

Managing Canada Geese in Urban Environments

A Technical Guide

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About This Guide

This manual is intended for anyone concerned with urban Canada goose management. We define urban geese as those that spend most, if not all, of their life in the urban or suburban environment. This includes resident geese as well as those commonly referred to as “migrants,” which summer

elsewhere but spend part or all of the fall to early spring period in urban or suburban areas. Although this guide emphasizes Canada geese, many of the techniques and management strategies listed are also useful for ducks, swans, and perhaps other waterfowl species.



Introduction

Canada geese are perhaps the most widely recognized birds in North America. Geese flying in a V formation signal changes in season and for many people have come to symbolize nature and wildlife.

In the early 1900s, Canada goose populations were nearly eliminated in most parts of North America by unrestricted harvesting of eggs, commercial hunting, and draining of wetland habitat. Thanks to enactment of strict harvest regulations, creation of protective refuges, changes in crop planting and harvesting techniques, and creation of large, open grassy areas, most Canada goose populations have rebounded and are no longer at risk. This astounding recovery occurred partly because Canada geese adapt readily to habitats found in urban and suburban areas.

Scientists recognize several “races” or subspecies of Canada geese. The geese most commonly found in urban areas during spring and summer in the eastern and mid-western regions of the United States and Canada are called giant Canada geese (*Branta canadensis maxima*), whereas those found or observed in urban areas during the spring and summer in western regions of the United States and Canada are called western Canada geese (*Branta canadensis mollitti*). These two subspecies have the largest body sizes of the many races of Canada geese.

The giants have undergone a phenomenal population increase from only a few thousand in 1965 (Hanson 1965) to an estimated 1.1 million in 1996 (Wood et al. 1996) in the central United States alone. This growth rate is not peculiar to North America; in Britain, numbers of Canada geese increased by an estimated 8 percent annually from 1976 to 1991 (Allan et al. 1995). Lesser Canada geese (*Branta canadensis parvipes*), usually thought of as migrants, have bred in Anchorage, Alaska, since the early 1970s, and their numbers have been increasing (Laing 1997). Although a few geese may be desirable in a park, suburban pond, or backyard, such small populations increase rapidly and sometimes lead to problems that can be difficult to control.

Conflicts between Canada geese and humans in the urban environment have increased as goose populations have grown (Conover and Chasko 1985). Geese may be only a nuisance owing to their droppings, aggressive behavior, and noise, or they may represent a potential serious environmental threat or risk to human health and safety. Urban Canada geese may also fly to surrounding agricultural lands to feed on crops such as corn, soybeans, rice, winter wheat, and other grains.

A common complaint about geese is the accumulation of droppings and feathers. Sixty geese seems to be a threshold for complaints about goose droppings (J. Cooper, University of Minnesota, pers. comm.). In one park in London, England, reestablishing overgrazed lawns and

cleaning goose droppings from sidewalks cost more than \$60 per bird (Allan et al. 1995).

Heavy concentrations of goose droppings contain nitrogen, which can result in eutrophication of ponds and lakes, leading to excessive algal growth (Kear 1963, Manny et al. 1994), closure of public swimming areas, and reduced water quality. Goose droppings do not appear to add nitrogen to a feeding area because most nutrients originate from the grass of the same area (Groot Bruinderink 1989); the nitrogen in the droppings, however, may be in a form that is more available to plants and thus overfertilize an area.

Besides the direct impact of Canada geese residing in urban areas, they can act as decoys for migratory geese, causing periodic increases in urban goose populations. Geese in urban areas are very aggressive around their nests or goslings and may attack or threaten pets, children, and adults.

Geese will also trample grass in medium-heavy soils, which creates a surface “hard pan” that prevents vegetative growth (Traill-Stevenson 1988). This causes erosion and loss of habitat for other species (Wall 1984). Geese in high concentrations or even a smaller flock that remains in the same place for an extended period of time may overgraze the grass (Conover 1991), creating large, dead spots on lawns.

High concentrations of geese increase the likelihood that avian diseases will be transmitted, creating the potential for massive die-offs. Disease organisms originating from a single species of waterfowl can also spread to other species (Friend 1987). Diseases such as coccidiosis, avian influenza, schistosomes, chlamydiosis, salmonella, and avian cholera are transmitted under these circumstances (Guth et al. 1979, Skene et al. 1981, Friend 1987, Webster et al. 1993, Gomis et al. 1996). Canada geese are suspected of transmitting salmonella to cattle (Lowney et al. 1997). Transmission of disease or parasites from geese to humans has not been well documented, but the potential exists (Luechtefeld et al. 1980, Wobeser and Brand 1982, Hill and Grimes 1984, Pacha et al. 1988, Blankespoor and Reimink 1991, Graczyk et al. 1997).

Because geese like open, grassy areas, are large, and tend to form flocks, they may possibly strike airplanes at airports (Milsom 1990). Most modern aircraft are engineered only to withstand the impact or engine ingestion of a single 1- to 3-pound bird. At the Reno-Sparks, Nevada, airport from 1986 to 1989, Canada geese were involved in 11 airplane strikes, costing a total of \$250,000 in damage. The Federal Aviation Administration (FAA) threatened to close the airport if it did not institute goose control (Fairairzl 1992). In 1995, a U.S. Air Force Boeing 707 E-38 AWACS jet took off from Elmendorf Air Force Base, Alaska, and ingested at

least 13 Canada geese. The \$184 million aircraft crashed, and the entire 24-person crew was killed. Also in 1995, a Concorde jet lost two engines after ingesting several geese while landing at the John F. Kennedy Airport in New York, and a similar event occurred at New York's La Guardia Airport.

Waterfowl accounted for 35 percent of all reported monetary losses resulting from wildlife strikes to U.S. civil aircraft. Geese and swans comprised 58 percent of all water-

fowl involved in bird strikes against U.S. civil aircraft from 1992 to 1996 (Cleary et al. 1997). The FAA estimates that 240 goose-aircraft collisions occur annually.

As a result of the increasing numbers of geese living in urban landscapes, some major metropolitan areas in the Pacific, upper Midwest, Northeast, and mid-Atlantic states are faced with the increasing challenge of balancing Canada goose use of urban sites with human needs.

Biology of the Canada Goose

Descriptions and General Behavior

Canada geese have gray-brown wings and backs; light gray to dark brown sides and breasts; black tails, feet, legs, bills, and heads; and black necks with distinctive white cheek patches that usually cover part of the throat. They also may exhibit the largest size variation of any animal species in the world; depending on the subspecies and race, body weights range from 3 to 15 pounds (Bellrose 1976). Males tend to be bigger than females, and juveniles attain complete adult plumage three to four months after hatching.

Breeding Behavior

Canada geese usually begin nesting at three years of age, although a few individuals nest when they are two years old (Bellrose 1976). Pairs usually stay together for life unless one dies; in that case the remaining goose usually finds another mate, generally within the same breeding season (Kossack 1950).

Nesting

Canada geese usually nest within 150 feet of water, and most nests are surrounded by or are very close to water (Bellrose 1976, Wright and Giles 1988). Water provides access to food, a place to drink, aids in preening and bathing, and is an avenue of escape from predators (Kossack 1950). A typical Canada goose nest is bowl-shaped, approximately 1.5 feet in diameter, and made from the surrounding vegetation lined with goose down plucked from the female's breast (**Figure 1**). Nest site selection in suburban areas is quite variable. Canada geese may nest in areas with only a small tree or shrub, in a patch of annual vegetation, at the base of a mature tree, or in an elevated nest structure provided for them.

A good view of the surrounding area is always important in nest site selection. Nesting females tend to use the same immediate area year after year. Most subspecies of Canada geese do not tolerate concentrated nesting areas, although Canada geese nesting in urban environments may nest within 6 to 10 feet of each other (Allan et al. 1995), allowing some areas to support many nesting pairs. Both males and females defend the nest site territory before incubation (Kossack 1950). Egg laying is initiated shortly (perhaps within 24 hours) after nest construction starts.

Giant Canada geese nest in the spring, earlier in years with warmer weather and in areas further south. In Virginia, the first eggs are laid in late February (M. Lowney, VA USDA-APHIS-WS); in northwestern Missouri around March 15 to 20 (Brakhage 1985); in northern Illinois from late March to mid-April (Kossack 1950); in Jackson Hole, Wyoming, around the beginning of April (Craighead and

Craighead 1949); in central Wisconsin around April 4 (Collias and Jahn 1959); and in south central Ontario around mid-April (Lumsden 1969, J. Sullivan, Canadian Wildlife Service).

After the eggs are laid, the male does not incubate but will stand guard and defend the incubating female by striking at its opponent with its wings or nipping with its beak. Giant Canada geese lay an egg about every 1.5 days (Kossack 1950, Brakhage 1985), and eggs are laid throughout the 24-hour day (Kossack 1950). Average clutch size for giant Canada geese is slightly more than 5 eggs per nest (Bellrose 1976); nests may contain 1 to 15 eggs. The average incubation period is 26 to 28 days (Bellrose 1976). Incubation does not begin until all eggs are laid, so that all goslings usually hatch the same day.

If the nest is destroyed or the eggs are eaten or removed by predators, Canada geese may renest, usually in or near the first nest. Renesting is more common when nest failure occurs early in the egg-laying period. If egg loss occurs after more than one week of incubation, renesting is rare (Brakhage 1985). A clutch takes between 8 and 36 hours to hatch completely (Kossack 1950). Usually within 24 hours of hatching, the goslings may be led up to 2 miles to a grassy feeding area with water nearby for protection (Kossack 1950).

Feeding

Parents often move their broods to areas chosen for the presence of suitable food, visibility, and proximity to water. Canada geese are grazers and they prefer lawn grass in urban areas. They tend to choose open areas with few obstructions to give them views of potential predators. Conover and Kania (1991) found that, in Connecticut, all



Figure 1. A typical Canada goose nest.

urban sites with goose problems were characterized by a lawn next to a body of water. Geese also prefer fertilized plants over unfertilized ones (Owen 1975, Owen et al. 1977).

Both parents, especially the males, will vigorously defend their broods for approximately 10 weeks, after which time the goslings can fly (Sherwood 1965, Owen et al. 1986); this behavior declines as the goslings grow.

Occasionally, goslings from several broods join together to form gang broods (Williams and Marshall 1937, Naylor 1953, Geis 1956, Brakhage 1965, Craven and Rusch 1983). It is not uncommon to observe gang broods of 20 to 100 goslings following 2 to 20 adults. Gang broods are more common in areas of high nest densities. The geese eventually separate into family units.

Molting

Adult Canada geese undergo a complete replacement of flight feathers each summer, which takes about a month for most individuals (Hanson 1965, Williams 1967, Dimmick 1968). Nuisance goose management is very important during this period because all birds present are flightless and thus vulnerable to capture. Nonbreeding yearlings, non-nesting adults, and adults whose nests have been destroyed are usually the first to molt, beginning around June 1 in the northern states (Steel et al. 1957, Sherwood 1965) and June 15 in the mid-Atlantic and southern states. A portion of the non-nesting geese migrate to areas farther north before molting, although many geese choose to molt in nearby areas.

Molting geese select areas near water that have good grazing and unobstructed views so as to see potential predators. Mown lawns, parks, and golf courses suit their habitat requirements. Adults with young will molt at the brood rearing area 10 to 20 days after the nonbreeding geese initiate their molt (Sherwood 1965).

Migration

Canada geese nesting in the continental United States and southern Canadian provinces usually migrate only short distances, generally staying within their state of birth or flying to neighboring states. The smaller races of Canada geese, which breed above 50° latitude (the U.S.–Canadian border from Washington to Minnesota is at 49° latitude), begin migrating south after September 1 before the onset of cold weather. These smaller Canada geese start arriving in large numbers in the northern states during late September and may join flocks of giant Canada geese using urban areas. Although only a small portion of migratory geese use urban areas, they may have a startling impact on the environment when, within the span of a few days, a pond that previously had only a few geese on it suddenly supports a flock of several thousand. Migratory birds are usually much more wary of human activities than resident geese.

Mortality

Canada geese hatched in urban environments may have very low first-year mortality. Johnson and Sibly (1991) found that 77 percent of urban goslings survived to their first molt, and Smith et al. (in press) measured survival rates of urban-born juvenile geese well above 90 percent from September through the first hunting season. These high survival rates are a key reason for the explosive growth of urban flocks. In comparison, first-year survival of migratory, juvenile giant Canada geese from rural areas has been estimated to range from 25 to 84 percent and averages 59 percent (Samuel et al. 1990, Smith et al. in press). If Canada geese survive past their first year, their annual survival rates become higher.

Regulations Covering Canada Geese

Canada geese are protected by the Migratory Bird Treaty Act of 1918 (16 USC 703-711). This act made it illegal to harvest waterfowl or other migratory birds except during the hunting season or by permit. It prevented the unrestricted egg harvesting and commercial hunting for meat and feathers that was commonplace in the United States in the late 1800s and early 1900s. This treaty gave the U.S. and Canadian governments (U.S. Fish and Wildlife Service and Canadian Wildlife Service, respectively) the authority to set limits, make regulations, and issue permits to harvest or take waterfowl.

In addition to federal permits, most states require permits anytime one intends to destroy eggs or nests, capture, translocate, disturb, or harvest Canada geese. Local laws or regulations may also affect the use of control techniques

such as firearms, chemicals, and auditory and visual scaring devices. People or organizations intending to implement such techniques must determine what their responsibilities are under these various laws. An initial call should be made to your U.S. Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS), Wildlife Services office (formerly Animal Damage Control), or the Canadian Wildlife Service to ascertain the legality of any contemplated control techniques, including hazing, chemical application, shooting, nest or egg destruction, capture, or translocation.

Products, laws, and registrations change, so check with local authorities about possible violations before deciding what method to use.

Management Strategies

Goose Ecology and Management

Successful and cost-effective management of Canada goose activities often depends on identifying the site characteristics most attractive to the geese (e.g., security, food, nesting sites, water) (Flegg 1980). Techniques are then chosen based on their potential for reducing those characteristics. This is an ecological approach to management. Choosing techniques while ignoring the biological or behavioral aspects of goose activity will likely not solve the problem.

An example of a sound ecological approach to reduce goose grazing in an area is to provide an alternative feeding site, haze the geese off the area where the grazing is unwanted, and reduce the attractiveness of the original site to prevent future use (Conover 1992). Simply hazing the geese off the problem site, thereby creating a potential problem elsewhere or even at the same site at a later time, does not provide a long-term solution (Mott and Timbrook 1988).

