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Development of an Integrated Canada
Goose Management Program in Virginia

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DEVELOPMENT OF AN INTEGRATED CANADA GOOSE MANAGEMENT PROGRAM IN VIRGINIA

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Abstract: Wildlife managers in the State of Virginia developed an integrated Canada goose (*Branta canadensis*) damage management program in 1996 to address increasing damage caused by resident (non-migratory) Canada geese, primarily in urban/suburban areas. The previous Canada goose damage management program relied primarily on harassment and relocation. The integrated program was made available to citizens, homeowner associations, businesses, organizations, city and county governments, and state and federal agencies in 1997. The Integrated Canada Goose Management Program was developed by U.S. Department of Agriculture-Animal and Plant Health Inspection Service-Wildlife Services, Virginia Department of Agriculture and Consumer Services, Virginia Department of Game and Inland Fisheries, and the U.S. Fish and Wildlife Service. An aggregate of environmental, hunting, animal welfare, and agriculture groups, airports, golf courses, utilities, homeowner associations, federal agencies, and state and county government attended a focus group meeting and commented on the integrated Canada goose damage management plan. The plan implemented biological control, habitat alteration, harassment, exclusion, husbandry, repellents, and population management strategies. A new method, capture and euthanasia, was made available under the population management strategy. Capture and euthanasia was made available because other population management methods (i.e., hunting) were unavailable in some urban/suburban areas, relocation of resident Canada geese was unrealistic because resident Canada geese were a problem statewide, and resident Canada goose populations numbered >200,000 birds in 1996 and were growing 10-15% annually statewide. Canada geese captured in urban/suburban areas in 1997 (n=1,548) were brought alive to meat processors for processing and packaging. Hunters for the Hungry, a statewide charity, distributed processed Canada goose meat to local food banks. The entity requesting capture and euthanasia services under this program reimbursed USDA for services received.

Key Words: *Branta canadensis*, Canada goose, capture, damage management, euthanasia, integrated response, Virginia

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INTRODUCTION

Conflicts and damage between humans and wildlife are common in the State of Virginia. The United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (USDA-APHIS-WS), Virginia Department of Agriculture and Consumer Services, Office of Plant and Pest Services (VDACS), and Virginia Department of Game and Inland Fisheries (VDGIF) received 2,043 Canada goose damage complaints from the public from April 1, 1992 through June 30, 1996 (Lowney and Dewey 1997). Canada goose complaints

were the first or second most common wildlife damage complaints reported to APHIS and VDACS each year during this period. Resident Canada geese are believed to be involved in nearly all complaints about Canada goose damage. The term "resident Canada goose" refers primarily to a locally breeding Canada goose that nests and raises its young in Virginia. Resident Canada geese do not migrate to Canada, but remain in Virginia year-round.

Canada goose complaints have been received from 53 counties and 10 independent cities in

Virginia (Figure 1). The greatest number of calls has come from counties in northern Virginia, including Fairfax and Loudoun Counties. The higher densities of both Canada geese and humans in northern Virginia probably contribute to the large number of damage complaints from that region.

Historically, there was a loose agreement among VDACS, APHIS, and VDGIF on how to manage damage involving resident Canada geese. VDACS, VDGIF, and APHIS worked together or separately to capture and relocate resident Canada geese since 1979 to alleviate local damage (Table 2). VDACS and APHIS provided technical assistance, loaned propane cannons, and sold or loaned pyrotechnics to alleviate damage or conflicts involving resident Canada geese. VDGIF provided technical assistance and created hunting opportunities to alleviate damage involving resident Canada geese.

APHIS is directed by law to protect American agriculture, human health and safety, property, and natural resources from damage associated with wildlife. VDACS is directed by law to protect Virginia agriculture, property, and human health and safety from damage associated with wildlife. VDGIF is directed by law to conserve wildlife and provide recreational opportunity to hunt, fish, trap, and boat in Virginia. The U.S. Fish and Wildlife Service (USFWS) is directed by law to conserve, protect, and enhance migratory birds and threatened and endangered species.

Wildlife damage management is defined as the alleviation of damage or other problems caused by or related to the presence of wildlife. It is an integral component of wildlife management (Leopold 1933, the Wildlife Society 1990, Berryman 1991). The coalition of state and federal agencies use an Integrated Wildlife Damage Management (IWDM) approach (sometimes referred to as Integrated Pest Management, or IPM) in which a combination of methods may be used or recommended to reduce wildlife damage. IWDM is described in Chapter 1, 1-7 of *The Animal Damage Control Program Final Environmental Impact Statement* (USDA 1994).

