FINAL DRAFT

A Comprehensive Plan for Managing Broome County's Resident Goose Population

Photograph Provided by André LaClair

Prepared for:

The Broome County Legislature

By:

The Broome County Environmental Management Council's
Goose Management Task Force

Authored by: André LaClair
With Contributions by: Karen Ciatyk, Beth Egitto, Bill Heaviside, Stacy Merola, Tom Tasber and Jacob Thompson

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1. Abstract

Over the past decade, there has been a dramatic increase in the Canada Geese population residing in Broome County. Concentrating in public and private open spaces, they have become common fixtures during the spring, summer, and fall. The growth of the goose population has led to negative impacts on the quality of open spaces, especially those intended for human recreational use. Unfortunately, the goose population continues to grow while the human tolerance level continues to decline.

This report proposes a comprehensive plan for addressing the resident goose population through the following steps:

1. Define the current scope of the problem surrounding the establishment of resident goose populations, identify land use practices that exacerbate the problems, and identify the scale of problems created by the non-migratory goose population.

2. Identify the primary biological factors influencing population dynamics.

3. Identify the full range of techniques used to manage goose populations, and define the expected short and long term effectiveness, and associated financial costs.

4. Provide an economic method to measurement the effectiveness of the primary control methods, and use this methodology to recommend the "best-value" management techniques to be included in a comprehensive management plan.

5. Use the exercises above to document a recommended strategy and propose an implementation plan with which Broome County can execute the management strategy.

Photograph Provided by André LaClair

Illustration 1. Family of Canada Geese – Late Spring

2. Problem Definition

2.1 Historical Background

Resident Canada Geese are those residing within the continental United States in the spring and summer. This distinguishes them from *migratory* Canada Geese that reside in their historical ranges in northern Canada during these seasons. In the early 20th century, decades of over-hunting, egg harvesting and habitat loss reduced the migratory Canada Geese population along the Atlantic Flyway to critically low numbers. Captured Canada Geese from the mid-west were maintained as captive stock initially, and were used either as live decoys to attract the remnant migratory birds in the fall, or released on private hunting preserves for member hunting activities. As surviving (or escaped) birds reproduced, resident populations formed that became comfortable in the vicinity of human activity, particularly after un-regulated hunting was eliminated by the enactment of the Migratory Bird Treaty Act of 1918. The initial New York resident populations originated from the lower Hudson Valley and Long Island regions.

2.2 Land Use Practices

The resident goose population has adapted to habitat that has been significantly altered by humans such as open grassy areas and fields containing low-growing agricultural grain crops. These comprise a setting particularly well suited for the resident goose life style especially when located near open waters. Golf courses, ball fields, and parks are planted with grasses that the geese find attractive as a food source. Many open spaces are landscaped with flowering trees and shrubs that produce berries or small fruits that attract the geese seasonally. In addition, agricultural plantings of grain crops provide succulent grassy feed early in the growing season and waste grain is available in cut fields after harvest in the autumn. Human land use practices have created excellent feeding opportunities, near-by nesting locations, and an environment almost completely devoid of natural predators, thus causing increases in individual goose life span.

2.3 Problems and Potential Concerns

The most evident consequence of high goose population density is extraordinary fecal deposition. Canada Geese typically defecate 7 times an hour and the average area soiled by one deposit is roughly 1¾ square inches. Based on simple statistical analysis, it was determined that in a 12-hour period, a single goose can soil an area of approximately 31 square feet to the extent that it is physically impossible for a person to walk though the area without stepping in the feces. In one week's time, the defecation by a flock of 50 geese can render an area of over 10,000 square feet (about one third of a football field) impassible. This problem will be amplified by continued growth of the resident population. Further, after the nesting season adult geese become very aggressive when protecting a family of goslings, which can be an intimidating situation for many people.

2.3 <u>Problems and Potential Concerns (cont'd)</u>

Although current knowledge suggests that goose feces poses no threat to human health, such as passing E. Coli or other bacteria, the current scenario could provide a convenient path of exposure to future diseases or microbes due to the increased interactions between humans and geese. This path of exposure is a potential threat to the declining migratory goose population, since the resident and migratory geese do congregate for a period during the spring and fall migrations. In addition, documented cases show that large resident populations impact the water quality of pools, ponds, small lakes, and streams with low flow (as in summertime). Fecal deposition in water bodies and run-off can lead to algal growth that will alter small freshwater ecosystems.

In addition to the impacts of fecal deposition, a large flock can ruin carefully manicured grasslands as on golf courses and parklands. Agricultural lands may be damaged early in the growing season when plants are beginning to sprout, and the plants are the most tender and nutritious to the geese.

Photograph Provided by André LaClair

Illustration 2. Canada Geese Feeding in Cut Corn Field

Although not documented in Broome County, the risk of bird collisions with aircraft is a serious issue that could become grave if the goose population grows significantly. Furthermore, the Interstate-81 corridor between Otsiningo Park and Broome Community College experiences occasional goose/vehicle collisions that potentially threaten human life and property.

