All redactions on this page are pursuant to (b)(6).

USDA APHIS

Unites States Department of Agriculture
Animal and Plant Health Inspection Services
Wildlife Services

Permit Review
☐ **Renewal**
Permit No:
☐ **Without Change**

1. Name, Address, and Telephone Number:	2. Location of Damage:	
Caswell F. Holloway, Commissioner NYC DEP 59-17 Junction Blvd Flushing, NY 11373	Prospect Park (Parkside Ave, Ocean Ave) N 40.65487 W -73.97333	
	3. County: Kings	4. State: New York
Telephone:	Fax:	

5. Resource/Damage Estimate:

A. Resources Damaged:	B. Description of Damage:
Threat to aircraft and human safety, US Airways flight 1549. Turf grass/Lawn	Potential aircraft strike, fecal droppings on grassy areas, potential decrease in recreational use.

6. Migratory Bird Species: / 7. Permit Recommendation:

Depredating Species	Number Involved	Recommendation	Number Recommend	Methods
1. Canada Geese	241	X Yes ☐ No	241	Lethal trapping during the molt
2. Mute Swans	1	☐ Yes ☐ No	1	Lethal trapping during the molt
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

No known non-lethal methods used. This property is one of approximately 25 whose cumulative goose population in NYC is a threat to aviation safety. Hunting is not practical or legal. Hazing will move geese short distances and they will return. Habitat alteration would be inconsistent with the use of this multi-use park including walking trails, fishing access, boating, animal zoo, baseball field's and recreation area.

8b. COMMENTS:

The damage is consistent with that described in the NY WS Canada goose environmental assessment and the environmental consequences are not substantially different. Also, the U. S. Fish and Wildlife Service has issued an environmental impact statement for the management of resident Canada geese in response to the overabundance. WS has issued a Record of Decision to implement depredation and control orders for resident Canada geese and Alternative F from the EIS. The U. S. Fish and Wildlife Service promulgated regulation 50 CFR 21.49 for the management of resident Canada geese.

9. Recommended Actions:

Action:			
	☐ Habitat Alteration	☐ Exclusion	☐ Chemical Repellant
☐ Harassment	☐ Egg/Nest Treatment	☐ Shooting	☐ Other
☐ Capture & Relocate	☐ Husbandry	☒ Lethal Trapping	

10a. WS Investigator Name and Address: (print)	10a. WS Investigator Signature:
[redacted] USDA Wildlife Services 1750 Pennsylvania Ave Brooklyn, NY 11239	[redacted] Date: June 4, 2010
Telephone: (347) 545-2067 Fax: (718) 942-2251	Email:

The damage is consistent with that described in the NY WS Canada goose environmental assessment and the environmental consequences are not substantially different.

☒ Approved
☐ Denied

[redacted] 6-15-10

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SECTION 1

1. _____ Work Initiation Document #

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES
WORK INITIATION DOCUMENT FOR WILDLIFE DAMAGE MANAGEMENT

2. 06 / 14 / 10 (MM / DD / YY)

3. TYPE OF WORK INITIATION DOCUMENT (mark all that apply):

- [ ] Private Property
- [ ] Temporary
- [x] Non-Private Property
- [ ] Adjacent Landowner
- [ ] Addendum to a Work Initiation Doc.
- [ ] Amendment to Existing Work Initiation Doc.

Assign to These Special Groups: a. _____ b. _____ c. _____

SECTION 2

4. Cooperator's Name [redacted] _____ Last [redacted] _____ First _____ Middle

5. Cooperator's Address 59-17 Junction Blvd (Street) Flushing (City)

Where Will Work Be Performed? (give address or directions, if different from address above) Prospect Park, Park Ave New York, NY

6. Business / Farm / Ranch / or Common Name Prospect Park 7. NY (State) 111373 (Zip Code)

8. Owner's or Representative's Name _____ (If different from Cooperator's) 9. (718)595 [redacted] Cooperator Telephone Number (include Area Code)

10. Owner's or Representative's Address (if different from Cooperator's) _____ Street _____ City _____ State _____ Zip Code

SECTION 3

11. WS Employee and Work Location Information

[redacted] WS Employee Name

Kings County

New York State

12. Land Class Information

Land Class	Acres
1. City	127
2.	
3.	
4.	
Total Acres	

13. Adjoining Property Information Document #

1. _____
2. _____
3. _____
4. _____

14. Species Information

1. Canada Geese
2. _____
3. _____
4. _____

[ ] If box is checked, attachment lists additional species

SECTION 4

16. In consideration of the benefits to be derived from the proper management of damage caused by those species listed in Section 3 Item 14 (and Item 15 if applicable), I the undersigned cooperator or cooperator's representative, do hereby give my consent, and concurrence, to the Animal and Plant Health Inspection Service (APHIS) (to include its officials, employees, and agents) to use, upon lands owned, leased, or otherwise controlled by me, and identified by this Work Initiation Document, the following methods and devices:

COMPONENTS: 1. corral traps 2. _____ 3. _____ 4. _____ 5. _____ 6. _____.

17. [ ] If box is marked, an attachment lists additional methods or devices

SECTION 5

18. I, the cooperator or cooperator's representative, have been informed of the methods and the manner in which the control materials and devices listed in Section 4 will be used, and of the possible hazards associated with their use. I understand that APHIS, (to include its officers, employees, and agents) will: exercise reasonable precautions to safeguard all persons and to prevent injury to animal life other than those listed in Section 3, Item 14 (and Item 15 if applicable); guard against the mishandling of control devices and materials; and exercise due caution and proper judgment in all wildlife damage management operations. I understand the APHIS, WS will maintain restricted use pesticide application records on applications made under this Work Initiation Document, and that APHIS, WS will provide copies of the records or record information promptly upon the property owner's or cooperator's request. I understand that APHIS may collect Global Positioning System (GPS) coordinates at the project site as part of component or activity tracking or as wildlife disease monitoring or research data.

SECTION 6

19. In consideration of these understandings and of the benefits to be derived, I, the cooperator or cooperator's representative, agree to: take reasonable precautions to prevent injury to livestock and other domestic animals; assume responsibility for injury to my property or to the property under my control, when said injury is not the result of negligence on the part of APHIS; assist in maintaining such warning signs as APHIS may place for the purpose of notifying persons entering onto such lands of the possible hazards associated with wildlife damage management measures in use thereon; and to give adequate warning of these possible hazards to persons I authorize to enter onto such lands. Further, in recognition of the benefits to be derived from the use of specified methods and devices authorized by this Work Initiation Document, I, the cooperator or cooperator's representative, agree not to concurrently use or allow to be used upon lands covered by this Work Initiation Document, any toxic material that might reasonably be expected to take a species listed above in Section 3, Item 14 (and Item 15 if applicable) unless such use of said toxicant is agreed to by APHIS in writing.

SECTION 7

20. SPECIAL CONSIDERATIONS:

All feral ducks and feral geese will be released on site.

SECTION 8

21. [redacted] Commissioner

ADDRESS 59-17 Junction Blvd. Flushing, New York 10007

DATE 6/17/10

22. SIGNATURE / TITLE (APHIS Representative) [redacted] State Director

ADDRESS 1930 Route 9 Castleton, NY 12033

PHONE (518)477-4837

DATE 6/14/10

WS FORM 12A (2007)

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New York City Hazardous Wildlife Mitigation Task Force
Minutes of Meeting
March 5, 2009

In Attendance:

Cas Holloway, Office of the Mayor
[redacted], Office of the Mayor
[redacted], Office of the Mayor, Dep. Counselor to the Mayor
[redacted], NYC Economic Development Corp.
[redacted], NYC Dept. of Correction
[redacted], NYC Parks & Recreation
[redacted], NYC Dept. of Environmental Protection
[redacted], USDA
[redacted], Aviation, PANYNJ
[redacted], GOCOR, PANYNJ
[redacted], LGA, PANYNJ
[redacted], JFK, PANYNJ
[redacted], Aviation, PANYNJ
[redacted], LGA, PANYNJ
[redacted], Aviation, PANYNJ

This was the first meeting of this group, assembled to address wildlife that resides on city properties and may pose a hazard to flight at John F. Kennedy International and LaGuardia airports.

The meeting opened with attendee introductions followed by [redacted] providing summarized background information on the formation and objectives of what he proposed be called the New York City Wildlife Hazard Mitigation Task Force.

[redacted] and [redacted] then proceeded to discuss a list of Priority Properties for Mitigation. The list, compiled by NYC Parks and DEP, contained 15 properties owned by the city and used as parks, former landfills, golf courses and properties adjacent to highways. [redacted] and [redacted] discussed the need for assessments and development of mitigation programs for each of these properties.

There are other large properties as well that are within the airport 5-mile radius that are not owned by the city, which attract large quantities of birds, most notably Gateway National Park and properties in the town of Hempstead. Representatives from the federal and local government will be invited to participate on the task force.

The next meeting will be scheduled for the last week of March or early April.

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New York City Wildlife Hazard Management Steering Committee
Minutes of Meeting
April 30, 2009

In Attendance:

Cas Holloway, Office of the Mayor
[redacted], Office of the Mayor
[redacted], Office of the Mayor, Dep. Counselor to the Mayor
[redacted], NYC Economic Development Corp.
[redacted], NYC Dept. of Correction
[redacted], NYC Dept. of Correction
[redacted], NYC Parks & Recreation
[redacted], NYC Dept. of Environmental Protection
[redacted], Town of Hempstead DCW
[redacted], NYS Dept. of Environmental Conservation
[redacted], National Park Service
[redacted], US Fish & Wildlife Service
[redacted], USDA
[redacted], USDA
[redacted], USDA
[redacted], Aviation, PANYNJ
[redacted], LGA, PANYNJ
[redacted], JFK, PANYNJ
[redacted], Aviation, PANYNJ
[redacted], LGA, PANYNJ
[redacted], Aviation, PANYNJ

The meeting opened with a review of the list of priorities from the previous meeting, held March 5, 2009. [redacted] recommended changing the name and purpose of the group from a task force to a steering committee; attendees indicated agreement. Attendees agreed on having quarterly task force meetings.

NY City, Cas Holloway and [redacted]: Indicated that park priorities and concessions language will be put into existing and new leases. The City already has compiled a list of properties within the airports' 5-mile radius and has worked with USDA on a plan and contract to reduce the population of geese on these properties. USDA will survey City properties and provide a final assessment for review.

PANYNJ, [redacted], [redacted] and [redacted]: Agreed to incorporate the responsibility to make notifications to property owners by phone of potential bird hazards on properties within the 5-mile airport radius, but the agency cannot take on the responsibility to mitigate hazards on these properties.

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USDA, [redacted] and [redacted]: indicated they will make a note of properties that present wildlife hazards and will discuss with the airports how to best notify property owners. Wildlife Hazard Management Plans (WHMP) will be updated at the airports this year.

General discussion ensued about inserting language into the airports' WHMPs about the requirement to notify and work with property owners to mitigate wildlife hazards. NY City indicated there is a precedent for agreement between the PA & NYC in the LGA WHMP, which mentions Rikers Island. PA expressed concern over language in the WHMP that may incur compliance requirements beyond what is required by FAR Part 139. Suggestion made to attach Memoranda of Agreement (MOA) to airport WHMPs and the NY City plan/contract with USDA.

NY City, [redacted]: Raised the issue of funding and suggest the Steering Committee should decide what projects are worthwhile, or perhaps a sub-committee should be formed to draft the MOA and assess proposed projects. PA concurred. [redacted] reminded the Committee of the primary goal of reducing the population of geese this year. Some discussion ensued about the possibility of expanding the Committee to include the State of NJ.

PANYNJ, [redacted]: Expressed concerns about the airports funding off-airport projects. Agreed a sub-committee should be formed to draft the MOA, assess projects and make funding source recommendations.

PANYNJ, [redacted]: Suggested that the Committee should also look at habitats in general surrounding the airports to assess possible future projects, such as tree thinning. [redacted] suggested we start small and then expand; make it a group effort. [redacted] suggested assessments be done property by property. [redacted] reminded the Committee that we have an obligation to address all wildlife hazards, primarily birds, but not just geese. [redacted] pointed out that the Committee should focus on Canada geese because that species currently poses the biggest problem.

PANYNJ, [redacted]: Directed the Committee's attention to the proposal for habitat modification projects on Rikers Island. [redacted] indicated NY City's concurrence with the projects, but questioned the means of funding and implementation. [redacted] suggested the PA, USDA and City revisit the projects to identify options to reduce costs. After [redacted] talked about the efficacy of each of the three Rikers Island projects, general consensus was that the project to fill in the pond should have top priority and should move forward.

NY City, [redacted]: Passed around copies of a draft NYC WHMP plan, proposed by USDA, for the Committee's review.

USFWS, [redacted]: Indicated her agency's willingness to work with the airports and City on potentially relaxing some depredation limitations.

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Around the table comments and closing remarks

US Park Service, [redacted]: Raised the question about wildlife hazard management requirement within the 3-mile zone that encompasses national park property.

PANYNJ, [redacted]: Brought up the issue of addressing hazards on properties in Nassau County and suggested the possibility of working with smaller towns directly and through Nassau County. She cited the example of the program the PA has with local towns oiling eggs in all wetlands within the 5-mile radius and how it has successfully helped to reduce the population of geese.

PANYNJ, [redacted]: Suggested the Committee focus on addressing the main problem of a bird hitting an airplane, and reminded all of the main purpose of both the Committee and our people in the field is to prevent strikes to prevent anyone from getting hurt and property from getting damaged.

NY City Parks, [redacted]: Suggested the Committee also identify private properties, such as cemeteries and golf courses, within the airports'5-mile radius that may be contributing to the bird problem.

NY City, [redacted]: Asked if the list of surveyed sites had changed. [redacted] stated that the list that was handed out to Committee members was not yet an all-inclusive list

All agreed that the next meeting will be held on June 4, 2009 at 10:00 am in the PA offices at 225 Park Avenue South.

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New York City Airports
Hazardous Wildlife Management Steering Committee
Minutes of Meeting
June 4, 2009

In Attendance:

[redacted], Office of the Mayor
[redacted], Office of the Mayor
[redacted], NYC Economic Development Corp.
[redacted], NYC Dept. of Correction
[redacted], NYC Parks & Recreation
[redacted], NYC Dept. of Environmental Protection
[redacted], NY State Dept. of Environmental Conservation
[redacted], National Park Service
[redacted], US Fish & Wildlife Service
[redacted], Town of Hempstead DCW
[redacted], USDA APHIS-Wildlife Services
[redacted], USDA APHIS-Wildlife Services
[redacted], Aviation, PANYNJ
[redacted], Aviation, PANYNJ
[redacted] Aviation, PANYNJ
[redacted], Media Relations, PANYNJ
[redacted], Law, PANYNJ
[redacted], Law, PANYNJ
[redacted], JFK, PANYNJ
[redacted], Aviation, PANYNJ
[redacted], LGA, PANYNJ
[redacted], Aviation, PANYNJ
[redacted], EWR, PANYNJ
[redacted], Aviation, PANYNJ

Meeting opened with a review of the minutes from the meeting of April 30th.

New Business

Committee discussed how often it should meet; all agreed meetings should initially be held quarterly. Next meeting was tentatively agreed to be held September 3rd.

[redacted] provided information on USDA's efforts with the NYC Mayor's Office to manage geese on city properties/urban areas. He advised that, beginning June 5th, USDA personnel will survey bird activity and nesting on 49 sites in Queens and then prepare recommendations for mitigating the geese. Roundups should commence by June 15th for removal of geese on all 49 sites and be completed by June 29th. [redacted] expected the teams to complete roundups on about 5 sites per day, with roundup activity starting each morning and continuing into early afternoon. He expected to round up approximately 1,000 geese in total from the 49 sites. Public access to sites on which USDA is working will be restricted with

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NYPD assisting with law enforcement. NYC Public Affairs personnel will be onsite to handle any press. PANYNJ will assist with disposal of geese. Birds will be brought to JFK once each day to be euthanized and for subsequent carcass disposal.

[redacted], [redacted] and [redacted] provided an update on the status of the MOU between NYC and PANYNJ for the depredation of Canada geese on city properties. The Committee engaged in a discussion on associated media relations/public affairs efforts and points of contact for each agency. [redacted] indicated that he will be the point of contact for the 1st week to talk to the public. He also stated that USDA does not release dates or inform the public of specific sites where they will be working. [redacted] indicated that USDA is already in contact with Senator Schumer's office. The Committee agreed that one agency should be make distribution to all public offices and elected officials to prevent possible confusion created by unsynchronized press releases from multiple sources. [redacted] advised the Mayor's Office will coordinate press releases. Representative from each agency will provide their respective media relations points of contact to [redacted].

[redacted] asked if this roundup would be a one-time effort. [redacted] advised that development of a continuous, long-term approach should be a goal of the Committee. [redacted] suggested that expanding wildlife mitigation to areas outside the 5-mile radius should be considered for the long term. [redacted] suggested development of a mission statement for the Committee. General discussion ensued on the purpose of the Committee and development of a mission statement. Drafting of mission statement was assigned to [redacted] and [redacted].

General discussion ensued about mitigation within the two airports' 5-mile radii. [redacted] suggested that there is an opportunity to put a mitigation plan in place at Ferry Point before the proposed golf course is completed there [redacted] suggested that PANYNJ can make notifications to landowners of their responsibilities. [redacted] advised that notifications should provide mitigation guidance to landowners. [redacted] indicated that the Committee should approve mitigation steps via a comprehensive Memorandum of Agreement with PANYNJ. [redacted] asked for members to form the subcommittee to draft the MOU. Selected subcommittee members are: [redacted], [redacted], [redacted] and [redacted].

[redacted] advised the Committee on the National Park Service policy on protected species and protected properties (designated refuge areas). [redacted] and [redacted] discussed conflicting goals with regard to Jamaica Bay park. [redacted] and [redacted] agreed that USDA and NPS will conduct separate effort to resolve conflicts over protection of wildlife residing in the vicinity of JFK that can pose a hazard to aircraft operations.

[redacted] discussed issues about working more closely with NYC DEC to address issues with trees and other wildlife attractants on City park properties.

[redacted] informed everyone that the Smithsonian Museum will be releasing information on the geese that were struck by US Airway Flight 1549.

[redacted] and [redacted] provided a status on the "Bird Radar" undergoing pilot testing at JFK. Site selection and setup is expected to be complete by June 15, at which time radar testing will

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commence. [redacted] asked if the test will be expanded to include LGA and EWR. [redacted] said that the FAA is considering it.

[redacted] advised that PANYNJ is in the process of hiring another wildlife biologist, who will report to [redacted] to assist her by administering wildlife hazard management programs for all five PANYNJ airports.

[redacted]: Indicated that LGA is also bringing on a wildlife biologist through its contract with USDA. She expects the biologist to commence work at LGA by September.

United States Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services

Summary: New York City Canada Goose Removals

Summer 2009

Ryan Collins
Wildlife Biologist
USDA-APHIS-Wildlife Services

JUSTIFICATION

The Metropolitan New York City region has an estimated 20,000 – 25,000 resident Canada geese, which is approximately five times the amount that most people would find socially acceptable (B. Swift, NYS DEC, Bureau of Wildlife, pers. comm.). The increasing abundance of these 8-10 pound flocking birds in urban and suburban landscapes has resulted in a significant aviation safety hazard for the flying public and military aircraft.

The Federal Aviation Administration advisory circular 150/5200-33B recommends a distance of 5 miles from the edge of any airport to wildlife hazard attractants. The Federal Aviation Administration and Air Force have also established a zero-tolerance policy for Canada geese on or near airports due to the high probability of aircraft damage and reduced public safety.

Based on the current population size of resident Canada geese, efforts to reduce the number of resident geese in metropolitan New York City were implemented to protect aviation safety, water supplies from fecal contamination, public and private property from damage to turf and ornamental plantings, loss of land use due to excessive fecal droppings, and against unintended consequences of hazing programs. In addition, the population of resident Canada geese within 5 miles of John F. Kennedy International Airport and LaGuardia Airport were targeted to the extent reasonable.

OBJECTIVE

To reduce the resident Canada geese population at City-owned public parks, ball fields, and other man-made and natural habitats within 5 miles of airports in metropolitan New York City.

BENEFITS EXPECTED

Decreasing the resident Canada goose population would reduce the year-round risk these birds pose to aviation safety. While migrating birds temporarily increase the risk to aviation safety, the reduction of resident Canada geese was a step in reducing the abundance of larger-bodied birds that cause the most damaging strikes to aircraft.

METHODS

Site Evaluations – In early June 2009 Wildlife Services (WS) conducted site evaluations at 52 City-owned properties to determine which sites needed geese removed (Table 1). WS biologists documented the number of Canada geese and/or damage (fecal droppings, turf damage) present on site. Risk to local aircraft movements was also assessed. Additionally, efforts to reduce damage caused by Canada geese (e.g., no feeding waterfowl ordinance) were documented. The list of sites eligible for geese removal were reviewed and confirmed with WS and New York City. Of the 52 proposed sites, 17 were

selected for goose removals in the boroughs of Brooklyn, Bronx, Manhattan, and Queens (Table 2).

Removal - Canada geese were captured during the summer molt period (when the birds are unable to fly) utilizing standard goose round-up procedures. The summer molt period is approximately June 15 to July 15 each year. If geese were in the water, then biologists and specialists used kayaks or motor boats to push the geese onto shore and then into corrals. The captured geese were placed alive in commercial turkey crates and then transported to a secure location and euthanized with methods approved by the American Veterinary Medical Association. Euthanized geese were disposed of in accordance with local health ordinances.

RESULTS

Removals were conducted on June 15th through June 18th and July 6th through July 8th. WS made secondary visits to 6 of the 17 sites where additional geese were observed but uncaptured. WS removed 1,235 of the 1513 Canada geese observed at the 17 selected sites (Table 2).

SUMMARY/DISCUSSION

The 47 proposed removal sites were compiled based on observations of Canada geese outside the molting period in 2008-2009. Canada geese will often move temporarily prior to the molt to locations where food and water are accessible without flying. The proposed sites with no geese present during site evaluations were more likely sites where geese were feeding and loafing through most of the year but these sites were vacated at the time of site evaluation due to lack of suitable molting habitat.

The 17 removal sites provided a great amount of information as to the preferred molting sites of resident Canada geese in New York City. Based on this information WS will be able to identify similar habitats that may be harboring geese during future molting seasons than can be targeted for removals.

While removal capture techniques are highly effective at capturing many geese, additional capture methods may be useful in capturing geese in areas where capture corrals are not feasible or in capturing geese that have already become flighted.

RECOMMENDATIONS

1. Expand Canada goose removals to all City owned properties up to 7 miles from airports. This will further reduce the risk of a strike to aircraft by protecting against movement of Canada geese throughout New York City.

