “on-demand” call playback, meaning that I used call units on “test” mode for only as long as needed to disperse the geese and I never used DC timer-activated play settings for the duration of the study. Call playback was always reinforced thereafter by firing banger/screamer shells, launched from a Model RJ 1 Scare-Away launcher (Reed-Joseph International Co., Greenville, MS), as needed to move geese—a change in the planned method, suggested by Rich Christian, Wildlife Specialist with USDA APHIS Wildlife Services. In “on-demand playback and reinforcement”, one or both call units were turned on using “test” mode setting, and allowed to play for 1- 3 mins. If any geese were still present, noise-producing shells were fired toward them until they left the property.

Following removal of all geese 5 June, I was the only person to use call units or harassment at this site until the study ended. I had access dawn to dusk, 7 days per week, and began with daily 6-hr alternating morning and afternoon observations. I extended that to every second day, once no geese were seen there for 5 consecutive days. Weekly interviews with treatment plant manager and employees continued to provide accurate counts of when, where, and how many geese were seen on the property 6 days/week, even when I was not present. Dropping counts continued until the study ended, in case not all geese were observed or reported.

### Study Site 3

This study site consisted of 2 farms 1 km NW of the town of Hustisford. The larger farm, >45 ha in total area, was surrounded on 3 sides by Lake Sinissippi and its extensive cattail marsh, to the west of the property. The farm had 22.25 ha of alfalfa and 9.2 ha of soybeans, both heavily damaged by molting/brood-rearing resident geese in prior years, despite the farmer’s use of propane can-

nons, screamer and banger shells, and kill permits for >4 years. There also was 1-ha mowed lawn and boat landing, heavily used by geese for feeding and night roosting. No previous official USDA reports of crop loss existed, as the farmer had not sought compensation for losses. Yet, USDA personnel provided materials and assistance for goose dispersal, and so were familiar with extent of past crop damage. The farmer said that in prior years, he had patrolled the property 3-4 times most days on a golf cart to drive geese off fields.

Soybeans were not yet planted 16 May, when I met the farmer. During a tour of this and the following property, I counted some 70 geese on lawns/boat landings, and 20-22 pair of adults with goslings (120-140 total birds) feeding in alfalfa, on soybean stubble, or on waters of the marsh and lake within 100-200 m of the farm shoreline. On 30 May, 4 call units were set up on this farm, 2 on the soybean field 300 m WNW of the house, and one 250 m north of the house, where alfalfa came nearest the water edge. The last unit was placed on the lawn below the house, as the owner expressed a desire to be rid of the geese and droppings on his lawn and boat landing. No unit was set to play calls, and only the last was connected to its battery. The farmer was instructed to turn on the call play back for 1-2 mins if he saw geese on the lawn/boat landing, and always to follow the calls with screamer or banger shells if the geese didn’t leave. This 83-year-old farmer and I both participated in goose dispersal efforts on the property for the remaining 90 days of the study. We used only the “on-demand” mode of playback with the exception of 2 nights (7 and 8 July), when I set the DC timer to play calls at 2 am to scare off several geese that were night roosting on the lawn and dock, following the 7 July fireworks in the Hustisford town park.

The second farm was >50 ha, abutting the south border of the first. Only 2 fields of 4.85 ha each, one corn and one soybeans, both with shoreline contact, and a 0.5-ha grassy boat landing area with large shade trees, were considered for protection, based on prior years’ losses and the request of the landowner. At unit installation 30 May, corn and soybeans in these fields were already 8-12 cm high and were showing minor goose feeding damage at sites nearest the lake. Two call units were placed near water areas on those fields. The property owner was instructed to turn them on only briefly when geese were present, and to chase geese away when the units were used (he had no launcher for banger shells). These fields were rented out, and the resident owner who had requested assistance was not as active in removal efforts as the other farmer at site 3.