3. Biological Factors

To develop an effective goose management plan, it is necessary to identify and quantify the factors that contribute to population growth. The study of animal population growth and decline is referred to as population dynamics. If the resident population is increasing, it is important to recognize the growth rate and the limitations on the future population. Further, an understanding of goose life history and behavior is required for an effective plan. Life history and behavior address the annual cycle of events in the lives of the population, such as (any) migration behavior, courting, nesting, rearing of young, molting, and seasonal feeding habits. Behavioral response to potential threats, weather, and other environmental influences is also considered.

3.1 Population Dynamics

Geese, like people, have two basic needs for survival: an ample food source and a safe living environment. A population can be maintained within a region only if the rate of food production equals or exceeds the rate of food consumption. If the nesting and fledgling rates exceed the rate of population predation, the population will continue to grow.

Natural predation occurs when natural enemies of geese raid nests and consume eggs or goslings, or capture and consume adult geese in the act of hunting. The lack of natural predators, as in a man-made, urban-like environment, will not compensate adequately for the populations gains due to nesting. Artificial (human) predation is accomplished by egg addling and hunting.

Broome County Parks Department is currently conducting limited egg addling as part of their annual depredation permit to reduce local populations by an estimated 4%. The NYSDEC estimates that hunting statewide has approximately a 15% to 20% impact on the existing population. In Broome County, the natural predation rate is in the neighborhood of 10% to 12%, while the nesting success rate statewide is approaching 80%. A simulation was developed to model all the factors that influence goose population dynamics, including local food production rates, nesting and fledgling rates, natural predation, mortality, and human predation. The NYS DEC data suggests that the current resident goose population in Broome County is approximately 5000 individuals. Broome County encompasses an area of 468,000 acres, so the overall density of geese is approximately 0.011 geese per acre. However, the actual area that consists of potential goose habitat is only a small percentage of the county that includes open non-wooded spaces in the vicinity of water bodies, and agricultural croplands in proper season. These acreages consist of roughly 14,000 agricultural acres and 8000 grassy open space acres (refer to Appendix 1), yielding an actual density of 0.23 geese per acre.

The simulation model was used to generate the data presented in Figure 1 and is based on current conditions within the County, including man-made food production that supports the geese, and the human activities that eliminate geese (addling). This simulation assumes that the food production rate is large enough that the geese cannot deplete the supply (production always exceeds consumption), which is a reasonable assumption if the population is not near the environmental carrying capacity. Figure 1 illustrates that under current conditions the resident population will quadruple in 10 years.