2. Work with neighboring landowners to expand removal efforts, especially large property owners like National Park Service, Nassau County, the towns of Hempstead, North Hempstead and Oyster Bay, and the Village of Valley Stream.

3. Utilize additional capture techniques to increase the number of sites and geese that can be captured.

Table 1. New York City properties surveyed for Canada geese presence during the Spring of 2009.

New York City Owned Properties	
Alley Pond Park	Baisley Pond Park
Marcus Garvey Park	Canarsie Beach Park
Harlem River Park	Clearview Park and Golf Course
St. Mary's Park	Crocheron Park
Riverside Park	Edgemere Park
Capt Tilly Park	Ferry Point Park
Bronx Park	Flushing Meadow Park
Crotona Park	Forest Park and golf course
Pelham Bay Park	Fort Totten
American Ballfields Park in Broad Channel	Fresh Creek Park
Canarsie Cemetary	Hermon MacNeil Park
Wards Island WWTP	Kissena Park and Golf Course
Hunts Point WWTP	Little Bay Park
Bowery Bay WWTP	Springfield Park
Newtown Creek WWTP	Old Flushing Meadow Airport/College Point Park
Jamaica WWTP	Powells Cove
Rockaway WWTP	Pugsley Creek Park
Tallman WWTP	Rainey Park
Wards WWTP	Randalls Island Park
North River WWTP	Soundview Park
DEP 26th Ward	Roy Wilkins Park
Brookville Park	Spring Creek Park
Wards Island Park	South Brother Island
North Brother Island	New York Botanical Gardens
Bronx Zoo	Fountain Avenue Landfill
Pennsylvania Avenue Landfill	Rikers Island

Table 2. Total number of Canada geese observed and removed at New York City properties during June 15-18 and July 6-8, 2009.

Selected Sites	Distance from nearest PANYNJ airport boundary	Number of Canada geese observed on day of removal	Number of Canada geese captured
Roy Wilkins Park	2.4 miles	8	8
Captain Tilly Park	3.4 miles	12	12
Kissena Park & Golf Course	4.2 miles	39	39
Alley Pond Park	7.5 miles	13	9
Flushing Meadows Park	1.7 miles	192	188
Old Flushing Airport/College Point Park	1.2 miles	88	45
Baisley Pond Park	1.3 miles	30	29
Brookville Park	0.9 miles	44	43
Fort Totten	4.2 miles	291	240
Clearview Golf Course	4.4 miles	12	12
Randall's/Ward's Island Parks	2.7 miles	116	96
Rikers Island	0.1 miles	195	112
Crotona Park	3.9 miles	7	7
Pelham Bay Park	4.9 miles	252	216
Riverside Park	4.8 miles	21	12
NYC DOT Belt Parkway right-of-way	3.2 miles	110	90
Bronx Zoo	4.9 miles	83	77
Total		**1513**	**1235**

United States Department of Agriculture
Animal and Plant Health Inspection Service
Wildlife Services

Management of resident Canada Geese to protect aviation safety in New York City in 2009

May 2010

Ryan Collins
Wildlife Biologist
USDA-APHIS-Wildlife Services

BACKGROUND/INTRODUCTION

The Metropolitan New York City region has an estimated 20,000 – 25,000 resident Canada geese, which is approximately five times the amount that most people would find socially acceptable (B. Swift, pers. comm.). The increasing abundance of these 8-10 pound flocking birds in urban and suburban landscapes has resulted in a significant aviation safety hazard for the flying public and military aircraft.

The Federal Aviation Administration advisory circular 150/5200-33B recommends a distance of 5 miles from the edge of any airport to wildlife hazard attractants. The Federal Aviation Administration and Air Force have also established a zero-tolerance policy for Canada geese on or near airports due to the high probability of aircraft damage and reduced public safety.

Efforts to reduce the number of resident geese in metropolitan New York City were implemented to protect aviation safety, water supplies from fecal contamination, public and private property from damage to turf and ornamental plantings, loss of land use due to excessive fecal droppings, and against unintended consequences of hazing programs. The overall objective was to reduce the resident Canada geese population at City-owned public parks, ball fields, and other recreation areas within 5 miles of John F. Kennedy International Airport (JFK) and LaGuardia Airport (LGA).

Wildlife Services (WS) performed a comparative analysis of data collected from June 2004 through May 2010 from JFK, LGA, and surrounding NYC owned properties to evaluate the Resident Canada goose population management program. The data analyzed included yearly Canada goose strikes, Canada geese surveyed on airport operations area (AOA), number of Canada geese depredated (i.e. killed) at each airport, and Canada geese surveyed at surrounding parks.

METHODS

Site Evaluations – In early June 2009 WS conducted site evaluations at 52 New York City-owned properties to determine which sites needed geese removed. WS biologists documented the number of Canada geese and/or damage (fecal droppings, turf damage) present at the site. Risk to local aircraft movements was also assessed. Additionally, efforts to reduce damage caused by Canada geese (e.g., no feeding waterfowl ordinance) were documented. The list of sites eligible for geese removal were reviewed and confirmed with New York City. Of the 52 proposed sites, 17 were selected for goose removals in the boroughs of Brooklyn, Bronx, Manhattan, and Queens.

Removal - Canada geese were captured during the flightless summer molt period utilizing standard goose round-up procedures. Canada geese were captured during using panels about 4 x 10 feet in size. Depending on the number of geese, from 6 – 10 panels would be used to create a corral trap. When geese were in the water, then Wildlife Services personnel used kayaks or motor boats to push the geese onto shore and then into corral trap. The live-captured geese were placed in commercial turkey crates, transported to a secure location and euthanized with methods

approved by the American Veterinary Medical Association. Euthanized geese were disposed of in accordance with local and state statutes.

WS evaluated 4 criteria for the effectiveness of reducing resident Canada geese on and within 5-miles of JFK and LGA. The effectiveness of reducing local resident Canada goose populations was compared prior and post to roundups being conducted in late June and early July 2009. The four evaluations were 1) number of geese observed at removal sites, 2) number of geese seen at each airport, 3) number of geese depredated at each airport, and 4) number of goose strikes at both airports, pre- and post roundups. The evaluations are described below.

Site Monitoring – In May 2010 WS visited 16 of the 17 goose removal sites and recorded the number of Canada geese observed at each site. The number of geese observed during the June 2009 surveys was compared to the number observed during the May 2010 surveys.

AOA Surveys – As part of each airport's wildlife monitoring program WS conducted standardized 3-minute point counts twice a month at strategically placed locations at JFK and LGA. Survey data from June 2008 through May 2009 were compared to June 2009 through May 2010.

Depredations – Airport staff depredated Canada geese year round when they were present on the AOA at both JFK and LGA to reinforce hazing and to remove immediate threats to aviation. In addition to airport staff depredating Canada geese, WS staff also removed Canada geese at JFK as part of the airports bird strike reduction program. The number of geese depredated from June 2009 – May 2010 was compared to the average number of geese depredated per year from June 2004 – May 2009.

Bird strikes – Both airports implement wildlife control measures to reduce the risk of bird strikes. Bird-aircraft strikes are reported on a voluntary basis to the Federal Aviation Administration (FAA) wildlife strike database. The number of Canada goose strikes from June 2009 – May 2010 was compared to the yearly average of geese struck from June 2004 – May 2009.

RESULTS/DISCUSSION

Removals were conducted during the period of June 15-18 and July 6-8, 2009. In total WS removed 1,235 of the 1,513 Canada geese observed at the 17 selected sites (Table 1).

During the June 2009 site evaluations, WS observed 1,105 Canada geese at the 17 roundup sites compared to 292 geese which were observed during May 2010 at 16 sites (Table 2). The significant decrease in geese surveyed can be directly related at to the removal of resident Canada geese in 2009. Since resident Canada geese generally only travel short distances (<3 km; Seamans et al. 2009, Preusser et al. 2008, Holevinski et al. 2007), the removal of geese from these sites should have fewer geese occupying them after the roundups. Conducting the surveys

in separate months also may have played a small role in the difference in numbers of geese surveyed since some geese may still be incubating nests.

Table 1. Total number of Canada geese observed and removed at New York City properties during June 15-18 and July 6-8, 2009.

Selected Sites	Distance from nearest PANYNJ airport boundary	Number of Canada geese observed on day of roundup	Number of Canada geese captured
Roy Wilkins Park	2.4 miles	8	8
Captain Tilly Park	3.4 miles	12	12
Kissena Park & Golf Course	4.2 miles	39	39
Alley Pond Park	7.5 miles	13	9
Flushing Meadows Park	1.7 miles	192	188
Old Flushing Airport/College Point Park	1.2 miles	88	45
Baisley Pond Park	1.3 miles	30	29
Brookville Park	0.9 miles	44	43
Fort Totten	4.2 miles	291	240
Clearview Golf Course	4.4 miles	12	12
Randall's/Ward's Island Parks	2.7 miles	116	96
Rikers Island	0.1 miles	195	112
Crotona Park	3.9 miles	7	7
Pelham Bay Park	4.9 miles	252	216
Riverside Park	4.8 miles	21	12
NYC DOT Belt Parkway right-of-way	3.2 miles	110	90
Bronx Zoo	4.9 miles	83	77
Total		**1,513**	**1,235**

During the period of June 2008 – May 2009 WS observed an average of 19.8 Canada geese per survey at LGA, while the average number of geese surveyed during the June 2009 - May 2010 period decreased to 15. During the same time period at JFK the average number of geese surveyed rose from 4.7 to 15.3 (Table 3). This increase in average number of geese surveyed at JFK may be due to an increased number of migratory Canada geese observed during surveys in December 2009 through March 2010.

The only Canada geese present in New York City from April through September each year are resident Canada geese. The same analysis was conducted for April through September (Table 3). The average number of resident Canada geese observed per survey at LGA from April to September was 4.0 in 2008-2009 and 0.8 in 2009 – 2010. There was a four-fold reduction in resident Canada geese observed at LGA from pre-roundup to post roundup.

The average number of resident Canada geese observed per survey at JFK from April to September was 0.5 in 2008-2009 and 2009-2010.The number of Canada geese observed at JFK stayed the same compared from pre-roundup to post-roundup. The most likely explanation for the lack of change in resident Canada goose abundance at JFK was nearly 800 resident Canada geese molt at Rulers Bar Hassock on Gateway National Recreation Area land which is 1.1 miles from JFK. These geese are occasionally seen flying from Rulers Bar Hassock to JFK.

Table 2. Number of Canada geese observed during monthly monitoring visits to roundup sites in June 2009 and May 2010.

2009 Roundup Sites	June-09	May-10
Alley Pond Park	14	13
Baisley Pond Park	42	0
Bronx Zoo	69	Not surveyed
Brookville Park	32	27
Captain Tilly Park	14	0
Clearview Golf Course	12	2
Crotona Park	7	0
Flushing Meadows Park	205	15
Fort Totten	150	20
Kissena Park & Golf Course	36	0
Old Flushing Airport/College Pt Park	76	74
Pelham Bay Park	177	22
Penn/Fountain Ave Landfills	110	38
Randalls/Wards Island	62	53
Rikers Island	72	11
Riverside Park	19	17
Roy Wilkins Park	8	0
	1105	**292**

The New York Botanical Gardens which is adjacent to the Bronx Zoo reports a decrease in large flocks of resident Canada geese loafing and grazing in 2010 compared to 2009. There are still small numbers of resident Canada geese using the New York Botanical Gardens which need to be harassed by a local dog harassment service to minimize damage to plant collections. However, the situation at the Botanical Gardens is greatly improved over the previous year with the removal of Canada geese from the Bronx Zoo in 2009 (K. Morrell, New York Botanical Gardens, pers. commun.)

Table 3. Average number of Canada geese observed per survey from airport operations areas at JFK and LGA airports for each month from June 2008 – May 2010. Months when only resident Canada geese are present are highlighted in blue.

		[redacted]	[redacted]	[redacted]	[redacted]	Oct	Nov	Dec	Jan	Feb	Mar	[redacted]	[redacted]	Average
LGA	**2008-09**	3	2	6	8	24	34	18	68	64	6	5	0	19.8
	2009-10	0	2	2	0	16	8	14	48	80	10	1	0	15.0
JFK	**2008-09**	0	0	1	1	38	6	0	0	10	1	1	0	4.7
	2009-10	0	0	0	3	0	10	19	26	34	92	0	0	15.3

Depredations by LGA staff averaged 23.2 Canada geese per year from June 2004 – May 2009. From June 2009 – May 2010 airport staff depredated 26 Canada geese, only slightly above the 5-year average. However, during 2008- 2009 new equipment was provided to LGA personnel to increase the effectiveness of lethal control on the AOA. At JFK, airport staff and WS combined to average 119 Canada goose depredations per year from June 2004 – May 2009. This number dropped to 87 goose depredations from June 2009 – May 2010, a reduction of approximately

27% (Table 4). This decrease in annual goose depredations at JFK over the past year may be due in part to less resident geese in the vicinity of JFK after the roundups.

Table 4. Number of Canada geese depredated yearly at JFK and LGA airports from June 2004 – May 2010.

Years (June-May)	LGA	JFK
2004-05	21	132
2005-06	27	83
2006-07	3	86
2007-08	2	116
2008-09	63	180
5 year average	23.2	119
2009-10	26	87

There were 4 total aircraft strikes with Canada geese at LGA from June 2004 – May 2009, averaging 0.8 per year. From June 2009 thru May 2010 there was 1 Canada goose strike at LGA, only a slight increase over the 5-year average. At JFK there were 6 aircraft strikes with Canada geese from June 2004 – May 2009, averaging 1.2 per year. During the same months of 2009 – 2010 there was 1 aircraft strike with a Canada goose, slightly below the 5-year average (Table 5). Due to low number of geese annually struck, the full benefits of the NYC Resident Canada goose management program are not expected for several years.

Table 5. Number of yearly reported aircraft strikes with Canada geese at JFK and LGA airports from June 2004 – May 2010.

Years (June-May)	LGA	JFK
2004-05	2	0
2005-06	1	2
2006-07	0	1
2007-08	0	2
2008-09	1	1
5 year average	0.8	1.2
2009-10	1	1

SUMMARY

The proposed NYC owned removal sites were compiled based on observations of Canada geese outside the molting period in 2008-2009. Canada geese often move temporarily prior to the molt to locations where food and water are accessible without flying. The proposed sites with no geese present during site evaluations were feeding and loafing through most of the year but were vacated at the time of site evaluation due to lack of suitable molting habitat.

The 17 removal sites provided a great amount of information as to the preferred molting sites of resident Canada geese in New York City. Based on this information WS will be able to identify similar habitats that may be harboring geese during future molting seasons that can be targeted for removals.

The varying annual differences in Canada goose numbers seen when comparing the different parameters make it difficult to evaluate the effectiveness of the NYC Canada goose program after only one year of population reduction. The large number of resident Canada geese living on Gateway National Recreation Area confounds an evaluation of effectiveness and is a hurdle to reducing risks to aviation. Another year of resident Canada goose removals with continued monitoring will aid in determining the efficacy of the program.

Overall, there have been decreases in the number of resident Canada geese one year after the 2009 removals. The average number of Canada geese surveyed at LGA airport has decreased by greater than four-fold. The number of Canada geese depredated has remained relatively constant at LGA, while at JFK Canada goose depredations have decreased by 27% - compared to the previous five year average. While the full impacts of the goose reductions on reduced strike risks may not be felt for several years to come, the fact is there are 1,235 less geese in NYC that could strike a plane. Lastly, the number of geese inhabiting NYC owned property has been reduced by 72% (based on number of geese surveyed at 16 capture sites). The reduction in goose numbers at these properties will lead to reduced risk to aviation of a goose striking an aircraft, reduced clean up of droppings, more use of parks by people for recreation, less water contamination, and less environmental degradation.

Literature Cited

Holevinski, R. A., P. D. Curtis, and R. A. Malecki. 2007. Hazing of Canada geese is unlikely to reduce nuisance populations in urban and suburban communities. Human – Wildlife Conflicts 1:257-264.

Preusser, S. E., T. W. Seamans, A. L. Gosser, and R.B. Chipman. 2008. Evaluation of an integrated non-lethal Canada goose management program in New York (2004-2006). Proc. Vertebr. Pest Conf. 23:66-73

Seamans, T. W., S. E. Clemons, and A. L. Gosser. 2009. Observations of neck-collared Canada geese near John F. Kennedy International Airport, New York City. Human – Wildlife Conflicts 3:214-222.

WS-ER (2/08)

Agreement No.: 09-7236-4567-RA
Accounting Code: 973-7236-045

INTER-GOVERNMENTAL AGREEMENT
between
CITY OF NEW YORK (CITY)
and
UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES (USDA, APHIS-WS)

ARTICLE 1

The purpose of this Cooperative Service Agreement is to manage and reduce resident Canada goose populations within 5-miles of LaGuardia and John F. Kennedy International Airports to maintain a safe flying environment, as required by Federal Aviation Administration regulations and policies.

ARTICLE 2

USDA, APHIS-WS has statutory authority under the Act of March 2, 1931 (46 Stat. 1468; 7 U.S.C.426-426b) as amended, and the Act of December 22, 1987 (101Stat. 1329-331, 7 U.S.C. 426c), to cooperate with States, local jurisdictions, individuals, public and private agencies, organizations, and institutions while conducting a program of wildlife services involving mammal and bird species that are reservoirs for zoonotic diseases, or animal species that are injurious and/or a nuisance to, among other things, agriculture, horticulture, forestry, animal husbandry, wildlife, and human health and safety.

ARTICLE 3

APHIS-WS and the City mutually agree:

1. The parties' authorized representatives who shall be responsible for carrying out the provisions of this Agreement shall be:

   Edward Skyler
   Deputy Mayor for Operations
   City Hall
   New York, NY 10007

2009-018127

Steven Lawitts
Acting Commissioner
Department of Environmental Protection
59-17 Junction Boulevard, 19th Floor
Flushing, NY 11373-5108

Allen Gosser, Assistant State Director New York
USDA, APHIS, WS
1930 Route 9
Castleton, NY 12033

2. To meet as determined necessary by either party to discuss mutual program interests, accomplishments, needs, technology, and procedures to maintain or amend the Work Plan (Attachment A). Personnel authorized to attend meetings under this Agreement shall be Edward Skyler or his designee, the State Director or his/her designee, and/or those additional persons authorized and approved by the Deputy Mayor for Operations, and the State Director.

3. USDA, APHIS-WS shall perform services more fully set forth in the Work Plan, which is attached hereto and made a part hereof. The parties may mutually agree in writing, at any time during the term of this Agreement, to amend, modify, add or delete services from the Work Plan.

ARTICLE 4

The City of New York agrees:

1. To authorize USDA, APHIS-WS to conduct direct control activities to reduce human safety risks and property damage associated with resident Canada geese striking commercial aircraft. These activities are defined in the Work Plan. USDA, APHIS-WS will be considered an invitee on the lands controlled by City. The City, through the agency with jurisdiction over the land in question, will be required to exercise reasonable care to warn APHIS-WS as to dangerous conditions or activities in the project areas.

2. To reimburse USDA, APHIS-WS for costs of services provided under this Agreement up to but not exceeding the amount specified in the Financial Plan (Attachment B), provided that neither a reimbursement made by the City nor the City's agreement to reimburse costs pursuant to this Agreement shall be deemed to constitute any admission by the City of liability for any wildlife hazard condition. The City will begin processing payment of invoices submitted by APHIS-WS within 30 days of receipt. The City of New York ("City") has not been debarred from contracting with Federal Agencies. The City and its agencies and related entities are party to many grant and other contracts and agreements with various Federal agencies. At any given time, Federal funds may have been advanced or reimbursed to the City under any such agreements and there may be on-

going discussions and negotiations between the City and the Federal government with respect to final amounts due.

3. To designate to USDA, APHIS-WS the City of New York's authorized individual whose responsibility shall be the coordination and administration of activities conducted pursuant to this Agreement, provided that the City's involvement in the completion of the Work Plan, is not intended to relieve the Port Authority of New York and New Jersey of its obligations to maintain a safe flying environment, as required by federal law, including without limitation, the rules and regulations of the Federal Aviation Administration Advisory Circular 150.5200-33B.

4. To notify USDA, APHIS-WS verbally or in writing as far in advance as is practical of the date and time of any proposed meeting related to this Agreement.

5. USDA, APHIS-WS shall be responsible for administration and supervision of the program.

6. All equipment purchased for the program is and will remain the property of USDA, APHIS-WS.

7. To coordinate with USDA, APHIS-WS before responding to all media requests.

8. To coordinate with the New York Police Department if law enforcement services become needed to carry out this agreement.

ARTICLE 5

USDA, APHIS-WS Agrees:

1. To conduct activities within approximately 5-miles of LaGuardia and John F. Kennedy International Airports as described in the Work and Financial Plans. City-owned properties where Canada geese are to be removed will be identified by the City of New York in consultation with USDA, APHIS-WS and New York State DEC.

2. To designate Allen Gosser as the authorized USDA, APHIS-WS individual who shall be responsible for the joint administration of the activities conducted pursuant to this Agreement.

3. To bill the City of New York for actual costs incurred by USDA, APHIS-WS during the performance of services agreed upon and specified in the Work Plan. USDA, APHIS-WS shall keep records and receipts of all reimbursable expenditures hereunder for a period of not less than one year from the date of completion of the services provided under this Agreement and the City of New York shall have the right to inspect and audit such records. All invoices with supporting documentation shall be submitted to

Management of resident Canada geese in metropolitan New York City

[redacted] with a copy to [redacted]. Invoices shall be submitted no more than once monthly.

4. To coordinate with the City of New York before responding to all media requests.

5. To confirm via email from [redacted] or his designee all properties on which they plan to take geese with NYC before taking billable action.

ARTICLE 6

This Agreement is contingent upon the passage by Congress of an appropriation from which expenditures may be legally met and shall not obligate USDA, APHIS-WS or the City of New York upon failure of Congress to so appropriate. This Agreement may also be reduced or terminated if Congress only provides USDA, APHIS-WS funds for a finite period under a Continuing Resolution.

ARTICLE 7

USDA, APHIS-WS assumes no liability for any actions or activities conducted under this Cooperative Service Agreement except to the extent that recourse or remedies are provided by Congress under the Federal Tort Claims Act (28 U.S.C. 1346(b), 2401(b), and 2671-2680).

ARTICLE 8

Pursuant to Section 22, Title 41, United States Code, no member of or delegate to Congress shall be admitted to any share or part of this Agreement or to any benefit to arise therefrom.

ARTICLE 9

All activities will be conducted in accordance with all applicable Federal, State and local laws, rules, and regulations. Nothing in this Agreement shall prevent USDA, APHIS-WS from entering into separate agreements with any other organization or individual for the purpose of providing wildlife damage management services exclusive of those provided for under this agreement.