Following these important points greatly increases the probability of developing a successful goose management strategy:

- (1) A single, quick-fix solution is unlikely to reduce goose problems. An integrated approach using several techniques in combination is much more likely to succeed.
- (2) Timing is critical.
- (3) Public or neighbor relations are usually important to success.
- (4) Be aware of relevant laws and ordinances.
- (5) Use common sense.

- (6) It is rarely desirable or possible to eliminate all geese in a given area. Most management programs strive for a reduction in goose numbers and related problems to a level all stakeholders can tolerate.

Human Dimensions and Goose Management

Public attitudes toward wildlife may result in conflicts, depending on personal belief systems and the interest of some people in the welfare of individual animals. Urban areas by definition contain high densities of people, and locally overabundant wildlife may create a nuisance situation, affect human activities, or create perceived or real threats to human health and safety. "Problems" with Canada geese or other wildlife are socially defined and may vary among different stakeholder groups.

Although most people view Canada geese as a charismatic and highly valued species, individual tolerance of goose behavior differs. For example, a property owner who decides to attract geese by feeding them or encouraging nesting spends his or her own resources to interact with the geese. Geese are very mobile, however, and may cause problems on neighboring properties whose owners may not appreciate the droppings, feathers, noise, and aggressive behavior. It is easy to see how this could result in social and management conflicts. If the problem occurs on private lands, the homeowner and nearby neighbors may work out a solution, or the community and local government may get involved by establishing ordinances prohibiting certain activities (e.g., feeding waterfowl). On public lands such as

parks or athletic fields, the community should have input into choosing acceptable control techniques.

Goose management is undertaken to meet human needs and interests. Solving goose conflicts may involve changing stakeholders' attitudes or behaviors, as well as modifying goose behaviors or directly reducing flock size. Stakeholders should be involved in several steps of the management process, including the following:

- setting goals and objectives,
- determining appropriate control techniques,
- talking with the community about the management plan, and
- evaluating program achievements.

In some situations, professional wildlife managers may recommend lethal control, such as hunting or a roundup, to reduce goose numbers. Some people, however, do not believe in killing or even managing wildlife. In these situations, a citizen task force with representative stakeholders from the local community may help resolve conflicts and recommend acceptable management approaches.

Citizen task forces have been used successfully to solve problems involving deer and geese in some cities. This method permits interested stakeholders to assist in developing management schemes and does not exclude groups with animal welfare viewpoints. Task forces typically review pertinent goose biology, examine management options, select appropriate management techniques that are both biologically feasible and socially acceptable, identify sources of manpower and money to implement control activities, and coordinate dissemination of information to the media aimed at keeping the community informed of their deliberations and decisions. Experience suggests that the key reasons for the success of a task force are

- relevant stakeholder representation,
- an external, trained facilitator,
- accurate and complete biological information, and
- technical support from state or federal wildlife management agencies. These factors often lead to recommendations with broad-based support and viable management strategies.

Wildlife agency personnel should be able to explain reasons for potential wildlife problems and be familiar with the possible questions and answers concerning goose biology and management. A professional wildlife manager needs to maintain credibility for the biological insight he or she brings to a conflict situation by avoiding taking sides in values discussions, and rendering an "expert opinion" that reflects a values position veiled by biological content.

If confronted, agency staff should realize that the argument is counterproductive, be good listeners, sympathize

with the individual's or group's feelings, and explain management options in understandable terminology. It may be necessary to have law enforcement personnel on site if confrontational situations are anticipated.

Development of an Integrated Management Strategy

Important considerations in choosing management techniques include

- time(s) of year when the problems occur,
- available control options given the biology of the geese and the characteristics of the area(s) involved,
- probable effectiveness of the techniques,
- acceptability, cost, and legality of control methods, and
- community support for taking action.

There is no "silver bullet," no one technique or strategy that can be used everywhere. Complexities of urban goose issues and the current limitations of available techniques make quick-fix solutions unlikely. Resolving a problem requires an integrated management program. Short-term strategies can relieve immediate problems, and long-term approaches will maintain goose populations at or below target levels. Combining two or more techniques often improves results. Some combinations include pairing auditory with visual tactics, hazing with diversionary feeding, hazing with habitat modification, or shooting with summer roundups or egg addling.

The community should determine its management goals (e.g., number of geese or levels of damage that are compatible with human uses of an area) before any direct population management or intervention. Before implementation, population objectives for the goose flock and control methods should be publicized to minimize social conflicts when the program is initiated. Public and school lectures are a good way to disseminate facts and science-related information (Colvin et al. 1983). In Minnesota, a "media" day for the local television, radio, and newspapers was held on goose roundup day to aid in publicizing a control program (Keefe 1996). Call-in radio shows are cost-effective and useful for widespread dissemination of information (Colvin et al. 1983).

Field personnel applying techniques should be able to explain the background and biology of the problem to the public. Agency staff must realize that multiple wildlife acceptance capacities exist among various stakeholder groups, and strong differences of opinion are unlikely to be resolved while management activities are taking place. Field coordinators should notify local law enforcement departments of their activities, and agency staff should keep all necessary permits ready for presentation if requested.

Techniques

The following pages describe the current state of knowledge about urban goose management practices and equipment suppliers. The primary intent is to provide a list of techniques used to alleviate conflicts with urban geese.

Appendix A includes a summary table of management options and sources of equipment. Some techniques may require pesticide applicator licenses, special training, or local, state, provincial, or federal permits. It is up to the operator to know these requirements. Products, laws, and registrations may change, so check with local authorities before selecting a technique.

Some techniques are highly specialized, site-specific, or best used in combination with other methods. In addition, response by individual geese to management techniques may vary greatly (Swift 1998). Thus no attempt was made to rank the techniques from best to worst, and the methods are not listed in priority of use. The techniques are categorized based on physical impact on geese (least to greatest): discontinuance of feeding, habitat modification, hazing/scaring, repellents, inhibiting reproduction, and finally removal. Within categories, groupings are based on similarity of techniques.

Always be alert to new techniques or new and creative adaptations of established methods. Several journals (*Crop Protection*, *Journal of Wildlife Management*, *Wildlife Society Bulletin*, *Journal of Applied Ecology*, and others) are a source of scientifically tested management techniques. Additional information can be found in *Proceedings of the Bird Control Seminar*, the biennial *Proceedings of the Eastern Wildlife Damage Management Conference*, *Great Plains Wildlife Damage Control Workshop*, and *Vertebrate Pest Conference*. There is also an e-mail listserv, "WDAMAGE," in which human-animal conflicts, including the use of new and old techniques, are often discussed. To subscribe, write to LISTSERV@LISTSERV.NODAK.EDU and, in the text of your message (not the subject line), write: SUBSCRIBE WDAMAGE firstname lastname.

Discontinuance of Feeding

Feeding waterfowl and other birds is a popular pastime for many people (Figure 2), but it is also a major cause of high urban bird populations, especially during harsh winters when natural food sources are in short supply. Canada geese are grazers and therefore **do not need** handouts to exist. Feeding waterfowl encourages them to congregate in an area and may make geese more aggressive toward people. Thus reducing handouts by well-intentioned people may help make an area less attractive to geese, ducks, and other birds.

Feeding waterfowl can lead to crowding and increased susceptibility to diseases such as avian cholera, avian botu-

lism, and duck plague. All of these diseases have the potential to kill large numbers of geese and other waterfowl. Generally, fewer waterfowl gather at urban feeding areas as compared to the large congregations at refuges. Therefore, fewer birds in urban areas would die compared to the many thousands that often die at refuges during outbreaks of disease.

Education and regulations may help decrease human feeding of waterfowl. Many people enjoy feeding ducks and geese at public parks, however, and law enforcement agencies sometimes consider that antifeeding regulations are unenforceable and usually ignored by the public. Educational signs explaining the rationale for the feeding bans may assist enforcement and have been used with varying levels of success by numerous organizations and municipalities. Homeowner associations and corporate parks often more readily accept prohibition of waterfowl feeding than do individuals. One way to decrease public feeding of flightless geese during their summer molt is to fence off the routes used by the geese to reach the feeding areas.

Habitat Modification

Preferred habitat for geese is a large, unobstructed lawn area close to open water. Many urban features, including parks, industrial sites, residential complexes, golf courses, and planned residential communities, provide such an environment. Urban planners should consider problems with waterfowl and other wildlife while new projects are being developed. It is much easier and less expensive to design a facility without features that attract waterfowl than to retrofit an existing site.

The basic principles of habitat modification include eliminating, modifying, or reducing access to areas that cur-



Figure 2. People feeding geese.

rently attract geese. For example, in a problem area with an open lawn adjacent to a pond, goose use may be reduced by changing the lawn, the open water, or the shoreline using habitat modification techniques. Unfortunately, both humans and geese appear to find lawn areas near water attractive (Addison and Amernic 1983).

People are often reluctant to make appropriate landscape modifications to discourage goose activity. Eighty-four percent of urban respondents to a survey conducted in the Fraser Valley of British Columbia were opposed to changing landscaping practices to control geese (Breault and McKelvey 1991).

Habitat modification techniques alone usually cannot prevent geese from using an area, especially after a flock is established. A combination of landscape modification (which makes geese more wary at a site) and hazing, however, may have additive effects (Conover and Kania 1991). Implementing habitat modification techniques is often very expensive (Keefe 1996), but in the long term they may be the most cost-effective solution.

Before attempting large-scale habitat modifications, the following points should be considered. Habitat modification is designed to change goose behavior patterns but may also influence the suitability of the area for other desirable wildlife (other waterfowl and birds, some amphibians, turtles, fish, and other aquatic animals). Moreover, geese discouraged from using one location may become someone else's problem. If several nearby areas have nuisance goose flocks, a coordinated effort may be necessary to resolve the conflicts. In some communities, this may not pose a significant problem. For example, 100 percent of the respondents to a Vancouver, British Columbia, public survey indicated their willingness to collaborate to solve goose problems (Breault and McKelvey 1991).

Elimination of straight shorelines, islands, and peninsulas

Islands are prime nesting sites for geese, which prefer long, straight, uninterrupted shorelines well removed from heavy human traffic. These areas provide security and a good view of potential predators. Eliminating islands and peninsulas, and modifying uninterrupted shorelines with shrubs or boulders every 10 to 20 yards, may reduce an area's attractiveness to geese, as well as to other waterfowl and shorebirds. This technique, however, is not always successful because geese may use shrubs or hedges as nesting sites. Elimination of islands is probably the most productive way of reducing secure nesting habitat, but it is expensive and difficult once the island is built and the pond filled with water.

Shoreline modification of some protected waterways may require state and Army Corps of Engineers permits. Islands or peninsulas suitable for nesting geese should be eliminated between late summer and early spring because disturb-

ing Canada goose nests requires federal permits. Used alone, this technique may not provide significant relief from problem geese, but when combined with feeding bans and the addition of walking paths that will be heavily used, shoreline modification may be successful in some situations.

Placement of walking paths by water

Geese prefer to rest or feed on grassy areas next to water. If jogging or walking paths are placed along a shoreline, geese may be less likely to use the immediate area for feeding, nesting, or loafing.

People should have easy access to all parts of the shoreline, and the walking path should be in place before the geese become well established in the area. If citizens feed waterfowl or other wildlife on or near the paths, the effectiveness of this technique may be diminished. In addition, urban geese are incredibly adaptable and may tolerate high levels of human activity.

Placement of grassy areas away from water

Placing new soccer, baseball, and football fields or moving existing playing fields at least 450 feet from water may reduce goose use of the fields during the molting period when the geese are reluctant to move far from the safety of water. Geese with flight capabilities will readily use athletic fields a mile or more from water sources.

Removal of nesting structures

Wildlife officials—and well-intentioned private citizens—sometimes build and maintain artificial nesting structures for geese. Usually these structures are erected to augment available nesting sites or compensate for a lack of nesting materials. Canada geese are very adaptable and readily nest in man-made structures. There are several successful artificial nest designs such as tubs, elevated platforms, and round hay bales turned on end.

Artificial nest structures are designed to reduce the threat of predators and are often safer than natural nest sites. Eliminating these structures may reduce goose production and make the area less attractive for nesting geese.

Modification of pond and field water levels

Increasing the water level in a pond may flood preferred nesting areas such as islands and peninsulas, thereby reducing or eliminating goose nesting at a specific water body (Allan et al. 1995). Conversely, reducing water levels (draw-downs) in ponds and lakes may eliminate islands by joining them to the shore. Predators or humans may then gain access to the nesting areas, reducing the attractiveness of the site and thus successful nesting.

These techniques are illegal if they are used during the nesting season with the intention to drown clutches of eggs.

Changes in the water level may also adversely affect other wildlife.

Encouragement of early water freeze-up

Favorable winter habitat for geese includes open water. Turning off fountains or water aerators leads to earlier freeze-up, thereby eliminating winter habitat for the geese.

Overhead placement of lines or grid wires

A grid or network of multiple parallel lines of wire, kevlar, stainless-steel line, twine, cotton rope, fishing line, or mylar tape stretched 1 to 2 feet above the water surface restricts goose landing and takeoff (Figure 3). Pochop et al. (1990) present a good overview on the use of grids and lines for repelling birds. The lines do not have to be spaced equidistantly or be parallel. Generally, larger birds are repelled by grids with wider spacing than those effective for smaller birds. UV-resistant lines, ranging in thickness from 10- to 28-gauge and constructed as a grid with 6-foot spacing, can effectively keep geese off small ponds. If access to the pond is needed, raise the grid to 10 to 12 feet above the water surface and increase the grid spacing to 15 feet. Tie strands to poles for easy repair in case lines break, and take up excessive slack.

To increase effectiveness, the grid system should be in place before the geese arrive. In addition, a perimeter fence should be constructed to prevent the geese from walking into the area under the grid. The grids or lines can be visually enhanced with the addition of mylar streamers tied at intervals along the lines. Periodic maintenance is necessary to prevent sagging lines.

Stringing highly visible polypropylene ropes between trees to block the flight paths to water also prevents geese from landing (Summers and Hillman 1990). The ropes should be loose enough to move in the wind, increasing their visibility. They must be obvious enough to allow flying birds easily to avoid the area. Otherwise geese, and possibly other birds, could strike the ropes and be injured.

Summers and Hillman (1990) used a mylar tape grid system suspended 5 feet above the ground over a wheat field. Rows of tape were spaced 75 feet apart and supported at 65-foot intervals. Cross rows were spaced about 130 to 150 feet apart. This grid used approximately 265 feet of tape per acre and took about 0.36 man hours per acre to construct. This technique has also been modified to repel Canada geese in other situations, including sewage lagoons in Virginia (approximately 28-gauge wire in parallel lines 20 feet apart) and over a lake in Nevada (10- and 15-gauge black plastic wire in a 30-foot square grid). A grid system made from heavy cotton line has successfully deterred geese from swimming pools.