3.1 Population Dynamics (cont'd)

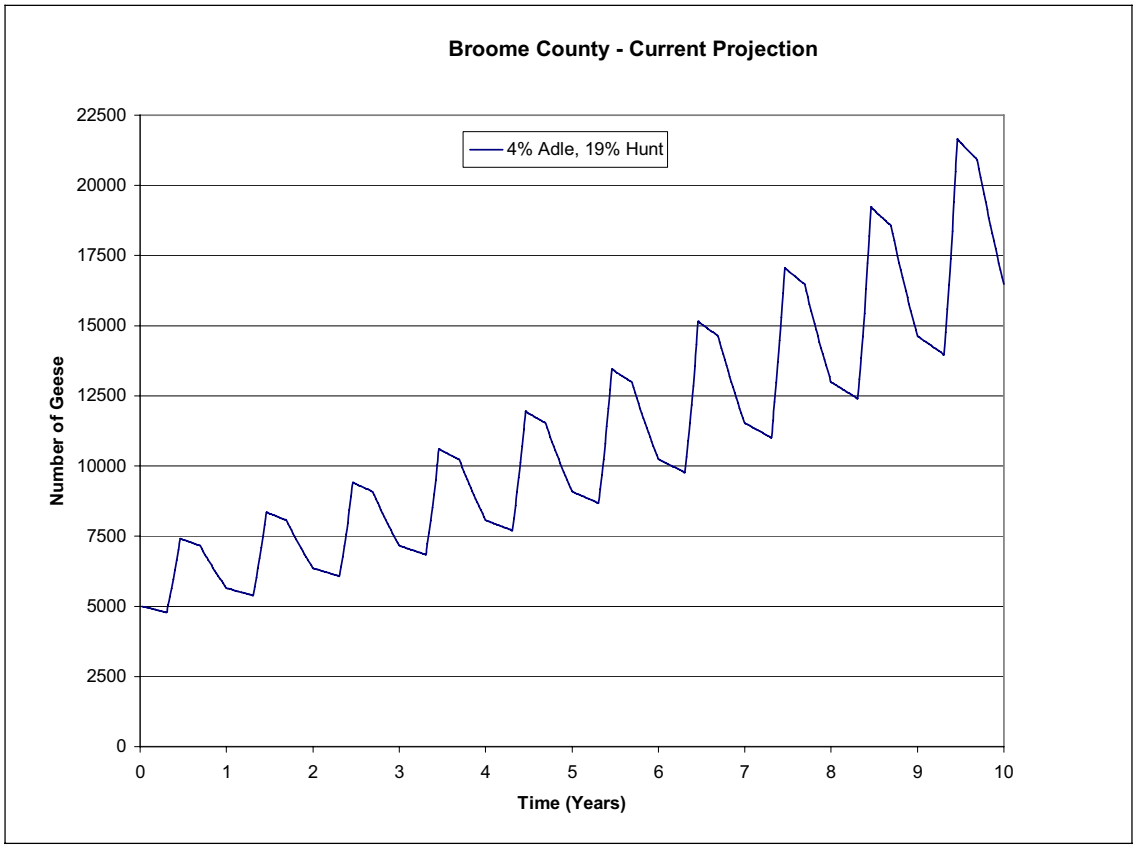


Figure 1. Broome County Resident Goose Population Forecast (Unlimited Food Supply)

Analysis of the available food supply and its production rate can provide insight into an ecosystem's potential carrying capacity for a given species. 'Carrying Capacity' is the maximum population of a species that can be supported by an ecosystem. A larger population will consume resources faster than they can be replenished, and therefore degrades the ecosystem. Canada Geese consume approximately one half pound of forage daily. An estimate of the carrying capacity can be determined with estimates of the croplands that may provide seasonal forage for the geese in the late spring and then after fall harvest, estimates of grassland areas in the vicinity of water bodies, and knowing the monthly quantity of food produced per acre for these two land types. If the goose population increases to a point where the food consumption exceeds the food production the population will "crash" due to geese starving or leaving the area to find new food sources.

Figure 2 provides a simulation where the growing goose population reaches a level where the food consumption exceeds food production. This model assumes that the geese cannot totally destroy the vegetation that produces the food supply, which is not necessarily a realistic assumption. However, this illustrates what the County's effective carrying capacity is at this time.

3.1 Population Dynamics (cont'd)

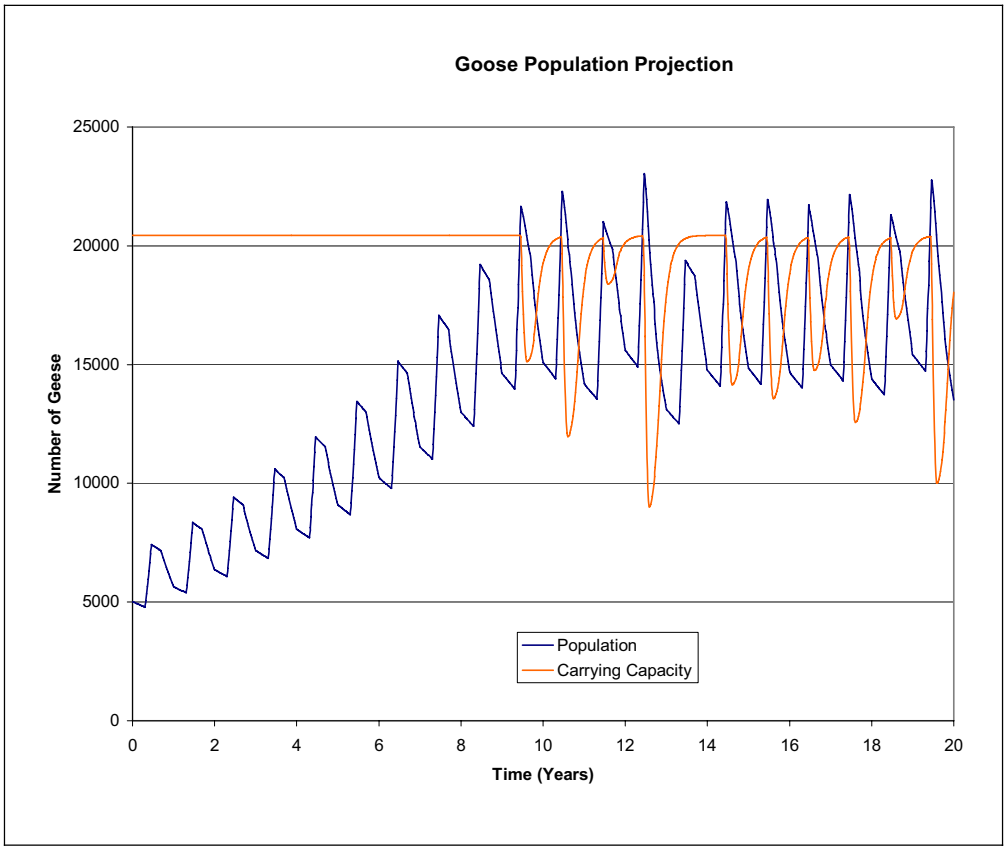


Figure 2. Broome County Resident Goose Population Forecast (Limited Food Supply)

It should be noted here that other factors that can influence population dynamics, including floods, droughts, and disease epidemics are not considered by the model. These factors can have significant impact on carrying capacity and brood production.