ARTICLE 10

The City of New York certifies that USDA, APHIS-WS has advised the City that there may be private sector service providers available to provide wildlife management services that the City is seeking from USDA, APHIS-WS.

ARTICLE 11

The performance of wildlife damage management actions by USDA, APHIS-WS under this agreement is contingent upon a determination by USDA, APHIS-WS that such actions are in compliance with the National Environmental Policy Act, Endangered Species Act, and any other applicable environmental statutes. USDA, APHIS-WS will not make a final decision to conduct requested wildlife damage management actions until it has made the determination of such compliance.

ARTICLE 12

This Cooperative Service Agreement may be amended at any time by mutual agreement of the parties in writing. Also, this Agreement may be terminated at any time by mutual agreement of the parties in writing, or by one party provided that party notifies the other in writing at least 90 days prior to effecting such action. Further, in the event the City does not provide necessary funds, USDA, APHIS-WS is relieved of the obligation to provide services under this agreement. In the event of termination, the City agrees to reimburse USDA, APHIS-WS for services performed up to the date of termination.

In accordance with the Debt Collection Improvement Act of 1996, the Department of Treasury requires a **Taxpayer Identification Number** for individuals or businesses conducting business with the agency.

City of New York Taxpayer Identification Number (TIN) 13-6400434

CITY OF NEW YORK:

BY: (b)(6) _____ 6/5/09
Date

Edward Skyler
Deputy Mayor for Operations
City Hall
New York, NY 10007

BY: (b)(6) _____ 6/03/09
Date

Steven Lawitts
Acting Commissioner
Department of Environmental Protection
59-17 Junction Boulevard, 19th Floor
Flushing, NY 11373-5108

APPROVED AS TO FORM
CERTIFIED AS TO LEGAL AUTHORITY
(b)(6)
ACTING CORPORATION COUNSEL
JUN 01 2009

UNITED STATES DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

BY: _____ 6-8-09
Martin Lowney, State Director — Date
USDA, APHIS, WS
1930 Route 9
Castleton, NY 12033

BY [redacted] (b)(6) _____ 6/10/09
for — Date
Director, Eastern Region
USDA, APHIS, WS
920 Main Campus Drive; Suite 200
Raleigh, NC 27606

ATTACHMENT A
WORK PLAN

A. JUSTIFICATION AND OBJECTIVES

On January 15, 2009, US Airways Flight 1549 struck a flock of Canada geese approximately 4 miles from LaGuardia Airport, New York City which damaged both engines. The plane made an emergency landing in the Hudson River and all 155 passengers and crew survived. The $60 million aircraft was destroyed. Over the past 10 years, there have been 78 reported Canada goose strikes with aircraft in New York. These strikes have caused more than $2,231,864 in aircraft damage, excluding US Airways Flight 1549. In addition, in 1995 an Air France Concorde departing John F. Kennedy International Airport ingested Canada geese destroying 2 of the aircraft's 4 engines, causing more than $7 million in estimated damage.

The State of New York has close to 250,000 resident Canada geese, which is more than three times the state's population goal of 85,000. The Metropolitan New York region has an estimated 20,000 – 25,000 resident Canada geese, which is approximately five times the amount that most people would find socially acceptable (B. Swift, pers. comm.). The increasing abundance of these 8-10 pound flocking birds in urban and suburban landscapes has resulted in a significant aviation safety hazard for the flying public and military aircraft.

The Federal Aviation Administration advisory circular 150/5200-33B recommends a distance of 5 miles from the edge of any airport to the wildlife hazard attractant. The Federal Aviation Administration and Air Force have established a zero-tolerance policy for Canada geese on or near airports due to the high probability of aircraft damage and reduced public safety.

The population of resident Canada geese needs to be reduced in metropolitan New York City to protect aviation safety, water supplies from fecal contamination, public and private property from damage to turf and ornamental plantings, loss of land use due to excessive fecal droppings, and against unintended consequences of hazing programs. In addition, the population of Canada geese within 5 miles of John F. Kennedy International Airport and LaGuardia Airport should be eliminated to the extent reasonable.

Background

In North America there are many different classifications of Canada geese, but the principal distinction for management is whether geese are "migratory" (generally those that breed in northern Canada or Alaska) or "resident" (those that breed locally in the U.S. and southern Canada). Most migratory Canada geese nest north of the 48° N latitude in sub-Arctic Canada, and these populations likely spend very little time in the New York City area, as they pass through over a few weeks during spring and fall migration. Resident Canada geese nest south of the 48° N latitude and are a product of releasing live bird collections and live decoys, and stocking of Canada geese by state agencies to establish huntable populations in rural areas.

(Atlantic Flyway Council 1999). These geese generally remain in the local area year-round, except when very severe winter weather forces the birds south to find open water or food

The first releases of geese that established the resident population occurred in New York in the early 1900s. In 1935, the federal government prohibited the use of captive Canada geese as decoys for hunting, and many of those semi-domesticated geese were released by live bird collectors and hunting clubs in Long Island Sound, Delaware Bay, and Chesapeake Bay. State wildlife agencies in the eastern U.S. relocated or stocked thousands of Canada geese from the 1950s to the 1980s, mostly in rural huntable areas.

Atlantic Flyway Resident Canada Goose Management Plan

Resident Canada geese have increased in numbers to an estimated 1.02 million birds living in the Atlantic Flyway in 2008. The Atlantic Flyway is comprised of 17 eastern states along the Atlantic Ocean. In response to the increasing number of resident Canada geese and escalating damage to public and private property, natural resources, and human health and safety, the U.S. Fish and Wildlife Service published a management plan for resident Canada geese, the "*Atlantic* Flyway Resident Canada Goose Management Plan". The purpose of the plan is to strike a balance between people who enjoy consumptive and non-consumptive uses of resident Canada geese, land owners and managers, and the public. This management plan supports National Environmental Policy Act compliance for federal actions related to resident Canada goose management. A Final Environmental Impact Statement for Resident Canada Goose Management was completed in 2006, and USDA, APHIS-WS and the U.S. Fish and Wildlife Services have issued their Records of Decision to implement the Environmental Impact Statement. The States, local governments, and individuals would be unable to implement actions to manage migratory Canada geese or receive permits to reduce their damage unless the federal agencies complied with the Act.

The goal of the Atlantic Flyway Resident Canada Goose Management Plan is to reduce the number of resident Canada geese in the 17 Atlantic Flyway states to 650,000 birds. New York State established a population goal of 85,000 resident Canada geese. Population estimates for resident Canada geese are determined in the states each spring using the Breeding Waterfowl Populations Survey. Annual estimates tend to vary somewhat, but in recent years there have been an estimated 250,000 resident Canada geese in the state of New York.

The New York State Department of Environmental Conservation, Bureau of Wildlife, Fisheries, and Marine Resources estimates 20,000 – 25,000 resident Canada geese live in metropolitan New York region, including Long Island and the Lower Hudson Valley. Resident Canada geese have high survival in urban and suburban areas due to restrictions on the discharge of firearms which affects federal and state management plans to manipulate population levels by legal hunting. Furthermore, there are additional distinct biological differences between resident Canada geese and migratory Canada geese which compound the difficulty of managing a species infrequently exposed to hunting mortality. Resident Canada geese are sexually mature at age 2 while migratory Canada geese may not reproduce until 3-5 years of age due to the harsh climate where they nest. Resident Canada geese restrict most of their daily movements to 1.5 – 3.0 miles according to three recent New York studies (Holevinski et al. 2007, Preusser et al. 2008,

Seamans et al. 2009). Resident Canada geese also adapt to hunting by locating properties where hunting is prohibited or does not occur.

Geese Population Reduction Programs

Numerous hazing programs have been implemented by state and federal agencies, local municipalities and private landowners. Non-lethal hazing programs have also been promoted by animal interest groups, the consequences of which have recently been identified:

1) Hazing moves problem geese from one property to another (Holevinski et al. 2007, Preusser et al. 2008), which increases management costs to all landowners and distributes the property damage over additional properties;
2) Egg and nest destruction increases the number of resident geese that molt migrate to the sub-artic, resulting in damage to vegetation and loss of food resources for nesting migratory geese (Luukkonen et al. 2008). It was reported at the February 2009 Atlantic Flyway meeting that some 200,000 resident Canada geese may be spending the summer in the sub-artic;
3) Increasing the risk of bird-aircraft collisions because the resident Canada goose population in many suburban and urban areas is permitted to continue to increase due to a lack of mortality when these resident populations should be reduced in abundance to reduce risk of a bird strike to aircraft (Holevinski et al., 2007),
4) High hazing costs continue annually to protect drinking water supplies from fecal coliform bacteria, cryptosporidium, and giardia instead of reducing the abundance of resident Canada geese (Klett et al. 1998, Nadareski, pers. Commun. April 21, 2009,); and
5) Hazing is an ineffective and costly strategy for long term management of Canada goose populations (Holevinski et al. 2008).

Hunting is the traditional method used by state and federal wildlife agencies to manage Canada goose populations within social and biological carrying capacities. Hunters call and decoy geese into locations used as part of the daily feeding and loafing routine. The federal government allows hunters to use shotguns or bow and arrows to harvest migratory birds. The discharge of a shotgun with shot of the appropriate size to harvest a goose could travel up to 300 yards. Many municipalities, including New York City, have local ordinances prohibiting the discharge of firearms for public safety reasons. The high density of people and structures in New York City makes the discharge of shotguns infeasible for most locations in the city, even if the discharge ordinance was not in effect.

The Federal Aviation Administration issued Advisory Circular 150/5200-33B in August 2007 to provide guidance about certain land uses that have the potential to attract hazardous wildlife on or near airports. The Federal Aviation Administration funded studies about wildlife hazards to aircraft and learned not all wildlife are equally hazardous. Canada geese are the third most hazardous animal which planes strike in North America due to the high probability of the strike resulting in damage or major damage to the aircraft (Dolbeer et al 2000). Only deer and vultures are more hazardous to aviation than Canada geese. Seamans et al. (2009) recommended management of all Canada geese, including lethal removal, within 5 miles of airports to reduce the risk of a strike to aircraft. The higher risk of damage which may be caused by Canada geese

caused the Federal Aviation Administration and Air Force to declare a zero tolerance policy for Canada geese.

John F. Kennedy International and LaGuardia Airports have active bird hazing program to reduce the abundance of birds in critical airspace for approach and departure of aircraft. Even though both airports implement wildlife control measures to reduce risk of a bird strike or damaging bird strike to aircraft, strikes do occur. While the risk of a strike is low the consequences can be catastrophic. At John F. Kennedy International Airport there have been 676 reported bird strikes from January 2004 to December 2008. Five of these strikes involved Canada geese of which 1 strike caused substantial damage and 1 strike caused minor damage to the aircraft. At LaGuardia Airport there have been 410 reported bird strikes from January 2004 to December 2008. Four of these strikes involved Canada geese of which 1 strike caused minor damage.

Objective

To conduct best efforts to remove all resident Canada geese from all City-owned public parks, ballfields, and other man-made and natural habitats within 5 miles of airports in metropolitan New York City. This objective was created from guidance provided in Federal Aviation Administration, Advisory Circular 150/5200-33B.

B. RESULTS OR BENEFITS EXPECTED

The United States Department of Agriculture, Wildlife Services program and the City of New York, Department of Parks and Recreation surveyed parks, ballfields, and other properties near LaGuardia and John F. Kennedy International Airports in February and March 2009 and June 2008. USDA, APHIS-WS counted 822 Canada geese on 10 properties within 8 miles of LaGuardia Airport in March 2009 and 1,129 Canada geese on 27 properties within 8 miles of JFK International Airport in June 2008. Parks and Recreation surveyed Canada geese on 29 properties within 5 miles of both airports in March 2009. A total of 54 different sites were surveyed by the government agencies, including some non-city owned properties. The number of geese at each site ranged from about 2 to 450. Some of the properties were surveyed by both government agencies. An estimated 3,000 – 4,000 resident Canada geese may be using the 54 different sites.

Decreasing the resident Canada goose population will reduce the year-round risk these birds pose to aviation safety. While migrating birds temporarily increase the risk to aviation safety, the reduction of resident Canada geese is a step in reducing the abundance of larger-bodied birds that cause the most damaging strikes to aircraft.

C. APPROACH

The USDA, APHIS-WS is the agency with expertise and authority to manage wildlife damage. The USDA, APHIS-WS program would use an evaluation and removal approach outlined in its National Environmental Policy Act documents. The document "Canada Goose Damage

Management in the State of New York" is located at
http://www.aphis.usda.gov/regulations/ws/ws_environmental_new_york.shtml

Site Evaluation

A wildlife biologist will visit each site during the second half of May or early June to conduct a site evaluation to determine if the geese are to be removed during the summer molt of about June 15 to July 15. Only City-owned properties will be included in the site evaluation and geese removal. The site evaluation documents the number of Canada geese and other bird species of concern using the site and damage to the site. Other damage, such as risk to local aircraft movements, will be assessed. Additionally, efforts to reduce damage caused by Canada geese and other pertinent information (e.g., no feeding waterfowl ordinance) will be documented. The list of sites eligible for geese removal will be reviewed and confirmed with USDA and the City.

Removal

Canada geese can be removed by several methods. As this action will take place during summer molt (when the birds are unable to fly), USDA, APHIS-WS will most likely capture geese by herding the geese into capture pens. Canada geese are captured during the molt using panels about 4 x 10 foot in size. Depending on the number of geese, from 6 – 10 panels would be used to encircle the geese. If the geese are in the water, then biologists and specialists will use kayaks, canoes, or motor boats to push the geese towards shore. The captured geese are placed alive in commercial turkey crates. The geese would be brought to a secure location and euthanized with methods approved by the American Veterinary Medical Association. Euthanized geese would be buried. Various other methods such as hand grabbing or netting nesting geese may be used infrequently.

The following two methods may also be used, but will not be the preferred method within molting season:

1) Sedating: The USDA can use appropriate sedatives to immobilize and capture Canada geese when the legal hunting season is closed and up to 30-days before the hunting season. Sedated geese would be placed alive in turkey crates. The geese would be brought to a secure location and euthanized with methods approved by the American Veterinary Medical Association. Euthanized geese would be buried. If this method is required, the City and the USDA will work together to mutually approve the sedatives used.

2) Cannon or rocket net: a net about 40 x 60 feet in size is folded up and placed on the ground at a location where geese congregate to feed or loaf. The location has been pre-baited to accustom the geese to the site and net. The net is fired over the geese by using one of three mechanisms. Nets can be fired over the geese by 3-4 heavy projectiles attached to the net and propelled by smokeless powder, black powder or compressed air. The captured geese are placed alive in commercial turkey crates. The geese would be brought to a secure location and euthanized with methods approved by the American Veterinary Medical Association. Euthanized geese would be buried. Rocket and cannon

nets can be used any time of year, but involve the use of explosives that are subject to New York City regulations.

Public Notification

USDA, APHIS-WS will coordinate its public affairs staff with public affairs staff of the New York City government, New York State Department of Environmental Conservation, and U.S. Fish and Wildlife Service. The City of New York will take the lead on informing the public and political leaders about the Canada goose management action. USDA, APHIS-WS will support the City through jointly developed communication plan.

The City of New York may need to provide security during the capture and removal of Canada geese from public parks and lands. USDA, APHIS-WS will work with the New York Police Department or other law enforcement entities when capturing and removing Canada geese.

D. RESOURCES REQUIRED

The capture of Canada geese during the molt will require about 6 people trained to capture and handle the birds. USDA, APHIS-WS shall provide a district supervisor and 4 wildlife specialists for this project. New York City shall provide at least one, but not more than two, wildlife staff members to assist with this project. It is estimated that about all identified sites could be visited and geese removed during the molt over a 4-week period in New York City.

E. STIPULATIONS AND RESTRICTIONS

USDA, APHIS-WS' activities under this cooperative effort will be limited to the State of New York. Techniques will be environmentally sound, safe and selective. If applicable, any needed Federal, State and local permits will be secured to perform wildlife damage management activities, and these activities will be within the policy guidelines of USDA, APHIS-WS. All program activities will be conducted within local, State and Federal regulations.

The performance of wildlife damage management actions by USDA, APHIS-WS under this agreement is contingent upon a determination by USDA, APHIS-WS that such actions are in compliance with the National Environmental Policy Act, Endangered Species Act, and any other applicable environmental statutes. USDA, APHIS-WS will not make a final decision to conduct requested wildlife damage management actions until it has made the determination of such compliance.

F. AUTHORIZATIONS

Migratory birds are protected by the Migratory Bird Treaty Act and regulations in Title 50 Code of Federal Regulations. The taking of migratory birds is a highly regulated activity requiring compliance with federal and state statutes. Migratory birds may be taken under the authority of a

permit issued by the U.S. Department of Interior, Fish and Wildlife Service or under the authority of a depredation order. The federal government published a depredation control order for resident Canada geese at airports or military airfields. The State of New York allows the management of resident Canada geese within the constraints of this federal depredation order. Title 50 Code of Federal Regulations, Part 21.49 allows USDA, APHIS-WS to act as an agent of the airports in New York City and to take resident Canada geese on property within 3-miles of the airport after permission has been authorized by the landowner. Resident Canada geese residing from 4-5 miles from the airport will be taken under a depredation permit issued to USDA, APHIS-WS by the U.S. Fish and Wildlife Service.

G. REPORTS

USDA, APHIS-WS will prepare a report by August 31 summarizing Canada geese removed from properties within 5 miles of airports in New York City.

H. MEASURES OF ACCOMPLISHMENT

The effectiveness of the Canada goose program in New York City will be evaluated by using existing metrics:

1) Reduction in Canada goose strikes at New York City airports,
2) Reduction in risk to aviation, measured by evaluating the number of geese at airports through monthly monitoring already being conducted at the airports by the Port Authority,
3) Surveying parks, ballfields, and other properties within 5-miles of the airports during the month of May or June annually, and
4) Monitoring the change in Canada geese harassed or removed at airports in New York City on a monthly and annual basis.

I. LITERATURE CITED

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J. EFFECTIVE DATES

The cooperative agreement shall become effective on June 8, 2009, and shall expire on June 7, 2010.

Agreement #: 09-7236-4567-RA, amendment 1
Account #: 073-236-045

EXTENSION AND AMENDMENT

THIS EXTENSION AND AMENDMENT, made as of 6/9/10 by and between the City of New York ("the City") and the United States Department of Agriculture Animal and Plant Health Inspection Service Wildlife Services (USDA, APHIS-WS).

WITNESSETH:

WHEREAS, the City and USDA, APHIS-WS entered into an Inter-Governmental Agreement (the " Agreement") commencing on June 8, 2009 and concluding on June 7, 2010, to manage and reduce resident Canada goose populations within 5 miles of LaGuardia and John F. Kennedy International Airports to maintain a safe flying environment; and

WHEREAS, the City and USDA, APHIS-WS wish to extend and amend the Agreement; and

WHEREAS, pursuant to Article 12 of the Agreement, the City and USDA, APHIS-WS mutually agree to revise Cooperative Service Agreement No. 09-7236-4567-RA;

NOW, THEREFORE, in consideration of the promises and conditions recited herein, the parties agree as follows:

1. All terms capitalized and not defined herein shall have the same meanings ascribed thereto in the Agreement.
2. Article 1 and Article 5 (1): The distance for activities pursuant to the Agreement shall be amended from 5 (five) to 7 (seven) miles of LaGuardia and John F. Kennedy International Airports.
3. Article 3 (1) The City's authorized representatives for the Agreement shall be Stephen Goldsmith, Deputy Mayor for Operations, and Caswell F. Holloway, Commissioner, Department of Environmental Protection, and their names shall be substituted for any other named City representatives in the Agreement.
4. Attachment A (J). The expiration date of the Agreement shall be extended to: June 30, 2011.
5. Except as stated herein, all other terms and conditions in the Agreement remain in full force and effect.
6. Attachment B shall be revised to include an additional amount of $45,535 (forty five thousand, five thirty five dollars) available for the time period of 6/8/2010 - 6/30/2011, for a total agreement amount of $91,070 (ninety one thousand, seventy dollars) available for the time period of 6/8/2009 - 6/30/2011.

IN WITNESS WHEREOF, the parties have executed this Amendment as of the date and year first written above.

City of New York

(b)(6)

Caswell F. Holloway
Commissioner, New York City Department of Environmental Protection

Date: 06-09-10

USDA Animal and Plant Health Inspection Service Wildlife Services

Charles S. Brown
Regional Director

Date: 6/9/10

Management of resident Canada geese in metropolitan New York City

ATTACHMENT
FINANCIAL PLAN

Salary and Benefits	(b)(4)
Travel	
Vehicle Usage	
Equipment and Supplies	
Program Support	
TOTAL	$45,535

The distribution of the budget from this Financial Plan may vary as necessary to accomplish the purpose of this agreement, but may not exceed $45,535.

Financial Point of Contact

City: (b)(6) (914) 773- (b)(6)
<Name to call for billing questions> Phone

APHIS, WS: _____ 518-477-4837
<Budget Personnel Name> Phone

Human–Wildlife Conflicts 3(2):242–250, Fall 2009

Observations of neck-collared Canada geese near John F. Kennedy International Airport, New York

Thomas W. Seamans, U.S. Department of Agriculture/Wildlife Services' National Wildlife Research Center, 6100 Columbus Avenue, Sandusky, OH 44870, USA *thomas.w.seamans@aphis.usda.gov*

Scott E. Clemons, U.S. Department of Agriculture/Wildlife Services, 1930 Route 9, Castleton, NY 12033-9653, USA

Allen L. Gosser, U.S. Department of Agriculture/Wildlife Services, 1930 Route 9, Castleton, NY 12033-9653, USA

Abstract: Canada geese (*Branta canadensis*) often cause significant damage when they strike aircraft. They are responsible for a reported minimum of $2.6 million in damage per year to civil aviation in the United States. Knowledge of goose movements in relation to airports would allow wildlife managers to allocate time and funds to manage those populations that pose the greatest threat to aircraft. We placed alpha-numeric neck collars on 300 Canada geese within 8 km of both John F. Kennedy International Airport (JFKIA) and LaGuardia Airport in New York, New York. We conducted weekly observations for 2 years within a 12-km radius of JFKIA at locations used by the geese. At the conclusion of the study, 45% of the collared geese remained within an 8-km radius of JFKIA, and four were killed at JFKIA during wildlife control operations. We observed birds at their original banding sites 75% of the time, and within 5 km of the banding location 95% of the time. Geese that remained in the study area were re-sighted at a mean straight-line distance of 3.6 (±3.1) km from their original banding location. We note that 78% of the re-sighting locations used by geese were within 8 km of JFKIA and that movements of these geese could take them over or onto JFKIA. Oiling goose eggs to kill the embryos, rounding up of flightless birds within 8 km of the airport, and bird-control activities at JFKIA and nearby areas all should be continued to reduce the probability of a catastrophic bird strike between aircraft using JFKIA and local Canada geese.