## RESULTS

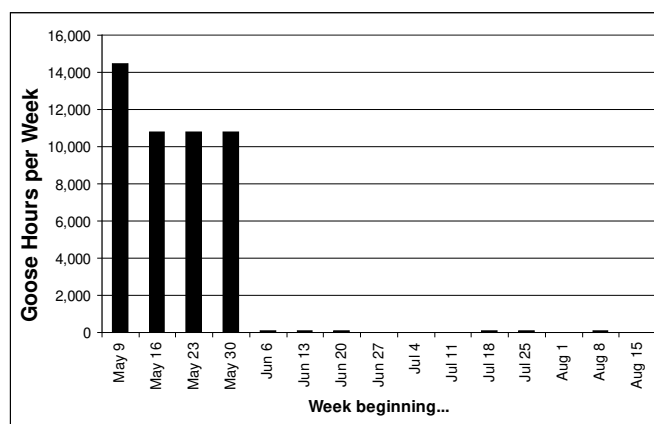
### Study Site 1

Once all units were set up and activated on 16 May 2007, all geese within visible range on the water and field assumed alert postures, began to call and coalesce, and moved together to make a block of 15 to 20 pairs of adults with goslings and single or paired adults, moving away on the river. In 20 mins, they swam out of vision around a bend 300 m to the southeast, toward a distant expanse of marsh. Only one pair with 5 young entered the field from the river in the following 6 hrs of observation. Three sets

of adults and young were seen to run across the length of the field from the northwest corner to the river, coming from ponds 2-300 m across the road, disappearing up the river where the others had gone. The following morning at 0600, I was unable to find any geese within 0.5 km of the treated field, after searching on foot and by car. During the next 7 days, I heard distant geese call from the marsh to the south of the test field, but only 2 pair with young entered the field to feed. Flying geese approached the field but left immediately after the call units went off. On 24 May, I saw 15 to 20 geese milling at the far bend of the river. By the 26 May, more geese were seen congregated at the far bend. Each day thereafter, they came 40-50 m nearer the field, swimming in tight bunches and turning away when the call played. I found the first evidence of night feeding on soybeans on 29 May, with many rows of 6-cm soybeans cropped off and goose droppings in the rows. I set the call units for night playback at alternate-hour intervals. On 31 May, over 100 geese and goslings swam down river and entered the field with the alarm calls still playing. Habituation was considered complete, and I removed the call units. They had provided almost complete protection to the field for 12 days before failing. Since I could hear geese calling on the marsh 0.5 km away all 14 days, I assume they heard the call units for that time. Lacking any reinforcement, they habituated. Few other brood feeding site options existed along that stretch of the river for several km in either direction, as most of those fields planted to winter wheat already were too tall for goose consumption before this study began. So, hunger may have contributed to the habituation. Had my goal been to protect young winter wheat from geese, as originally planned, a 10 to 14-day window of protection would have caused a substantial decrease in crop damage from grazing, at the crop's most vulnerable stage of growth.

### Study Site 2

Initial estimates gave an arbitrarily low count of 86 geese/day (range 68-162) for the week prior to the study. Numbers went up daily as more broods arrived. The 16 May use of the call playback and human harassment continued until nearly all geese were gone from the sewage plant. Units were shut off when nesting geese were found. Rich Christian, WS Wildlife Specialist, and I returned at 1400 hr on 5 June and began the "on-demand call use, with banger/screamer shell reinforcement" protocol. When alarm call playback was followed by these shells, geese gave alarm calls of their own and ran off the property with goslings in tow. Small goslings and adults with them ran to the ponds. Flighted birds present flew off instantly. All geese, except 5 young goslings that refused to leave the ponds, had left the property. I remained until dark. The 5 goslings left 20 mins after calls were shut off. Grass was closely mowed at 1700-1830 hrs that evening, destroying all prior goose droppings. Estimated goose hrs/wk at the sewage plant dropped from 14,445 to hold at roughly 10,800 from 17 May to 6 June, while units were off and dispersal efforts stopped. From 6 June to 28 August, the plant averaged 53.6 geese/hr/week once "on-demand" reinforced call use began (Figure 1). Crop loss on the adjacent field fell from 297 bu in 2006 to 17 bu in 2007, a 94.3% reduction. Most loss occurred on <0.2 ha

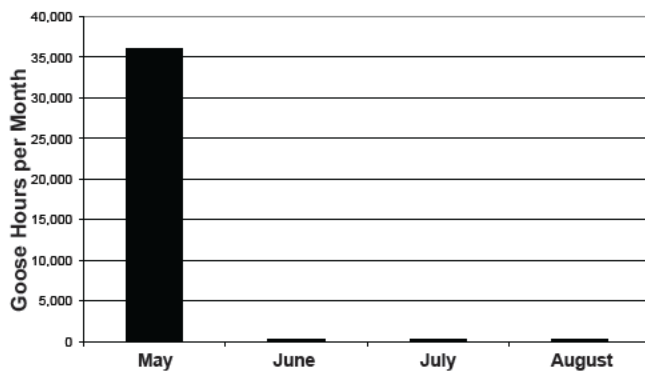


**Figure 1. Goose hours per week prior to and following the initiation of the use of alarm calls and human harassment for 45 mins, at Study Site 2 (Hustisford Sewage Treatment Plant). Alarm call use began on 16 May 2007 but was immediately suspended, and then resumed on 5 June 2007, reinforced with screamer and banger shells (see text).**