One key conclusion from this simulation analysis is that if population reductions are desired as part of a management plan, they should be put into action immediately. No reduction technique can be 100% successful, but if the goal is to reduce the population by 10%, this effort will be only 25% as expensive today as opposed to 10 years from now, since the population is expected to quadruple in that time period. The NYSDEC literature indicates that if hunting pressure is increased so that the annual take is 30% of the population rather than the current 15% to 20%, then the resident population might be stabilized.

3.2 Life History and Behavior

Figures 1 and 2 above also illustrate the annual life cycle of Canada Geese. Each year, there is a substantial population increase from roughly April to May corresponding to the nesting season. A significant decrease in population, although not as substantial as the spring increase, occurs around September, corresponding to the annual resident goose-hunting season in New York. The annual life cycle and the associated annual population dynamic are illustrated together in Figure 3 below.

In addition, geese have an annual molt occurring from late June through early August. At this time, the geese are flightless, which greatly reduces their mobility and restricts them to their favorite foraging grounds and manicured recreational areas. Since this time period coincides with the peak annual population and peak annual use of parks, ball fields, and golf courses, the peak of human activities and the peak of goose habitation on the County's open spaces coincide resulting in the current state of conflict.

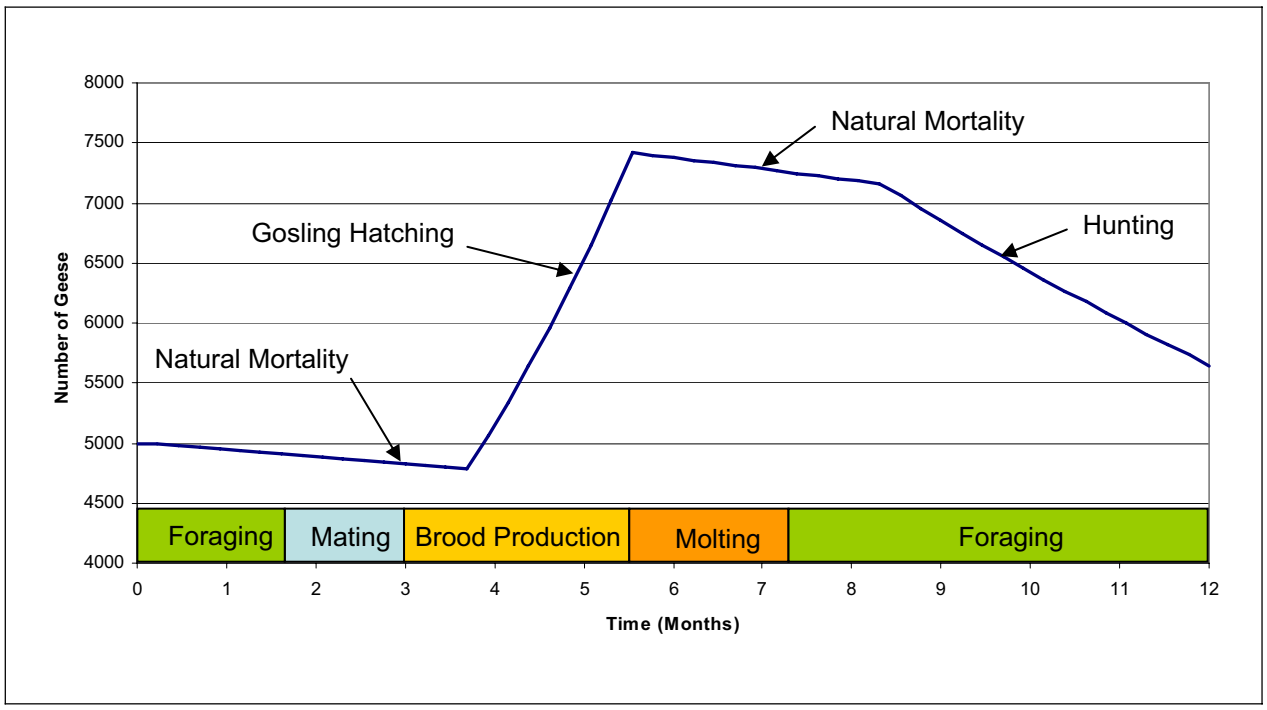


Figure 3. Canada Geese Annual Life Cycle

3.2 Life History and Behavior (cont'd)

There are additional behavioral traits that aggravate the resident goose problem. Geese are highly territorial, particularly during mating and nesting seasons. Most wild geese will attack humans and other large predators when provoked, as when approaching nesting sites or goslings.