Despite the efforts by APHIS, VDACS, and VDGIF, the number of Canada goose damage or conflict complaints and the resident Canada goose population continued to increase. APHIS, VDACS, and VDGIF believed damage to property, human health and safety, and agriculture would continue to increase, especially in urban/suburban environments, if resident Canada goose damage management strategies did not change and resident Canada goose populations continued to grow at 10-15% per year. Additionally, the public was frustrated by increasing Canada goose damage and perceived government inaction. APHIS, VDACS, VDGIF, and USFWS formed a coalition in December 1993 to develop a resident Canada goose management plan. We will report on development of the plan, implementation of the program, and results through 1997.

DEVELOPMENT OF THE PLAN

Canada geese are a public resource managed by the state and federal governments on behalf of the public. The Coalition decided several types of information were needed to help explain Canada goose damage management to the public: population status and biological information about resident Canada geese, data on damage, and information about the methods available to alleviate damage. Public input was requested by the Coalition to improve the resident Canada goose management plan.

Canada Goose Biology And Population Status

Present-day populations of resident (non-migratory) Canada geese originated from birds that were released or escaped from private waterfowl collections or hunting clubs 40-50 years ago, and from birds that were moved here from other areas (Costanzo 1993). These geese were descendants from non-migratory stocks of geese and probably included a mix of several different subspecies, including, the giant (*Branta canadensis maxima*), western (*B. c. moffitti*), and interior (*B. c. interior*) races of Canada geese. Twenty years ago, the resident Canada goose population in Virginia was limited to the northern and northern piedmont regions. Since that time, the population of geese has grown and expanded statewide.

Population status of resident Canada geese in Virginia has been determined by VDGIF staff using survey data from the Atlantic Flyway Breeding Waterfowl Plot Survey since 1991 (Table 1). Local breeding populations of Canada geese in Virginia have been increasing for the last 7 years, averaging a 10-15% annual population growth (G. Costanzo, VDGIF, pers. commun.). This increase may be the result of exploitation of human-provided food resources (i.e., grass, turf; Conover and Chasko 1985) and a predator-reduced urban/suburban environment. Also, resident Canada geese that reside mainly in urban or suburban settings are afforded almost complete protection from harvest by hunting (U.S. Fish and Wildlife Service 1995).

Canada goose feeding behavior, habitat preference, breeding behavior, and adaptability to human-created environments create situations in which Canada geese and humans conflict. Canada geese feed on clover, grasses, and cereal grains. Along the Atlantic Flyway, Canada geese seem to have changed from a diet dominated by aquatic plants to a diet dominated by upland crops (Bellrose 1976). Canada geese also favor short, manicured grass, particularly near a water source, for loafing and feeding. Golf courses and other developed areas serve as adequate habitat for resident Canada geese because food, water, and protection from predators are available (Conover and Chasko 1985). Additionally, humans feeding the geese enrich the attractiveness of developed environments.

Both non-migratory (resident) and migratory Canada geese occur in Virginia. Migratory Canada geese occur in Virginia from late September through early March (G. Costanzo, VDGIF, pers. commun.). Banding studies suggest a majority of resident Canada geese remain within 20-25 miles of where captured and banded (G. Costanzo, VDGIF, pers. commun.) unless severe winter weather forces them to migrate (P. Costelli, NJ Fish and Game, pers. commun., Johnson and Castelli, unpublished data). Ninety-five percent of resident Canada geese observed wintering in the Chesapeake Bay region (Delaware, Maryland, and Virginia) did not migrate (Hestbeck 1995).

Resident Canada geese nest from March through June in Virginia. Eggs hatch in approximately 30 days. Parent geese are very protective and aggressive in defense of the nest and young.

Canada Goose Damage

Canada goose damage/conflicts affect several types of resources in Virginia, including property, human health and safety, agriculture, and natural resources (Table 2). Property damage most often involves landscaping and walkways, usually on golf courses and water front property. Geese graze turf and also feed by pulling grass plugs from golf greens in summer.

Canada geese negatively impact human health and safety in several ways. First, fecal matter is a disease concern (i.e., Salmonella) to humans by contact with hands and then eyes, nose, and mouth. Canada goose presence on and around airports creates a threat to aviation and human safety. Canada geese have been involved in aircraft strikes in Virginia, resulting in costly repairs to airplanes. These geese also act aggressively to small children during nesting and brood rearing, resulting in children being bitten and beaten with wings. Additionally, traffic hazards are created when Canada geese walk across streets and other roadways.