Key words: airport, bird–aircraft collision, *Branta canadensis*, Canada goose, home range, human–wildlife conflicts, movements, neck collars

Aircraft collisions with bats (Peurach et al. 2009), deer (DeVault 2008, VerCauteren et al. 2009), and birds (Bernhardt et al. 2009, Dale 2009, Dolbeer and Wright 2009, Dove et al. 2009, Linnell et al. 2009) in the United States cost civil aviation an estimated $628 million per year. Canada geese (*Branta canadensis*) alone cause a minimum of $2.6 million of damage per year (Dolbeer and Wright 2008). From 1990 to 2007, Canada geese caused 14 accidents with civil aircraft that resulted in human injuries (Dolbeer and Wright 2008, Dove et al. 2009). In 1995, Canada geese caused a U.S. Air Force (USAF) AWACS aircraft to crash on takeoff, resulting in the death of all 24 crew members and the complete loss of the $190-million aircraft (Wright 1997). Canada goose strikes to USAF aircraft cost, on average, $710,000 per strike (USAF 2008). In a ranking of wildlife hazardous to aviation, geese (primarily Canada geese) were ranked third out of 21 species groups (Dolbeer et al. 2000). With the possible exception of the empennage (i.e., aircraft tail assembly), no part of an aircraft can sustain a goose strike without suffering some level of damage (Dolbeer and Eschenfelder 2002).

In the northeastern United States, population trends from North American Breeding Bird Survey data show that Canada goose populations have increased from 1966 to 2007 by 12.6% per year (Sauer et al. 2008). In New York State, the resident population of Canada geese is estimated to be 200,000 (N.Y. State 2009). Knowledge of goose movements in areas associated with airports is critical for safe airport operations, given the year-round ubiquity of Canada geese throughout most of the continental United States (Washburn et al. 2007, Groepper et al. 2008). For example, Cooper (1991) identified individual Canada geese that routinely traveled into airspace at the Minneapolis-St. Paul International Airport and suggested that managers could select the individual birds that should be removed

to reduce bird-strike hazards while maintaining a local goose population. York et al. (2000) found that at least 20% of harassed geese returned multiple times to harassment sites located on an Alaskan airfield. Organizations that promote goose harassment make claims of clearing specific areas of geese, but have not documented where or how far harassed geese travel (GeesePeace 2009). In contrast, Holevinski et al. (2007) determined that Canada geese moved only about 1.2 km after harassment and showed a strong affinity to their original location. Documenting movements of harassed and nonharassed geese throughout an entire year would be enlightening because movements may vary by season and by population status (whether birds are migrants or residents). Such knowledge of goose movements will allow airport biologists to make more efficient use of time and money to control those specific individuals or populations that present hazardous conditions to aircraft. Also, by understanding goose movement patterns, biologists can avoid harassing geese in a manner that creates, rather than removes, a safety hazard.

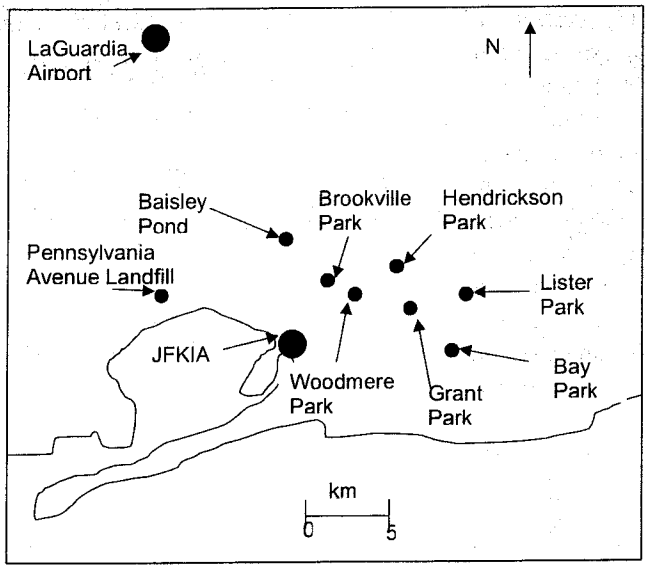

Figure 1. Nine Canada goose-banding locations in relation to John F. Kennedy International Airport and LaGuardia Airport, New York, New York.

The Federal Aviation Administration (FAA) has established a distance of 8 km around airports in which hazardous wildlife attractants should be avoided (FAA 2004). Therefore, the purpose of this study was to document movements of Canada geese originating within about an 8-km radius of the John F. Kennedy International Airport (JFKIA) to determine which geese pose a threat to aircraft there.

Methods

United States Department of Agriculture/ Wildlife Services (WS), the Town of Hempstead, New York City Department of Environmental Protection, Port Authority of New York and New Jersey, New York State Department of Environmental Conservation, New York City Parks and Recreation, and the WS National Wildlife Research Center collaborated to capture and neck-collar resident Canada geese within Nassau and Queens counties on Long Island during June 2006. Healthy birds at 9 locations <9 km from either JFKIA or LaGuardia Airport (LGA; Figure 1) were captured, aged, sexed, banded with a standard aluminum U.S. Fish and Wildlife Service (FWS) leg band, fitted with a yellow alpha-numeric auxiliary neck collar, and released at the capture site. Additional Canada geese at the Pennsylvania Avenue Landfill were banded only with FWS leg bands.

Once per week, from August 2006 to July 2008, we observed collared and non-collared geese at the 9 original banding sites by using binoculars and spotting scopes. We drove or walked throughout each location at random times of the day to locate the geese, then counted them and record our observations on a standardized data sheet. Additionally, we weekly searched up to 10 additional parks within a 12-km radius of JFKIA for collared geese, as time and resources allowed. We gathered public sightings that were reported and hunter harvest data from the U.S. Geological Survey, Bird Banding Laboratory.

We compiled and separately recorded observations for each individual collared goose into 3 categories: weekly observations at the original banding site, weekly observations at additional locations, and weekly observations in which the individual was not located. Also, we used Google Earth™ and converted recorded observations into straight line movements from

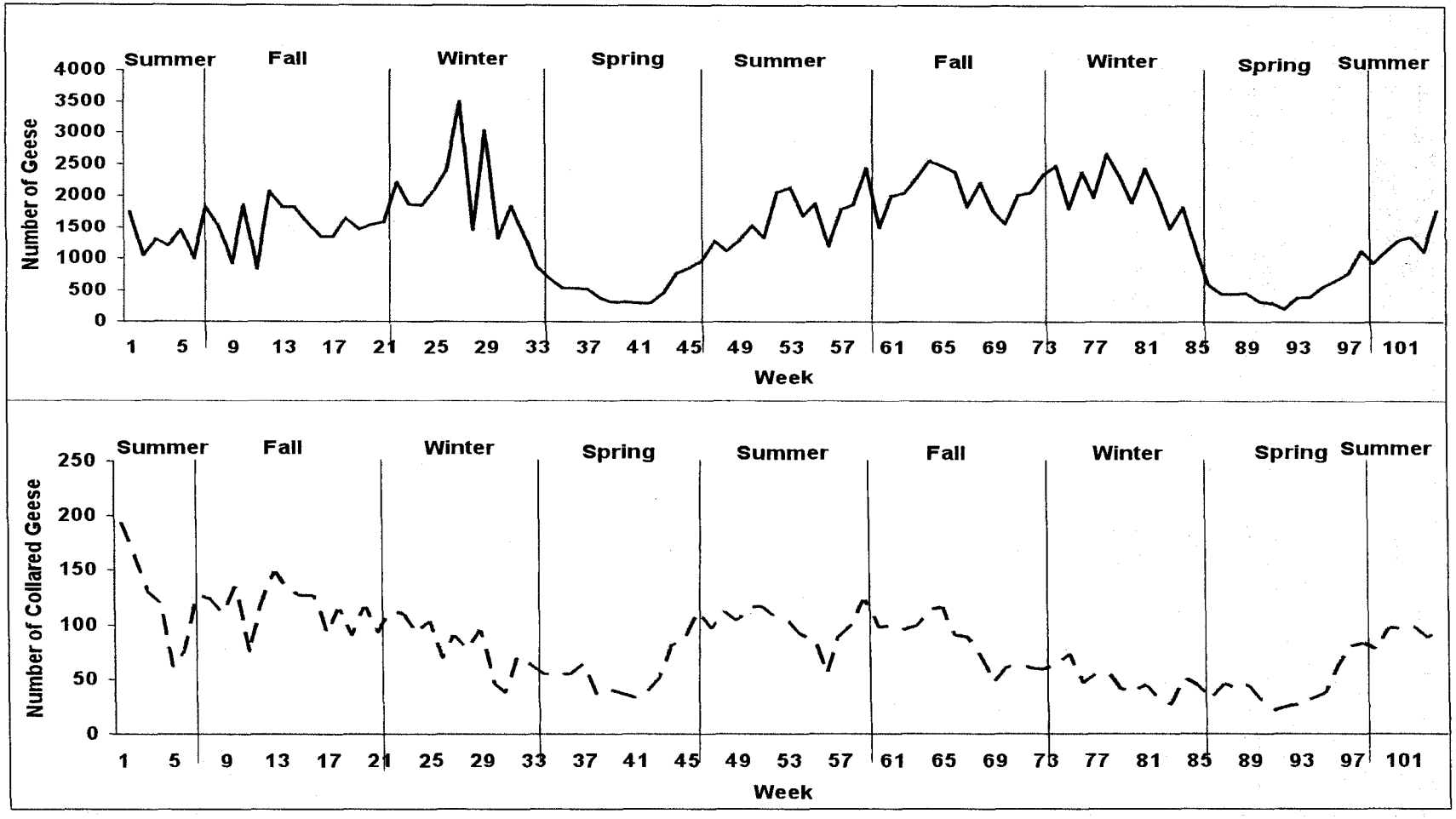

Figure 2. Weekly totals of all Canada geese and Canada geese with study collars observed at 17 parks and 1 reclaimed landfill located within a12-km radius of John F. Kennedy International Airport, New York, New York, from August 2006 to July 2008. No observation were made in week 100.

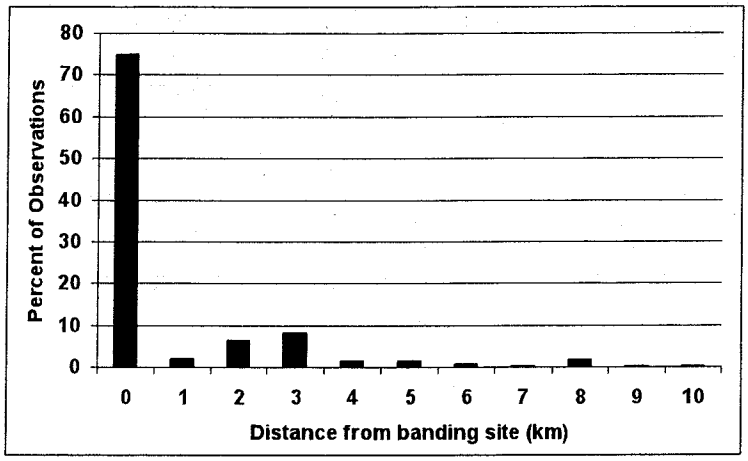

Figure 3. The percentage of observations of collared geese based on the distance (km) of re-sighting from the original banding location of 8 New York City parks and 1 reclaimed landfill within 12 km of John F. Kennedy International Airport, New York, New York, from August 2006 to May 2008.

Table 1. Number of Canada geese, by sex and age, banded and collared at 8 New York City parks and 1 reclaimed landfill in June 2006.

	Sex			Age		Total
Location	Male	Female	Unknown	After hatch year	Hatch year	
Baisley Pond Park	14	19	2	34	1	35
Bay Park	5	20	0	24	1	25
Brookville Park	16	17	0	28	5	33
Flushing Meadows Park	18	17	0	35	0	35
Grant Park	19	18	0	37	0	37
Hendrickson Park	15	23	0	38	0	38
Lister Park	18	9	0	27	0	27
Pennsylvania Ave. Landfill	15	20	0	35	0	35
Woodmere Park	18	17	0	35	0	35
Total	138	160	2	293	7	300

the original banding location to points where the birds were observed.

Results

In June 2006, we captured and collared 300 flightless Canada geese (Table 1) within 8.7 km of JFKIA and LGA at 9 locations (8 parks, and 1 reclaimed landfill; Figure 1). Additionally, we placed FWS leg bands on 32 Canada geese at the Pennsylvania Avenue landfill site. This banded goose population represented approximately 1.5% of the estimated total population in the New York City and Long Island area (B. Swift, N.Y. State Department of Environmental Conservation, personal communication).

We conducted observations during 104 weeks,

Table 2. The percentage of observations in which a banded goose was observed at the original banding location and the number of additional locations geese from a banding location were observed from August 2006 to May 2008, within 12 km of John F. Kennedy International Airport, New York, New York.[1]

Banding location	% of times observed at banding location	Additional locations where geese observed
Baisley Pond Park	25	10
Bay Park	32	5
Brookville Park	34	10
Flushing Meadows Park	58	7
Grant Park	43	7
Hendrickson Park[1]	7	10
Lister Park	39	14
Pennsylvania Ave. Landfill	27	14
Woodmere Park	18	12

[1]64% of total banded geese were molt-migrants that left the area when flight feathers grew in.

visited a mean (± standard deviation) of 17 (± 2) parks each week and observed the following each week: 1,451 (± 706) Canada geese, 80 (± 34) study collars (5.5% of the population), and 4 (± 3) nonstudy collars (Figure 2). At the conclusion of the study, 45% of the original 300 collared geese remained within an 8-km radius of JFKIA. One hundred six geese (35%) were not observed for the last quarter of the project, 14 geese (5%) were never observed after being collared, and 45 (15%) geese were killed. Three of the killed geese (one each from Brookville Park, Baisley Pond Park and Woodmere Park) were shot at JFKIA during wildlife control operations. Additionally, one of 32 geese leg-banded at the Pennsylvania Avenue Landfill was shot at JFKIA. Over this same time period, 323 additional Canada geese were shot at JFKIA during wildlife control operations.

For the birds reported to the Bird Banding Laboratory as killed, 84% were shot, and the mean distance from the original banding locations was about 107 km (3–1,162 km minimum–maximum distance). Only 14 birds were reported to the Bird Banding Laboratory as observed, and these were a mean distance of about 90 km (7–550 km minimum–maximum) from the original banding location.

For individual sites, the percentage of weekly counts in which geese were observed at their original banding location varied from 7 to 58% (Table 2). Individual geese were found at 5 to 14 locations, in addition to their original banding location (Table 2). We observed birds at their original banding sites 75% of the time, and within 5 km of the banding location 95% of the time (Figure 3). Geese that remained in the study area were re-sighted a mean straight-line distance from their original banding location of 3.6 (±3.1) km (Table 3).

Discussion

Our study objective was to determine whether Canada geese originating within an 8-km radius (as established by FAA Advisory Circular 150/5200-33A) of JFKIA could pose a threat to aircraft using the airport. We found that most of our recoveries within the 12-km radius of JFKIA that we searched occurred within 5 km of the original banding location, with 75% of the observations at the original banding location. Based on a mean straight-line distance from banding locations, geese from 3 of the 9 sites would have routinely traveled far enough to reach JFKIA. Using the maximum straight-line distance traveled, birds from 7 of the 9 sites had the potential to reach JFKIA. Therefore, 78% of the locations used by geese within 8 km of JFKIA could support geese that would travel onto or over JFKIA. The 4 banded geese that were shot at JFKIA all came from within a 5-km radius of the airport. Additionally, during

Table 3. The mean straight-line distance that collared Canada geese were observed away from their original banding location during observations conducted from August 2006 to May 2008.

Banding location	Distance of banding site (km) from JFKIA[1]	Mean (SD) distance (km) from banding site
Baisley Pond Park	2.4	4.1 (3.0)
Bay Park	8.0	4.0 (1.2)
Brookville Park	1.9	1.8 (0.7)
Flushing Meadows Park[2]	9.7	11.0 (3.3)
Grant Park	6.0	2.8 (0.3)
Hendrickson Park	5.6	3.5 (2.5)
Lister Park	8.7	6.2 (3.8)
Pennsylvania Ave. Landfill	4.8	2.6 (3.6)
Woodmere Park	1.6	5.2 (4.0)
Mean	5.4	3.6 (3.1)

[1]John F. Kennedy International Airport
[2]Flushing Meadows Park is 5.5 km from LaGuardia Airport

LGA airport bird surveys, we observed 2 neck-collared geese that moved 6.5 km from Flushing Meadows, past LGA, to Rikers Island.

Approximately 1.2% of the geese shot at JFKIA during wildlife control operations were our banded geese. If our assumption of banding 1.5% of the local goose population is correct, then it is also possible that, due to the similar percentage of banded birds being shot at JFKIA, the geese shot at JFKIA were originating mostly from the New York City or Long Island areas. However, hunters preferentially select geese with neckbands (Craven 1979, Alisauskas et al. 2006). Based upon comments from personnel conducting bird control at JFKIA, shooters were selectively targeting collared geese out of flocks. This selection would bias the data and give a false impression of bird movement. Also, during the study, migratory geese came into the JFKIA area and would have been subject to control activities. Therefore, the total number of birds subject to control was actually higher than the local population, and the percentage of banded birds compared to the total population would have been <1.5%. That 1.2% of the birds shot were banded supports the proposal of the selection of banded over unbanded birds during control activities at JFKIA. Based upon our re-sighting data showing local movements (5 km), then, it is more likely that the majority of birds shot at JFKIA are originating from within the 8-km radius of the airport.

At the conclusion of the study, 55% of the banded geese appeared to be absent from the study area. We know the fate of 15% of the birds, as they were killed and their collars were reported. Approximately 5% were reported alive, but they were outside of the study area. The fate of the remaining 35% of the geese was unknown. Studies have indicated that neck collars can reduce survival of geese, although the exact cause for this reduction is unknown (Castelli and Trost 1996, Schmutz and Morse 2000). Additionally, neck collar retention is variable (average retention of 28 to 90%) over the life of the collar (Samuel et al. 1990, Campbell and Becker 1991, Wiebe et al. 2000, Samuel et al. 2001). It is possible that poor collar retention may explain some of the missing birds, although we found no lost collars, and none were reported found during the study.

The 2 counties included in the study area, Nassau and Queens, have a combined human population of 3.5 million, or about 2,000 people per km^2 when the total area is considered; however, when only land area is computed, the density is about 5,000 people per km^2 (U.S. Census Bureau 2008). With such a dense human population, potential feeding and loafing locations for resident Canada geese are limited, and most sites are likely subject to human disturbance. Open areas, such as Jamaica Bay

and the Gateway National Recreation Area, likely would provide alternative foraging and roosting locations for geese displaced from the parks around JFKIA. However, JFKIA lies between most of the parks and Jamaica Bay; thus, the geese would likely cross the airport to reach the open spaces and therefore increase the risk of a bird strikes at the airport.

Although this study did not focus on geese at LGA, Canada geese also pose a threat to aircraft using that airport. In an effort to reduce the hazard posed by Canada geese at LGA, from 2004 to 2007 Wildlife Services conducted a goose-removal program of all geese observed at Rikers Island, which is adjacent to LGA. The number of Canada geese removed from Rikers Island decreased yearly (2004, n = 518; 2005, n = 288; 2006, n = 200; 2007, n = 166) and the number of goose strikes at LGA likewise decreased by 80% (A. Gosser, USDA/WS, unpublished data). This removal is an example of management efforts necessary to reduce the risk of bird strikes posed by resident Canada geese. However, strikes that occur away from the immediate airport environment, such as the incident in which U.S. Airways Flight 1549 struck multiple Canada geese at approximately 1,000 m above ground level (AGL) in January 2009, will not necessarily be reduced by such local control. Measures to make aircraft more visible or noticeable to birds may reduce such strikes and should be investigated.

We documented Canada goose movements within an 8-km radius of JFKIA, but we did not determine how high above ground the birds fly when moving between sites. We do know that, in general, an aircraft approaching JFKIA on a 3° glide slope would be about 152 m AGL when it is 3 km from the runway (Flight Safety Foundation 2000). Because 74% of all bird strikes occur ≤150 m AGL (Dolbeer 2006), it is critical to manage hazardous bird species within this volume of air space, as they pose the greatest immediate threat to aircraft. Three of the sites in this study were less than 3 km from JFKIA; therefore, geese using those sites should be monitored and managed appropriately.

Based on this study, most of the resident Canada geese in Nassau and Queens counties remain ≤5 km from their primary foraging and loafing areas. Therefore, Canada geese within 5 km of JFKIA pose the greatest hazard. However, marked geese within 8 km of JFKIA likely crossed JFKIA airspace when travelling to areas where they were observed in this study. Therefore, goose management efforts (oiling goose eggs to kill the embryos and rounding up of flightless birds) within 8 km of the airport and bird-control activities at JFKIA and nearby areas should be continued to reduce the probability of a catastrophic bird strike with aircraft using JFKIA.

Acknowledgments

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Monitoring and influencing feral Canada goose (*Branta canadensis*) behaviour to reduce birdstrike risks to aircraft*

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Abstract

Canada Geese (*Branta canadensis*) were caught and ringed at 55 moult sites within 13 km of a UK airport between 1999 and 2004. More than 2500 visits were subsequently made to some 300 sites, resulting in over 10 000 re-sightings of individual birds. The breeding, moulting and foraging ecology of individuals was used to assist in the development of a management plan to help reduce the birdstrike risk to aircraft operating out of the airport. Canada Geese were struck on 11 occasions by aircraft between 1994 and 2004. Strikes were not randomly distributed throughout the year, with four incidents occurring during the pre-breeding season and seven in the post-moult period. The breeding and moult locations of birds that were known to be involved in transiting either the airfield or its approaches were identified. Management actions including egg oiling, direct deterrence and habitat change were instigated and the effects monitored. A significant reduction in the risk to flight safety was achieved through the use of an integrated strategy based on rigorous research and monitoring protocols. This paper discusses the results of monitoring and their use to drive the management regime.

Keywords: *Birdstrike, aviation, Canada goose, risk management*

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1. Introduction

Any birds in the vicinity of an airport represent a potential risk to aircraft flight safety (Boekpoel 1974). Eighty-eight civil aircraft have been destroyed by birdstrikes around the world with the loss of 243 lives (Thorpe 2005). Large flocking bird species, such as Canada Geese (*Branta canadensis*), represent a particular hazard when they are present on or near airfields (Mackinnon 2001).

Currently, there are no civil aircraft engines in use anywhere in the world that are certified to tolerate an impact with a 3.629 kg (8 lb) bird and continue operating (Eschenfelder 2000). Whilst a strike with such birds does not mean that an aircraft will crash, 67% of all birdstrike collisions involving Canada Geese have resulted in damage to aircraft (Allan 2004). As many Canada Geese throughout the world have abandoned their migratory strategies and adopted a successful residential strategy (Cooleman 2005), a year round birdstrike risk at some airports is now occurring.