Grid systems can also be used over land because they prevent flying geese from landing. An alternate feeding area



Figure 3. Grid-wire system to prevent geese from landing in ponds.

nearby may enhance the effectiveness of this technique (Summers and Hillman 1990).

Drawbacks to lines and grids include an inability to treat large water bodies without using a floating support system; visual degradation of the area; impairment of access by people, equipment, and other animals; and the risk of death, injury, or entanglement of birds.

A variation of the grid method can be constructed by stringing kevlar lines on a 5 x 5 foot spacing at water level. This method effectively breaks up the water's surface and hinders swimming geese. The lines are not easily seen, so this technique is useful in areas such as golf courses and parks where visual distractions need to be minimized. Geese may habituate to the grid, however, and learn to submerge below the lines while swimming. In addition, this method may be hard to implement in areas with widely fluctuating water levels. It is not known if this technique affects other species.

Similar to the water-level grid, HDPE plastic balls (Bird Balls) can be placed to cover the water surface completely. The floating balls create a physical barrier that prevents geese from using the pond. This technique is effective for keeping many species of birds off industrial ponds and requires little maintenance once deployed. Drawbacks are that the balls are visually distracting, will affect any wildlife that attempt to reach the pond's surface, and prevent light from entering the water (which may deter growth or survival of plants, fish, and other aquatic species).

Fence barriers

Fences can prevent geese from walking from water to grazing areas (Figure 4). Effective materials include woven wire, chicken wire, plastic snow fencing, construction-site silt fencing, corn cribbing, chain link fencing, netting, mylar tape, monofilament lines, stainless-steel wire, and picket fencing. Regardless of material, openings should be no larg-



Figure 4. Barrier fencing used during summer molting periods.

er than 3 inches, the fence should be at least 30 inches tall, and it should be long enough to discourage the geese from walking around the ends.

Fences are most effective during the prenesting period and during flightless periods in early summer when geese have young or are molting. Fencing the perimeter of an area may prevent adult geese and goslings from accessing food sources. The effectiveness of a barrier fence may be enhanced if landscaping modifications are also used.

If the fence is constructed from mylar tape, the strands should be supported at least every 20 feet, and they should have at least one twist over that length (Figure 5). Secure the mylar to the posts with duct or electrician's tape (do not knot because the mylar will break). A mylar tape fence must be long enough so that the geese cannot walk around it to get into the problem area.

Smooth-wire, rope, or string fences have also been used effectively in some situations, although simple barriers rarely work for long periods. Thick string mounted 12 inches above the ground was used to eliminate goose activity near ponds on a golf course (Breault and McKelvey 1991). A barrier fence made from five monofilament lines (at least 20-pound test) set at 4, 8, 12, 18, and 24 inches above ground has also been effective (Figure 6). The closer-set wires or lines exclude both goslings and adult geese. Another successful fence was made from 20-pound test monofilament line spaced 7 and 12 inches above the ground on poles placed 6 feet apart (Pochop et al. 1990).

This technique will not work if the geese fly into the area. Deer may also walk through single or multiple-strand

fences, breaking strands and increasing maintenance. Flagging or signs should be placed on the wires to prevent people from tripping on the fence.

Electric fences: Electric fences can prevent geese from walking into grassy areas, particularly during the summer molt period. Like other fences, they will not deter flying geese from entering an area. Birds or other animals that come in contact with the fence receive an uncomfortable but harmless shock. Warning signs, which are sold by many electric fence manufacturers, should be placed directly on the fence at least every 20 feet no matter where the fences are used. As with any barrier, the fence should be long enough so that geese cannot walk around the ends.

Electric fences are typically powered by battery, solar power, or 120-volt chargers. Some fences are constructed with highly visible, brightly colored polytape, interwoven with at least five strands of conductive, stainless-steel, or aluminum wires. Ten-gauge wire has also been used effectively, although most people find polytape or polywire (electroplastic twine) easier to use than steel or aluminum wire. Usually two strands of the polytape or 10-gauge, high-tensile wire are attached to fiberglass or plastic fence posts. The strands should be placed 8 and 16 inches above the ground with no visible sag between the posts (Figure 7). Follow the manufacturer's instructions for installation or hire a fencing contractor.

The fence should be examined regularly to make sure that the strands are not broken and are taut. Use a voltmeter weekly to ensure that the system is working, and fix problems if they occur. The immediate area on either side of the electric fence should be cleared because if vegetation or other items come in contact with the strands, they will short out. Check local regulations for any restrictions on the use of electric fences in your area. Electric fences will be ineffective if the geese fly into and land on a grassy spot.

Vegetative barriers

Shrubs or hedges may block favored pathways of geese or obstruct their line of sight, making the area less attractive because of the potential for attack from predators (Conover and Kania 1991). Vegetative cover also enhances the attractiveness and long-term effectiveness of barrier fences. To be successful, a plant barrier must make geese feel that if they are threatened, their ability to escape is reduced.

Vegetative barriers work best when goose numbers are low and available habitat nearby is unoccupied. In areas where goose numbers are high, vegetative barriers quickly lose their effectiveness. Canada geese have been observed

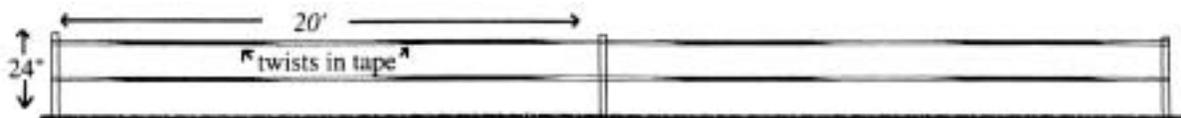


Figure 5. Diagram of a mylar tape fence.

using woods or shrubby areas as escape avenues. Dense vegetation around ponds may reduce the effectiveness of harassment techniques, especially if dogs are used (Swift 1998; see Dogs, page 21). Vegetation will not discourage use of the area by flying geese or those accustomed to walking through hedges.

Any barrier planting will require protection from geese and other animals during establishment. Local garden centers or Cooperative Extension offices may be able to suggest sources for native plants that should thrive in the area.

Plants should be dense and high enough (at least 30 inches) to prevent adult geese from seeing through or over them, and dense enough to prevent the geese from walking through gaps between the plants or stems (Quarles 1995). Nonetheless, geese often manage to force their way through shrubs.

Thick hedges are most effective during early summer when geese have young or are molting. Prairie grasses may provide an effective barrier as long as they grow tall enough early in summer. Planting or preserving cattails, bulrush, or other tall aquatic vegetation along shorelines can create a visual barrier and may prevent geese from coming ashore. Unfortunately, these plants may also create conditions favorable to muskrats whose island-like houses are used as nest sites by geese.

Wide plantings (20 to 30 feet long and at least 30 inches tall) are more likely to be successful than narrower ones. In extensive plantings, mowed or cleared serpentine footpaths prevent the geese from having a direct line of sight through the planted area, yet still provide shoreline access for humans. A low-maintenance prairie planting or a wildflower area along the shoreline may reduce goose use of the property. Natural meadows have been used as an alternative plant barrier, although seasonally flooded meadows along



Figure 6. Fence made from monofilament lines.

water areas in Wisconsin have been found to attract both migrant and giant Canada geese. As resident geese become more accustomed to people and urban landscapes, the success of managing goose problems with vegetative barriers continues to decrease.

Rock barriers

When geese leave a water body, they generally use routes that allow them easy access onto land as well as a clear view of potential danger. Large boulders placed along a shoreline may create a barrier that discourages goose use and access to grazing sites. The boulders should be at least 2 feet in diameter to hinder geese when they are getting out of the water. A combination of a rock barrier and dense vegetation placed above the boulders may enhance the effectiveness of both methods.

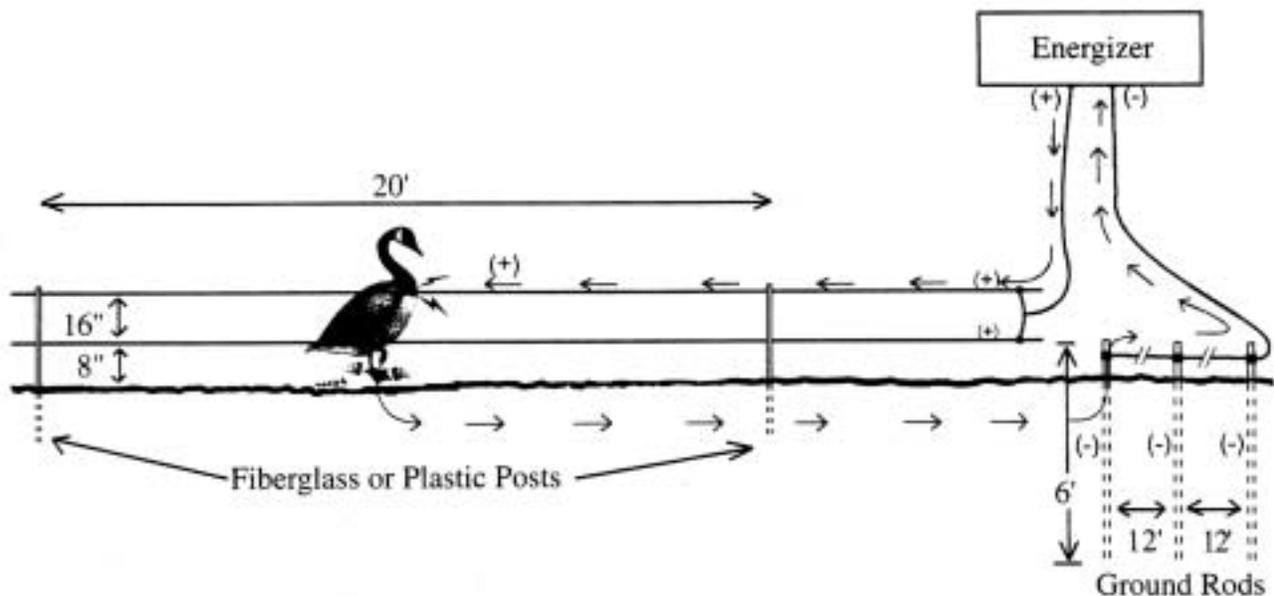


Figure 7. Diagram of an electric fence.

When geese become accustomed to people, the effectiveness of rock barriers will decline. Geese are adept at climbing over small rocks and have been seen to negotiate rock shorelines with little trouble. Shoreline modification of some protected waterways may also require state and Army Corps of Engineers permits.

Tall trees

On small ponds (<1/2 acre in size), trees located in the flight paths between water and grassy areas may prevent geese from landing. The trees must be both dense enough to prevent geese from flying through the canopy, and tall enough to increase the angle of climb or ascent above 13 degrees (Conover and Kania 1991, Allan et al. 1995). Ponds larger than a half acre in size will provide ample open water for landing; consequently this method will have limited applications. Because most trees grow very slowly, this technique should be considered only part of a long-term management plan.

This technique is effective only in discouraging geese from flying into an area and will not prevent them from walking to a grazing site. Geese like areas with shade for grazing and loafing, and if they are able to walk into a grassy spot, tall trees may actually attract them.

Decreased attractiveness of grazing areas

Canada geese prefer to eat grass, especially young shoots, which are found in abundance on mowed lawns. Several techniques can reduce the lawn area and the amount of young grass shoots, making an area less attractive for feeding.

Reduce or eliminate mowing: Geese can find young grass shoots easily on mowed lawns because their growing leaves are the highest. As grass continues to grow, the young, tender shoots become harder to find (Conover 1992). A grass height of 6 inches will reduce the abundance of young, tender shoots and make it more difficult for the geese to find them. Allowing the grass immediately surrounding a pond to grow tall may reduce a site's attractiveness for feeding geese, although tall grass may provide suitable nesting sites.

Increasing grass length at airports may be unacceptable (Blokpoel 1976). Dried, long grass can be a fire hazard (Blokpoel 1976, Cooper 1991), and long grass at airports can obscure runway lights. Mowing near signs, lights, and runway intersections where visibility is important can overcome this obstacle (Brough and Bridgman 1980). In addition, tall grass in the spring may also attract nesting waterfowl as well as pheasants and other birds (Kirsch 1969), which could create bird strike hazards.

Reduce fertilizer use: Because geese prefer fertilized plants over unfertilized ones (Owen 1975, Owen et al. 1977, Ruger 1985), reducing fertilizer use may decrease an area's attractiveness for feeding.

Stop watering lawn: If watering is reduced or stopped, grass may stop growing during dry periods, and new shoots will not be produced as frequently. If this technique is applied in the fall, fewer migratory geese may be attracted to the site.

Reduce lawn area: Reducing the size of mowed grassy areas minimizes foraging sites for geese. Leaving the lawn unmowed effectively eliminates the tender shoots, leaving only the coarser and older grass blades, which may encourage geese to feed elsewhere.

Plant less palatable plant and grass species: Geese prefer Kentucky bluegrass, the dominant grass in many lawns, and tend to feed less on tall fescue if given a choice (Conover 1985b, Conover 1991). They will readily eat fescue, however, if it is the only grass available. Planting less preferred plants or grass species to discourage geese from a specific area will work more effectively if good alternative feeding sites are nearby (Conover 1985b). In addition, during fall and winter months, dormant species of grass are less attractive to Canada geese (Conover 1991).

Canada geese will readily feed on almost any short grass or legume, including the following:

- Kentucky bluegrass (*Poa pratensis*)
- brome grasses (*Bromus* spp.)
- new growth on canary grass (*Phalaris arundinacea*)
- colonial bentgrass (*Agrostis tenuis*)
- perennial ryegrass (*Lolium perenne*)
- quackgrass (*Agropyron repens*)
- red fescue (*Festuca rubra*, a grass)
- new growth on mowed or burned switch grass (*Panicum virgatum*)

Canada geese tend to avoid the following plants:

- mature tall fescue (*Festuca arundinaceae*, a grass)
- periwinkle (*Vinca* spp., a groundcover)
- myrtle (*Myrtus* spp., a groundcover)
- pachysandra (*Pachysandra terminalis*, a groundcover)
- English ivy (*Hedera helix*, a groundcover)
- hosta or plantain lily (*Hosta* spp., a groundcover)
- *Euonymus fortunei* (an evergreen prostrate vine or shrub)
- ground junipers (*Juniperus* spp., an evergreen shrub)

Alternative Feeding Areas

The theory behind alternative or diversionary feeding is to provide an area that has better forage quality than the site where damage is occurring (Owen 1990). Lure crops and bait stations are the two basic diversionary feeding techniques (Lostetter 1956). Providing alternative feeding areas enhances the effectiveness of most hazing and habitat manipulation techniques.