Agricultural resources damaged by Canada geese include grain crops and possibly livestock. Grazing of pastures and alfalfa meadows can deprive livestock of food and impose economic hardships on livestock producers. Geese have grazed a variety of crops in Virginia: barley, wheat, rye, oats, corn, and peanuts.

Geese are suspected of affecting the health of livestock by contaminating drinking water and pastures. Salmonella has been detected in cattle herds in northern Virginia. State veterinarians suspect Canada geese are the most likely source in transmission of salmonella to affected cattle (Dr. Lisa Crofton, Dr. Joe Garvin, Dr. Robert Ruth, and Dr. Ronald King, VDACS, pers. commun.) and that Canada geese are a risk factor to cattle for salmonella (Dr. Lauren Worneck, VA Tech, pers. commun. to Dr. Lynn Tobias, USDA-APHIS-Veterinary Services). Salmonella causes shedding of the intestinal lining and severe

diarrhea in cattle. If undetected and untreated, salmonella can kill cattle and calves. Cattle producers are concerned about the health of livestock drinking from ponds contaminated with large quantities of goose droppings.

Canada geese negatively impact Virginia's natural resources. Excessive numbers of Canada geese have affected water quality around beaches and wetlands. Accumulated droppings in swimming areas are considered unhealthy by resorts and swimmers. Sewage treatment plants in Virginia are required to test effluent water quality before release from finishing ponds into the environment. Sewage treatment plants find coliform bacteria counts increase when Canada geese are present and decline when the geese are removed (R. Pennington, Upper Occoquan Sewage Authority, pers. commun.; Amy Pratt, Upper Occoquan Sewage Authority, unpublished data).

The majority of Canada goose damage occurred March through October, with 40% of damage reported during June and July (Table 3). Canada goose damage has occurred in many forms, with a majority of the complaints (83%) involving droppings or feeding/grazing (Table 4).

METHODS AVAILABLE TO REDUCE CANADA GOOSE DAMAGE

The scientific literature and experience of the Coalition were used to identify strategies and methods that had the best potential to reduce damage caused by Canada geese. Methods are components of a strategy. Methods such as unregistered toxicants and drugs, experimental contraceptive drugs, effigies (scarecrows), and lure crops were determined to be harmful to the environment, illegal, or ineffective, and were removed from consideration (Lowney and Dewey 1997). Further, a method initially considered (biological control: mute swans) was removed from consideration after analysis determined this method was harmful to the environment and ineffective (Lowney and Dewey 1997). The following methods were considered viable means to alleviate damage caused by Canada geese: a) harassment (distress calls, pyrotechnics, reflective tape, flags), b) biological control (dogs), c) exclusion, d) habitat alteration, e) husbandry (stop

artificial feeding, remove domestic or feral waterfowl), f) repellents, and g) population management (hunting, relocation, harassment and supplemental shooting, nest/egg destruction, euthanasia). Lowney and Dewey (1997) discuss the effectiveness of the methods available to alleviate damage caused by Canada geese.

PUBLIC INPUT

Federal agencies are required by the National Environmental Policy Act (NEPA) to seek public involvement when significant federal actions are considered or may be taken. Federal agencies also may elect to write environmental assessments (EA) as communication and decision documents even though the federal action categorically may be excluded by NEPA. The Coalition chose to request public involvement to improve the plan and to use the EA as a communication document.

Public involvement was solicited 3 ways. A legal notice was placed in the *Richmond Times Dispatch* and *Roanoke Times* for 5 days requesting comments on a proposed EA to manage damage and conflicts associated with non-migratory (resident) Canada geese. Additionally, 76 letters describing the scoping process were mailed to affected groups: homeowner associations, golf courses, county government, federal agencies, state agencies, environmental advocates, animal welfare advocates, hunters, business, universities, schools, and waterfront property owners. Finally, 30 representatives of the above groups were invited to a group meeting to discuss Canada goose biology and population status, damage in Virginia, and alternatives to alleviate damage. At all stages of the public input process, comments were solicited and appropriate changes made to the EA.