The total UK Canada goose population now stands at approximately 120 000 individuals including 96 000 in England (Hansard 2005). At an airport in south-east England, an increasing population of approximately 3000 birds (Budgey et al. 2001) has been recorded in the vicinity of an aerodrome and has resulted in a series of high profile birdstrikes with aircraft since 1994 (Hull 2006).

The majority of birds are struck by aircraft at heights below 609 m (2000 ft) (CAA 2002). Aircraft on standard approach routes reach an altitude of 609 m approximately 13 km from an airport. International birdstrike experts therefore consider that bird attractive sites within this distance of an airport should be assessed, and management action implemented, should they be considered to have the potential to increase the birdstrike risk at an airport (IBSC 2006). Additionally, the International Civil Aviation Organisation (ICAO) stipulates in its standards and recommended practices (Annex 14, November 2003) that 'Garbage disposal dumps or any such other source attracting bird activity on, or in the vicinity of, an aerodrome shall be eliminated or their establishment prevented, unless an appropriate aeronautical study indicates that they are unlikely to create conditions conducive to a bird hazard problem'. In the UK, the 'vicinity' constitutes being within 13 km of an airport.

Studies were therefore initiated to investigate the flight safety concerns following a birdstrike with a flock of Canada Geese in 1998. The objective of the investigation was to determine whether particular patterns of behaviour that created a specific risk could be identified and whether management of that risk

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*The relevant wildlife licenses for all management activity related to the removal of, or the prevention of breeding of, Canada Geese are stated within the text of this paper in accordance with the regulations of the UK government.

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would be possible. A preliminary study was therefore initiated in 1999 to determine whether birds in the surrounding environment could be marked and the movements of individuals determined. The programme was expanded to mark birds and monitor behaviour during subsequent years. The survey area was limited to within 13 km of the airport.

2. Methods

Over 4000 birds within 13 km of the airfield were caught and marked and their habits monitored between 1999 and 2005. Birds were captured on the banks of water bodies during their annual moult period when they were flightless. Standard round-up techniques that involved trained canoeists corralling geese into a specifically designed holding pen, were used. Birds were then fitted with individually identifiable metal and coloured rings before release. Eight birds were fitted with radio-equipped necklaces under British Trust for Ornithology licence.

Bird movements were monitored on a daily basis throughout the year using binoculars, a telescope, and a Telonic TR4 radio-receiver for tracking tagged birds. Over 2500 visits were made to over 300 sites to record behaviour, movements and numbers of birds. Visits were made to foraging areas around the airfield throughout the autumn, the key period during which birdstrikes with this species were recorded. Monitoring was undertaken between dawn and dusk to evaluate movements. The numbers of geese in different localities were recorded, and their arrival/departure movements noted. Tagged birds within flocks assisted greatly in locating nocturnal roost sites of flocks. Cobra Generation Two night vision equipment ($\times 5$ magnification) was used to count roosting flocks at night.

Habitat management was undertaken according to the type of work required. Different agricultural crops were planted during autumn or spring and harvested according to standard agricultural best practice. When necessary, fields were cultivated or ploughed at the earliest opportunity to remove any attraction to birds. For population management, goose nests were located in March and early April, and at every site where breeding was confirmed and access could be gained, visits were made to dip eggs in paraffin oil to prevent hatching as described by Cummings et al. (1997). Where required activities were carried out under a WLM licence within the 1981 Wildlife and Countyside Act. The numbers of birds present in the area was assessed by undertaking routine censuses in late June/early July when birds were gathered in moult flocks. Up to 14 observers were used to visit all waterbodies within the area during the 2-week period when birds were flightless. Some individually identifiable birds that had been observed creating a critical flight safety risk were removed at moult under veterinary supervision under a WLM licence within the 1981 Wildlife and Countryside Act, or were shot when they were passing over the airport.

3. Results

The number of birds caught and ringed varied significantly between years ($t = 3.697$, $P = 0.02$). In total 4380 birds were ringed at 46 moult sites between 1999 and 2004 as part of this study. Three birds were observed moving from the west of the study area after approximately 500 were marked in that area in 2001. Six thousand birds were ringed between 1977 and 2003 as part of a separate study to the east of our study area.

3.1. Movements of marked birds

Moult, feeding and breeding sites of Canada Geese were routinely visited to determine the presence and movements of marked birds in the area. Sampling rates ensured all moult sites were visited routinely throughout the study period. A total of 11 061 re-sightings of 2608 different individual ringed birds were made. Examples of such individual movements both within and outside the 13-km safeguarding circle are depicted in Figure 1.

Of primary importance to the management of the birdstrike risk from this species was the post-moult foraging preference. Figure 2 shows the recorded movements of birds during the post-moult period between August and September when the majority of birdstrikes occurred. The north–south trend of the majority of the movements was very marked, and it was clear that many passed directly over the airfield itself or the immediate western approaches. Such movements presented a serious birdstrike risk as the fast, low-flying geese were sharing the airspace with large commercial aircraft at the point of take-off or landing.

Confirmation that the majority of feeding sites were located to the north of the airfield (the rectangular box at the centre of the circle) was provided by direct observation.

Eighty-nine percent of all foraging birds censused within 1 km of the airport during the post-moult period were located in cereal crops to the north of the airfield. The remaining 11% of birds were distributed between grassland foraging or unknown locations. Observations in the field via radio-tracking movements or night vision monitoring confirmed that during this critical post-moult period, all birds from the cereal fields could be located at small roost sites to the south or north of the airfield that were not normally used at other times of year. A mean of 82% of birds were located on the roost to the south. An appropriate management strategy to prevent birds either feeding to the north, or roosting to the south was therefore possible.

Geese were present foraging in cereal fields between 17 July and 25 September (Figure 3). This

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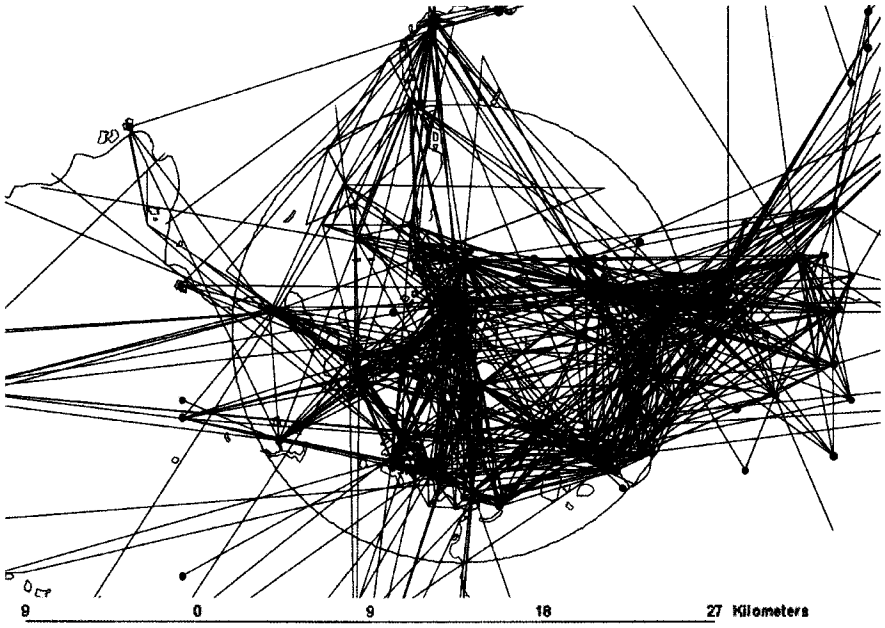

Figure 1. All recorded movements of individually colour-marked geese, 1994–2005. Circle centred on airport representing 13-km airport safeguarding circle.

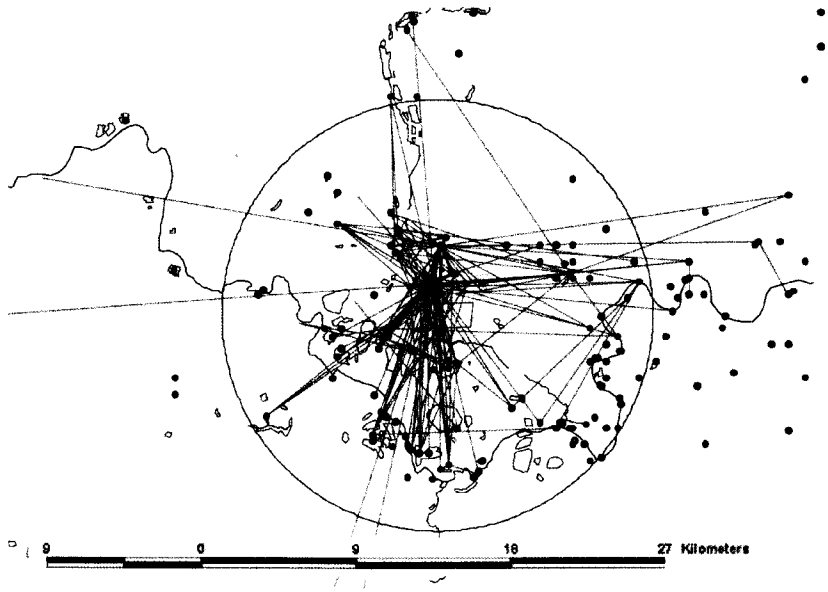

Figure 2. Recorded movements of individually colour-marked geese between July 17th and September 25th, 2000–2005. (Aviation safeguarding circle (13 km) centred on airport).

coincided with the period between first harvest and field cultivation. Peak movement periods generally occurred during late August and early September. Monitoring thus allowed the costs of control to be targeted at the period during which the risk to flight safety was at its highest. From 2004, birds were deterred from the southerly roost sites and allowed to remain *in situ* on the northern fields and roost sites. The number of overflights was therefore reduced.

Through a combination of active deterrence at problem roost sites and the removal of specific individuals known to directly overfly the airport during August and September, the number of bird movements over the airfield was reduced by over 63% between 2003 and 2004 (Figure 4). A mean of 287 geese known to be involved in overflying were removed each year between 2002 and 2004. To reduce the hazard still further, habitat management

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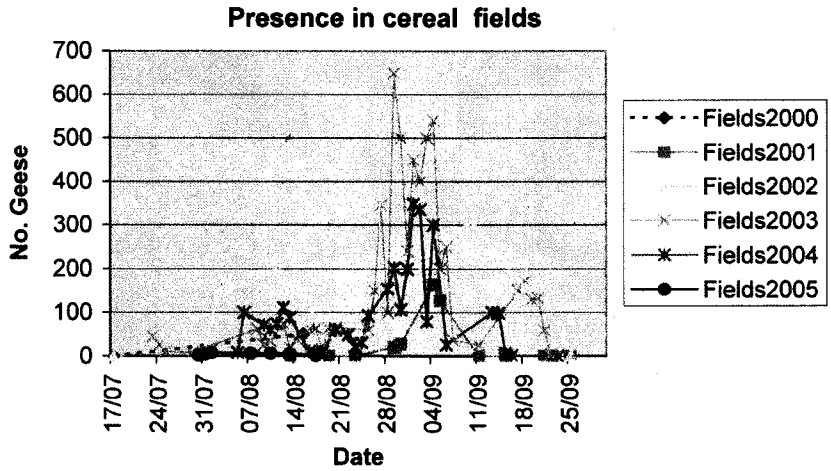

Figure 3. Numbers of geese using cereal fields north of the airfield between 17 July and 25 September.

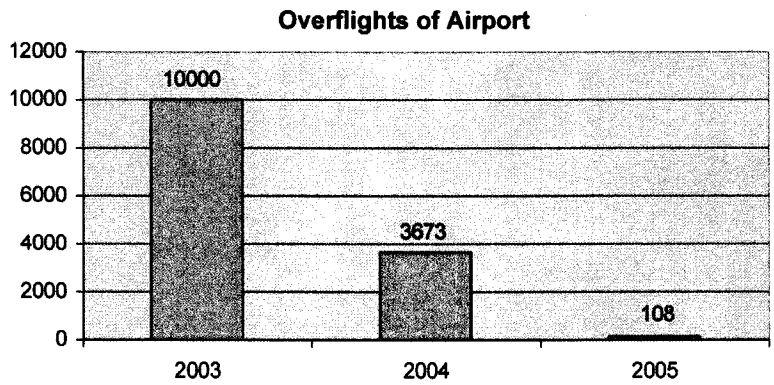

Figure 4. Overflights during the post-moult period.

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in the foraging areas to the north of the airfield was introduced in 2005. The result was an almost complete removal of the foraging attraction and further significant reductions in the amount of overflying. Seven out of nine fields (ca. 600 acres) were changed from cereal crops to field beans, lupins or linseed.

3.2. General population management

To reduce the total number of birds using the area, a programme of habitat and population management was implemented. Habitat management at public amenity sites was often impossible, however, as any attempt to reduce their appeal to breeding geese might also damage the attractiveness to human visitors. Population management through inhibiting the breeding process was, therefore, the predominant technique used to reduce the numbers of birds present in the critical area.

In total, 2980 eggs were prevented from hatching during the study period (Figure 5). Numbers oiled increased year on year due to increases in the number of sites at which breeding occurred. At comparable sites, however, a 38% reduction in the number of birds present and attempting to breed was achieved between 2002 and 2005.

3.3. Changes in the moult population

The population was monitored throughout the study period and the total population in the vicinity of the airport during the moult period evaluated through capture and observation between the 18 June and 15 July each year. Census data showed a consistent trend of reducing goose numbers in the study area. The preliminary moult census's undertaken between 1999 and 2002 indicated approximately 3750 birds were present within the safeguarded area of the airfield. The total number counted in 2003 was 3236, with 3012 present in 2004 and 2490 in 2005.

Monitoring allowed the identification of key areas for management to reduce the risk of birdstrikes with Canada Geese. Observations of marked birds allowed the moult locations, breeding locations and feeding locations of local birds to be identified. It also

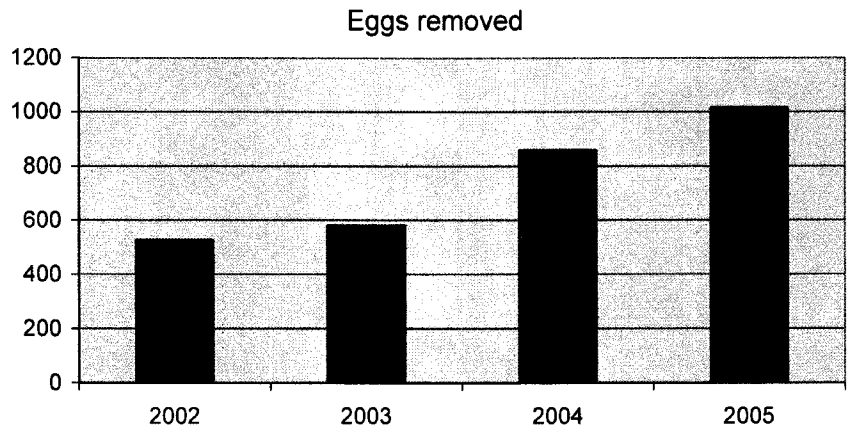

Figure 5. Population management in the breeding season.

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confirmed that the birds within the vicinity of the airport were effectively from a closed population. Ninety six percent of movements recorded were of less than 20 km resulting in a population expansion driven by recruitment as opposed to immigration. This factor alone confirmed that any management action would be targeted at the local birdstrike-causing population.

Monitoring confirmed that several moult flocks remained resident to the north of the airport throughout the year and used the same site to moult, breed and rest. Whilst it appeared that these sites did not contribute to the risk to aircraft, many offspring moved away from these sites with the resultant risk that they flew through the airspace around the airport. The large number of unringed birds (often young birds) present in critical areas during the autumn period confirmed this finding. Marked birds were, however, identified when present and their moult/breeding locations identified. Monitoring therefore confirmed the sites at which problem birds, and thus control measures, should be targeted.

The nationwide and local populations were increasing at around 8% per annum (Rehfisch et al. 2002). The annual survival rates for Canada Geese in this area were estimated to be about 85% (Kirby et al. 1996). As recruitment was thought to be the main driver behind population rises in this area, management at nest sites across the study area was implemented to try and stem the risk from an ever increasing population. Egg management was successful in reducing the population with overall numbers declining from 3750 birds prior to management to 2490 birds by 2005. In the earlier years of this study access permissions and unknown sites accounted for the reduced number of eggs being managed across the critical area. Based on the survival estimates of Kirby et al. and the numbers of young left at the moult period, the population should have declined by approximately 100 birds by 2003. In fact, population numbers had fallen by almost 500. This tallied with the additional removal of approximately 250 birds that had been identified overflying the airfield during the preceding autumn. By 2004, improved breeding control and similar adult management action only resulted in a reduction of just over 200 birds. With adult removal rates remaining the same across years it was difficult to target why population reductions differed between years. As with 2003, the 2005 data showed that over 1000 eggs were prevented from hatching and just 140 young were present at the moult. Alongside adult removal of around 250 birds the overall population number again fell by 520, a figure suggesting little immigration and effective recruitment management. The increasing number of eggs oiled in combination with targeted removal of a mean of 287 adult birds between 2002 and 2005 was therefore sufficient to sustain reductions in the local population.

4. Discussion

Hunting pressure in the area varies between years but could account for the majority of adult mortality within this population. Shoots occur on a large number of agricultural sites throughout the area with several sites located within the study area (Wilson, pers comm.). In addition to this, the targeted removal of overflying birds and known outbreaks of avian botulism (removed at least 110 individuals from the population during the study period), will also have contributed to overall reductions. It is considered, therefore, that agricultural management and targeted management will have added to the impact of egg management. Reform of the legislative protection for Canada Geese in the UK in 2005 may result in future increases in adult mortality.

Despite the initial breeding and adult removal exercises that resulted in a reduction in the total numbers of birds present in the vicinity of the aerodrome, the numbers of birds crossing the airfield

during the post-moult period continued to create a significant risk. Approximately 10 000 bird movements through the near approaches to the airport or over the runways were observed in 2003. Six hundred and fifty birds were observed in harvested crop fields to the north of the airport. Two birdstrikes occurred. Following intense on-airfield deterrence to divert birds around the airfield and deter birds from roost sites to the south of the airport, 3600 similar bird movements occurred again during the same period in 2004. There were no resultant birdstrikes. This represented a significant improvement in the situation but did not result in an acceptable reduction in the problem. Large numbers of birds (up to 350) were present in fields to the north of the airport with numerous individuals still transiting the critical area.

Following the removal of the majority of cereal crops planted, however, overflying of the airport was almost eliminated. Just over 100 bird movements across the airfield were recorded during the same period in 2005 with no birdstrikes and no routine movements noted. This represented a similar movement rate to that which would occur at any other time of year and did not involve regular and predictable flight paths of birds. Just under 20 birds remained in the critical fields to the north of the airport. Over 300, however, were present in other fields in close proximity to the airport. These birds did not transit the airport or its approaches but still had the potential to create further risk. Disturbance by dog walkers, shooters, foxes or other predators could result in movements of these birds across the airfield, hence further effort to reduce the risk from large flocks in the near vicinity of the airport may still be required.

Habitat management allowed a reduction in the levels of other management effort required. Long-term agreements were reached to maintain these reductions in attractive habitat. The need to control adult birds as part of the risk reduction strategy was negated as birds ceased to fly over the airport on a routine basis. Egg management was continued to ensure the population did not return to the levels observed during previous years. Whilst it is difficult to assign the results achieved to particular aspects of this regime, the methods used demonstrate that a flexible, integrated management approach can result in successful reduction in the hazards present in the vicinity of an aerodrome.

We therefore recommend the use of mark-release-recapture studies to identify, manage and reduce wildlife hazards around airports or other such sites to ensure a targeted and successful reduction in risk.

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Evaluation of an Integrated Non-Lethal Canada Goose Management Program in New York (2004 - 2006)

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ABSTRACT: New York State has an estimated population of 249,702 resident Canada geese. Human-goose conflicts are increasing, including unacceptable accumulation of goose feces in public parks, overgrazing of landscaped lawns, noise, and aggressive behavior of individual geese. An integrated Canada goose management program was conducted and evaluated at 8 sites in Orange County, New York from 2004 to 2006. The program, conducted from March through November each year, consisted of egg oiling (300-470 eggs oiled a year), hazing to reduce local goose populations using multiple techniques, public outreach/education, and program monitoring. The monitoring component included goose movement and population surveys using neck-collared geese and standardized fecal counts, at both managed and unmanaged sites. We monitored 3 unmanaged ("control") sites to provide a comparison. We conducted fecal surveys, as an indirect method for potentially estimating site-specific goose populations and associated reduction in damage. The number of droppings counted, when standardized to droppings per foot per day, decreased at treated sites (2004, 0.16; 2005, 0.12; 2006, 0.05) but did not differ at unmanaged sites, indicating a sustained population reduction on site during the project. In addition, the mean number of geese observed at treated sites decreased each year (2004, 77; 2005, 19; 2006, 11) while the mean number at unmanaged sites did not differ. The alternate location of the majority of dispersed geese is unknown, although monitoring of marked birds indicates that many birds moved only short distances (<2 km). The implementation of an integrated non-lethal goose damage management program over 3 years reduced the number of Canada geese at specific locations and minimized local conflicts. The widespread adoption of this type of program could reduce human-Canada goose conflicts across a larger landscape but will require extensive coordination of local projects, a public involvement process, and an intensive, long-term commitment of resources.

KEY WORDS: border collie, *Branta canadensis*, Canada geese, damage management, egg oiling, feces, hazing, New York, nuisance geese

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INTRODUCTION

In the Atlantic Flyway, there are currently 1.1 million resident Canada geese (*Branta canadensis*) (USFWS 2007). Geese are considered resident geese if they nest or reside in the areas of Southern Quebec and the Maritime Provinces of Canada, southward through the states along the Atlantic coast (Nelson and Oetting 1998, Sheaffer and Malecki 1998, Johnson and Castelli 1998). Resident goose populations have experienced significant increases in recent years, with populations growing at a rate of 7.9% per year (Sauer et al. 2006). The population of resident geese has grown so rapidly that they now meet or exceed the number of geese in all 4 flyways (USFWS 2002). With these population increases have come an increased number of conflicts associated with resident geese, particularly in urban and suburban areas (Fairaizl 1992, Forbes 1993, Cooper and Keefe 1997, Lowney et al. 1997, Holevinski et al. 2007).