Diversionary feeding is best suited for rural or suburban fringe sites where geese may be tolerated at certain properties (van Eerden 1990). For best results, the geese must be

hazed from the problem area and should easily find the alternative feeding sites with ample food.

Lure crops are generally fields of swathed or flooded grain left for the geese to consume. A lure crop does not have to provide only grain; a well-fertilized and mown site planted with Kentucky bluegrass may be very attractive to geese. For best results, the lure crops should not be visited by the depredating geese until they are driven from the nuisance site. The geese should not be disturbed once they find the lure crop. Extreme concentrations of feeding waterfowl at a site can make the lure crop less attractive because of trampling and food depletion. Clover will withstand trampling better than row crops.

At bait stations, loose grain is provided instead of a crop being planted for waterfowl consumption. Again timing is important because this technique is most effective if the bait is available a few days after the geese are observed feeding at the problem area. An advantage of this technique over lure cropping is that trampling of the bait is reduced (Vaudrey 1974), and more birds can be accommodated.

Combining hazing techniques with alternative feeding areas has successfully kept migrant waterfowl out of crops (Stephen 1961) and resident geese away from parks. This combination can keep geese away from specific areas during parts of the year yet retain them in the vicinity during the waterfowl hunting season.

The use of lure crops or bait stations may cause legal problems for hunting during the fall. In the United States, it is illegal to bait or lure waterfowl with grain for hunting purposes. In Canada, it is illegal to hunt within 400 yards of a lure crop or bait station.

Alternative feeding areas may also increase nuisance problems over time. Waterfowl drawn to the diversionary feeding sites may disperse to nearby areas, thus creating additional problems. For this technique to be effective, availability of the crop must coincide with the need to disperse the geese.

Hazing and Scaring Techniques

These techniques are usually designed to frighten geese away from problem sites. It is permissible to harass Canada geese without a federal or state permit as long as the geese are not touched or handled by a person or an agent of a person (e.g., a trained dog). Hazing techniques are non-lethal and therefore are generally well accepted by the public. Hazing presents some problems, however, including habituation of the birds to the devices (Zucchi and Bergman 1975, Blokpoel 1976, Ruger 1985, Summers 1985, Aubin 1990), possible influence on other animal species, failure of the hazed birds to leave the general vicinity (Brough 1969, Conover 1984, Summers 1985, Swift 1998), and complaints from neighbors about the noise made by the devices.

Hazing is most effective if implemented before or at the initial stages of a conflict situation (Hockbaum et al. 1954, Fitzwater 1988, Marsh et al. 1992). Once geese have become accustomed to using an area, they are more difficult to haze or scare (Swift 1998).

Heinrich and Craven (1990) did not detect habituation by migrant geese to a sonic scarer over a seven-week period. Urban geese, however, are accustomed to a wide variety of sounds associated with humans (Swift 1998), quickly become habituated to noisemaking devices, and are more difficult to haze than migrant geese (Blokpoel 1976, Fairaizl 1992). To reduce the potential for habituation, the sounds should be as varied as possible (both in location and variations of signal content), should be presented as infrequently as possible, and should be reinforced occasionally (such as by using real gunfire to back up explosions or chasing a flock to back up human effigies).

Initiating hazing when birds first arrive will reduce the number of presentations that are necessary, delaying habituation (Slater 1980, Aubin 1990). This can be accomplished manually or automatically with a call-activated switch controlling the hazing device. A call-activated switch compares sounds it "hears" to various characteristics of a goose call. If a match is made, the hazing device is triggered. Call-activated switches should be able to reduce not only habituation but also noise pollution, propane consumption (if attached to a propane exploder), and maintenance of the hazing device (Heinrich and Craven 1989). A single, call-activated trigger, placed in a grid pattern with other triggers or linked with several exploders, could increase the coverage area. This device, however, may be activated by sounds other than Canada geese (e.g., vehicle noise, wind, and other animals) (Heinrich and Craven 1989). Price and Adams (1989) suggest improving call-activated switches by measuring the shape of the energy spectrum of the target species instead of measuring a key frequency and duration. Thus the hazing device would be activated only if the goose call were louder than background environmental sounds (Price and Adams 1989).

The use of a combination of techniques almost always works better than any single technique alone (Wright 1963, Brough 1969, Ruger 1985). Martin (1979) suggests combining visual and acoustical scarers to increase their effectiveness. Conover and Perito (1981) found that starling distress calls used with an owl decoy reduced nearby bird landings compared with either technique used alone. Hochbaum et al. (1954) and Inglis (1980) found that combining gunfire with scarers increases the efficiency of the scarers. Scare-eye balloons combined with distress calls increased the aversive effect over scare-eyes alone (Inglis et al. 1983).

Efficiency of hazing can be enhanced if undisturbed areas can be set aside within the normal activity range of the geese, where the birds can retreat when frightened away from sensitive areas (Stephen 1961, Owen 1980, Conover

1984, Ruger 1985). Brough (1969) also found that it is difficult to scare feeding birds away when alternative food sources are scarce.

If geese are hazed from an area, they usually do not disperse very far (Spanier 1980) and may become someone else's problem. After implementing a hazing technique, modifying attractive habitat features is recommended.

Hazing birds at airports may increase the number of goose flights, adding to the potential for aircraft-bird collisions (Cooper 1991). Scare devices employed at airports must not leave any debris (e.g., shell cartridges, primer caps, or other metal or plastic pieces) that could be ingested by jet engines (Blokpoel 1976).

Noisemaking devices

Use of these techniques in close proximity to human activities or houses may be unacceptable and may require permits or licenses, especially within city limits. Geese often become habituated to these devices, especially if they are used alone. Habituation may be reduced by the occasional shooting of a few birds. To supplement harassment by shooting, however, the proper state, federal, or provincial permits first must be obtained. In addition, people not familiar with firearms should contact their state wildlife agency or USDA-APHIS-Wildlife Services office for appropriate instruction or training materials.

If the devices cannot be triggered automatically, labor to fire them will be a major portion of the cost of these techniques. People using these devices should wear eye and ear protection.

Sirens, airhorns, and whistles: Simple auditory devices such as emergency sirens, nautical horns, and electric whistles played at loud levels can be used to scare geese. They can be mounted on vehicles, hand held, or operated remotely. Migrant geese appear more susceptible to these noises and are less likely to become habituated than geese accustomed to urban environments (Heinrich and Craven 1990).

Blanks: Firing nonprojectile, blank cartridges from firearms or starters' pistols on a field or grassy area can be effective at scaring geese (Hochbaum et al. 1954, Kemper 1995). For habituated geese that do not scare easily, blanks can be combined with a taped distress call to increase effectiveness (Kemper 1995). Gunfire used at the time of setup enhances later use of other scare devices alone at the same location (Hochbaum et al. 1954). For maximum effectiveness, the shooting should be performed in the same area as the scare devices (Inglis 1980).

Bangers, screamers, and whistle bombs: Bangers are specialized projectiles usually fired from a 15-mm launcher with a range of 20 to 30 yards. Bangers are less expensive than cracker shells. Screamers or whistle bombs are also fired from a 15-mm launcher and usually have a 30-yard range. The propellant flies erratically and emits a shrill whistle or scream. Use caution because if these projectiles are fired at too low a trajectory, they may start fires in dry vegetation.

Cracker shells: Crackers are special shells fired from a 12-gauge shotgun. Projectiles fly up to 100 yards and explode with a bang similar to that of a large firecracker. When firing cracker shells, hold the gun barrel at or above 45 degrees, and do not use a full-choke barrel. It is possible for the shot shell wad to stick in the barrel of the gun, leading to a dangerous situation if another shell is fired. The barrel should be inspected after each shot, and using a break-action shotgun simplifies inspection. A hardwood dowel longer than the barrel can be used to clear the wad. Use caution because if these projectiles are fired at too low a trajectory, they may start fires in dry vegetation.

Propane cannons and exploders: Propane cannons and exploders do not fire a projectile but simply create a noise much louder than a shotgun blast (**Figure 8**). Detonations are controlled by a timer, and the devices should be turned off when the geese are not using the area. Some cannons can be controlled by photocells for daytime use only; others can be placed on "kitchen-type" timers for use only during specific hours. They should be moved regularly to delay habituation by the geese.

A single exploder is effective for 10 to 50 acres depending on conditions and the landscape. Cannons that rotate randomly on detonation may minimize habituation by geese. Two single exploders set to trigger at different intervals (e.g., one every 10 minutes, one every 7 minutes) are more effective than a single cannon. The sound produced by an exploder has been intensified by attaching an open-ended drum to the muzzle end of the exploder, thus redirecting and amplifying the sound (Bird and Smith 1963), although this may be contrary to the manufacturers' instructions or void any warranty.

Propane exploders work best when used with other techniques such as flagging or scare balloons. Combining a cannon with a moving human silhouette carrying a gun will increase the effectiveness of both techniques (Wright 1963).



Figure 8. Propane cannon.

Other pyrotechnics: Fireworks produce a loud report and a flash and have been used to scare birds from fields at night. They pose a significant fire and safety hazard, however, so they should be used very carefully. Local regulations may limit the use of fireworks in residential areas.

Distress calls: Recorded distress calls can scare geese away from a specific area and also prevent more geese from landing (Spanier 1980). Briot et al. (1988) suggest that the volume of the distress calls should be approximately 80 decibels at its source. Distress calls tend to be species-specific, so only Canada goose distress calls will be effective on geese. Species-specific distress calls may be effective at much lower volumes than other hazing techniques (Slater 1980).

Recorded bird calls can be either natural or synthetic. Natural calls are sounds produced by the animal and may be recorded in wild or captive settings. Birds may not habituate as quickly to natural distress calls as to other hazing sounds such as a propane cannon (Slater 1980). To vary the stimuli as much as possible, synthetic bird calls can be used in combination with actual recorded calls (Aubin 1990). Synthetic calls are created in a sound studio and contain only specific characteristics of a bird's call. They are easier to modify, start with a higher signal-to-noise ratio, and will not degrade over time as would naturally tape-recorded calls (Aubin 1990).

Success with distress calls has been mixed. Aguilera et al. (1991) found them to be ineffective against Canada geese, but other field tests of alarm calls indicated that all geese within 160 yards of a broadcast took flight. Mott and Timbrook (1988) reported that Canada goose alarm calls deterred geese for two to three weeks, but the geese moved only a short distance and returned immediately after the calls stopped. These results suggest that distress tapes might be more effective on migrant rather than resident geese when only short-term success is needed. Combining alarm calls with a visual stimulus will increase the effectiveness of both techniques (Blokpoel 1976, Conover and Perito 1981, Inglis et al. 1983).

Ultrasonic devices: Hearing of bird species tested fell within the human range (20–20,000 Hz), making it unlikely that ultrasonic sounds would affect them (Blokpoel 1976, Boudreau 1968, Erickson et al. 1992). In laboratory settings, restrained Canada geese responded to bursts of high-intensity 22–23 KHz sound by becoming catatonic. Bird calls contain many inflections and tonal qualities, however, so it is unlikely that a narrow, unwavering beam of sound would mean anything to birds (Boudreau 1968). Ultrasonic sound waves attenuate quickly, drastically reducing the effectiveness of this technique in field situations.

Erickson et al. (1992) reviewed many studies on the use of ultrasound in bird control and concluded that it was ineffective. Similar conclusions were reached in other studies that tested devices producing pulsed or continuous



Figure 9. Flag placed in an agricultural field.

ultrasonic tones (Blokpoel 1976, Martin 1979, Griffiths 1988, Woronecki 1988).

Visual frightening devices

These techniques are usually inexpensive, may be quickly implemented, are quiet so they can be used in most urban situations, and are easily combined with other hazing tactics. Drawbacks are that they may visually detract from an area, require regular maintenance owing to normal wear, and may be targets for vandals. Geese may become habituated to these devices, especially if they are used alone, and are unlikely to disperse far from them.

Strobe lights: Strobes may be useful only if the goose problem occurs at dusk or at night. Flashing or rotating lights startle geese and make them uneasy. This technique is very quiet, but because of the lighting effect it may be unacceptable if used near human activity or houses.

Mylar tape: Mylar tape is silver on one side, usually red on the other, and is very shiny and reflective. It can be used in two ways: as streamers set on poles or strung between posts in the form of a fence (see Fences).

A mylar fence will not be effective if the geese fly into the area. Deer, dogs, other animals, and children routinely break mylar tape, thus necessitating daily examination and repair of tape fences. Mylar streamers may deter geese as they fly into an area and will not break as often as a mylar fence but should also be examined regularly, especially after a storm or high wind.

Flags: Flags placed in agricultural fields have been used to discourage geese from landing (Figure 9). This technique is most suitable if there is a steady wind.

Waterfowl have color vision comparable to that of humans (Oppenheim 1968, Lipcius et al. 1980). Several flagging techniques use black plastic, although some hunters use black flags to attract geese to decoys. Lipcius et al. (1980) reported that orange was the most aversive color to geese. Kear (1964) observed that goslings were indifferent to red or orange and avoided blue colors. Heinrich and Craven (1990) found that, although brightly colored flags deterred migrant geese from a field, the geese would land in a nearby field and walk over to the field where flags were present. These results indicate that the flag's color may be less important than where it is placed and how frequently it is moved.

Many types, colors, and sizes of flags have been created to scare Canada geese. A simple design uses plastic garbage bags on tall poles. The thicker the bags, the better. To make this basic flag:

- (1) cut a large garbage bag along the sides and bottom, creating two flags.
- (2) cut three slits one-third the length of one flag to create four flaps.
- (3) mount flag on poles 8 feet or higher above the ground.

This design has several variations: (1) 6-foot x 30-inch mylar strips on 4-foot stakes, (2) 2-x-3-foot poly sheeting on 6-foot poles, (3) colored mesh vegetable bags filled with straw and suspended from 10-foot poles placed at an angle to permit the bag to swing free, and (4) a pole with a crosspiece at the top with a garbage bag draped and stapled to the crosspiece (the "garbage bag scarecrow").

"Eye-spot" or other balloons or kites: "Eye-spot" or "scare-eye" balloons are large, beach ball-sized, thick-skinned balloons that have been used to scare geese in some situations (Figure 10). Eye-spots elicit a flight response from several species of birds (Inglis 1980). Experiments on the effectiveness of eye-spots (Inglis et al. 1983) found that

- (1) three eyes are more aversive than two; two are more aversive than one,
- (2) "pupils" inside the circles are better than plain circles,
- (3) eyes with colored irises are more effective than black and white images,
- (4) eyes surrounded by a head outline diminish the scaring effect, and
- (5) scare-eyes used with distress calls had an additive aversive effect.