IMPLEMENTATION OF THE PROGRAM

The Integrated Canada Goose Management Program was implemented in steps within each federal and state agency's authority until the complete program could be implemented in 1997. The cumulative impacts of the integrated Canada goose management program would be expected to slow the population growth rate of resident Canada geese and reduce the number of

complaints coming from the same local areas. The Coalition looked at which strategies could be implemented by citizens coping with goose damage and which strategies could be implemented by federal and state agencies (Table 5). We report here on strategies and methods that were implemented by state and federal agencies.

Removal of problem waterfowl would be expected to alleviate damage. And, other Canada geese would be expected to fill the vacant habitat over time. The amount of time to reoccupy the vacant habitat could range from months to years (Table 6). It would be expected to take years for waterfowl to return to the population levels that existed before relocation, nest/egg destruction, hunting, and capture and euthanasia were implemented. The reduction of Canada goose damage would be expected to be satisfactory to most affected citizens.

Hunting

VDGIF has regulatory authority to set hunting seasons for resident Canada geese within a framework established by the USFWS. A September hunting season for resident Canada geese was initiated in 1993 to help control the population growth rate of resident Canada geese and provide recreational opportunity (Costanzo 1994) (Table 7). A regular November-January hunting season prior to 1995 allowed for the harvest of resident and migratory Canada geese. However, the November-January hunting season on Canada geese was closed in 1995 due to declining numbers of migratory Canada geese (*Branta canadensis interior*) caused by successive years of poor nesting conditions in the Arctic. A special late winter hunting season was initiated in 1997 from January 15-February 8 to help control the growth rate of resident Canada geese while the regular season was closed. The late winter hunting season was allowed west of Interstate 95 to minimize potential harvest of migratory Canada geese that winter primarily east of Interstate 95.

Relocation

Relocation of problem waterfowl was an acceptable option to most people. Only state and federal agencies were permitted to relocate

waterfowl in Virginia. VDACS and APHIS, assisted by VDGIF, captured and relocated 9,844 resident Canada geese from 1979 through 1996 to alleviate local damage in Virginia. Canada geese were captured in 30 counties and relocated to rural areas. Fifty-seven percent of the resident Canada geese were captured in Fairfax, Albemarle, James City, and Prince William counties. Relocation temporarily alleviated damage in one location, but likely stimulated future damage in another location.

Factors limiting relocation of wild animals are disease transmission, funding, food, shelter, water, and intra- and interspecific competition (Nielsen 1988). Relocation successfully has resolved many urban/suburban Canada goose problems in Virginia (Lowney and Dewey 1997). However, the availability of release sites limits relocation of waterfowl (Fairaizl 1992), and the availability of release sites in Virginia was approaching zero. Release sites for Canada geese were identified as having adequate water and grass at least 25 miles away from golf courses, office parks with retention ponds, city, county, or state parks, and recreational areas.

Nest/Egg Destruction

Egg addling, oiling, freezing, and puncturing would be effective at reducing Canada goose recruitment into the local population (Christens et al. 1995). However, the aggressive behavior of nesting Canada geese could intimidate some people and result in eggs not being treated as recommended. VDACS and APHIS would treat or remove eggs/nests when requested and resources allowed. Canada geese that had eggs oiled in successive years learned to nest away from the water, making it more time consuming to find nests (R. Thomas, VDACS, pers. commun.).

The expected results of nest/egg destruction were that damage would continue if the method was used alone. Damage would continue because Canada geese are long-lived birds and population levels were exceptionally high in some regions of Virginia. The number of geese recruited into the local population would be less than if nest/egg destruction did not occur. Adult populations of Canada geese would be expected to remain stable

until other birds immigrated into the local area.

Euthanasia

Resident Canada geese causing conflicts would be captured primarily with panel traps during the summer molting period. Geese could be captured with rocket nets, swim-in and decoy traps, dip nets, and by hand. Alpha chloralose (Investigational New Animal Drug-6602) also could be used to capture Canada geese. Resident Canada geese captured from March 21 through August 31 would be processed for human consumption and donated to charity. Birds captured with alpha chloralose would be unavailable for human consumption for 30 days pursuant to Food and Drug Administration (FDA) restrictions. Only APHIS employees would be allowed to use alpha chloralose, per FDA restrictions.

Canada geese would be captured from September 1 through March 20 and euthanized to protect human health and safety only. Resident Canada geese would be processed for human consumption and donated to charity. Because migrant Canada geese could be present during the September 1 through March 20 time frame, the USFWS and VDGIF have requested that capture and euthanasia of migrant Canada geese be avoided.