Photograph Provided by André LaClair

Illustration 3. Aggressive Canada Goose Behavior

Wild geese readily establish territories where the food quality and quantity is high, and will not readily vacate a location that provides a palatable food source, even if there is a significant level of natural predation. The geese are even more resilient in the presence of predators when the flock size is large, due to their sense of safety in numbers.

3.2 Life History and Behavior (cont'd)

The following illustrations show the predator/prey relationship between snow geese and coyotes in the Bosque del Apache Federal Wildlife Refuge in central New Mexico. Despite the obvious climatic and environmental differences from Broome County, there are also some striking similarities. The geese feed primarily on open grasslands planted to attract and feed migratory waterfowl. There are also crop fields that allow waste grain foraging in autumn. These fields lay next to the Rio Grande River, and outside the immediate valley there is only a hostile, arid environment where the geese could not survive. Broome County is similar in that its grasslands (parks, etc) and croplands tend to be found near the major rivers, and are surrounded by densely wooded hillsides, only marginally more hospitable to geese than the outlaying deserts of New Mexico. The Bosque Del Apache Preserve represents an ecosystem operating very close to its carrying capacity for geese. Hunting is employed, croplands are plowed under in the winter, and wetlands are temporarily drained to encourage the population to disperse and continue its migration.

Note the high goose population density in these photographs and the placid relationship between the geese and the coyotes. Illustration 5, where the single coyote watches the geese fly is actually 30 yards from where the geese are starting to land, suggesting that natural predation alone in an artificial environment may not dramatically reduce the prey population.

Photograph Provided by André LaClair

Illustration 4. Coyotes and Snow Geese between Meals

Illustration 4 above clearly shows that natural enemies may not encourage the geese to leave an area. This is important when considering artificial devices in an attempt to scare geese and coerce them to leave a site. Geese are highly adaptable, and it is well documented that most 'scarecrow-like' deterrents have, at best, only limited, short term effects.

3.2 Life History and Behavior (cont'd)

Photograph Provided by André LaClair

Illustration 5. Coyote Watching Snow Geese Land for a Meal

Photograph Provided by André LaClair

Illustration 6. Snow Geese Moving to a New Foraging Site

3.3 Importance of Predation

Predation is a critical and integral part of establishing balance in nature. Broome County, with large tracts of grassy open spaces near the principal river corridors within urban and suburban environments have created an unnatural environment where resident geese have ample food, shelter, and nesting locations without a naturally compensating presence of predators. Without predation, natural populations can over-populate their environment causing significant, if not permanent, ecological damage. This leads to rapid population declines, not only for the geese but also for other species dependent on the shared environment. Figure 4 below illustrates current environmental conditions within Broome County, with the hunting pressure increased from the current 19% take to a 32.5% take, and with no addling program in effect.