Helium-filled eye-spot balloons tethered 10 feet above the ground with 75-pound-test monofilament line can also be used. Eye-spot balloons have also been used as heads on "garbage bag scarecrows" with success.

Balloons should not be used near trees, shrubs, or other objects that could cause punctures, nor should they be hidden from view. Eye-spot balloons are also attractive to humans and may be stolen. Generally, balloons affect only small areas, and the geese become accustomed to them.

Kites used for hazing are usually shaped to depict a bird of prey such as an eagle or hawk. Although researchers have found that a hawk silhouette elicited an alarm response from goslings (Tinbergen 1951), kites are not mentioned specifically in the literature as hazing devices for Canada geese (Conover 1979). Inglis (1980) found that birds habituated to hawk kites very quickly. Flying kites can also be very labor intensive. Kites are hazardous to low-flying aircraft and cannot be used near trees or overhead wires (Fazlul Haque and Broom 1984).

Scarecrows: Scarecrows, especially human effigies, may scare geese from specific areas. Movement, especially that of arms on human effigies, enhances the effectiveness of scarecrows (Markgren 1960, Inglis 1980, Conover 1985c). Human effigies that inflate or pop up periodically are also more effective than static ones.

Nonmoving, human-shaped scarecrows are more effective if they appear to be carrying a shotgun (Inglis 1980, Quarles 1995). Geese were deterred from landing in fields surrounded by trees in which inanimate scarecrows were placed, although the birds would land nearby and walk into the field (Heinrich and Craven 1990).

The addition of sound devices may also increase the efficacy of scarecrows (Wright 1963, Conover and Perito 1981, Cummings et al. 1986, Marsh et al. 1992), especially in areas where the geese have lost their fear of humans. Combining a propane cannon with a moving human silhouette carrying a mock gun increased the effectiveness of both techniques (Wright 1986). Marsh et al. (1992) suggested using a lifelike scarecrow in addition to distress or scare tapes.

Placing scarecrows in the area before birds arrive enhances their effect. A human scarecrow (a mannequin with orange overalls and yellow plastic overcoat) in a boat reduced waterfowl use of a pond by 75 percent. Resident waterfowl eventually habituated to the floating scarecrow, but migrant waterfowl did not (Marsh et al. 1992).



Figure 10. "Eye-spot" or "scare-eye" balloon.

Geese were found to land less frequently near models of geese that had their heads and necks stretched up fully (which mimics an alarm posture) (Inglis and Isaacson 1978). An inanimate scarecrow designed to imitate a dead goose has been used near the Kansas City area with mixed success. Open-winged decoys were found to work better than closed-winged decoys (Murton 1970). Dead gulls have been used successfully to scare gulls at airports (Hardenberg 1965, de Jong and Blokpoel 1966, Saul 1967); the dead gulls had a tendency, however, to lose feathers and body form after a few days, especially after a severe storm. Using dead Canada geese as effigies may be objectionable to some people and may require additional state or federal permits.

Decoy swans (see Swans, below) have been used with limited success to deter geese from landing on ponds (Kemper 1995). To be successful, however, the decoys need to be in place before any geese arrive. Eagle scarecrows are advertised to scare geese, but Craighead and Craighead (1949) report that Canada geese apparently do not fear eagles. Snake models are ineffective with most birds (Marsh et al. 1992). Plastic alligators were used to scare geese in Illinois.

Dogs: Dogs have been used in several locations to chase geese (Figure 11). The dog may be allowed to roam (if not against leash laws); tethered to a long lead (which may require relocating the dog and tether frequently to cover more area); chase and retrieve a decoy projected over a large flock; or periodically released to chase the birds. If the dog is allowed to roam, an invisible pet fence may be an option to keep it on the property.

The use of dogs may be enhanced by habitat modification (i.e., making the overall area less attractive to the geese) and by providing a nearby untreated area where the geese would be tolerated. The best times to use dogs to harass geese are during spring (to reduce nesting) and late summer after the geese regain flight (Swift 1998, Castelli and Sleggs in review).

Dogs, especially border collies, have been effective in keeping golf courses and other large properties free of geese when directed by a handler (Kemper 1995, Swift 1998, Castelli and Sleggs in review). They may be purchased from a dealer for \$2,000 to \$4,000, or they may be rented from trainers weekly, monthly, or semipermanently. It was estimated to cost an initial \$9,400 to purchase two dogs, invisible fencing, and kennels, and \$2,000 per year to maintain a border collie program at a corporate complex in New Jersey from 1990 to 1997 (Castelli and Sleggs in review).

Once dog harassment has ended, the geese may quickly reestablish themselves near pretreatment numbers (Swift 1998). By federal law, dogs cannot be allowed to catch or harm geese. During midsummer when the birds are flightless, dogs should be leashed to prevent them from capturing the geese. The use of dogs to harass geese may require a state permit. Local leash laws should also be consulted before dogs are used.



Figure 11. Trained dog scaring a goose.

Swans: In the wild, swans (genus *Cygnus*) can be very aggressive and territorial toward Canada geese, even driving them off nests (Kossack 1950). Releasing native swans in urban areas, however, is contrary to most, if not all, North American swan restoration plans. It has also been observed that because swans and geese prefer similar habitats, the swans may actually attract geese. The non-native mute swan (*Cygnus olor*) has been used in the past to keep Canada geese out of ponds; the swans, however, can be even more problematic than the geese. The use of live mute swans is not recommended because they are not a native species, and they may become more aggressive than geese.

Falcons: Trained falcons have been used to chase birds away from airports, but no mention was made in the literature of using trained birds of prey on Canada geese (Blokpoel 1976). Because geese are so much larger than falcons, it is unclear whether falcons would chase geese or whether the geese would even recognize them as a threat.

Radio-controlled aircraft: Radio-controlled (RC) aircraft have been used since the early 1980s to haze birds, mainly over airports. Fixed-wing and helicopter RC aircraft were effective in scaring Canada geese away from the Reno, Nevada, airport (Fairaizl 1992). By the third day of use, the geese took flight as soon as the RC aircraft left the ground. After use of the RC aircraft ceased, it took 10 days for geese to return to pretreatment numbers at the airport (Fairaizl 1992). This technique was used successfully on birds at the Auckland Airport in New Zealand (Saul 1967) and the Ben Gurion International Airport in Tel Aviv, Israel (Amir 1989). Though effective, RC aircraft are labor intensive and expensive.

Vehicles and boats: Pickup trucks used to haze geese at the Minneapolis-St. Paul International Airport were ineffective. The geese simply flew to the other side of the runway or to nearby grassy areas (U.S. Fish and Wildlife Service 1981). Geese in urban areas are likely habituated to vehicles and would probably not respond to this technique. Vehicular

patrols do have some applications, especially if combined with noisemaking devices such as cracker shells. In rural areas, one person in a vehicle efficiently covered 30 square miles of farmland (Hochbaum et al. 1954).

Airboats were effective at hazing large numbers of Canada geese off specific parts of Horicon National Wildlife Refuge in Wisconsin (Rusch et al. 1985). The airboats were useful day or night but were expensive, labor intensive, and unpopular with citizens disturbed by the noise at night (Rusch et al. 1985). Hovercraft combined with bird bangers have been used successfully to scare geese from a water-supply reservoir.

Flocks of geese in rural areas have been hazed with fixed-wing airplanes or helicopters (Vick 1970), but this is extremely dangerous and we do not recommend it. The only exceptions may be the use of helicopters in emergency situations such as public health or disease outbreak. Helicopters are very expensive to operate (\$300-\$500 per hour), and permits may be required. Canadian Wildlife Service permits are required to use aircraft to haze migratory birds in Canada.

Chemical Repellents

Chemical repellents are an attractive tool because they are visually and acoustically unobtrusive, may be applied directly to the problem area, may not harm the geese permanently, and are generally accepted by the public (Mason and Clark 1992). Limitations on repellents include high costs, necessity to reapply them frequently, odors associated with the few registered products, influence on the behavior of other wildlife, and poor or mixed efficacy. Repellents cannot prevent goose activities such as loafing or swimming, and they have had inconsistent or inconclusive results at reducing grazing, limiting their overall utility.

Methiocarb was shown to be an effective repellent for geese (Conover 1985a) and other birds (Dolbeer et al. 1994). In addition, some insecticides for turfgrass may have bird-repellent properties (Kendall et al. 1993). However, none of these products is currently registered by the U.S. Environmental Protection Agency as a goose repellent.

The only available goose repellents for turf areas, ReJeX-iT and Bird Shield, are made from a naturally occurring, nontoxic, biodegradable food ingredient called methyl anthranilate (MA). MA is an aversive chemical that apparently makes grass unpalatable to Canada geese. Therefore, if the geese are using the grass area for activities other than feeding, MA may not be effective. MA is fairly reactive once exposed to the environment, so that it does not persist and accumulate (Vogt 1992). Recent advances in applying ReJeX-iT by fogging, however, may eliminate these problems.

MA, like all pesticides, should be applied only at rates suggested on the label. The labels for both ReJeX-iT and Bird Shield warn that they should only be applied in non-

fishbearing waters, indicating that they may kill or at least adversely affect fish. Lepidoptera (moths) were attracted to pools of water that had been treated with MA and subsequently drowned (Belant et al. 1995). Both ReJeX-It and Bird Shield are general-use repellents that are available to homeowners. Belant et al. (1995) suggested that much lower levels of MA were needed to repel birds from water than from grass. Tests evaluating ReJeX-It's effectiveness on Canada geese (Cummings et al. 1991, Belant et al. 1996) and other species (Mason et al. 1991, Avery et al. 1996) have been inconclusive.

Control of Reproduction

Canada geese have a long life span once they survive their first year (Bellrose 1976, Cramp and Simmons 1977). Legband recovery data indicate that some geese live longer than 20 years.

The most efficient way to reduce the size of an urban flock is to increase mortality among adult geese. Hunting is the major cause of goose losses, but geese may seldom be available to hunters in an urban environment.

Impairing reproduction can stabilize flock size, and several techniques can lower the reproductive output of Canada geese. These techniques are time-consuming and are most appropriate for urban areas with concentrated nesting sites. All of the techniques covered in this section require federal and state permits.

Techniques that inhibit reproduction require a long-term commitment because the population declines only with the loss of adults. To equal the effect of removing an adult goose, all eggs produced by that goose during its lifetime must be destroyed, which may be much more expensive than killing the adult. In Minnesota, destruction of a single egg (including labor, equipment, and travel) cost an estimated \$6.38 (Cooper and Keefe 1997). Multiplying that cost by the number of eggs a typical goose produces over its lifetime indicates that egg destruction is equivalent to about \$80 per adult removed (Cooper and Keefe 1997). Killing an adult goose was estimated to cost \$0 to \$24, depending on the method used (Cooper and Keefe 1997). These costs may be reduced by using trained volunteers where local, state, and federal laws permit.

To be effective, birth control efforts must be nearly complete. If a small number of geese, nests, or eggs are not treated, the resulting recruitment may be sufficient to offset any losses to mortality. Population simulations indicated that an urban Canada goose flock could remain stable even if 72 percent of the eggs were removed each year. Even if 95 percent of eggs were removed, the population would fall to only 75 percent of its original size in 10 years (Barnard 1991). It is also likely that the survival of remaining clutches would be enhanced (Owen 1990). Birds that fail to hatch eggs for several years in succession may shift to new

breeding sites, increasing densities and potential conflicts in those areas.

Wright and Phillips (1991) suggested a combination of egg destruction and increased winter shooting to reduce local populations, although this method is not applicable in all areas. Even forcing breeding pairs to renest may reduce goose numbers locally because early-nesting geese hatch more eggs and rear more young than do later-nesting birds (Johnson and Sibly 1991).

Remove new nesting material daily

Removing a nest forces breeding geese either to relocate to an undisturbed area, build a new nest, or nest later in the season. Canada geese may take from a day to a week to construct a nest before they lay eggs. Destroying nests is very labor intensive, requiring daily (or more than once a day) visits to potential nesting areas. Nest removal is further complicated by the difficulty in finding nests and the tendency of geese to nest on islands. Additionally, the nest initiation period may last for several weeks, and the first egg may be laid less than 24 hours after the nest is initiated.

This technique has limited application in small areas where nests are easily accessible, visible and labor is cheap or free. Once eggs have been laid, this technique is usually not useful.

Oiling, addling, or puncturing eggs

Oiling eggs prevents gases from diffusing through an egg's outer membranes and pores in the shell, thereby causing the embryo to die of asphyxiation (Blokpoel and Hamilton 1989, Christens et al. 1995). Typically, the eggs are taken out of the nest, covered with an oily substance by brushing, dunking, or spraying, then replaced in the nest.

Addling (or shaking) involves vigorously shaking the eggs until sloshing is heard, thus destroying the embryo.

Puncturing is done by pushing a thin, strong pin through the shell (**Figure 12**), which introduces bacteria. The pin can be rotated inside the egg to ensure that the embryo is destroyed. The eggs are treated and replaced so that the female goose continues to incubate in a futile attempt to hatch the eggs. If eggs are simply removed, geese generally renest and produce another clutch.

Baker et al. (1993) suggested that, in the interest of humane treatment, these techniques be performed as early in incubation as possible. This must be balanced against getting to the nest after all the eggs have been laid; otherwise a repeat visit will be required because eggs laid after the initial visit will remain viable. Egg oiling should be performed between the fifth day after the last egg of a clutch is laid and at least five days before hatching is anticipated. If the eggs are aged by flotation and incubation is beyond 18 days (Westerkov 1950), the eggs can probably be removed without causing renesting.

During the initial visit, the nests must be marked so they can be relocated. Nest sites should be recorded on a map and a flag placed about 30 feet from the nest bowl. Placing the flags closer may attract predators, and nests or eggs taken by predators may stimulate renesting. All flags should be placed in a consistent direction (e.g., always north) from the nest bowl. Then the eggs in the nest should be treated (oiled, addled, or punctured) and marked with a soft pencil. A second visit to the nest, 7 to 10 days after the first, may be necessary to treat any eggs laid after the first visit.

The gander usually defends the nest much more intensely on the second visit than on the first, so that additional field personnel may be needed just to fend off the geese. During the second visit, new eggs will be unmarked and probably cleaner. Eggs addled during the previous visit will have started to build up gas from decay and should not be touched because they may burst if handled. In addition to the mess and unpleasant smell, with few or no eggs left to incubate the goose pair may renest.