Captured geese would be processed by meat/poultry packers. A statewide charity, Hunters for the Hungry, would be used to notify local food banks of the availability of processed Canada goose meat. State and local prisons/jails could be recipients of processed waterfowl. The cost of processing waterfowl would be born by the citizens, organizations, or local governments requesting removal of the problem Canada geese.

Waterfowl captured from industrial sites would not be used for human consumption because chemical residues may be presented in the tissue of Canada geese (Amundson 1988, cited from Cooper 1995). There is no evidence in the literature to indicate that geese captured on golf courses, parks, or other turf areas are unfit for human consumption (Cooper 1995). New York Department of Environmental Conservation (DEC) tested for pesticide residue and heavy

metals in Canada geese from Clarkstown, NY, in 1997 and found no pesticide residues (B. Swift, NYDEC, pers. commun.) and lead was below Environmental Protection Agency limits established for fish (Dr. Tripathi, VA Department of Health, pers. commun.). The Michigan Department of Agriculture analyzed Canada goose tissue for heavy metals and pesticides in 1997 and found results similar to those of NYDEC.

The capture and euthanasia of resident Canada geese normally would be conducted by APHIS when other alternatives were demonstrated to be ineffective or impractical. Additionally, artificial feeding would be stopped to the extent possible and "Do Not Feed the Waterfowl" signs would be posted by affected property owners, as appropriate. Domestic waterfowl would be removed from the area by APHIS, VDACS, another agent, or the property owner. An egg addling, oiling, puncturing, or freezing program would be conducted by APHIS, VDACS, another agent, or by the property owner to minimize the number of birds to be euthanized in appropriate situations.

Harassment, exclusion, removal of domestic waterfowl, and shooting to supplement harassment would be implemented by government agencies, if requested and resources allowed. Harassment, exclusion, and shooting to supplement harassment would be implemented by the government agencies using the same techniques as a private citizen or company managing Canada goose damage. The removal of domestic waterfowl most would likely be done with alpha chloralose. All methods implemented by APHIS would be reimbursed by the entity requesting assistance.

RESULTS OF INTEGRATED PLAN IN 1997

The Integrated Canada Goose Management Program was implemented in 1997 to reduce damage caused by resident Canada geese by integrating methods incorporating harassment, biological control, exclusion, habitat alteration, husbandry, repellents, hunting, relocation, shooting to supplement harassment, nest and or egg destruction, and euthanasia.

Technical assistance on alleviating damage caused by Canada geese was provided by VDACS, VDGIF, and APHIS in 1997. VDACS and APHIS received 331 requests to provide technical assistance to citizens in 34 counties and 9 independent cities in Virginia between July 1, 1996 and June 30, 1997. APHIS responded to 121 of the 331 requests for technical assistance during this 1-year time frame and made recommendations to alleviate damage involving Canada geese (Table 8).

Between July 1, 1996 and June 30, 1997, APHIS recommended 8 individuals apply for a Migratory Bird Depredation Permit to harass and shoot Canada geese to supplement harassment. The USFWS reviewed the permit applications and sent permits to VDGIF for review, signature, and issuance to the applicant.

Two nests of Canada geese were removed by APHIS because the geese were attacking people at a business and a nest was blocking construction at a park. In the business case, the geese nested next to the main entrance of the business. Eggs were oiled by APHIS at 3 locations, resulting in 285 eggs being treated. Between July 1, 1996 and June 30, 1997, 10 individuals applied after APHIS' recommendation to USFWS for a Migratory Bird Depredation Permit to oil, addle, puncture, or freeze eggs. These permit applications were reviewed by USFWS and sent to VDGIF for review, signature, and issuance to the applicant.

Sixteen locations in northern, central, southwestern, and eastern Virginia had 1,760 Canada geese captured during the molt occurring in mid-June through mid-July. Canada geese were captured at airports, homeowner associations, a theme park, businesses, a sewage treatment plant, public and private recreational parks, a military base, and golf courses by APHIS, VDACS, and VDGIF employees working together. Two processors were contracted by APHIS to process 1,548 Canada geese for human consumption. Hunters for the Hungry, a statewide charity, distributed the Canada geese products to local food banks. One hundred twenty-eight juvenile Canada geese were relocated because of the goslings' size and age.

Eighty-four Canada geese involved in a research project also were released unharmed.

Two locations in Virginia had 103 Canada geese captured and euthanized to protect human health and safety. Alpha chloralose was used because the projects were conducted when the geese could fly. The geese were buried in accordance with federal regulation and *Alpha Chloralose Use Guidelines and Handbook*.