of corn nearest the treatment plant fence during the period 17 May to 5 June, when the call units were shut off. An area of >190 ha around the plant was largely goose-free from 6 June to 28 August. Between 6 June and 18 July, only 93 total geese were observed on, and dispersed from, the plant; the largest group seen was 26 geese, observed by WS personnel on 11 June while collecting several geese for contaminant testing. The area from which geese were dispersed (hence, the crop area protected) was much larger than the 3 to 8-ha, per 1 and 2 call units, respectively, previously reported for urban settings (Whitford 2003). Between 18 July and 28 August, only 2 groups of flighted geese, (numbering 12 and 17 birds, respectively) were seen on treatment ponds, and they left readily. Dropping counts from 6 June to 28 August revealed only 8 night dropping piles and roughly 1,340 small scattered droppings (counted in groups of 10s for tally), supporting a total 80-day estimate of 590 goose hours on the property, a 99.6% decrease from pre-study goose activity. Results were accomplished with only 11 activations of the alarm call units and 16 screamer and banger shells used. Total time spent removing geese after initial clearing of property was less than 1.3 hrs over 80 days; it would have totaled less than 20 mins, if a few goslings had not refused to leave the ponds while alarm calls played. Goose removal can easily be done by treatment plant personnel as they check water chemistry of ponds 4 times daily.

### Study Site 3

Beginning May 31 with first use of the lawn-based call unit and shells, goose presence on the 2 farms dropped from the pre-study estimate of 36,000 to <200 goose/hrs/mo, in less than 3 days. It remained <200g/hrs/mo until study completion (Figure 2). As at site 2, no sign of habituation or loss of effectiveness was found when using "on-demand call play back and reinforcement." For the 2 farms, <0.3 ha of corn was damaged by geese, roughly 60 soybean plants showed goose nibbling evidence, and alfalfa loss was limited to 1-2 hrs feeding by 20 geese over the duration of the study, as indicated by droppings,



**Figure 2. Reduction in goose hours per month by brood-rearing and molting resident Canada geese at Study Site 3 (2 farms on a point in Lake Sinissippi, WI), following “on-demand alarm call playback” reinforced with screamer and banger shell use, initiated 5 June 2007.**

interview data, and observations. These 40 ha of fields were declared to have had “no significant goose damage for 2007” by USDA crop evaluation personnel. There were no prior year loss records, but both farmers had complained of past significant losses of all crops. There is no doubt a 99.4% reduction in goose hours on the property reduced 2007 losses to near zero.

Farmer Bill Germer, interviewed 6 June, stated he had used the call unit on his lawn 3 times (with shells) on 31 May and 1 June, and he did not see or hear any geese anywhere for the next 4 days. I heard and saw no geese on the marsh, lake, or land within the visible parts of >190 ha around the call unit that day. Only 79 geese total were seen on this property, and only 7 intrusions by geese were reported or observed from 6 June through 28 August. Two call units put up were never activated; one near alfalfa was used 4 times, and the lawn unit was used 13 times, including 5 times it was used to scare geese from the corn field >250 m south on the second farm in the study. Units on the second farm were activated twice by the owner and twice by me. In all, 19 banger and screamer shells were fired, and less than 1.8 hrs were expended between the 3 people involved in goose dispersal for actual goose-related activities. Fewer than 500 droppings were found on the property. Short incursions by 20-30 geese occurred at 0500-0545 on 14 and 18 June, both stopped by use of lawn unit on Germer farm. Geese damaged a 35 × 10-m area of stunted corn along a tree-lined field edge.