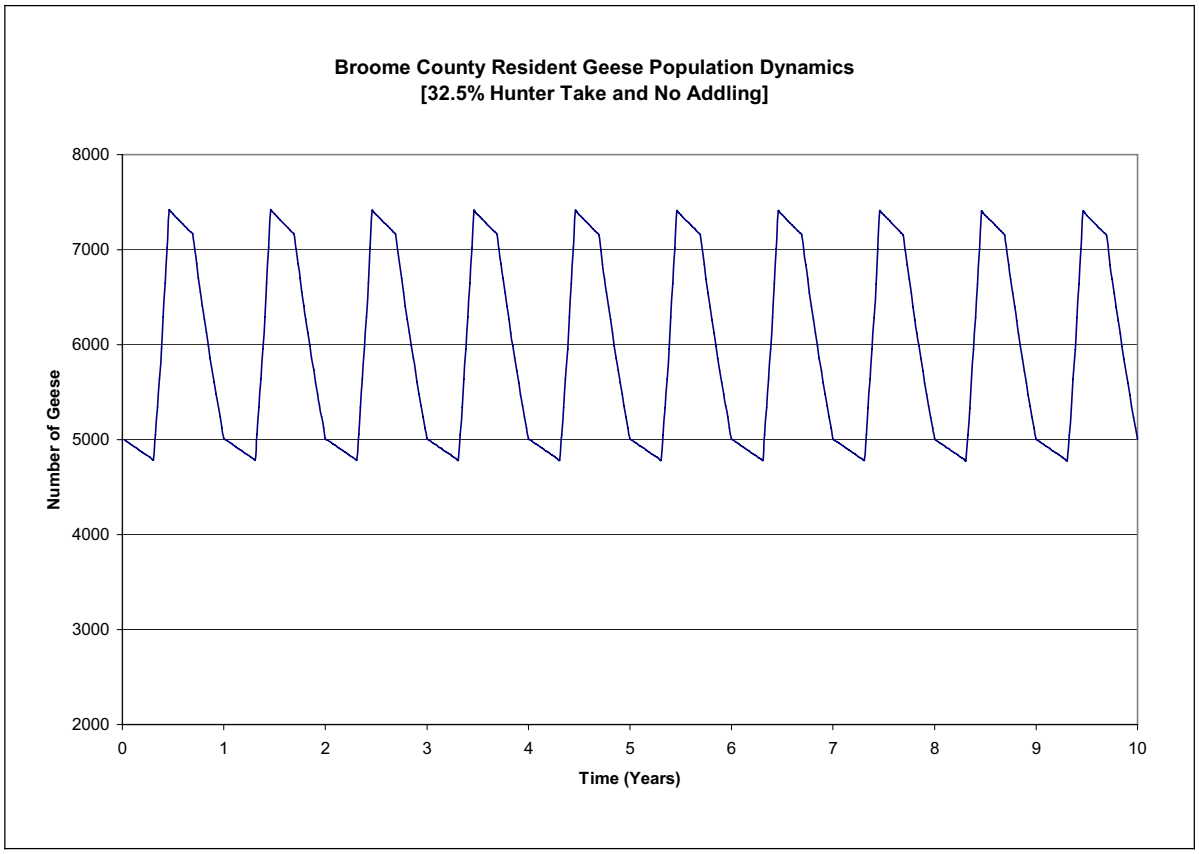


Figure 4. Broome County Resident Goose Population Forecast with Increased Hunting Pressure

Note that the selected 32.5% hunter predation effectively maintains a constant annual average population. This is in close agreement with the 30% value suggested in the NYSDEC studies. This represents a hunter harvest that is nearly double the historical harvest percentage.

3.3 Importance of Predation (cont'd)

Figure 5 below illustrates another simulation where the addling efforts are expanded such that slightly more than 69% of the produced eggs are addled. Like the increased hunting scenario shown in Figure 4, the annual average population is stabilized. Also note that the annual range in the population size is much smaller than in the Figure 4 hunting example. However, this percentage of nests addled is 17 times current efforts within the County (~4%). In practice, this will require a broad-based and dedicated effort.

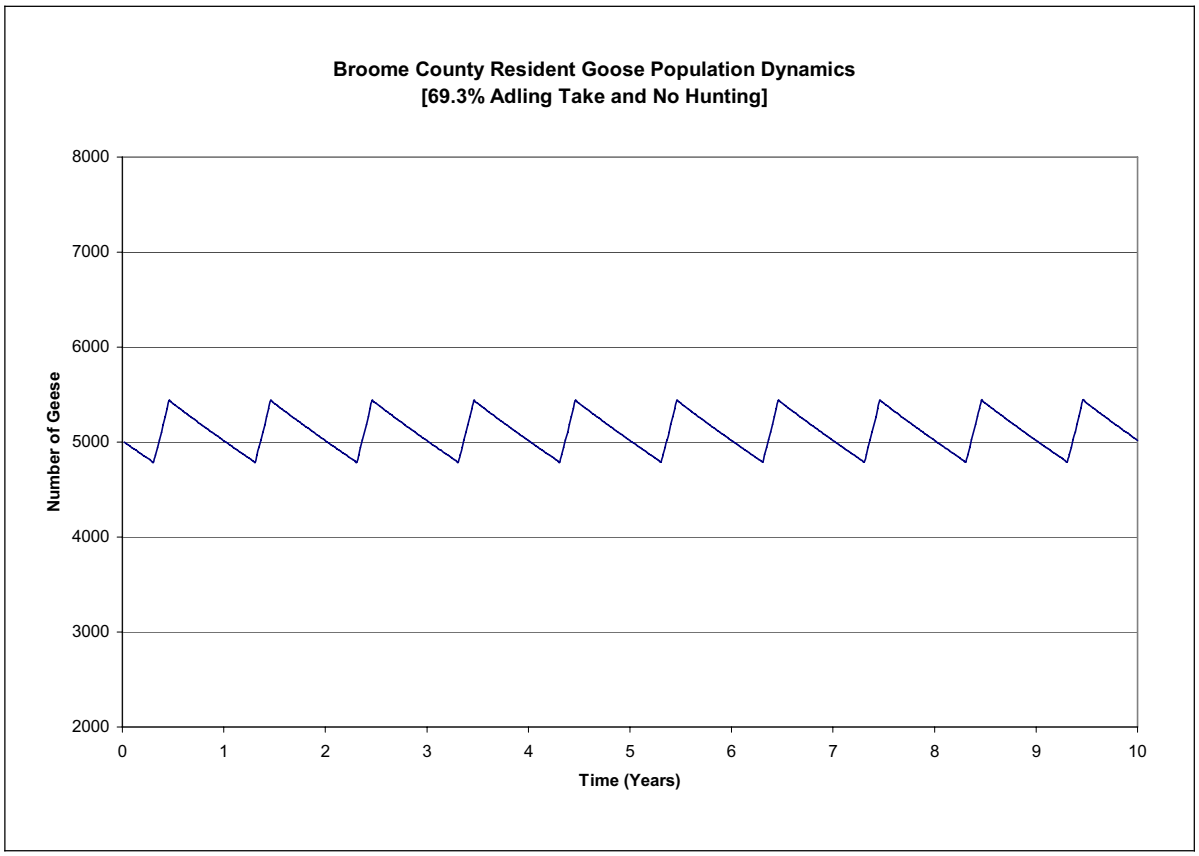


Figure 5. Broome County Resident Goose Population Forecast with Increased Addling Efforts