Resident geese have several biological advantages over migratory geese: they breed at a younger age, have larger clutch sizes, and have higher nest success rates and higher survival rates then migratory geese (Smith et al. 1999). Canada geese, primarily resident populations, have caused conflicts in at least 37 states at both feeding and loafing areas (Forbes 1993). These conflicts include overgrazing and excessive droppings on lawns, golf courses, pastures, athletic fields, public parks and beaches, playgrounds, cemeteries, and residential areas. Urban geese create traffic hazards and are aggressive towards people during the breeding season. Urban and suburban areas have experienced an increase in goose conflicts, as geese target areas with water bodies adjacent to mowed lawns, which provide ideal habitat. Desired qualities include short grass, open space for flight clearance, and water, which provides a safe refuge from predators (Holevinski et al. 2007, Conover and Kania 1991, Converse 1985, Cooper and Keefe 1997). Costs related to replanting and reseeding overgrazed lawns and cleaning up goose droppings is estimated to exceed $60 per goose (Allan et al. 1995).

Large flocks of geese can also be a potential source of disease for both humans and other waterfowl. Urban geese often come into contact with exotic, domestic, or hand-reared waterfowl, which can be a source of duck virus enteritis (USDI 2003). This virus is a highly contagious disease of waterfowl caused by the herpes virus and kills many infected birds (Baldassarre and Bolen 2006). Urban geese often mingle with waterfowl outside urban areas and may spread diseases into the migrating population. Urban geese can create human health and safety concerns. Public beaches have been closed due to excessive fecal coliform levels that been attributed to

geese (Woodruff et al. 2004). Goose feces have been found to contain *Salmonella*, *Listeria*, and *Campylobacter*, which can be carried into drinking water supplies (Graczyk et al. 1998, Clark 2004). Heavy concentrations of goose droppings can cause eutrophication of lakes and reservoirs, as well as excessive algae growth; this, in turn, lowers water quality for other aquatic life (Clark 2004).

Populations of geese near airports create hazards, and Canada geese are ranked as the third-most-hazardous species involving collisions with aircraft (Dolbeer et al. 2000). From 1990-2005, geese were involved in 1,279 strikes with civil aircraft and caused $395 million in damage (Cleary et al. 2006). Eschenfelder (2000) stated that currently there are no civil aircraft engines in existence that are certified to tolerate an impact with a bird the size of an adult Canada goose and continue operating.

Management of Canada geese is best accomplished using a variety of tools and techniques. Killing geese is often viewed as unacceptable in many urban communities; therefore, some communities look to non-lethal techniques, which can be more socially acceptable to the public. However, some non-lethal techniques have little or no effect. These include the use of dead goose decoys (Seamans and Bernhardt 2004), plastic alligator heads, coyote effigies, scary-eye balloons, swans, and distress calls (Mott and Timbrook 1988, Aguilera et al. 1991). Some techniques do work to alleviate problems for several weeks or months, including chemical repellents (Cummings et al. 1992, 1995; Dolbeer et al. 1998), grid-wires, propane cannons, and mylar tape (Smith et. al. 1999). Natural and artificial barriers can reduce access to certain areas by geese and limit geese numbers in defined areas during the molt (Gosser et al. 1997). Recently, an integrated hazing approach using pyrotechnics, dogs, and lasers has become a popular method of deterring geese from a site (Castelli and Sleggs 2000, Swift 2000, York et al. 2000, Holevinski et al. 2007). Hazing involves continuously harassing geese until they leave the site, using one or more scare tactics. Translocation (capture and transfer programs) was popular in the past, but very few states remain willing to accept more geese. Many states including New York now prohibit translocation, due to concerns associated with the spread of avian diseases. Avian contraceptives are being developed, but results have varied (Bynum et al. 2005, VerCauteren and Marks 2003). One long-term management approach to reduce goose populations and the associated damage is egg oiling. This technique is often endorsed as a non-lethal form of control, when in fact it is a form of lethal control. Other population management techniques to reduce local goose populations include capture-and-euthanize programs, most often conducted during the goose molting period, and implementation of hunting seasons that target resident geese. These lethal approaches, in conjunction with habitat modification, may lower local populations (Gosser et al. 1997, Cooper 1998).

There are an estimated 249,702 resident geese in New York state (USFWS 2007). From 1 Jan. 2004 to 31 Jan. 2006, there were 206 newspaper articles covering urban goose issues in 30 newspapers throughout NY. In 1996, there were 30 Canada goose depredation permits issued by the U.S. Fish and Wildlife Service in New York; by 2006 that number had increased to 337 (USFWS 2008).

We examined the efficacy of an integrated goose management program that included egg oiling and the use of border collies, remote-controlled boats, kayaks, and pyrotechnics to chase resident Canada geese from parks in Orange County, New York communities that did not want to conduct "roundups" (capture-and-euthanize programs) or were unable or unwilling to implement limited shooting programs. To monitor and document reduction in damage, we conducted a standard fecal count survey of goose droppings at managed and unmanaged sites to determine if the program was reducing the number of droppings and associated conflicts. Our goals were: 1) to test a resident Canada goose management program that could be recommended to communities to reduce goose population to a more acceptable level, and 2) to determine if the implementation of a standardized droppings count could provide a suitable index to on site goose populations and damage reduction.

Study Area

This study was conducted at 11 locations in Orange County, NY. Orange County is located in the lower Hudson Valley of New York on the west side of the Hudson River and is 80 km north of New York City. Orange County borders both Pennsylvania and New Jersey and measures 211,343 ha, with more than 35,000 ha of parkland. Eighteen percent of county land is in agriculture. The landscape is primarily suburban-residential, interspersed with areas devoted to agricultural production. The human population is estimated at 359,089, with people living primarily in several densely populated urban centers bordering large tracts of undeveloped lands. Orange County has a history of urban goose conflicts, and in 2005 the Orange County Parks and Recreation Department had begun making inquiries to various wildlife management agencies about establishing a county-wide program to manage geese at locations that were had documented goose complaints on both public and private properties.

We identified 11 sites as high human-goose conflict areas, based on conversations with the Commissioner of Parks, town officials, and on records of public complaints. The high priority sites included 1) Mill Pond, located in Monroe, NY (a village park and a 3.2-ha pond with a bike path); 2) Twin Lakes, located just outside the town of Monroe (10.66 ha in size, used as a water-ski school); 3) Thomas Bull Memorial Park, just outside of Middletown (has an 18-hole golf course with approximately 28 ha of day-use area, including 2 ball fields and extensive lawns; it has a 2.4-ha fishing pond as well as 4 smaller ponds on the golf course, and it borders the Walkill River); 4) Silver Lake (a 13.7-ha lake, with a condominium complex on the south side and an assisted living center on the west side); 5) Alder Pond (a18-ha floral supply distribution center, with a 0.2-ha pond0; 6) Algonquin Park, located in the City of Newburgh (a 17-ha park with a 0.4-ha pond and a large picnic area) 7) Mary Harriman Park (a small urban park located in the

town of Woodbury, containing a 2.4-ha pond surrounded by 2 baseball fields and a roller hockey rink); 8) Union Hall, located at the Laborers International Union in Newburgh (has 40 ha of woods and large lawns, with 0.7-ha and 0.2-ha ponds); 9) Washington Lake (a 61-ha lake that is reservoir for the City of Newburgh; it has a picnic area and is considered a trophy bass management area for veterans and people with disabilities); 10) Northeast Business Center–Grainger Building (a large, 85-ha distribution center, located adjacent to Stewart International Airport, with 3 retention ponds of 0.4, 0.3, and 1.5 ha in size); and 11) Newburgh Auto Park (a car dealership located on Route 17K in Newburgh, with 69 ha of lawns as well as two 0.4-ha retention ponds).

METHODS

Egg Oiling

Egg oiling was conducted to stabilize goose populations on all managed study sites that had nesting geese. Oiling eggs also facilitates summer and fall hazing programs by reducing the number of goslings present, which otherwise promote a stronger site fidelity for breeding adults and result in a larger number of geese producing droppings. In 2004, 2005, and 2006, trained volunteers assisted with egg oiling programs. Volunteers and county and town park employees attended a 2-hour training session that provided them with a background on goose biology, how to properly oil nests, and how to safely interact with nesting geese. During 2004, 29 people were trained, and in 2005 18 people were trained. No additional training sessions were held in 2006. Nest searches began in late March and two person teams searched an area once per week for 3 weeks. Nests were flagged and the eggs were marked with a permanent black marker, coated with corn oil, and returned to the nest. After a 1-week period, nests were treated again to ensure that the entire clutch had been oiled and that the adults were continuing incubation. Nests were visited a third time to remove treated eggs and checked to ensure that no renesting had occurred. Egg oiling took place from 6 April to 25 April 2004, 15 April to 2 May 2005, and 4 April to 20 April 2006.

Capture and Banding

In late June and early July 2004 and 2005, we used drive traps to capture a total of 174 adult geese and 38 juvenile geese during the summer molt. All geese were sexed, aged, and fitted with standard aluminum U.S. Fish and Wildlife Service leg bands. Yellow alpha-numeric auxiliary neck bands were also placed on 88 adult geese. The location of collared geese was recorded, as well as associated flock size at study sites or other locations within the study area.

Nuisance Abatement

A border collie was obtained through a trainer who specialized in training dogs to herd geese. From 24 May to 10 November 2004, 25 May to 24 October 2005, and 16 May to 3 November 2006, Monday through Friday, trained border collies were used to scare geese out of Union Hall, Mill Pond, Algonquin Pond, Thomas Bull Park, and Mary Harriman Park. Harassment sessions lasted until the geese had left the site, and they occurred at random times throughout the day. Sites were visited multiple times per day. Geese were harassed throughout the molt period to ensure that flighted geese were not loafing with molted geese, and geese searching for molting sites from points further south did not use these locations. The dog stalked geese on land until they flew away or entered the water. The dog was then sent into the water and further stalked geese until they flew away. In some cases, geese were herded off high-impact/high-conflict properties to areas considered to have low-impact/low-conflict potential. Washington Lake, Newburgh Auto Park, and Grainger were identified as experimental control sites, where no harassment or other management was conducted.

In conjunction with the trained border collie, we used 2 electric remote-controlled model boats (Aquacraft Hammer, and Traxxas Villian) powered by 7.2-volt 6-cell rechargeable batteries to harass the geese that flew into the water. The Aquacraft Hammer was dark blue in color 24 inches long, and had an average speed of 20 mph. The Traxxas Villian was white, 31 inches long, and had an average speed of about 25 mph. Both boats had a run time of approximately 15 minutes before batteries needed recharging. The range on the boats was about 250 yards from the remote-control unit.

In larger bodies of water, a 1-person kayak was used to assist the border collie. The kayak was used to chase geese, block swimming routes, or to pose as a threatening presence. Pyrotechnics were used in areas where it was difficult for the dog and remote-controlled boats to penetrate dense aquatic vegetation. Lasers were also used at dawn and dusk at 2 treatment sites to haze geese from roosting sites.

Program Monitoring

Standardized fecal counts were conducted at 5 treatment and 3 control sites. At each site, one 100 × 2-meter transect was set up and delineated with spray paint. Within each transect, goose droppings ≥1.3 cm were counted, and then the area was raked clean. Counts were conducted on Monday and Thursday of each week, from 27 May to 10 November 2004, 23 May to 10 October 2005, and 19 May to 2 November 2006. Total fecal counts were standardized to droppings per day per m, using the number of preceding days since the last count.

The number of droppings counted per day per m was compared between years within treatments using Kruskal-Wallace one-way analysis of variance, because data did not meet the assumption for normality (Zar 1984). Then number of geese observed was compared between years within treatments using Kruskal-Wallace one-way analysis of variance. Treated and control sites were not compared, because the sites could not be considered as independent sites because of documented interchange of geese among sites.

RESULTS

Nuisance Abatement

During 2004, we hazed geese on 73 days in Orange County, from 24 May to 10 November, and made 364 site visits ($\bar{x}$ = 1.2 visit/day), hazing an average 175 geese

/day. The border collie and remote-controlled boat combination was used in 70% of 189 events and removed all geese on site 72% of the time. The border collie alone was used in 11% of 189 events and removed all geese on site 70% of the time. We documented 12,800 goose flights (sum of geese in all flocks chased) out of parks. No geese were present at a treatment site on 22 visits.

During 2005, geese were hazed on 86 days, from 19 May to 29 October 2005, with an average of 109 geese hazed/day (-37% compared to 2004). The border collie/ remote-controlled boat combination was used on 28% of 239 events and removed all geese 62 % of the time. The border collie alone was used on 53% of 239 events and removed all geese on site 68% of the time. Sites were visited 516 times, and we documented 9,432 goose flights out of parks. No geese were present at a treatment sites on 130 visits.

During 2006, geese were hazed on 106 days, from 11 May to 3 November, with an average of 78 geese hazed/day (-28% compared to 2005). We visited parks 786 times ($\bar{x}$ = 2.5 visits/day). The collie and remote-controlled boat combination was used in 31% of 271 events and removed all geese on site 92% of the time. The border collie alone was used in 25% of 271 events and removed all geese on site 79% of the time. We documented 8,297 goose flights out of the parks. No geese were present at a treatment site on 475 visits.

Population Stabilization

Nest searches were conducted and eggs oiled for all 3 years of the project. Nest searches took anywhere from 2 to 8 hours to complete depending on the size of the location. During each visit, all eggs located were oiled, even if they had already been oiled on previous site visits. For each year, only the highest number of nests and eggs are reported. On 6 April, 15 April, and 26 April 2004, a total of 299 eggs from 65 nests were oiled during 3 visits to Orange County. Eggs were treated at control sites and adjacent wetlands only. Sites were monitored from May to June 2004, and 160 goslings were observed at treatment sites. During the following year, at the request of the county, all locations were searched for nests as well as adjacent wetlands. From 15 April to 2 May 2005, 404 eggs from 72 nests were oiled. Monitoring of all oiled sites found 35 goslings. A total of 473 eggs from 92 nests were oiled from 4 April to 20 April 2006. A total of 24 goslings were observed at oiled sites. Only the highest number of goslings observed at each site was recorded. There were no goslings observed on Mill Pond or Thomas Bull in 2006.

Harassment

The mean number of geese observed at managed sites was documented on days when fecal counts were conducted. The mean number of Canada geese observed at managed sites decreased (T = 357.9, P < 0.01) each year of the study. The mean number of geese at unmanaged sites remained stable (T = 3.35, P = 0.18) during the study period.

During 2004, we found that geese responded to being chased by the border collie by flying into the water. The dog was subsequently sent into the water to continue the chase. In some instances, it took up to 45 minutes for the geese to leave the water and the site. Using the remote-controlled boat without the dog resulted in geese leaving the water and running up on shore, but did not result in them flying away from the site. The combination of border collie and remote-controlled boat together was the most effective combination used. With this combination, all geese were removed from a site during 72% of 189 events in 2004. After the molt, the same combination removed all the geese in 95% of 111 events. Use of the border collie and remote-controlled boat reduced the goose population at the managed sites by 71% during the first month of use. The average amount of time required to clear a site of geese was 33 minutes.

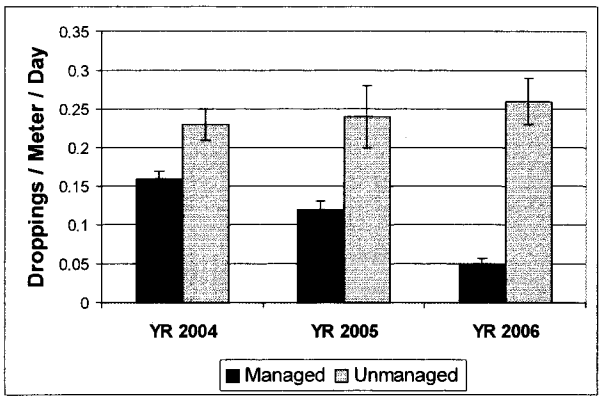

Figure 1. The mean number of Canada goose droppings counted along 100-meter transects at managed and unmanaged sites in Orange County, NY.

Fecal Counts

The mean number of Canada goose droppings at managed sites decreased (T = 56.6, P < 0.01) each year while unmanaged site counts remained stable (T = 0.23, P = 0.89) (Figure 1).

Marked Geese

While no standardized route was driven to document collared geese, collared geese observations were made while driving and working throughout the study area on a daily basis. Only 2 geese were observed from those collared at Chadwick Lake (n = 10) during the 3-year study. Also, geese collared at Twin Lakes were seldom observed during the study. Band return data showed that many of these geese were likely molt migrants from Long Island and Pennsylvania. In 2004, collar observations were made from 28 June to 10 November; during that period, collared geese from Algonquin Park were observed on 298 occasions at managed sites where they were chased away 5-13 times each (mean = 9.25, n = 21). The same geese were observed 159 times at unmanaged sites.

During 2005, collar observations were made from 18 May to 28 October. An additional 30 geese were collared at Washington Lake on 8 July 2005. Collared geese were observed on 137 occasions at managed locations, and 231 times at unmanaged sites. Collared

geese from Algonquin Park were chased away 1-16 times each (mean = 5.2, n = 24). Six collars from Washington Lake appeared at Algonquin Park, a distance of 3.9 km, and were chased away once and not observed at Algonquin Park for the remainder of the year.

In 2006, collar observations were made from 11 May to 30 November. Collared geese were observed on 66 occasions at managed sites, and 250 times at unmanaged sites. Collared geese from Algonquin were chased away 1-10 times each (mean = 2.7, n = 16). Over the 3 years, there was a 78% reduction in the number of collared geese observed at managed sites, and a corresponding 57% increase in collared geese at unmanaged sites.

Collared geese were observed on the airfield of Stewart International Airport on 3 occasions and were associated with flocks of up to 20 geese. Collared geese were frequently observed at unmanaged locations around Newburgh. The furthest movement recorded by geese within the study area was 3.9 km and was made by geese moving from Washington Lake to Grainger. The furthest movement outside the study was of a goose banded in Newburgh and hunter harvested 632 km away near Quebec City, Canada, in 2005.

During the course of this study, 7.5% of the banded geese were hunter harvested, with band returns coming from New York (8), Pennsylvania (4), Maryland (2), and Delaware (1).

Program Costs

Funds for the 3 years of this study were provided through a Congressional directive. Material costs were $7,500, which included the purchase of a trained border collie, 2 remote-controlled boats and batteries, a battery charger, kayak, life vests, and miscellaneous items. The salary for one person to harass geese from the 5 locations, visiting each site 3 times per day, 5 days per week for 8 months, was $32,000.

DISCUSSION

Management of nuisance geese on private and public land has spawned a new industry that uses border collies as a management tool. The success of these companies suggests that few people and communities are willing to use lethal methods to control Canada goose populations. Unfortunately, the same property owners and communities are surprised at the amount of effort involved; typically, multiple visits are required per day several days a week, and our research showed that the same flock of geese may have to be chased away up to 21 times during the season. Some locations required up to 5 hours of harassment per visit, as the geese would fly from one extreme end of the park to the other. The goal is to get the geese to leave the site entirely, and in these situations, moving geese is physically demanding work, as a person constantly had to stay with them and keep them moving to encourage them to leave.

Several of the locations we worked with did not have the funds necessary to hire a staff member to chase geese, or they were concerned about purchasing and housing a dog and acquiring all the materials necessary to perform the work. Our research showed that the collared geese would return to the parks in the spring after ice-off, and the whole process would start again. That is why a multi-year budget is needed to accomplish management objectives.

A key element to successfully hazing geese from specific locations can be attributed to the reduction of goslings from the site, because adult geese defend their goslings and rarely abandoning them when threatened. Nest searches and egg oiling, which reduced the number of goslings, was enhanced by the participation of the local communities. The addition of 8 town employees and 18 park staff as well as the observations of the volunteers who attended the egg oiling training sessions allowed for more efficient and complete coverage of the areas.

As an example of the difficulty involved in moving adult geese with goslings, we highlight work done in July 2006 at Thomas Bull Park. We located a group of geese consisting of 6 adults, 22 goslings, and 1 domestic goose. The group was initially harassed for 65 minutes using a kayak and remote-controlled boat. The harassment was repeated the following day for the same duration. By the third day, this group had left the site and was not observed again that year. Pressuring flocks of geese in this manner caused the goslings to emit distress calls, which further distressed the adults. We believe this caused the adults to relocate broods to safer brood-rearing locations. The combination of egg oiling with harassment is an example of a successful integrated program, where one technique (oiling) reduced the necessity for another (harassment).

Holevinski et al. (2007) found that a remote-controlled boat and border collie combination removed greater then 90% of geese. Results would likely have been similar in this study had we not chosen to harass geese through the molt in 2004 and 2006. This was done because pressuring molted geese caused several of them to relocate to lower-impact areas within or near treatment sites. Castelli and Sleggs (2000) found that border collies successfully reduced geese at a corporate complex in New Jersey. At a nuisance/suburban site located in Rockland County, New York, Swift and Felegy (2000) experienced a >50% reduction of geese while conducting a similar study. During 2005 and 2006, the remote-controlled boat and border collie combination was used on 28% of all events. We believe this decreased in number of intervention was attributed to geese associating the dog with the remote-controlled boat and not attempting to land in water (53% of 239 events).

The collared goose data showed that geese did not move far from areas in which they were being hazed. For example, 16 geese collared at Algonquin in 2004 were hazed from the park 48 times in 2006. This shows a high site fidelity to an area from which they had been harassed for the past 3 years. Twelve of the 59 geese banded at Algonquin were observed at an unmanaged location 1.2 km away on 161 occasions in 2004. This is similar to findings by Holevinski et al. (2007) of hazed radio-marked geese moving an average of 1.18 km, at an urban site in Brighton, NY. Collared geese hazed in a Rockland County, NY study were observed <2 km from the hazing site (B. L. Swift, NYDEC, unpubl. data). While the number of geese utilizing the managed locations de-

creased, there was a corresponding increase in geese at unmanaged areas within 3 km of the managed locations. Hazing geese does not remove the problem flocks from the general area, but instead simply moves the targeted population to a nearby area, usually <2 km from the treatment sites. In some instances, those are low-impact areas, but often they are not.

Although geese were observed at all managed sites, fecal counts showed a gradual decrease in number of droppings over time, indicating that geese were spending less time loafing and foraging at those sites. The primary complaint of most communities experiencing goose damage is the accumulation of droppings. Using a combination of border collies and remote-controlled boats, we were able to significantly reduce the fecal load at management sites.

More than half of the geese collared in 2004 were still observed in 2006. This shows a high site fidelity to historic nesting and molting areas. Collared geese were readily observed throughout all management periods. A total of 57% of all collar observations occurred at the Newburgh Autopark, a site that was not managed and that was considered a low-impact site because it consisted of a large field and pond that was only used during car shows and sales events. This suggests that geese were learning to avoid the treatment sites during the day. Based on the decrease in the number of droppings documented during fecal counts, this avoidance likely continued throughout times when we were not on site harassing the geese.