## DISCUSSION

The primary difference between this research and previous alarm call playback research on geese dispersal (Mott and Timbrook 1988, Aguilera et al. 1991) is that the alarm calls used in this study were unquestionably alarm and alert calls, based on 7 years of sonographic call and behavioral research on *B. c. maxima* (Whitford 1987). Calls of the other authors were, at best, distress, flight, and alert calls, based on descriptions of goose reactions and call sources. I used on-demand call playback coupled with screamer/banger shells, rather than comparing effectiveness of the 2 techniques separately, as in Aguilera et al. (1991). Theirs was a very short-duration study, with only 3 tests each per 5 sites with “alarm call” and 2 with

“alert call” per site. Their conclusions were questionable, since their method employed calls played from a distance >40 m, and they fired shells into groups of geese, “continuing to fire shells until all geese left, reporting a maximum of 12 shots in succession” (Aguilera et al. 1991). With a car-mounted speaker, Mott and Timbrook (1988) played “alarm calls” while driving towards geese. There is no way to judge whether birds fled the approaching car or the calls. They reported a “96% reduction in geese” when using “racket bombs,” versus the 76% success for the car alone. However, they defined that geese “left” if they moved >100 m. When used in the manner of the current study, permitting call playback to make birds visibly nervous before firing shells, both alarm/alert calls and the shells appear to have much greater effectiveness than either alone. Geese often gave voice to alarm calls themselves as they ran/flew away, extremely rare for the species (Whitford 1987). Voicing the call seemed to increase long-term avoidance of the area where they made the calls.

In my personal experience, the results seen in this study developed faster and lasted longer, in terms of area avoidance, than in use of any other goose dispersal methods. Geese in this study were effectively gone within 24-28 hrs of the first use of the combination, and they stayed gone for weeks or months. My best guess is the success stems from synergistic effects resulting from “on-demand” use of the calls coupled with the screamer/banger shells. At the first study site in my research, all geese moved at least 0.4 km away within an hour of alarm call activation. Habituation followed in 10-12 days without reinforcement. With the screamers and bangers used to reinforce calls at study sites 2 and 3, the same rapid dispersal was seen, but habituation did not occur. The few birds that were seen at these sites from 5 June to late July, before geese regained flight ability, were thought to mostly be newly-arrived birds, late nesters, and molters coming to traditional molt and brood-rearing sites, as reported in White and Combs (2004), or birds displaced by holiday boating, camping, and park activities. After mid-July, new birds arriving were flighted and did not stay when greeted with alarm calls and shells. No killing of birds was needed to make the process effective, and it should work in any area where use of pyrotechnics is permitted. “On-demand” use of the call eliminates habituation concerns, and it also means that playback of calls would be far more acceptable to most neighbors than regularly ongoing call repetition, and it would rarely need to be repeated.

As an observation from this study, the use of the alarm call playback to move goslings <2 weeks of age will backfire if water is nearby. Goslings innately run to water when they hear alarm calls, and those <2 weeks old appear to have the strongest instincts to stay in the water. Use of banger and screamer shells with alarm calls at the sewage plant only made the young goslings refuse to follow parents’ attempts to lead them away. In mixed-age gosling broods subjected to these calls, older goslings followed the parents, while the younger remained in the water. I learned to turn off the calls after 2-3 mins of playback, not use screamers, and to let the goslings calm down and follow the parents off the ponds and away from the dispersal site. I wasted several periods of >20 mins ineffectually

trying to move goslings, which walked out soon after call units were turned off.

## CONCLUSIONS

On-demand use of alarm/alert call playback effectively induced long-term avoidance of emerging crops and sewage treatment facilities by brood-rearing and molting resident geese, within as few as 4 days, when coupled with screamer or banger shells reinforcement. And, no evidence of habituation was evidenced in the 90 days of the study, using this method. Study site 3 results proved the method could be successfully applied by an 83-year-old farmer, investing less than 2 hrs of his time over the study, and still produce a 99.45% reduction in crop loss over areas of 30-40 ha or more, with only 2 call units regularly used.

## ACKNOWLEDGEMENTS

I thank the following people and organizations for their cooperation and assistance with this project: at USDAAPHIS Wildlife Services, Waupun WI, I thank Charles "Chip" Lovell, Dist. Supervisor/Wildlife Biologist; Dan Hirschert, Assistant District Supervisor/Wildlife Biologist; and especially Rich Christian, Wildlife Specialist, who assisted me in the field at times, found research sites and cooperating farmers, and introduced the idea of reinforcing calls with banger shells; Dennis Uecker, Superintendent of the Hustisford Water/Waste Treatment Utility, for his cooperation and information in permitting the project on the city property; Bill Germer, owner Lakeview Farm, Hustisford, for his assistance with the project; Bird-X, Chicago IL, for providing Goose-Buster alarm call equipment, and Capital University, the Geist Endowed Chair Fund, for additional travel and equipment funds.

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