Many oils are effective in reducing the success of hatching (Baker et al. 1993, Christens et al. 1995, Pochop et al. 1998). Only 100 percent food grade, corn oil is exempt from U.S. Environmental Protection Agency regulations in the United States, however, and this is the only oil that may be used to treat eggs (Federal Register, Wednesday, March 6, 1996, 66 (45): 8876-8879). Mineral oil (Daedol 50 NF) is registered as an avicide in Canada and may be used to treat eggs there. Christens et al. (1995) found that spraying mineral oil on eggs either early or late in incubation prevented 100 percent of eggs from hatching. In Britain, eggs treated with liquid paraffin did not hatch (Baker et al. 1993). The paraffin did not affect the plumage of the nesting adults, nor did the geese make any attempts to form a second nest after the first nest failed. The liquid paraffin appeared to enter the egg's surface quickly, and subsequent



Figure 12. Egg puncturing to reduce production of young geese.

dissection showed that the embryos died rapidly. The eggs must be completely covered with liquid paraffin because partial coating did not prevent hatching (Baker et al. 1993).

At Burnaby Lake, British Columbia, addling had a stabilizing effect on the local goose population. An average of 665 eggs were treated from about 117 nests each year (Smith 1995).

Incubating female Canada geese may spend only 8 minutes per day feeding, relying mainly on stored fat to support their daily energy needs during this time (Cooper 1978). Treating eggs tended to increase the incubation time spent by the female (Baker et al. 1993), which may add to her nutritional stress (Cooper 1978).

Overall costs for these methods may be as high as \$40 per egg treated (Keefe 1996) but would be lower in high-density nesting areas.

Replacing eggs with dummy eggs

Eggs can be removed from the nest and replaced with dummy wood or plastic, unfertilized, or hard-boiled eggs. The goose will continue to incubate rather than renest.

In Toronto, Canada, seven years of egg removal reduced the local population from 1,000 to 600 geese because adults continued to be killed by hunting and other causes (Addison and Amernic 1983). Seventy-two percent of the nests that contained wooden or hard-boiled eggs continued to be incubated for an average of 38 days. Although only two replacement eggs were put into the nests, few geese laid more eggs, resulting in only one gosling hatching from 39 nests (Wright and Phillips 1991).



Figure 13. Capturing live geese during a "round-up."

This method may be simpler than oiling, addling, or puncturing because once potential nest sites are identified, field workers need to visit the nest only once. During this visit, the intensity of the gander's nest defense may require one person to keep the gander away from the nest while another attends to the eggs. This visit should be made sometime after the first week of incubation to ensure that a complete clutch has been laid and that renesting is unlikely to occur.

When eggs were removed during the first week of incubation but not replaced, 80 percent of goose pairs renested. If eggs were removed after the first week of incubation (when laying was completed), 21 percent of the pairs renested, but only 28 percent of the second clutches were incubated (Wright and Phillips 1991). Overall costs for these techniques may be as high as \$40 per treated egg (Keefe 1996).

Sterilization by surgical neutering

Surgical sterilization of male Canada geese (vasectomy) is effective in reducing productivity, although breeding males must first be caught, identified, and then treated (Converse and Kennelly 1994). In a survey of urban citizens and golf course superintendents, 81 and 90 percent of the respondents, respectively, approved of adult sterilization as a control method (Breault and McKelvey 1991). The drawbacks of this method include high labor costs and the need for experienced field staff (Converse and Kennelly 1994, Keefe 1996). Sterilization may also alter the behavior of treated males, allowing other males to mate with the female geese.

Sterilization by oral contraception

Although chemical inhibition of reproduction in problem animals is conceptually attractive and perceived to be humane, chemosterilants are not yet commercially available for Canada geese (Allan et al. 1995). New experimental drugs that inhibit bird reproduction are currently being tested by the USDA National Wildlife Research Center and other research institutions.

Removal

Removal of geese has several advantages. This technique may be applied directly to the problem population, its effects are obvious and immediate, and it carries much less risk that the geese will move and create conflicts elsewhere. Use of translocation or lethal techniques outside of legal hunting seasons requires permits (see Regulations Covering Canada Geese), and lethal techniques are almost always controversial.

Some techniques require the capture of live geese. If the geese are flightless, they are usually easily rounded up by herding them into specially designed nets (Figure 13), or capturing them with long-handled dip nets. If the geese are capable of flight, they must be immobilized with drugs or

captured in rocket-nets. All capture techniques require permits, and local, state, and federal officials should be consulted before they are used.

Canada geese are usually captured by drive trapping, in which a group of flightless geese is herded into a net (Pakulak and Schmidt 1970). Drive trapping is used to catch adult geese during their molting period in early summer, as well as juveniles before they have gained the ability to fly. The net should be set up on a dry, flat area away from roads or other areas where the geese may be injured. On hot days, the capture area should be shaded and close to the transportation vehicles. The net should be 48 inches tall and made of cotton or plastic so the geese do not injure their bills while scraping against it. The net should be supported every 15 to 20 feet with poles. Generally, the net is placed in the shape of a circle with an open side that forms a funnel. People herd the geese into the net by walking slowly, hands outstretched, forcing the geese toward the open end of the net. Canoes and other boats can be used to herd swimming geese onto the shore toward the capture area. Once the geese have been herded into the net, the side(s) of the funnel are closed. The geese can then be hand captured by wildlife personnel. Canada geese tend to congregate on the side of the net farthest from people. In large groups, the juveniles may be trampled, so they should be removed from the net first.

Drive trapping does not require the use of chemicals or baits, and the nets may be reused many times. It can be performed almost anywhere and does not harm the geese when done correctly. This method is relatively inexpensive because volunteers may perform much of the herding. Geese are flightless for a relatively short period of the year, however (see *Biology of the Canada Goose—Molting*), so this technique is feasible only during early summer.

Dip nets have been used to capture geese along banks of streams and rivers (Vaught and Arthur 1965). This technique is labor intensive and has a higher potential to injure the captured geese than does drive trapping.

Geese capable of flight may be sedated with alpha-chloralose, a sugar and chloral hydrate combination that immobilizes birds when orally ingested. This chemical has been used since 1897 to anesthetize laboratory animals (Balis and Monroe 1964). It is usually incorporated into bread bait by suspending it in corn oil or margarine, or as a tablet pressed into the bait (Belant and Seamans 1997). Alpha-chloralose is slow acting (30-90 minutes from ingestion to immobilization), nonlethal, and allows managers to control both the numbers and the specific individuals captured at problem areas (Woronecki et al. 1990, 1992, Woronecki and Dolbeer 1994).

Alpha-chloralose is closely controlled by USDA-APHIS-Wildlife Services and requires operator certification. To use alpha-chloralose, an application must be submitted to the appropriate Wildlife Services state director. Wildlife Services has produced several comprehensive handbooks for

using alpha-chloralose, from which the following information has been summarized.

Alpha-chloralose cannot be used during or 30 days before goose hunting seasons. Authorized alpha-chloralose users must also possess necessary local, state, and federal permits for capturing, relocating, or euthanizing birds. Adequate prebaiting is necessary to ensure that target birds will receive proper dosages and to prevent accidental dosing of nontarget animals.

Because of the prebaiting requirement and the logistics necessary for safe and proper handling of treated birds, alpha-chloralose is unsuitable for conducting large-scale capture of geese at nuisance areas.

Cannon nets are an efficient method for capturing large numbers of waterfowl. Generally, an area is baited with grain, and a net attached to projectiles is folded down on one side of the baited area. Once a sufficient number of birds are within the baited area, an operator triggers the cannons sending the net over the flock of feeding birds. Field staff then hand capture individual birds from under the net.

This technique requires large, open areas and has previously been used mostly in farm or refuge areas. Because the net is propelled by explosives, noise ordinances may preclude the use of this technique in urban areas.

Translocation

Relocating geese from urban environments has had mixed success (Addison and Amernic 1983, Cooper 1986, 1991). Translocating adult Canada geese is often ineffective because they have strong homing instincts and tend to return to their former nesting area (Cooper 1978, Keefe 1996). Although flightless young relocated without adults often do not return to their former homes (Cooper 1986, Smith et al. in press), relocating juveniles will not significantly reduce the local population because the adults continue to return and nest. This technique was widely used as long as other locations were willing to accept Canada geese, however today it is a short-term management technique because few, if any, locations will accept them.

In Minnesota, adult geese were trapped and moved to Oklahoma, and juveniles were moved within Minnesota for several years (Cooper 1986). Very few juveniles returned to capture sites. From 13 to 28 percent of the adults returned, however, and the rate of return increased over time (Cooper 1986). In a subsequent study, 10 to 20 percent of adults returned to their original capture sites (Keefe 1996). Overall, translocation reduced the breeding population 40 to 50 percent after one year and 70 to 90 percent after two years.

Translocating flightless, juvenile geese without adults to state-managed wildlife areas where hunting is allowed has successfully removed those geese from the urban environment. Many juvenile geese had not learned the location of

their birth site and did not return to their nesting area (Cooper 1986, Smith et al. in press). The juveniles remained near the release sites and added to the local sport harvest.

In Ohio and Michigan, 703 juveniles were translocated between 1988 and 1993 (Smith et al. in press), and none of these geese were seen back at their original nesting sites. They were harvested at a similar rate and distribution at the state game areas as birds born and raised at those sites, and their survival rates were half those of juveniles that remained in the urban areas.

Any trapping and handling technique for capturing and transporting Canada geese requires federal and state permits, trained personnel, and specialized equipment. Rounding up a flock of geese is labor intensive, expensive, and is usually performed by state wildlife personnel. In Minnesota, translocation costs were contracted to the University of Minnesota by the local government or private landowners (Keefe 1996). Between 1992 and 1996, translocation costs averaged about \$10 per bird.

Single-sex flocks

This technique has been used where some adult geese may be desired or tolerated but a breeding and expanding population is not. Creating and maintaining single-sex flocks is expensive, labor intensive, and ineffective.

Because male and female Canada geese look identical, experienced personnel must sex them using cloacal examination. This requires that all geese be rounded up and sexed and that one sex be transported elsewhere or euthanized. Because this technique is performed on adult geese, translocated birds that are not euthanized may find their way back to the treatment site. Meanwhile, the remaining birds will attract other geese.

Harvest techniques

Although hunting is the major cause of death in Canada goose populations, urban flocks can be difficult to hunt, within the framework of traditional seasons and bag limits. The same regulatory guidelines designed to protect migratory waterfowl, combined with increasing urbanization, have limited the effectiveness of waterfowl seasons for controlling populations of urban geese. Resident Canada goose flocks are more likely to be found in towns that have restrictive hunting or firearms ordinances (Conover and Kania 1991). Additionally, vocal and organized animal welfare groups may strongly oppose hunting (see Human Dimensions section). Coluccy and Graber (1994) found that 24 percent of citizens surveyed objected to any lethal means to control geese.

Where possible, harvesting Canada geese can enhance other potential management options. Hunting may increase the overall disturbance encountered by the geese, reduce the protected areas available to flocks for resting or feeding,

increase the effectiveness of acoustical harassment, and remove adult geese that contribute substantially to population growth. The effectiveness of harvest programs can be enhanced by additional removal or puncturing of eggs (Wright and Phillips 1991).

Regular hunt: Any person possessing a valid state hunting license (note: some states also require state waterfowl stamps) and federal waterfowl hunting stamp may shoot Canada geese in areas that are open to waterfowl hunting during prescribed seasons. Because of firearms restrictions and limited access, geese residing in urban environments are often not hunted.

Hunting is the most cost-effective method for managing goose numbers, and citizens often approve of managed hunts for this purpose (Breault and McKelvey 1991, Coluccy and Graber 1994). Areas with goose conflicts that are currently closed to hunting, but that have no firearms restrictions, should be opened during regular waterfowl seasons. Many states have implemented early seasons (starting September 1) in an attempt to harvest more resident Canada geese.

Special-purpose kill permits: This technique can be highly effective in removing small numbers of birds from specific areas or to supplement harassment programs. For example, shooting geese at an airport was found to be highly selective and effective (Godin 1994). These permits are granted to specific individuals for the purpose of killing Canada geese. In addition, many areas can support limited, tightly controlled hunting by special permit. This technique holds particular promise for golf courses, airports, municipal parks, and perhaps industrial sites.

Safety considerations and waterfowl hunting laws mandate that shotguns be used for goose hunting. Shotguns propel pellets over short distances and can saturate the target area at ranges up to 40 yards (DeMuth 1971, Wilson 1978). Thus the ability to hit the designated target is maximized while risk to nontarget animals is minimized. Because nontoxic steel shot is required for waterfowl hunting, size BB, BBB, or T shot loads are typically used for goose hunting. Geese that are accustomed to people in urban areas may be less wary and therefore may be taken with smaller shot. Size BB, steel-shot pellets have a maximum travel distance of 566 yards if the gun is fired at a 37-degree angle. A lower angle of fire will reduce the down range carry of pellets. Consult a local game warden or conservation officer for allowable and effective loads and angles of fire that could be specified for special permits.

At golf courses that geese use as feeding sites, the courses may be closed for two to three hours several mornings each week to permit access by a limited numbers of shooters, thus increasing the opportunity to harvest geese. Liberal bag limits are usually provided to help maximize the harvest because few shooters are usually allowed on the courses.

A goose control program using special-purpose kill permits may include the following components: (1) specific

location and time for the shoot, (2) shooter accuracy test, (3) shooter orientation session, (4) restrictions to shotgun and shell sizes, (5) shooting over decoys, (6) registering kill, and (7) local law enforcement. Similar culling programs have been successfully implemented for white-tailed deer in urban areas for several years.

Nest shooting: Shooting of adult geese at nest sites is applicable only in highly sensitive areas such as airports. Shooting nesting birds reduces flock size and specifically targets breeding geese. This technique is likely to be very controversial and should not be implemented without a substantial public education program. Annual treatments are usually required because new geese will move into the unused habitat unless successful habitat modification techniques are employed immediately after shooting.

Harvest for food bank supplementation: Several states have used nuisance geese as a source of meat for needy people. Supplementing food banks with the harvested geese appears to be acceptable to some communities. Although 24 percent of Missouri citizens surveyed (Coluccy and Graber 1994) objected to any lethal means to control geese, of those respondents, 41 percent approved of processing geese and distributing the meat to homeless shelters.

This method is less costly than most other removal techniques except hunting. Total costs, including capturing, penning, feeding, and processing the geese, varied from \$18 to \$25 per goose (Keefe 1996). In this pilot study, process-

ing costs were (1) breast only (1.5 pounds per goose), \$4.00 per pound (processed domestic goose at \$8.30 per pound), (2) whole breast and legs (3.5 pounds per goose), \$2.30 per pound (processed domestic goose at \$4.00 per pound), and (3) whole goose (9 pounds per goose), \$0.75 per pound (processed domestic goose at \$2.00 per pound).