Management Implications

It is unlikely that any park, town, community, or golf course will completely eliminate geese, even seasonally. However, adhering to and budgeting for a multi-year management plan will markedly reduce the conflicts created by Canada geese over time. The findings of this study were similar to previous research examining the use of border collies, remote-controlled boats, and lasers as tools to disperse geese from a location (Holevinski et al. 2007). This study documented the effectiveness and advantages associated with implementation of an integrated Canada goose management program using remote-controlled boats, dogs, kayaks and pyrotechnics in reducing the problem of site-specific goose overabundance and droppings. The disadvantages of this type of program are that it may be too costly or not cost-effective for some communities, and many times it moves the geese only short distances. The relocated geese may cause similar conflicts on nearby properties or can cause human health and safety issues at airports or freshwater reservoirs. Harassment programs of any type are not recommended in areas within 3 miles of an airport, due to the safety concerns of repeatedly forcing geese into the air in the vicinity of airplane approach routes (Baxter and Robinson 2007). Holevinski et al. (2007) found that hazing alone is unlikely to reduce nuisance goose populations in a community. Programs conducting egg oiling and hazing techniques are becoming more common as the nuisance goose problem increases. However, in order to stabilize the resident Canada goose populations in the 4 flyways at the current population level, 787,000 nests would have to be removed (or treated to prevent hatching) annually for the next 10 years (Federal Register 2006).

Private landowners and communities should consider managing their nuisance geese through population reduction and organized hunting programs where practical. Reducing the adult goose population could bring overall goose numbers to more manageable levels and states in the Atlantic Flyway are shifting hunting seasons to specifically target resident goose populations. In urban and suburban areas, harassment programs or round-ups may be the only management options available, with harassment programs the least cost effective management option because of the duration of time and labor required to keep the geese away for any period of time. Communities should also recognize that by allowing nuisance populations to grow, migratory populations of geese are negatively impacted at breeding locations in northern Canada, as a result of competition for food resources. Nuisance geese that have a failed nesting often undertake molt migrations into Canada. The influx of those molt migrant geese results in lower gosling survival and lower body weights in migratory geese (Ankney 1996). Our study showed that fecal counts could be used as an index to measure success of a harassment program, and that harassing geese with remote-controlled boats and border collies was an effective method to reduce populations of nuisance geese on individual sites.

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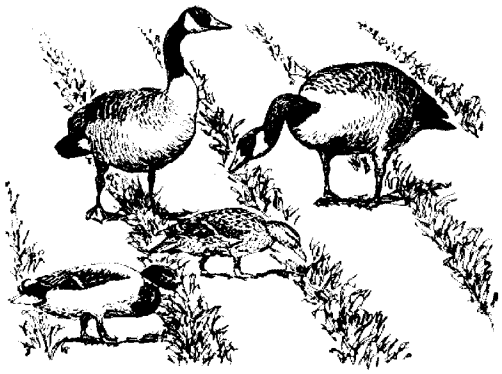

All redactions on this page are pursuant to (b)(6).

[redacted]/NY/APHIS/USDA
08/05/2010 02:08 PM

To [redacted]NY/APHIS/USDA@USDA
cc
bcc
Subject Fw: NYC Geese

[redacted]
Supervisory Wildlife Biologist
USDA-APHIS-Wildlife Services
1750 Pennsylvania Avenue
Brooklyn, NY 11239
Cell: [redacted]

----- Forwarded by Lee A Humberg/NY/APHIS/USDA on 08/05/2010 02:08 PM -----

[redacted]@parks.nyc.gov>
06/15/2010 08:23 PM

To [redacted]@aphis.usda.gov>, [redacted]@dep.nyc.gov>, [redacted]@aphis.usda.gov>
cc
Subject RE: NYC Geese

Some goose intelligence from the boroughs, more to follow:

Name	Land use	Pk #	D from JFK	Dfrom LGA	Water	Acres	Comments
Alley Pond Park	Large Park	Q001	5 - 6 miles	4 - 5 miles	Yes	671.4	Yes
Alley Park	Athletic	Q001A	5 - 6 miles	6 - 7 miles	No	26.3	Yes
Grover Cleveland Park	Small Park	Q002	5 - 6 miles	4 - 5 miles	No	5.3	None
Astoria Park	Large Park Area	Q004		1 - 2 miles	No	9.3	Geese are uncommo
Astoria Park	Large Park Area	Q004		1 - 2 miles	No	25.2	Geese are uncommor
Astoria Park	Large Park Area	Q004		1 - 2 miles	No	5.4	Geese are uncommo
Baisley Pond Park	Large Park	Q005	< 1 mile	6 - 7 miles	Yes	117.4	Yes
Bowne Park	Small Park	Q006		2 - 3 miles	Yes	11.6	Seasonal but can ran
Brookville Park	Large Park Area	Q008	< 1 mile		Yes	28.8	Yes, geese visit from
Brookville Park	Large Park Area	Q008	< 1 mile		Yes	63.1	Yes
Hermon A Macneil Park	Large Park Area	Q009		< 1 mile	Yes	20.5	Not a major issue wit
Clearview Park & Golf Course	Large Park	Q010		3 - 4 miles	Yes	112.3	Seasonal site has thr
Clearveiw Beach	Small Park	Q010A		3 - 4 miles	No	6.6	More info needed
Little Bay Park	Small Park	Q010A		3 - 4 miles	Yes	6.1	More info needed
Little Bay Park	Small Park	Q010A		3 - 4 miles	No	6.9	More info needed
Crocheron Park	Small Park	Q012		4 - 5 miles	Yes	7.1	Yes
Crocheron Park	Small Park	Q012		4 - 5 miles	No	34.9	Yes
John Golden Park	Small Park	Q012B		4 - 5 miles	No	19	None
Forest Park	Large Park	Q015	2 - 3 miles	4 - 5 miles	Yes	540.7	More info needed
Highland Park	Large Park	Q020	3 - 4 miles	5 - 6 miles	Yes	115.4	More info needed
Cunningham Park	Large Park	Q021	4 - 5 miles	4 - 5 miles	Yes	432.1	More info needed
King Park	Small Park	Q023	2 - 3 miles	5 - 6 miles	No	11.5	More info needed
Kissena Park	Large Park	Q024	5 - 6 miles	2 - 3 miles	Yes	247.3	Seasonal, depends or

							water body & golf co
Rainey Park Playground	Small Park	Q048		2 - 3 miles	Yes	8.8	Geese are uncommo
Rockaway Park	**Small Park**	**Q050**	**3 - 4 miles**		**Yes**	**40**	**No**
St Albans Memorial Park	Small Park	Q051	1 - 2 miles	6 - 7 miles	No	7.2	More info needed
Capt Tilly Memorial Park	**Small Park**	**Q052**	**3 - 4 miles**	**4 - 5 miles**	**Yes**	**9.7**	**Yes**
Memorial Field of Flushing	Small Park	Q086		1 - 2 miles	No	13.9	Not a major issue wi
George U Harvey Playground	**Playground**	**Q089B**		**1 - 2 miles**	**No**	**10.9**	**Not a major issue wit**
Joseph P Addabbo Memorial Park	Large Park Area	Q094	1 - 2 miles	6 - 7 miles	No	6.9	More info needed
Cedar Lanes Stables	**Other**	**Q094D**	**1 - 2 miles**	**6 - 7 miles**	**No**	**5.6**	**No**
Cedar Lanes Stables	Other	Q094D	< 1 mile	6 - 7 miles	Yes	5.1	No
Southern Parkway Fields	**Small Park**	**Q096A**	**< 1 mile**		**No**	**9**	**More info needed**
Flushing Meadows Corona Park	Large Park	Q099	3 - 4 miles	< 1 mile	Yes	939.6	Yes
Juniper Valley Park	**Large Park Area**	**Q102**	**4 - 5 miles**	**3 - 4 miles**	**No**	**47**	**None**
Juniper Valley Park	Large Park Area	Q102	4 - 5 miles	3 - 4 miles	No	6.2	None
Raymond M O'Connor Field	**Small Park**	**Q103**		**3 - 4 miles**	**No**	**5.6**	**More info needed**
Queensbridge Park	Small Park	Q104		3 - 4 miles	Yes	15	Geese are uncommo under bridge had gee
Springfield Park	**Large Park Area**	**Q107**	**< 1 mile**		**Yes**	**5.5**	**Yes, from time to tim**
Springfield Park	Large Park Area	Q107	< 1 mile		Yes	18	Yes, from time to tin
Liberty Park	**Small Park**	**Q121**	**2 - 3 miles**	**5 - 6 miles**	**No**	**8**	**More info needed**
Francis Lewis Park	Small Park	Q126		2 - 3 miles	Yes	8.6	Not a major issue wi
Smokey Oval	**Playground**	**Q129**	**2 - 3 miles**	**5 - 6 miles**	**No**	**5.3**	**More info needed**
Maurice Park	Small Park	Q131	5 - 6 miles	2 - 3 miles	No	7.2	Geese are uncommo installed
Rockaway Beach and Boardwalk	**Beach**	**Q162**	**1 - 2 miles**		**No**	**5.2**	**No**
Rockaway Beach and Boardwalk	Beach	Q162	1 - 2 miles		Yes	133	No
Beach 9th Street Playground	**Playground**	**Q162J**	**1 - 2 miles**		**No**	**9.3**	**No**
Rockaway Beach Boardwalk	Beach	Q163	3 - 4 miles		No	8.3	No
Rockaway Beach Boardwalk	**Beach**	**Q163**	**2 - 3 miles**		**Yes**	**59.7**	**No**
Rockaway Beach Boardwalk	Beach	Q163	2 - 3 miles		No	8.6	No
Rockaway Beach	**Small Park**	**Q164**	**4 - 5 miles**		**Yes**	**38.9**	**No**
Spring Creek Park Addition	Large Park	Q165	1 - 2 miles		Yes	5.6	No
St Michaels Playground	**Playground**	**Q174A**		**< 1 mile**	**No**	**5.8**	**Geese are uncommor installed**
Dr Charles R Drew Memorial Park	Small Park	Q220C	1 - 2 miles	6 - 7 miles	No	6.4	More info needed
Manton Playground	**Small Park**	**Q220G**	**3 - 4 miles**	**4 - 5 miles**	**No**	**7.1**	**More info needed**
Kissena Corridor West	Large Park	Q300	5 - 6 miles	1 - 2 miles	No	122.5	Issue seasonally at th varies
Kissena Corridor East	**Large Park**	**Q300A**	**4 - 5 miles**	**3 - 4 miles**	**No**	**50.9**	**More info needed**
Joseph F Mafera Park	Small Park	Q305	4 - 5 miles	4 - 5 miles	No	6.9	None
Jamaica Bay Park	**Wetland**	**Q309**	**< 1 mile**		**Yes**	**9.8**	**More info needed**
Rockaway Community Park	Large Park	Q371	< 1 mile		Yes	189	No
Cedar Grove Playground (PS 219)	**Small Park**	**Q376**	**4 - 5 miles**	**2 - 3 miles**	**No**	**5.4**	**More info needed**
Bayside Hs Athletic Fields	Athletic	Q387A		3 - 4 miles	No	6.6	No
Clearview Playground	**Other**	**Q387B**		**3 - 4 miles**	**No**	**6.2**	**No Issue**
Idlewild Park	Large Park	Q392	< 1 mile		Yes	273.9	Yes
Douglaston Park Golf Course	**Large Park**	**Q411**	**6 - 7 miles**	**6 - 7 miles**	**Yes**	**106.2**	**Yes**
Railroad Park	Small Park	Q412	1 - 2 miles		No	21.9	No
Rochdale Park (JHS 72)	**Small Park**	**Q413**	**< 1 mile**		**No**	**8.8**	**More info needed**
							Yes,major location,c

Frank Golden Memorial Park	Small Park	Q445		1 - 2 miles	No	11.4	flushing airport, nun
Roy Wilkins-Southern Queens Park	**Large Park Area**	**Q448**	**1 - 2 miles**	**6 - 7 miles**	**Yes**	**54.1**	**Yes**
Udalls Cove Park	Nature Sanctuary	Q452		5 - 6 miles	Yes	5.8	No
Udalls Cove Park	**Nature Sanctuary**	**Q452**		**5 - 6 miles**	**Yes**	**10.2**	**No**
Udalls Cove Park	Nature Sanctuary	Q452		5 - 6 miles	Yes	6.9	No
Queens Farm Park	**Large Park Area**	**Q453**	**6 - 7 miles**	**6 - 7 miles**	**No**	**24**	**More info needed**
Queens Farm Park	Large Park Area	Q453	6 - 7 miles		No	9.8	More info needed
Queens Farm Park	**Large Park Area**	**Q453**	**6 - 7 miles**		**Yes**	**12**	**More info needed**
Public Place	Wetland	Q454	< 1 mile		Yes	78.1	No
Fort Totten Park	**Large Park**	**Q458**		**4 - 5 miles**	**Yes**	**155.4**	**Yes has approx 12 ge young chicks)**
Dubos Point Wildlife Sanctuary	Large Park	Q459	1 - 2 miles		Yes	29.8	No
Powell's Cove Park	**Large Park Area**	**Q461**		**1 - 2 miles**	**Yes**	**21.5**	**Not a major issue wi**
Hook Creek Marsh	Wetland	Q466	< 1 mile		Yes	17.2	No
Broad Channel Park	**Beach**	**Q467**	**2 - 3 miles**		**Yes**	**16.9**	**Yes - 100**
Vernam Barbadoes	Nature Sanctuary	Q472	2 - 3 miles		Yes	21.1	No
College Point Park	**Small Park**	**Q476**		**< 1 mile**	**Yes**	**26.3**	**Actually called Colle issue close to Flushin varies**
Broad Channel Wetland	Wetland	Q478	1 - 2 miles		Yes	14.5	Yes

(b)(6)

Chief Naturalist
Natural Resources Group

DIST #	Name	Land use	Pk #	D from JFK
1	Cooper Park	Small Park	B025	6 - 7 miles
1	McCarren Park	Large Park Area	B058	
1	McCarren Park	Large Park Area	B058	
1	McCarren Park	Large Park Area	B058	
1	Msg McGolrick Park	Large Park Area	B114	
2	Com John Barry Park and Playground	Small Park	B021	
2	Fort Greene Park	Small Park	B032	
2	S Parks Cadman Plaza	Small Park	B113A	
3	Herbert Von King Park	Small Park	B088	6 - 7 miles
4	Maria Hernandez	Athletic	B016	5 - 6 miles
5	Highland Park	Large Park	B047	3 - 4 miles
5	Cypress Hills Park	Large Park Area	B103	2 - 3 miles
5	City Line Park	Playground	B141	2 - 3 miles
5	Spring Creek Park	Undeveloped	B165	1 - 2 miles
5	Spring Creek Park	Undeveloped	B165	1 - 2 miles
5	Spring Creek Park	Undeveloped	B165	1 - 2 miles
5	Spring Creek Park	Undeveloped	B165	1 - 2 miles
5	JHS 166/Linden Playground	Small Park	B214	2 - 3 miles
5	Park	Small Park	B371	1 - 2 miles
6	Coffey Park	Small Park	B077	
6	Red Hook Park	Baseball fields	B126	
6	Red Hook Park	Ballfields	B126	
7	Sunset Park	Small Park	B087	
8	Brower Park	Small Park	B012	5 - 6 miles
8	Lincoln Terrace/Arthur S Summers Park	Small Park	B054	4 - 5 miles
8	Mount Prospect Park	Playground	B159	
8	St Johns Recreation Center	Recreation Cente	B245	5 - 6 miles
9	Brooklyn Botanical Garden	Garden	B010	6 - 7 miles
9	Institute of Art and Science	Other	B048	6 - 7 miles
9	Wingate Park	Athletic	B254	5 - 6 miles
10	Dyker Beach Park	Large Park	B028	
10	John Paul Jones Park	Small Park	B035	
10	McKinley Park	Small Park	B060	
10	Owls Head Park	Small Park	B066	
10	Shore Road Park	Large Park	B082	
10	Fort Hamilton Athletic Field	Athletic	B192A	
11	Bensonhurst Park	Large Park Area	B007	
11	Bensonhurst Park	Large Park Area	B007	
12	Gravesend Park	Small Park	B042	
12	Friends Field Park	Athletic	B372	
13	Asser Levy Park	Small Park	B080	
13	Calvert Vaux	Small Park	B125	
13	Kaiser Park	Small Park	B129	
13	Six Diamonds	Small Park	B166C	
13	Steeplechase Park	Small Park	B369	
13	Coney Island Creek Park	Small Park	B379	
14	Parade Ground	Large Park Area	B068	
15	Manhattan Beach Park	Beach	B251	

15	**Manhattan Beach Park**	**Beach**	**B251**	
16	Betsy Head Memorial Playground	Small Park	B008	4 - 5 miles
17	**Paerdegat Basin Park**	**Large Park**	**B406**	**4 - 5 miles**
18	Canarsie Park	Large Park	B018	2 - 3 miles
18	**Marine Park**	**Large Park**	**B057**	**5 - 6 miles**
18	Joseph T McGuire Park	Large Park	B166D	4 - 5 miles
18	**Breukelen Park**	**Large Park Area**	**B247**	**3 - 4 miles**
18	Breukelen Park	Large Park Area	B247	3 - 4 miles
18	**Alex Lindower Park**	**Small Park**	**B329**	**5 - 6 miles**
18	Fresh Creek Park	Wetland	B384	2 - 3 miles
18	**Four Sparrow Marsh**	**Wetland**	**B394**	**4 - 5 miles**
18	Park-FR CRK BAS & SHR PKWY TO JAM BAY	Large Park Area	B165A	2 - 3 miles
18	**Park-FR CRK BAS & SHR PKWY TO JAM BAY**	**Large Park Area**	**B165A**	**1 - 2 miles**
18	Park-FR CRK BAS & SHR PKWY TO JAM BAY	Large Park Area	B165A	2 - 3 miles
18	**Park-FR CRK BAS & SHR PKWY TO JAM BAY**	**Large Park Area**	**B165A**	**1 - 2 miles**
18	Park-FR CRK BAS & SHR PKWY TO JAM BAY	Large Park Area	B165A	1 - 2 miles
18	**Park-FR CRK BAS & SHR PKWY TO JAM BAY**	**Large Park Area**	**B165A**	**1 - 2 miles**
18	Park-FR CRK BAS & SHR PKWY TO JAM BAY	Large Park Area	B165A	1 - 2 miles
18	**Park-FR CRK BAS & SHR PKWY TO JAM BAY**	**Large Park Area**	**B165A**	**1 - 2 miles**
18	Park-FR CRK BAS & SHR PKWY TO JAM BAY	Large Park Area	B165A	1 - 2 miles
18	**Park-FR CRK BAS & SHR PKWY TO JAM BAY**	**Large Park Area**	**B165A**	**2 - 3 miles**
19	Prospect Park	Large Park	B073	6 - 7 miles

Dfrom LGA	Water	Acres	Comments
4 - 5 miles	No	6.5	NONE
4 - 5 miles	No	9.5	NONE
4 - 5 miles	No	8.8	NONE
4 - 5 miles	No	12.4	NONE
4 - 5 miles	No	9.1	NONE
6 - 7 miles	No	10.1	NONE
6 - 7 miles	No	30.2	NONE
	No	9.2	NONE
6 - 7 miles	No	8.1	NONE
4 - 5 miles	No	6.9	NONE
5 - 6 miles	No	41.3	More Than 50
6 - 7 miles	No	5.6	More Than 50
6 - 7 miles	No	5.5	More Than 50
	Yes	19.6	More Than 50
	Yes	20	More Than 50
	No	5.2	More Than 50
	Yes	5.6	More Than 50
	No	9.6	NONE
	No	8.6	More Than 50
	No	7.9	none
	Yes	23.8	More Than 50 (morning)
	No	5	More Than 50
	No	24.4	NONE
	No	7.2	NONE
	No	17.6	NONE
	No	8.9	NONE
6 - 7 miles	No	8.8	NONE
	Yes	48.4	NONE
	No	11.5	NONE
	No	5.7	NONE
	Yes	214.2	THOUSANDS (after rain)
	No	5.8	NONE
	No	6.1	NONE
	No	25.6	More Than 50
	Yes	101.4	Hundreds
	No	6.3	NONE
	No	10.2	NONE
	Yes	7	NONE
	No	5.5	NONE
	No	6.5	NONE
	No	7.4	NONE
	Yes	75.9	More Than 50
	Yes	28.6	NONE
	Yes	22.4	More Than 50
	No	9.2	NONE
	Yes	7.5	More Than 50
	No	32.5	More Than 50
	Yes	10	NONE

	No	**19.9**	**NONE**
	No	8.3	More Than 50
	Yes	**109.3**	**NONE**
	Yes	158.5	Hundreds
	Yes	**612.5**	**Hundreds**
	Yes	102.2	Hundreds
	No	**10.5**	**More than Fifty**
	No	5.3	More than Fifty
	No	**6.3**	**Less than Fifty**
	Yes	52	Hundreds
	Yes	**77.1**	**Hundreds**
	Yes	11.8	Hundreds
	Yes	**30.9**	**Hundreds**
	Yes	68.8	Hundreds
	Yes	**36.9**	**Hundreds**
	No	54.3	Hundreds
	Yes	**58.6**	**Hundreds**
	Yes	25.7	Hundreds
	Yes	**41.2**	**Hundreds**
	No	38.3	Hundreds
	No	**13.4**	**Hundreds**
	Yes	476.4	Hundreds

Human–Wildlife Conflicts 1(2):257–264, Fall 2007

Hazing of Canada geese is unlikely to reduce nuisance populations in urban and suburban communities

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Abstract:
Growing populations of resident Canada geese (*Branta canadensis)* have caused increased nuisance problems in urban and suburban communities. Hazing, or persistent harassment, is often recommended as a nonlethal management strategy to alleviate these problems. Does hazing simply cause a local redistribution of birds, or can it solve nuisance problems by pushing geese to rural areas where hunting mortality could reduce the population? To answer this question, we marked 368 adult and 400 juvenile geese with leg bands in 1 urban and 1 suburban community in western New York State during June 2002 and 2003. This sample included 30 adult females with radio-transmitters and 151 adults with individually coded neck bands. From August 15 to September 25 and October 25 to November 15, we subjected these geese and their flock mates to post-molt hazing with border collies, lasers, pyrotechnics, remote-controlled boats, strobe lights, kayaks, a goose distress call device, or a combination of these techniques. Hazing was most successful using border collies in conjunction with remote-controlled boats (>90% of geese removed in 97% of 37 events), border collies alone (94% of 113 events), and nocturnal use of lasers (64% of 134 events). Radio-marked individuals demonstrated a strong affinity to hazing sites, averaging 16.9 hazing events per individual. Geese moved to areas where hazing was not permitted and were available for hazing only 51% of the time (n = 739). Geese moved 1.18 km (SD = 0.91) <2 hours after 153 hazing events, which was not far enough to place them in areas open to hunting. Although hunting was permitted >5 km from hazing treatment sites, only 13% (SE = 0.01) of adult geese and 7% (SE = 0.01) of juveniles were harvested in 2 years. Hazing alone is unlikely to reduce goose populations in urban and suburban communities by exposing them to hunting in adjacent rural areas.