Hunting seasons for resident Canada geese were established to reduce damage and provide recreational opportunity for hunters. A special September season was initiated in a 22-county area in 1993. In the first season, 2,523 hunters participated and harvested 2,316 geese (Table 7). The hunt zone was expanded to include the entire state in 1995 and the number of hunting days increased each year thereafter (Table 9). Interest also has grown during the past 4 years as the number of hunters participating in 1996 increased to 8,400 and the harvest increased to 9,200 geese.

The special late season initiated in 1997 also was successful in terms of hunter participation and goose harvest. Approximately, 5,500 hunters took >12,000 geese, predominately resident geese, during this 22-day season (Table 7). There is potential to add additional days and increase the bag limit during this late season in future years. Combined, the special hunting seasons for resident Canada geese in 1996-1997 harvested >21,000 geese.

APHIS and VDACS were not requested to harass, exclude, shoot to supplement harassment, or remove domestic waterfowl as part of the Integrated Canada Goose Damage Management Program in 1997.

Public reaction to the capture and euthanasia of Canada geese in 1997 was variable and became a public issue after the *Washington Post* published an article on July 9, 1997. All publics directly affected by resident Canada geese appreciated having the geese removed from the local environment. Over 300 individuals who wanted more information about the Canada goose program and 9 individuals who voiced opposition

to the Canada goose program contacted APHIS within 1 week following the article in the *Washington Post* about the removal of resident Canada geese. However, once the Integrated Canada Goose Management Program was explained, only 3 citizens remained opposed. One opposed citizen was adamant that Canada geese were an endangered species and another was a representative to Friends of Animals, an international animal protection organization. The article in the *Washington Post* generated 15 additional requests to remove Canada geese from properties. Citizens requested that Canada geese at the additional locations be captured; because the requests came after the molt, APHIS recommended other alternatives.

DISCUSSION

Effectiveness Of Removing Canada Geese

Several measures were implemented to determine if removal of Canada geese alleviated damage over the short and long term. Although our analysis was quantitative, our clients' analysis was qualitative. Capture data over multiple years at several locations were analyzed to measure efficacy of removing geese. The return rate to the capture site by relocated leg-banded adult resident Canada geese was 12.1% when geese were relocated <100 miles from the capture site, 2.9% when geese were relocated >100 miles from the capture site, and 0% when geese were relocated \geq 300 miles from the capture site; all geese were released at locations where adequate grass and water were available (J. May, VDACS, unpublished data). Also, 2.5% of leg-banded juvenile Canada geese released at a rural eastern Virginia location were recaptured in future years at urban locations reporting damage (J. May, VDACS, unpublished data).

Converse (1985), using computer banding records data from Patuxent Wildlife Research Center, reported 0.3-2.2% of all Canada geese relocated from Connecticut to Maine, New York, Rhode Island, Georgia, and West Virginia returned to the original capture site. Also, Cooper and Keefe (1997) reported 4% of juvenile Canada geese relocated 80+ km from the capture site and 4% of juveniles relocated to Oklahoma from Minnesota returned to the Twin Cities area in subsequent years. Cooper and Keefe (1997) reported 42%,

80%, and 42% of adult Canada geese relocated from Minnesota to Oklahoma in 1982, 1984, and 1985 returned to Minnesota. Because of mortality and the lower probability of leg bands being detected versus neck collars, the reported number of birds returning to the capture site would be underestimated in Connecticut and Virginia. Moreover, to calculate the percentage of relocated geese returning to the capture area, one assumes that all relocated geese returning to the capture area are encountered (Cooper and Keefe 1997).

Furthermore, of the 1,519 juvenile Canada geese released between 1985-1996 in eastern Virginia, 8.5% were reported being killed by hunters within 15 miles of the release site (J. May, VDACS, unpublished data). A troubling issue in reporting on the recapture or reports of banded geese was several thousand Canada geese were released in Nottoway and Lunenburg Counties, Virginia, and no band returns have been reported or recaptured, yet none of the relocated geese remained on the ponds where released.