At the time of this report, USDA approval was required for donations to food banks, so that it was necessary to use USDA-inspected processing plants. Keefe (1996) indicated that a metal detector should be used to detect the presence of steel shot in carcasses. If only geese netted during summer roundups are processed, shot detection is unnecessary.

One concern with processing Canada geese for food is that the geese may be contaminated with pesticides. Several die-offs or poisonings have occurred among Canada geese that were exposed to pesticides (Blus 1998). Most of these instances, however, involved pesticides used for crop protection and are unlikely to have any effect on Canada geese in urban environments. Additionally, many of the compounds responsible for the deaths or poisonings have been banned in the United States (Blus 1998). Environmental toxins that have caused problems in the past (e.g., PCBs, heavy metals such as lead and mercury, DDT, and DDE) have been tested for in samples of geese from urban areas. These tests found either no detectable residues or only baseline levels of contaminant (Cooper and Keefe 1997).

Summary

Canada geese are highly valued and widely recognized by most people as a harbinger of the changing seasons each spring and fall. This important native waterfowl species adds an aesthetic component to wetlands and provides opportunities for recreational harvest.

Geese are extremely adaptable and may use the food and protection provided by humans in urban landscapes for nesting, raising young, molting, feeding, and resting. This has led to increasing numbers of conflicts between Canada geese and people.

It is rarely desirable or possible to eliminate all geese from an area, and management programs strive to reduce goose numbers and related problems to a level that a community can tolerate. Conflicts with Canada geese or other wildlife are socially defined and may include nuisance situations or perceived threats to human health and safety. Solving goose conflicts may involve changing stakeholder attitudes or behaviors as well as modifying goose behaviors or directly reducing flock size.

Quick-fix solutions seldom reduce goose conflicts, and an integrated approach combining several techniques is usually the key to successful management programs. Problems need to be addressed at both the individual site and the landscape scale. Scare techniques, physical barriers, or both often provide short-term relief from goose conflicts on an individual property. This tactic, however, usually moves a problem goose flock to another site. Long-term solutions usually require some form of population management to stabilize or reduce goose numbers. Many communities have difficulty agreeing on the appropriate size of an urban goose flock.

Problems with resident geese are likely to increase in the near future. Because of low mortality of adult birds and favorable habitat conditions for breeding, current population projections indicate that resident goose flocks may double in size every five years. Biologists are finding that some techniques (e.g., habitat modifications or scare

devices) that were effective for low to moderate population levels tend to fail as flock sizes increase and geese become more accustomed to human activity.

Communities often debate the merits of lethal versus nonlethal strategies for managing goose conflicts. Although nonlethal control methods can reduce problems at a specific site, they seldom resolve community-wide issues. When civic leaders discuss lethal methods such as controlled hunting programs, goose roundups, or even egg treatments, they frequently experience strong resistance from animal welfare groups. Few elected officials are willing to bear this political pressure, and they often will discontinue lethal control programs.

Currently no federally registered oral contraceptive drugs are available for Canada geese. Experimental products are being evaluated and may become available during the next five years. Contraceptive agents may be useful for sites where the same small flock of geese can be hand-fed before the nesting season. Community-wide applications of these materials will probably be difficult and expensive, however. Urban flocks tend to be very mobile, and movement studies have shown that small subflocks or family groups of geese may use one or several different sites in the same day. In addition, resident urban geese may mix with migrant flocks before the nesting season, and it would be unacceptable to treat migrant birds with contraceptive agents.

Solving conflicts between people and Canada geese will create a tremendous management challenge for state and federal wildlife biologists for the foreseeable future. Balancing the biological and social dimensions of urban goose issues will require capable, credible, and professional wildlife agency staff. Elected officials must be willing to work with biologists and managers to find goose management solutions that have broad-based community support.

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- Woronecki, P. P., R. A. Dolbeer, T. W. Seamans, and W. R. Lance. 1992. Alpha-chloralose efficacy in capturing nuisance waterfowl and pigeons and current status of FDA registration. *Proceedings of the Vertebrate Pest Conference* 15:72–78.
- Wright, E. N. 1963. A review of bird scaring methods used on British airfields. Pages 113–19 in *Le problème des oiseaux sur les aérodromes*. R. G. Busnel and J. Ginan (eds.). Paris: Institute National de la Recherche Agronomique. 326 pp.
- Wright, R., and N. Giles. 1988. Breeding success of Canada and greylag geese *Branta canadensis* and *Anser anser* on gravel pits. *Bird Study* 35:31–36.
- Wright, R. M., and V. E. Phillips. 1991. Reducing the breeding success of Canada and greylag geese, *Branta canadensis* and *Anser anser* on gravel pits. *Wildfowl* 42:42–44.
- Zucchi, H., and H. H. Bergman. 1975. Long-term habituation to species-specific alarm calls in a song-bird *Fringilla coelebs*. *Experientia* 31:817–18.

Appendix A. Equipment Suppliers

The following equipment suppliers are listed in alphabetical order and categorized by materials provided. This table is provided for the user's convenience and is not considered a comprehensive list. No endorsement is implied for those

included nor were any suppliers intentionally omitted. Local sources of supply may be found in the yellow pages of your phone book or through area pest control firms.

Materials

Suppliers	lines/wires	plants	barrier fence	electric fence	chemical repellents	sonic scarers	blanks	bangers	screamers/whistlers	crackers	propane cannons/exploders	other pyrotechnics	distress tapes	ultra-sonics	strobes	reflective/scare tape	scare-eye balloons/kites	scarecrows	dogs	remote control aircraft
ABK				●																
ADPI			●																	
Air Birdstrike																			●	●
Arbico		●														●	●	●		
Avian Flyway				●																
Bird Barrier	●		●																	
Bird Gard ABC													●							
Bird-X			●			●								●	●	●	●			
BSRC					●															
Coast to Coast																●				
Cornell Labs													●							
DuPont Canada			●																	
FLR																		●		
Gallagher				●																
Garden Store		●																		
Gayle Steed																			●	
Green Valley			●																	
Gurney's Seed			●													●	●	●		
Internet			●																	
Invisible Fencing																			●	
J. A. Cissel	●		●																	
Johnny Stewart													●							

Materials

Suppliers

	lines/wires	plants	barrier fence	electric fence	chemical repellents	sonic scarers	blanks	bangers	screamers/whistlers	crackers	propane cannons/explosives	other pyrotechnics	distress tapes	ultra-sonics	strobes	reflective/scare tape	scare-eye balloons/kites	scarecrows	dogs	remote control aircraft
JT Eaton			●																	
Kencove				●																
M. J. Flynn											●									
Margo Supplies				●			●	●	●	●	●	●				●	●	●	●	
MDT & Associates																●	●			
Mike Consumer	●		●																	
Mill River			●																	
Miller Net			●																	
Nasco Farm			●	●							●					●	●	●		
Nichols Net	●		●																	
Nixalite			●		●												●			
Nylon Net Co.	●		●															●		
Peaceful Valley		●	●													●	●	●		
Premier				●																
RJ Advantage					●															
Reed-Joseph								●	●	●	●		●			●	●			
Richard Owen		●																		
Roy Ladrigan																		●		
Specialty Ag			●																	
Speedrite				●																
Steonco										●										
Sutton Ag						●			●	●	●					●	●	●		
Ted Doge																●	●			
Tenax			●																	
Tri Lite															●					
Twin Mountain				●																
Wildlife Control			●				●		●	●	●				●	●	●			

Appendix B. Suppliers' Addresses and Agency Phone Numbers

ABK

2501 Surrey Ct.
Lincoln, NE 68512
Telephone: 402-335-4069

ADPI Enterprises

3621 B St.
Philadelphia, PA 19134
Telephone: 800-621-0275
Fax: 215-739-8480

Air Birdstrike Prevention

15 Edgewood St.
Worcester, MA 01602
Telephone: 508-797-0002

Arbico

P.O. Box 4247
Tucson, AZ 85738-1247
Fax: 520-825-2038
Telephone: 800-827-2847
E-mail: arbico@aol.com
Web site:
<http://www.usit.net/biconet>

Avian Flyway

Lakewood Office Park, Ste. 101
2231 Ridge Rd.
Rockwell, TX 75087-5142
Telephone: 800-888-0165
Fax: 972-722-0165
E-mail: avianflyaway@azone.net
Web site: <http://www.azone.net/afi>

Bird Barrier America

E-mail: BBSales@BirdBarrier.com
Web site:

<http://www.birdbarrier.com>
West Coast

1312 Kingsdale Ave.
Redondo Beach, CA 90278
Fax: 310-793-1732
Telephone: 310-793-1733

East Coast

300 Calvert Ave.
Alexandria, VA 22301
Telephone: 703-299-8855
Fax: 703-299-0844

Bird Gard ABC

JWB Marlating
101 Hurlbut St.
Westwood, NJ 07675
Telephone: 800-555-9634
Fax: 201-666-7581
E-mail: birdgard@ix.netcom.com
Web site: <http://www.birdgard.com>

Bird-X

300 N. Elizabeth St.
Chicago, IL 60607
Fax: 312-648-0319
Telephone: 800-860-0473

B S R C

P.O. Box 785
Pullman, WA 99163
Fax: 888-332-0190
Telephone: 888-332-1989
E-mail: skham@bsrc.com
Web site: <http://www.bsrc.com>

Coast-to-Coast

Park Rapids, MN 56470
Telephone: 218-732-4513

Cornell Laboratory of Ornithology

Andrea Priori
Library of Natural Sounds
Ithaca, NY 14850
Telephone: 607-254-2407
(Monday–Friday, 1:00–5:00 p.m.)
Fax: 607-254-2439
E-mail: alp8@cornell.edu
Web site:
<http://www.ornith.cornell.edu>

DuPont Canada

201 South Blair St.
Ontario, Canada L1N 5S6
Telephone: 800-263-2742
Fax: 416-487-1985

FLR

Box 108
Midnight, MS 39115
Telephone: 601-247-1257

Gallagher Power Fence

18940 Redland Rd.
San Antonio, TX 78270
Telephone: 800-531-5908

The Garden Store

1950 Waldorf, N.W.
Grand Rapids, MI 49550
Telephone: 800-582-8649
Fax: 800-496-2852

Gayle Steed

Glenn Gael Working Border Collies
Martinsville, OH
Telephone: 215-493-6203

Green Valley Farm

9345 Ross Station Rd.
Sebastopol, CA 95472
Fax: 707-887-7499
Telephone: 800-827-9590

Gurney's Seed and Nursery Co.

110 Capital St.
Yankton, SD 57079
Telephone: 605-665-1930
Fax: 605-665-9718

Internet© Inc.

2730 Nevada Ave., North
Minneapolis, MN 55427
Telephone: 800-328-8456
Fax: 612-541-9692

Invisible Fencing Pet Containment

355 Phoenixville Pike
Malvern, PA 19355
Telephone: 800-824-3647

J. A. Cissel Manufacturing Company

P.O. Box 2025
Lakewood, NJ 08701
Telephone: 800-631-2234
Fax: 908-901-1166
E-mail:
105126.3443@compuserve.com

Johnny Stewart® Wildlife Calls

P.O. Box 7594
Waco, TX 76714-7594
Telephone: 800-537-0652

JT Eaton and Company

1393 East Highland Rd.
Twinsburg, OH 44087
Telephone: 800-321-3421
Fax: 216-425-8353

Kencove Farm Fence

111 Kendall Lane
Blairsville, PA 15717
Telephone: 800-536-2683

Margo Supplies Ltd.

P.O. Box 5400
High River, Alberta, Canada
T1V 1M5
Telephone: 403-652-1932
Fax: 403-652-3511

MDT & Associates

3527 Morgan Ave. North
Minneapolis, MN 55412
Telephone: 612-529-4355

Mike Consumer Products

P.O. Box 4000
Blue Mountain, AL 36204
Telephone: 205-237-9461
Fax: 205-237-8816

Mill River Supply

375 Adams
Bedford Hills, NY 10507
Telephone: 914-666-5774
Fax: 914-666-9183

Miller Net & Twine

P.O. Box 18787
Memphis, TN 38181
Telephone: 800-423-6603

M. J. Flynn

6410 Collamer Rd.
E. Syracuse, NY 13057-1032
Telephone: 315-437-6536

Nasco Farm and Ranch

Telephone: 800-558-9595
Web site: <http://www.nascofa.com>
E-mail: info@nascofa.com
Eastern Office

901 Janesville Ave.
Ft. Atkinson, WI 53538-0901
Fax: 414-563-8296

Western Office

4825 Stoddard Rd.
Modesto, CA 95356-9318
Fax: 209-545-1669

Nichols Net & Twine Co.

2200 Highway 111
Granite City, IL 62040
Telephone: 800-878-6387
Fax: 618-797-0212

Nixalite® of America

1025 16th Ave.
P.O. Box 727
East Moline, IL 61244
Telephone: 800-624-1189
Fax: 309-755-0077
Web site: <http://www.nixalite.com>

Nylon Net Company

615 E. Bodley
P.O. Box 592
Memphis, TN 38101
Telephone: 800-238-7529

Peaceful Valley Farm Supply

P.O. Box 2209
Grass Valley, CA 95945
Telephone: 916-272-4769

Premier Fence Systems

Box 89
Washington, IA 52353
Telephone: 800-282-6631

Reed-Joseph International Co.

P.O. Box 894
Greenville, MS 38702-0894
Telephone: 800-647-5554
Fax: 601-335-8850

Richard Owen Nursery

2300 East Lincoln St.
Bloomington, IL 61701
Telephone: 309-663-9551

RJ Advantage

501 Murray Rd.
Cincinnati, OH 45217-1014
Telephone: 800-423-2473
Fax: 513-482-7377

Roy Ladrigin

P.O. Box 277
Walton, KY 41094
Telephone: 606-525-1995

Specialty Ag

344 E. Dinuba Ave.
Reedley, CA 93654
Telephone: 209-638-3631
Fax: 209-638-4710

Speedrite

Grassland Supply
Rt. 3, Box 6
Council Grove, KS 66486
Telephone: 800-527-5487

Stonoco

P.O. Box 765
Trinidad, CO 81082
Telephone: 800-833-2264
Fax: 719-846-7700

Sutton Ag Enterprises

746 Vertin Ave.
Salinas, CA 93901
Telephone: 408-422-9693
Fax: 800-482-4240

Ted Dodge Service

7604 Michel
Mountain Ranch, CA 95246
Telephone: 209-754-1216

Tenax® Corporation

4800 East Monument St.
Baltimore, MD 21205
Telephone: 800-356-8495
Fax: 410-522-7015

Tri Lite

1335 W. Randolph
Chicago, IL 60607-1523
Telephone: 312-226-7778
Fax: 312-226-5335

Twin Mountain Fence Co.