Key words: border collies, *Branta canadensis*, Canada geese, hazing, human–wildlife conflicts, hunting mortality, lasers, nuisance control, pyrotechnics, remote-controlled boat

Canada geese (*Branta canadensis*) that nest or reside primarily in the temperate latitudes of North America are generally referred to as resident geese. In recent years, resident Canada goose populations have increased dramatically, with estimates for the northeastern United States being approximately 1 million birds (Conover and Chasko 1985, U.S. Fish and Wildlife Service 2003). With this growth has come an increase in the number of conflicts with people and human-related activities, especially in urban and suburban landscapes (Nelson and Oetting 1981, Conover 1985, Conover and Chasko 1985).

Conflicts arise from the congregation of geese in parks, playgrounds, athletic fields, residential areas, corporate complexes, golf courses, college campuses, airports, and shopping malls. Often these areas consist of mowed lawns in close proximity to water (Conover and Chasko 1985, Conover and Kania 1991, Cooper and Keefe 1997). Reasons for conflict include accumulation of feathers on lawns, water quality degradation, increased noise from vocalizations by geese, attacks by aggressive geese (Forbes 1993), and aircraft hazards (Nelson and Oetting 1998). Geese cause damage to turf by grazing and trampling, while accumulation of fecal deposits leads to unsightly and unsanitary conditions and concerns of disease transmission (Smith et al. 1999). When goose populations reach nuisance levels, innovative and acceptable management strategies are needed to effectively reduce conflicts. This usually involves a combination of lethal and nonlethal techniques (Coluccy 2001).

Lethal techniques for controlling goose populations, such as euthanization and hun-

ting, are often not accepted nor applicable in some locations. Euthanization can reduce a local goose population in a brief time, but moral and ethical issues arise, even when meat is processed and donated to food banks (Cooper and Keefe 1997). Hunting is a successful means of reducing Canada goose populations in rural areas (Conover and Chasko 1985), although in many urban and suburban locations it may not be effective due to safety concerns, public opposition, or local ordinances that prohibit the discharge of firearms (Smith et al. 1999).

Some communities and individual landowners in urban and suburban areas have taken steps to alleviate goose conflicts through nonlethal hazing programs, which are more socially accepted than lethal control techniques. Hazing, defined as the continuous harassment of birds until they leave a location, is frequently suggested as an option for urban and suburban goose control. Hazing techniques have been designed to scare geese using audio or visual stimuli. Trained border collies have been used effectively to chase geese out of problem areas (Castelli and Sleggs 2000). Pyrotechnics used as scare devices may be a temporary solution until geese become accustomed to the noise (Heinrich and Craven 1990). More recently, long-wavelength lasers directed toward geese were found to be a safe and effective method of removing birds from problem sites (Blackwell et al. 2002, Sherman and Barras 2004). A combination of hazing techniques may be necessary to move geese from multiple problem sites within urban and suburban communities, but where geese move in response to hazing is an important consideration.

One hypothesis having merit is that hazed geese will move from sites where they cause problems to areas where they may be exposed to hunting. However, this has not been adequately tested. The objectives of this study were to haze geese from problem sites with the intent of moving them completely out of a community, monitor their movements in direct response to hazing, and determine the efficacy of post-molt hazing to disperse geese and increase their exposure to hunting.

Study area

We selected 1 urban and 1 suburban community in western New York State, both with a history of goose-related complaints. The town of Brighton (Figure 1) is located in an urban area of Monroe County and directly borders the city of Rochester. The town encompasses 40 km^2, with an approximate population of 36,000 people and a housing density of 250/km^2. The town has developed a task force to discuss goose issues, and a border-collie service is used to haze geese at 1 public park and 2 privately-owned sites. Volunteers also participate in egg-oiling programs, coating eggs with vegetable oil to prevent gas exchange and reduce the annual production of young. The discharge of firearms is prohibited, and noise ordinances are in effect.

The town of Clarence (Figure 1) is a suburban community in Erie County and located 32 km northeast of downtown Buffalo. The town is approximately 85 km^2 with a population of 26,000 people at the time of our study and a housing density of 110/km^2. Over 52% of the total area is considered agricultural, but land is continually being converted to residential subdivisions with multiple drainage ponds, which attract geese. From 2001 to 2003, Clarence participated in an egg-oiling program and received a depredation permit to remove 20 nuisance Canada geese per year. Hunting is prohibited in parks and residential areas where geese are causing problems.

Methods

Capture and banding

In late June 2002 and 2003, we used drive-traps to capture 245 adult and 169 juvenile geese in at the urban site and 123 adults and 231 juveniles at the suburban site during their summer molt when the birds were flightless. Geese were aged, sexed, and fitted with standard aluminum U.S. Fish and Wildlife Service leg bands. All geese were handled in accordance with New York State Department of Environmental Conservation animal handling protocols.

In 2002, backpack-style radio transmitters, manufactured by Advanced Telemetry Systems (ATS, Isanti, Minnesota, Model A1560, 48 g; mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. government), were attached by elastic harness to 9 adult females in each community. Radio-marked geese were also fitted with a red plastic tarsal band with a unique white 3-letter code. Only adult females exhibiting a brood patch were radio-marked

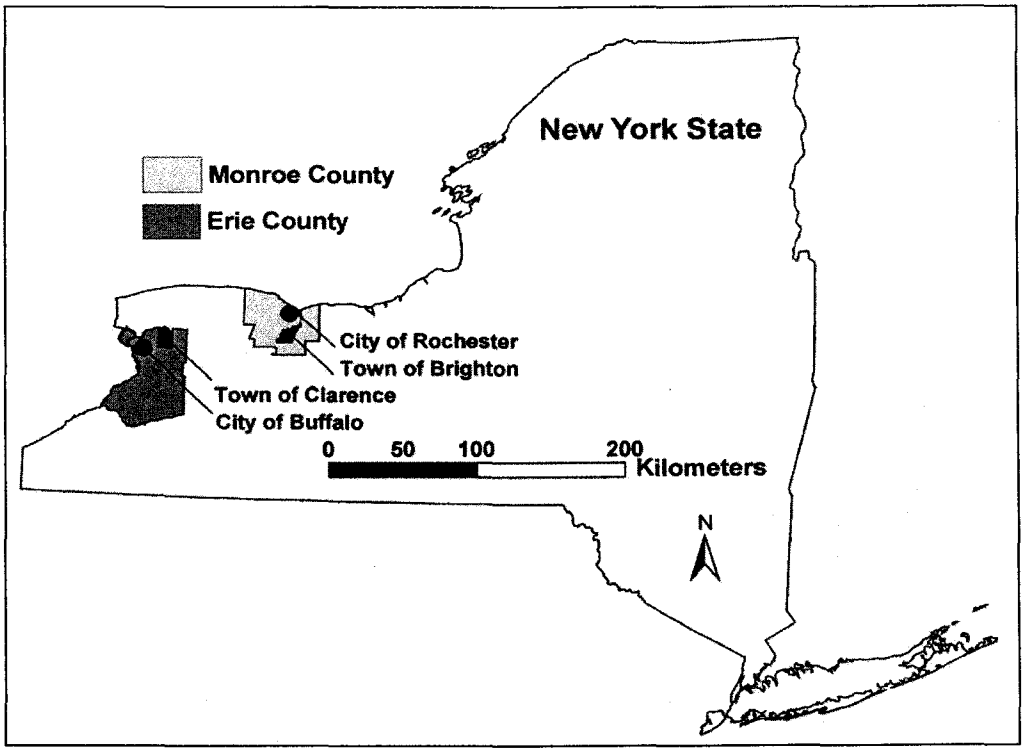

FIGURE 1. Study sites in western New York State where Canada goose hazing was done in an urban (town of Brighton, Monroe County, near city of Rochester) and suburban community (town of Clarence, Erie County, near city of Buffalo), 2002 and 2003.

to increase the likelihood of tracking geese in family groups through the hazing periods and to avoid marking a male-female pair that would provide similar movement data. In 2003, radio transmitters attached to plastic neckbands (ATS, Model A3880, 57 g) were placed on 7 adult females at Brighton and 5 females at Clarence. To supplement observational data of goose movements in 2003, a sample of adult geese (n = 118, Brighton; n = 33, Clarence) was fitted with plastic neckbands inscribed with unique alphanumeric codes.

Hazing

When geese regained flight after their summer molt, radio transmitters were used to locate problem flocks within each study site. Information recorded included date, time, location, number of geese present, transmitter frequency, and neck collar code. Movements of radio-marked and neck-collared geese were monitored during hazing periods, and locations were plotted using ArcView GIS v. 3.3 (Environmental Systems Research Institute, Inc., Redlands, Calif.).

Hazing included the use of border collies, pyrotechnics (Scare-Away Bird Bangers and Screamer Sirens with a 15-mm Single Shot Launcher, Reed-Joseph International Company, Greenville, Mo.), remote-controlled boats (AquaCraft Air Force™, Hobbico©, Champaign, Ill.), lasers (Avian Dissuader®, SEA Technology, Inc., Lebanon, Ky.), strobe lights, kayaks, a goose distress call device (GooseBuster®, Bird-X, Inc., Chicago, Ill.), or a combination of these. Individual hazing sites were similar within and among study areas, typically consisting of properties with mowed lawns in close proximity to open water. Hazing sites were evaluated to determine which hazing techniques could be used based on public perception, traffic considerations, town ordinances, and permission from townships and private landowners. Hazing occurred only where permission was granted, and only techniques approved for each site were used.

During 2002 and 2003, hazing was conducted at 5 sites in the town of Brighton (urban) and 4 sites in the town of Clarence (suburban) from

August 15 to September 25, a period 2 weeks prior to and through the special September Canada goose hunting season, and October 25 to November 15, the first 22 days of the regular waterfowl hunting season. Hazing occurred both day and night, alternating between study sites (towns). A hazing event was defined as the time a technique or combination of techniques was used to disperse geese from an area. If geese moved off of the property and were subsequently hazed at another location, a separate hazing event was recorded. When hazing occurred, the date, time, location, number of geese present, hazing technique(s) used, duration of hazing session, and number of geese remaining after hazing were recorded. At night, geese were counted in areas where there was sufficient light, or spotlights were used to illuminate an area to estimate the number of geese present. Events involving border collies occurred between 0700 and 2000 hours. Lasers were used only between 2000 and 0700 hours due to the need for low-light conditions.

The effectiveness of each hazing technique was calculated as a percentage by dividing the number of geese remaining after hazing by the number of geese present before hazing. A hazing event was considered successful only when >90% of geese were removed from the property. Ninety percent was chosen because the purpose of hazing was to remove as many geese as possible from problem sites, while realizing that some geese would not leave an area when hazed. If geese did not leave an area within 30 minutes, the hazing event was determined unsuccessful, and the hazing session ended. Hazing events were pooled across study sites to determine overall success of each technique.

Mean distances traveled by radio-marked geese from hazing sites to subsequent locations <2 hours after hazing were calculated from locations plotted in ArcView GIS. Affinity of geese to hazing sites was determined by the average number of times radio-marked and neck-collared geese were hazed throughout the September to November hazing periods. Availability of geese for hazing was determined as the percentage of total observations of radio-marked geese recorded at hazing sites. Geese were unavailable for hazing when located at sites where landowner permission was not granted to haze geese or where landowners prohibited the use of hazing techniques during a specified time of day.

Mortality

In 2002 and 2003, leg-band recoveries of adult and juvenile birds shot or found dead during the September Canada goose hunting season and the regular waterfowl hunting season were obtained from the U.S. Geological Survey Bird Banding Laboratory (Laurel, Md.). Only direct band recoveries, (i.e., recoveries during the first hunting season after banding) were used to evaluate vulnerability of geese to harvest.

Results

Hazing

Geese were hazed on 378 separate occasions (Figure 2). Techniques most frequently used were lasers (n = 134), border collies (n = 113), laser/pyrotechnic combinations (n = 54), border collie and remote-controlled boat combinations (n = 37), and pyrotechnics (n = 27) alone. Border collie and remote-controlled boat combinations removed >90% of geese in 97% of events, while border collies alone were successful in 94% of events. Laser and pyrotechnic combinations removed >90% of geese in only 64% of events; lasers were successful in 64% of events, and pyrotechnics in 59% of events.

The mean amount of time to successfully remove geese from a site varied with the technique used. Geese left the sites after a mean of 4.2 (SE = 0.6, range 1–30) minutes with lasers, 5.1 (SE = 1.8, range 1–25) minutes with pyrotechnics, 6.3 (SE = 1.2, range 1–26) minutes with laser and pyrotechnic combinations, 6.4 (SE = 0.8, range 1–30) minutes with border collies, and 17.5 (SE = 2.5, range 1–30) minutes with border-collie and remote-controlled boat combinations.

Hazing events (n = 4) using a goose distress call device never moved geese from a location. Three events using strobe lights also were ineffective; geese swam within 5 m of the light without being disturbed. Similarly, in 4 events, geese chased with kayaks would not leave the water. Two attempts at using kayaks and pyrotechnics in combination did not remove any geese during daylight hours. We discontinued use of these techniques and excluded them from further analysis. Average flock size during hazing periods was 47 (SE = 3.7) from August to September and 146 (SE = 10.8) from October to

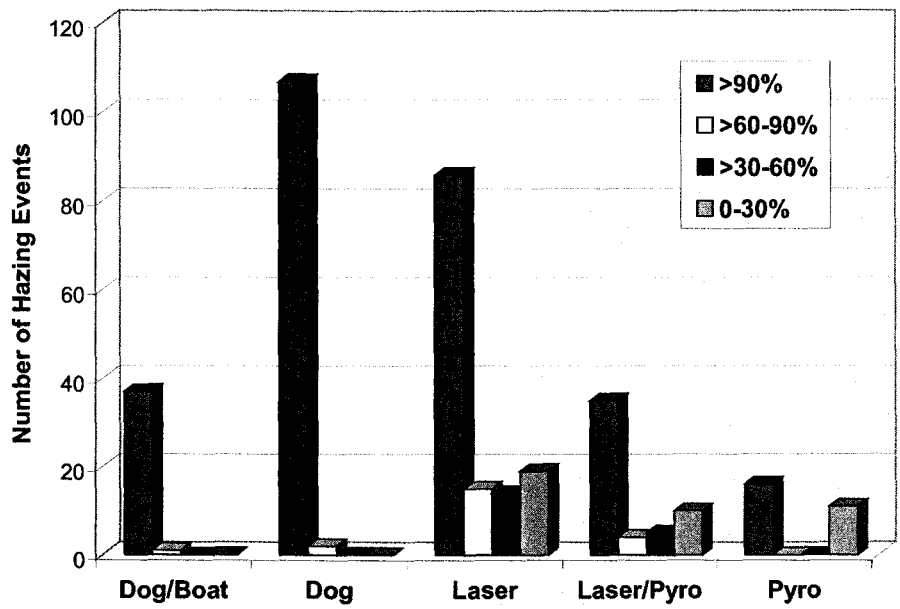

FIGURE 2. Percentage of resident Canada geese removed during each hazing event with border collie and remote-controlled boat combinations (Dog/Boat), border collies (Dog), lasers (Laser), laser and pyrotechnic combinations (Laser/Pyro), and pyrotechnics (Pyro) in Brighton and Clarence, New York, 2002 and 2003.

November. This was consistent between years, with the seasonal increase likely attributed to fall movements of local and migrant birds.

The average distance moved by radio-marked geese from a hazing site to a subsequent location <2 hours after hazing was 1.18 km (SD = 0.91, n = 153). Directly following a hazing event, geese moved a mean distance of 1.08 km (SD = 0.87, n = 61) with lasers, 0.80 km (SD = 0.34, n = 16) with border collies, 0.72 km (SD = 0.65, n = 41) with laser and pyrotechnic combinations, 0.61 km (SD = 0.31, n =24) with border collie and remote controlled boat combinations, and 0.53 km (SD = 0.42, n = 11) with pyrotechnics. Immediately after being hazed, geese moved to similar conflict sites within the community 80% of the time, and moved to alternate wetlands within the community where they were less likely to cause conflicts 19% of the time. Geese were tracked directly to a location where hunting could occur after only 1% of hazing events.

Radio-marked geese were located 739 times in this study, but were only hazed 378 times (51%). The remaining 49% of goose locations were in areas where hazing was not per-mitted. Only 23 of 30 radio-marked individuals were exposed to hazing techniques during the study. Seven birds were never located in hazing areas or died before hazing began. Observations of neck-collared geese were not used to determine availability for hazing because many hazing events occurred at night when neckbands could not be seen.

During the hazing periods, 122 of 151 (80%) neck-banded geese were observed near hazing sites. The remaining 29 (20%) neck-collared geese were never seen. Only 64 of 1,600 observations (4%) of these neck-banded geese occurred in areas open to hunting, 5–30 km from hazing sites.

Mortality

Although areas open to goose hunting existed <10 km from each study site, only 13.6% (SE = 0.01) of adult geese (n = 338), 7.5% (SE = 0.01) of juveniles (n = 400), and 8.0% (SE = 0.07) of radio-marked adults (n = 23) banded at hazing sites were harvested during open hunting seasons in this 2-year study. Of 46 geese harvested, 41 were recovered <50 km from the hazing sites, and 5 were recovered out-of-state.

Discussion

Many nonlethal hazing techniques have had limited success (Conover and Chasko 1985, Smith et al. 1999) because the techniques shift geese

from 1 location to another (Forbes 1993). They also can be costly and ineffective in providing long-term control (Hindman and Ferrigno 1990), often needing repeated treatments (Conover 1985, Cummings et al. 1991). Use of some techniques is limited due to public perceptions or town ordinances (Forbes 1993). A variety of techniques are available, but land use, public acceptance, and permission of landowners may limit their application (Allan et al. 1995). Despite these limitations, hazing continues to be a popular and accepted method of goose control in urban and suburban environments.

Border collies alone and border collies used in conjunction with remote-controlled boats were our most successful hazing techniques during daylight hours. Because border-collie handlers worked under contract for this study, use of dogs was limited to only 3 hazing sites within the urban study area. However, border collies would likely have removed geese from similar hazing sites in the suburban community. Despite their success in removing geese from problem sites, dogs chased geese 113 times at 3 hazing sites within a 3-month period. Therefore, geese were only temporarily removed from hazing sites and returned multiple times when dogs were not present. These findings were similar to border collie studies in Rockland County, New York, in 1997 and 1998 that showed that geese always left a hazing site when chased by dogs, but always returned (B. L. Swift, New York State Department of Environmental Conservation, unpublished data).

Lasers and laser and pyrotechnic combinations effectively removed geese from individual roost sites when we were in close proximity to the birds, and the laser beam could be directed at or near them. The limited effectiveness in 35% of events was attributed to obstructions in water bodies, such as islands, peninsulas, and patches of vegetation, which prevented the beam from reaching geese on their roost sites.

When pyrotechnics were used during the day, geese flew only far enough to avoid the stimulus. Because geese would not leave a hazing site in these instances, only 59% of hazing events involving pyrotechnics were considered effective (>90% removal of geese). Other studies indicate pyrotechnics only provide short-term relief, because geese habituate to the noise (Mott and Timbrook 1988, Heinrich and Craven 1990, Aguilera et al. 1991). During this study, town employees and individual landowners were observed using pyrotechnics at several sites, so geese may have habituated to them before this study began. Pyrotechnic use was limited to only a few sites in this study due to public perceptions, safety concerns, and noise ordinances, especially in residential and highly developed areas.

Most urban and suburban communities have numerous mowed lawns and man-made or natural water bodies that are preferred by geese (Conover and Kania 1991). Geese were mostly observed on lawns or ponds, but they also were found in less traditional areas, such as rooftops and parking lots. Their access to these nearby areas, where hazing was not allowed, greatly limited our ability to harass them continuously. Therefore, hazing had an impact on the localized movements of geese, but did little to move geese permanently out of study areas.

The distance that geese move in response to hazing often depends on flock size, frequency and predictability of the stimulus, and site conditions (Madsen and Fox 1995). Similar to our findings, Sherman and Barras (2004) reported that geese hazed with lasers moved <2 km from urban sites in Ohio. Even with intensive hazing (24 hours/day), post-molting geese at the Elmendorf Air Force Base in Anchorage, Alaska, moved only 3.53 ± 0.2 km (York et al. 2000). Some of our geese moved up to 3.6 km after a hazing event, but this distance was often not far enough to place them in areas accessible to hunting, or they used locations where hazing and hunting were prohibited.

We are uncertain whether movements geese made away from the study sites into areas open to hunting were a direct result of hazing. Because the study sites were close to agricultural fields (<10 km from all treatment sites), it is conceivable that some geese were making flights to feed on waste grain when they were harvested (Koerner et al. 1974, Craven and Hunt 1984). In larger metropolitan areas, where Canada goose conflict sites are farther from agricultural fields, foraging flights and resulting exposure to hunting may not occur.

The success of a Canada goose hazing program depends on the perspectives and roles of people in a community. Landowners who want geese removed from their property may consider a hazing program successful if geese simply move

onto a neighboring property. Local officials who receive complaints on a town- or city-wide basis, however, would label a program unsuccessful if geese simply move to similar locations within the community and continue to cause problems. However, if geese begin using sites that do not cause conflicts with people, hazing could be considered successful. Hazing geese to alternative sites throughout a community may have short-term benefits, but does not control increasing numbers of geese. Some type of direct removal (e.g., hunting, summer round-ups) is required for population management of resident goose flocks.

Management implications

This study confirmed previous research that hazing can disperse resident Canada geese from individual sites, especially with the use of border collies during daytime hours (Castelli and Sleggs 2000) and lasers at night (Blackwell et al. 2002, Sherman and Barras 2004). However, this dispersal is only short-term. Geese do not move far from hazing locations, and without continual harassment they will likely return.

Most auxiliary-marked geese and associated flocks in this study did not move far enough from hazing sites to be exposed to hunting. Therefore, hazing did not directly contribute to the reduction of Canada goose populations within communities. Instead, hazed geese often moved to nearby areas within study sites, potentially causing problems at new locations within the community. When implementing a hazing program on their property, landowners and property managers should consider potential impacts of Canada geese to surrounding areas.

Dispersing geese from several problem areas within a community would require frequent harassment of birds at each site and coordinated hazing efforts to prevent geese from using alternative locations. Hazing geese at every potential site would be virtually impossible due to the number of areas geese could use and property access limitations. Based on the time and effort needed to haze geese at multiple sites in this study, and the ability of geese to use a wide variety of habitats, hazing alone would not reduce goose populations at the community level.

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