3.3 Importance of Predation (cont'd)

Figure 6 below illustrates the simulation results for a more modest increase in the addling effort and a modest increase in the hunter harvest. This result shows a small annual decline in the overall population. This simulation represents a quadrupling of the current addling effort and a 36% increase in the annual hunting harvest.

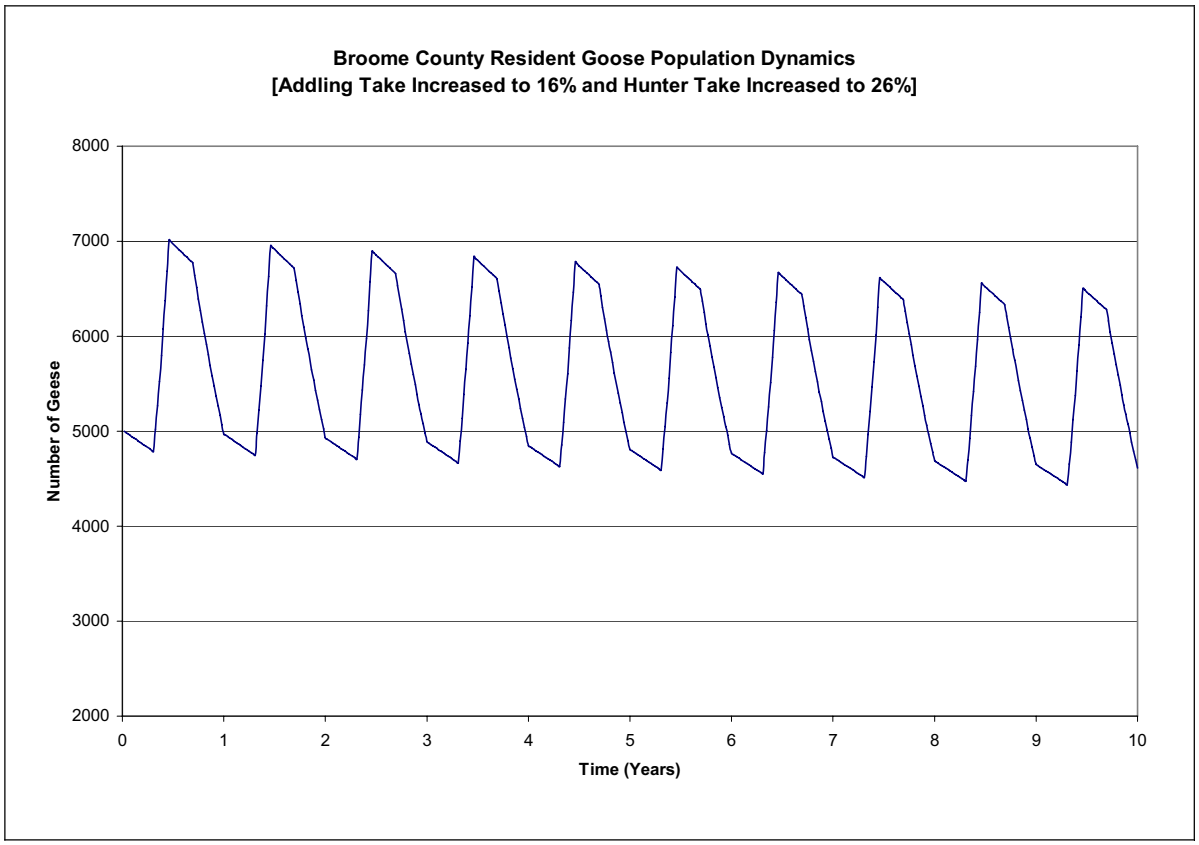


Figure 6. Broome County Resident Goose Population Forecast
with Modest Increases to Addling Efforts and Hunter Harvest

Recognizing the variability of the resident goose population response to multiple predation scenarios is a tool that can help shape a comprehensive strategy. In the next section, the litany of goose management tools and techniques will be reviewed, and then evaluated in the context of the biological factors discussed above.