P.O. Box 2240
San Angelo, TX 76902
Telephone: 800-527-0990

Wildlife Control Technology™

2501 N. Sunnyside Ave., #103
Fresno, CA 93727
Telephone: 800-235-0262
Fax: 209-294-0632
E-mail: wct@wildlife-control.com
Web site: <http://www.wildlife-control.com>

**Phone Numbers of USDA
Wildlife Services and
Canadian Wildlife Service
Offices**

For further information, check your local phone directory for the nearest state natural resources or conservation department, USDA-APHIS-Wildlife Services, or Canadian Wildlife Service office. If such an office is not provided, refer to the following list.

USDA-APHIS-Wildlife Services**Alabama**

Greensboro: 334-624-8711
Montgomery: 334-273-0384

Alaska: 907-745-0871**Arizona: 602-870-2081****Arkansas: 870-324-5038****California**

McArther: 916-336-5623
Maxwell: 916-438-2706
Modesto: 209-545-4639
Paso Robles: 805-237-0912
El Cajon: 619-561-3752

Colorado

Lakewood: 303-969-5775
Grand Junction: 970-242-9155

Connecticut: see Massachusetts**Delaware: see Maryland****District of Columbia: see Maryland****Florida: 305-883-7670****Georgia: 706-546-2020****Hawaii: 808-861-8575****Idaho: 208-334-1440****Illinois**

Springfield: 217-241-6700
Chicago: 773-686-6742

Indiana: 765-494-6229**Iowa: 515-233-9130****Kansas: 913-532-1549**

Kentucky: 502-582-5536
 Louisiana
 Crowley: 318-783-0182
 Monroe: 318-343-6499
 Maine: 207-622-8263
 Maryland: 410-269-0057
 Massachusetts: 413-253-2403
 Michigan: 517-224-9517
 Minnesota
 St. Paul: 612-290-3156
 Grand Rapids: 218-327-3350
 Mississippi
 Mississippi State: 601-325-3014
 Stoneville: 601-686-3157
 Missouri
 Columbia: 573-446-1862
 Whiteman AFB: 816-687-3046
 Montana: 406-657-6464
 Nebraska: 402-434-2340
 Nevada: 702-784-5081
 New Hampshire: 603-225-1416
 New Jersey
 Pittstown: 908-735-5654
 Atlantic City International
 Airport: 609-485-6938
 New Mexico
 Albuquerque: 505-761-4640
 Las Cruces: 505-527-6980
 New York: 518-477-4837

North Carolina: 919-856-4124
 North Dakota: 701-250-4405
 Ohio: 419-625-9093
 Oklahoma
 Pawnee: 918-454-2387
 Antlers: 405-298-3817
 Thomas: 405-661-2236
 Oregon
 Roseburg: 541-672-6418
 John Day: 541-575-1252
 Pennsylvania: 717-728-0700
 Rhode Island: see Massachusetts
 South Carolina: 803-786-9455
 South Dakota: 605-224-8692
 Tennessee
 Nashville: 615-736-5506
 Knoxville: 423-588-0299
 Jackson: 901-668-3388
 Texas
 Brownwood: 915-646-4536
 Bryan: 409-845-6201
 Ft. Stockton: 915-336-3303
 Ft. Worth: 817-978-3146
 Kerrville: 210-896-6535
 Kingsville: 512-593-2422
 Canyon: 806-656-2881
 San Angelo: 915-658-3513
 Uvalde: 210-278-4464

Utah
 Alpine: 801-756-7128
 Richfield: 801-896-8320
 Vermont: 802-828-4467
 Virginia
 Moseley: 804-739-7739
 Blacksburg: 540-552-8792
 Washington
 Olympia: 360-753-9884
 Moses Lake: 509-765-7962
 West Virginia: 304-636-1785
 Wisconsin
 Waupun: 800-433-0663
 Rhineland: 800-228-1368
 Wyoming: 307-261-5336

Canadian Wildlife Service
 Alberta: 403-951-8749
 British Columbia: 604-940-4722
 Labrador: see New Brunswick
 Manitoba: 204-983-5263
 New Brunswick: 506-364-5013
 Newfoundland: see New Brunswick
 Nova Scotia: see New Brunswick
 Ontario: 519-472-3745
 Quebec: 418-649-6300
 Saskatchewan: 306-975-4919

Appendix C. Summary of Techniques

The following table contains summary information for all of the methods described in the Techniques section. This table is intended as the “first stop” when deciding which technique(s) may be appropriate for use in a nuisance Canada goose situation. Abbreviations for information in the Strengths and Weaknesses headings are explained in the footnotes. Page references for detailed descriptions are also given.

- a** Detailed instructions and in-depth treatments for each technique are given here.
b Location where the technique is most effective; this is usually a conservative estimate.
c Period in the year or in the goose’s annual cycle when the technique is best applied.
d Categorical estimation of the techniques implementation costs. Other cost information appears in the techniques description section as well as in the Materials and Supplies section.

Technique	Page ^a	Application ^b	Timing ^c	Cost ^d	Required Permits	Strengths	Weaknesses
Discontinuance of public feeding	11	anywhere	anytime	little	-	In, Nf	Ps, Pu, often ignored by public
Habitat Modification							
Eliminate shorelines, islands, peninsulas	12	nest	anytime	high	state?	Np, Pt	E, Ps, Pu
Place walking path near water	12	anywhere	before arrival	high	-	Ap, Nf, Np, Pt, Q	E, Ps
Place field away from water	12	feeding/ loafing	before arrival	high–medium	-	Ap, Nf, Pt, Q	E, Ps, U
Remove nesting structures	12	nest	not nesting	little	-	In, Np, Rv	Ps, Pu
Modify water levels	12	nest or feeding	anytime	little	-	In, Np, Rv	Fa, Ps
Encourage early water freeze-up	13	feeding or loafing	fall or winter	little	-	In, Mm, Rv	Ps, will not affect resident birds during spring through fall

Ap = generally approved of by public, **Au** = can be automated, **B** = may attract other birds to area, **D** = dangerous, **E** = expensive, **Fa** = geese may not move very far, **Fl** = will not work if geese fly into area, **G** = eliminates gosling production, **Ha** = usually/must requires professional handler, **Hb** = habituation, **Ho** = cannot be used near houses, **Im** = immediate reduction or elimination of nuisance flock, **In** = inexpensive, **J** = effective on juvenile birds only, **K** = keeps geese in area if desired, but out of specific areas, **L** = labor intensive, **Mf** = must be moved frequently, **Mm** = works well with migrants, **NB** = nontoxic and biodegradable, **Nf** = reduces or eliminates feeding problems, **Np** = reduces or eliminates nesting problems, **Ps** = does little or nothing to reduce overall population size, **Pt** = permanent treatment, **Pu** = may not be favored by public, **Q** = quiet, **Rt** = requires trapping, **Rv** = reversible treatment, **S** = will affect other species, **U** = works best with undisturbed or untreated adjacent area, **Va** = vandalism, **Vi** = visually displeasing, **W** = will not work if geese walk into area.

Technique	Page ^a	Application ^b	Timing ^c	Cost ^d	Required Permits	Strengths	Weaknesses
String lines or grids above site	13	feeding	before arrival	medium + labor	-	Im, Rv	Ps, S, Vi, W
Fence barriers	13	feeding or loafing	molting, before arrival	medium + labor	-	Im, Nf	Fa, Fl, Ps, U, Vi
Vegetative barriers	14	nest or feeding	anytime	high	-	Im, Nf, Pt	Fl, Ps, U, need to protect establishing plants
Rock barriers	14	nest or feeding	anytime	high	state?	Im, Pt, Nf	Fa, Fl, Ps, U
Tall tree barriers	14	feeding	anytime	high	-	Pt, Im	Fa, U, W
Electric fence barriers	14	feeding or loafing	molting, before arrival	medium + labor	local?	Im, Nf	Fa, Fl, Ps, U, Vi
Reduce or eliminate mowing	16	nest or feeding	spring or summer	none		In, Im, Nf, Rv	B, Ps, Pu, airport safety compromised
Reduce fertilizer use	16	nest, feeding, or loafing	anytime	none	-	In, Nf, Rv	Ps, Pu
Stop watering lawn	16	feeding or loafing	fall or winter	none	-	In, Nf, Rv	Ps, Pu
Reduce lawn area	16	nest or feeding	anytime	high	-	Pt, Nf, Im	Fa, Ps, U
Plant unpalatable grass or vegetation	16	nest or feeding or loafing	anytime	high	-	Nf	Ps, Pu
Alternative feeding areas	16	feeding	at arrival	medium	-	K, Nf	B, Ps, U, geese and crop availability must coincide

Appendix C. Summary of Techniques (continued)

Technique	Page ^a	Application ^b	Timing ^c	Cost ^d	Required Permits	Strengths	Weaknesses
Hazing or Scaring							
Sirens, air horns, whistles	18	anywhere	before arrival	medium	local	Im, Mm	Fa, Hb, Ho, Mf, Ps, S, U
Blanks	18	anywhere	before arrival	medium + labor	local	Im	Fa, Hb, Ho, Mf, Ps, S, U
Bangers, screamers, whistle bombs	18	open areas	before arrival	medium	local	Au, Im	Fa, Hb, Ho, Mf, Ps, S, U
Cracker shells	18	open areas	before arrival	medium	local	Au, Im	Fa, Hb, Ho, Mf, Ps, S, U
Propane cannons or exploders	18	open areas	before arrival	medium	local	Au, Im	Fa, Hb, Ho, Mf, Ps, S, U
Other pyrotechnics	19	open areas, at dark	before arrival	medium	local	Im	Fa, Hb, Ho, Mf, Ps, S, U
Distress calls	19	anywhere	before arrival	medium	-	Au, Im	Fa, Hb, Ps, U
Ultrasonics	19	anywhere	before arrival	medium	-	Au, Q	Fa, Hb, Ps, U
Strobe lights	19	anywhere,	before arrival at dark	medium	local?	Au, Q	Ho, Fa, Hb, Mf, Ps, S, U
Mylar tape	19	anywhere	before arrival	medium	-	Im, Q	Fa, Mf, Ps, S, U, Vi
Flags	19	anywhere	before arrival	medium	-	Im, Q	Fa, Hb, Mf, Ps, S, U, Vi

Ap = generally approved of by public, **Au** = can be automated, **B** = may attract other birds to area, **D** = dangerous, **E** = expensive, **Fa** = geese may not move very far, **Fl** = will not work if geese fly into area, **G** = eliminates gosling production, **Ha** = usually/must requires professional handler, **Hb** = habituation, **Ho** = cannot be used near houses, **Im** = immediate reduction or elimination of nuisance flock, **In** = inexpensive, **J** = effective on juvenile birds only, **K** = keeps geese in area if desired, but out of specific areas, **L** = labor intensive, **Mf** = must be moved frequently, **Mm** = works well with migrants, **NB** = nontoxic and biodegradable, **Nf** = reduces or eliminates feeding problems, **Np** = reduces or eliminates nesting problems, **Ps** = does little or nothing to reduce overall population size, **Pt** = permanent treatment, **Pu** = may not be favored by public, **Q** = quiet, **Rt** = requires trapping, **Rv** = reversible treatment, **S** = will affect other species, **U** = works best with undisturbed or untreated adjacent area, **Va** = vandalism, **Vi** = visually displeasing, **W** = will not work if geese walk into area.

Technique	Page ^a	Application ^b	Timing ^c	Cost ^d	Required Permits	Strengths	Weaknesses
"Eye-spot" balloons kites	20	anywhere	medium + labor		-	Im, Q	Fa, Hb, Mf, Ps, S, U, Va, or Vi
Scarecrows	20	anywhere	before arrival	medium	-	Im, Q Vi	Fa, Hb, Mf, Ps, S, U, Va,
Dogs	21	anywhere	not at molt	medium high + labor	state/ local	Im	E, Ha, Fa, Ps, S, U
Swans	21	ponds, lakes	before arrival	medium	state, local	Im, Q	Fa, Ps, U
Falcons	21	open areas	before arrival	medium + labor	local	Im, Q	Fa, Ha, Ps, U
Radio-controlled aircraft	21	open areas	anytime	little - high	local	Im	Fa, Ps, S, U
Vehicles and boats	21	open areas, at dark	anytime	high	local	Im	D, Fa, Ps, Pu, S, U
Chemical Repellents	22	feeding	anytime	medium to high + labor	-	Ap, NB, Nf	Fa, Ps, U, must reapply frequently and after every rain
Reproductive Control							
Remove nesting material	23	nest	before laying labor		Fed., state	G, Np	Ps, Pu, L, limited period to apply
Oil/addle/puncture eggs	23	nest	incubation	little + labor	Fed., state	G	Ps, Pu, L
Replace eggs with dummy eggs	24	nest	incubation	little + labor	Fed., state	G	Ps, Pu, L
Sterilize: surgical neutering	24	nest	at molting	high	Fed., state	Ap, G	E, L, Ps, Rt
Sterilize: oral contraception	24					Ap	Ps, no effective delivery system

Appendix C. Summary of Techniques (continued)

Technique	Page ^a	Application ^b	Timing ^c	Cost ^d	Required Permits	Strengths	Weaknesses
Removal							
Translocate	25	anywhere	anytime	high + labor	Fed., state	Ap, Im	E, Ha, J, L, Ps, Rt
Single-sex flocks	26	anywhere	best at molting	high + labor	Fed., state	Ap, G	B, Ha, L, impossible to sustain, must put "extra" birds somewhere
Regular hunt	26	anywhere	anytime	none	Fed., state		Pu, too many urban areas closed to hunting
Special-purpose kill permits	26	anywhere	anytime	medium + labor	Fed., state	Im	L, Pu
Nest shooting	27	nest	incubation	little + labor	Fed., state	Np	L, Pu
Use as food bank supplementation	27	anywhere	best at molting	high + labor	Fed., state	Im	L, Pu, Rt

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Managing Canada Geese in Urban Environments

A Technical Guide

In many areas of the United States and Canada, the Canada goose has adapted to suburban landscapes, foraging on mowed lawns and nesting near ponds and reservoirs. Geese may congregate at parks, golf courses, and athletic fields, creating nuisance situations.

This manual is intended to help wildlife professionals, turf grass managers, and homeowners select appropriate management strategies for alleviating problems caused by resident, nonmigratory geese.

This guide complements the Cornell Cooperative Extension video, *Suburban Goose Management: Searching for Balance*, which describes suburban goose management, biology, and social issues. The manual provides additional details for selecting management actions to reduce conflicts with resident geese.

This publication is the result of collaboration by Cornell Cooperative Extension, the University of Wisconsin, and the Berryman Institute, Utah State University.

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