Efficacy of removing resident Canada geese was measured using the number of geese present during the molt in the year following initial removal (Table 6). The number of Canada geese removed from 4 representative locations was largest in the first year and significantly smaller in subsequent years (Table 6). Overall, the number of Canada geese declined in subsequent years at most locations even though the resident Canada goose population in Virginia was growing (Table 1) (APHIS and J. May, VDACS, unpublished data). The degree of long-term benefit in alleviating goose damage is best demonstrated at Dulles International and National Airports, where a more integrated Canada goose damage management program was implemented. Here Canada geese were removed during the molt and eggs were addled and oiled each year (Table 6). In contrast, Little Keswick School showed a large, increasing population of resident Canada geese in 1996 and 1997, which was comprised of >70% juvenile geese because no egg/nest destruction occurred. Initially, Occoquan showed a declining trend in resident Canada geese, then an increasing trend. Eggs/nests at Occoquan were oiled in 1997 for the first time. The

increasing population of resident Canada geese in Virginia, residual geese left at Occoquan after each roundup, and immigration of geese from surrounding areas into Occoquan, most likely contributed to the increasing population growth trend in recent years.

Clients measured success of the program in qualitative terms. Even though all clients were informed verbally and in writing that new resident Canada geese would occupy the vacant habitat, clients were willing to have geese removed. All clients were grateful to have the geese removed or at least substantially reduced in number. Golf courses, office parks, beaches, and homeowner associations reported effectiveness as a reduction in droppings, an ability to grow grass, less grazing damage to ornamental plants and grass, and a reduction in shoreline erosion. A less frequent qualitative measure of alleviating damage was the reduction in molted bird feathers. Airports measured effectiveness by a lowered potential for an aircraft strike due to fewer geese feeding and flying locally on the airport. Clients usually reported damage as being reduced in subsequent years after the initial removal of resident Canada geese.

Few clients provided monetary estimates of damage because few accumulated such information. Qualitatively, clients reported spending less labor cleaning droppings and feathers from property, repairing turf and golf greens, and tending gardens after resident Canada geese were removed from a property. The number of geese in subsequent years was reduced (Table 6) and clients believed they had less damage in subsequent years when Canada geese were removed.

Effectiveness of Hunting

Hunting was an integral and important part of the Integrated Canada Goose Management Program, especially for rural Virginia. Hunting seasons established during the past several years for resident Canada geese have helped control populations growth, resolve some damage complaints, and also provided recreational opportunity for Virginia sportsmen. A benefit of increasing hunting days was a 52% reduction in damage complaints involving agricultural crops

and livestock in 1997 over 1996 (APHIS, unpublished data). Hunting will continue to be an integral and effective means of managing resident Canada goose populations, especially where it is allowed.

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Table 1. Estimated population of resident Canada geese in Virginia from the Atlantic Flyway Breeding Waterfowl Plot Survey, 1991-1997. Survey conducted by Virginia Department of Game and Inland Fisheries.

<u>Year</u>	<u>Number of Canada geese</u>
1991	66,169 ± 88%
1992	121,225 ± 74%
1993	128,603 ± 82%
1994	129,409 ± 73%
1995	202,602 ± 85%
1996	208,146 ± 72%
1997	301,416 ± 85%

Table 2. Number of incidents by resource category involving Canada geese damage reported to the USDA-APHIS-Wildlife Services (APHIS) from April 1992 through June 1997, to the Virginia Department of Agriculture and Consumer Services (VDACS) from January 1992 through June 1997, and to the Virginia Department of Game and Inland Fisheries (VDGIF) from January 1992 through June 1996.

Resource Category	Resource Subcategory	Number of incidents		
		Reported to APHIS	Reported to VDACS ¹	Reported to VDGIF ¹
Property	Animal	4		
	Equipment	5		
	Landscaping	510		
	Structures	8		
	Other	3	1,037	250
Agriculture	Aquaculture	3		
	Field crops	44		40
	Livestock	15		5
	Range/pasture	18		
	Other	3	158	
Human Health and Safety	Human	260	54	10
	Aviation	30		
Natural Resources	Other	8	-	25
TOTAL		<u>913</u>	<u>1,249</u>	<u>330</u>

¹ VDGIF and VDACS track damage data by broad Resource Category only.

Table 3. Number of requests for technical assistance received by the U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services to alleviate Canada goose damage in Virginia from April 1, 1992 through June 30, 1997.

<u>Month</u>	<u>Number of requests</u>	<u>Percent of total</u>
January	21	4
February	32	6
March	39	7
April	45	8
May	50	9
June	114	21
July	103	19
August	48	9
September	26	5
October	31	6
November	11	2
December	21	4
	541	100

Table 4. Number of incidents of Canada goose damage by damage type reported to U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services in Virginia, April 1992 through June 1997.

<u>Damage type</u>	<u>Number of incidents</u>	<u>Percent of total</u>
droppings	568	62
feeding/grazing	196	21
human health & safety	58	6
damage threat	8	1
aircraft strike or threat	31	3
animal disease or threat of	17	2
nuisance	11	1
consumption/contamination	7	1
other	17	2
TOTAL	913	100

Table 5. Integrated wildlife damage management strategies and methods which could be used to alleviate damage involving resident Canada geese in Virginia.

<u>Method</u>	<u>Citizen</u>	<u>VDACS</u> ¹	<u>APHIS</u> ³
Harassment	X	X	X
Exclusion	X	M	X
Habitat alteration	X		
Husbandry -			
No feeding waterfowl	X		
Remove domestic waterfowl	X	X	X
Repellents	X		
Hunting ²	X		
Relocation		X	X
Shoot to supplement harassment	X	M	X
Nest/egg destruction	X	X	X
Euthanasia		M	X

¹ Virginia Department of Agriculture and Consumer Services

² Virginia Department of Game and Inland Fisheries would establish hunting programs.

³ U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services

M = actions may be conducted if permitted or resources are available.

Table 6. Changes in local resident Canada goose populations at locations in Virginia where Canada geese were captured during the molt and relocated or euthanized. Canada geese were caught by the U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, and Virginia Department of Agriculture and Consumer Services, Office of Plant Protection and Pest Services. Eggs of Canada geese were oiled at both airports in all years and Occoquan in 1997 to reduce recruitment.

<u>Location</u>	<u>Year</u>	<u># Canada geese present</u>	<u># Canada geese captured</u>	<u>Disposition</u>
Dulles International Airport	1997	63	63	Euthanized
	1995	257	249	Euthanized
National Airport	1997	45	44	Euthanized
	1996	0	0	
	1995	69	69	Euthanized
	1994	0	0	
	1993	4	0	
	1992	94	94	Relocated
Upper Occoquan Sewage Treatment Plant	1997	525	381	Euthanized
	1996	496	346	Relocated
	1995	473	258	Relocated
	1994	451	331	Relocated
	1993	630	580	Relocated
Little Keswick School	1997	30	0	
	1996	22	20	Relocated
	1995	2	0	
	1994	60	60	Relocated

Table 7. Number of Canada geese harvested during the September, November through January, and January through February hunting seasons in Virginia, 1993-1997. Data provided by Virginia Department of Game and Inland Fisheries.

<u>Year</u>	<u>September</u>	<u>November-January</u>	<u>January-February</u>
1993	2,316	11,484	0
1994	3,464	12,136	0
1995	5,500	Season closed	0
1996	9,200	Season closed	0
1997			12,020

Table 8. Recommendations made by the U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, or implemented by citizens to alleviate damage involving Canada geese in Virginia in 1997. APHIS received 121 requests for technical assistance with Canada goose damage between July 1, 1996 and June 30, 1997.

<u>Method</u>	<u>Number of times recommendation made</u>
Do nothing	2
Husbandry, change crop	1
Husbandry, stop artificial feeding	7
Husbandry, lure crop	1
Alter vegetation	5
Exclusion	2
Exclusion, overhead wire grids	15
Exclusion, perimeter fencing	18
Harassment, balloons	1
Harassment, pyrotechnics	74
Harassment, propane cannons	5
Harassment, distress calls	2
Harassment, reflective mylar tape	20
Harassment, flags	4
Harassment/shooting	2
Harassment, chase with vehicle (car, ATV, cart)	13
Biological control, dogs	13
Repellents, ReJeX-It [®]	6
Population Management, hunting	32
Population Management, nest/egg destruction	54
Population Management, harassment w/supplemental shooting	8
Population Management, euthanasia or relocation	18

Table 9. Number of days of Canada goose hunting offered by Virginia Department of Game and Inland Fisheries.

<u>Year</u>	<u>Seasons and daily bag limits</u>					
	<u>September</u>		<u>November-January</u>		<u>January-February</u>	
	<u>Days</u>	<u>Bag limit</u>	<u>Days</u>	<u>Bag limit</u>	<u>Days</u>	<u>Bag limit</u>
1997	21	5	-	-	22	3
1996	17	5	0	-	-	-
1995	10	5	0	-	-	-
1994	10	5	26	1	-	-
1993	7	3	26	1	-	-