4. Control Techniques

Numerous methods may be employed in an effort to extradite or eradicate resident geese. For each method there are numerous supporting products. Goose management techniques may be organized into four primary categories, as defined below:

- Scarecrow Tactics
- Harassment Approaches
- Habitat Modifiers
- Predation Techniques

A brief summary is provided for each category below, and subsequent paragraphs will include a review of the effectiveness and the associated costs.

4.1 Scarecrow Tactics

Scarecrow tactics employ products such as decoys, noisemaking devices, and visual hazing devices. Decoys may replicate natural objects that geese fear such as coyote, dog, and even goose effigies. The tactic is to conspicuously place these objects in the locations where the geese are not welcome. Noisemaking devices include sirens, sound-making systems that broadcast goose alarm calls, predator calls and sounds, shotgun blanks, and propane cannons. Random broadcasts are intended to alarm the geese and make them vacate the area. Visual hazing devices consist of inanimate objects that reflect light and/or move in the wind such as Mylar tapes and windmills, balloons and other objects with unnatural designs or large eye-like impressions, and lighting systems such as laser projectors.

Photograph Provided by Stacy Merola

Illustration 7. Otsiningo Park Resident Geese and Windmill Scarecrow Device

4.2 Harassment Approaches

Harassment approaches involve physically chasing the geese so that they will leave an area. This can be done with dogs, people on foot, bike or vehicle, remote-control aircraft or boats. This simply drives the geese from one area to another, and unless the population is nearing the region's carrying capacity, there will be no significant impact upon the total goose population.

4.3 Habitat Modifiers

Habitat modifiers consist of barriers such as fences and wires, chemical repellents that make grass and other edible plantings unpalatable to the geese, and extensive landscaping to make habitat unattractive to the geese, encouraging them to move elsewhere.

4.4 Predation Techniques

Predation techniques consist of chemical birth control products that are spread on the geese feeding areas, nest disruption, egg addling, which kills the goose embryo before hatching, traditional hunting, and lethal round-up activities. The intent of these approaches is to directly control the population of the resident geese in a given region.

4.5 Federal Regulations for Managing Resident Canada Geese

On August 10, 2006, US Fish and Wildlife published their Record of Decision on "Migratory Bird Hunting Permits; Regulations for Managing Resident Canada Goose Populations; Final Rule"; finalizing their resident Canada goose management environmental impact statement. The goal of this effort was to locate federal solutions to damage caused by resident Canada geese. The ruling's three components primarily focus on easing the permit process, allowing stakeholders the tools to deal with resident Canada geese in a timely manner.

Component One consists of four control orders (Airports, Nests and Eggs, Agricultural, and Public Health), each dealing with resident Canada goose management in specific cases. The second component addresses the expansion of current hunting methods, in both hunting seasons and hunting techniques. The final component creates as "Management Take Program", allowing the government to step in when all resident Canada goose depredation efforts fail. Appendix 3 summarizes the various components and control orders authorized by this final rule.

4.6 Effectiveness Review

A comprehensive plan for managing resident geese must include short and long-term goals, and define the methods for accomplishing these goals. A short-term goal may be to drive the geese away from areas where they are the greatest nuisance, whereas a long-term goal would be reducing the local population to a tolerable level. The Appendix 2 table provides a summary of the four major classifications of control methods noted earlier in this report. It identifies the method and/or tools, defines the expected sphere of influence (or range), indicates the expected goose response, the expected level of public support, documents negative consequences of applying that method or tool, and provides an estimated cost range for fielding that method or tool.

4.6 Effectiveness Review (cont'd)

A qualitative analysis ranking was conducted on the various control methods and tools, and a Qualitative Effectiveness Factor (QEF) was utilized to rank each item. This factor is calculated with the following formula:

$$QEF = EF_{PERFORMANCE} \bullet SF_{POLICY} \bullet F_{COST}$$

The Performance Efficiency Factor, ($EF_{PERFORMANCE}$), is a measure of how effective the method removes geese from a site, with respect to both duration and site size, scored as 1 for the poorest performance and 5 for the most effective.

The Public Support Factor, (SF_{POLICY}), is a measure of how well received the method is by the general public, scored as a 1 for the least acceptable and 3 for the most acceptable.

The Cost Factor, (F_{COST}), is the measure of the relative cost of implementation, scored as 1 for a very high cost and 3 for a relatively low cost.

Table 1 below shows the results of the QEF evaluation of all the various tools and methods. This data is based upon committee feedback with interested parties, and data compiled in an analysis conducted by Binghamton University students for an Environmental Policy class and also in "Managing Canada Geese in an Urban Environment. A Technical Guide.", published by Cornell University Cooperative Extension. (Refer to the bibliography in section 7.) Note that the methods and tools of the scarecrow category rank do not rank very high. With the exception of the birth control method, the predation category scores very high, which is expected since predation is a significant natural method for managing population growth. Only the permanent habitat changes score high; chemical repellents are very expensive and have a limited duration of effectiveness due to their susceptibility to rainfall. Wires and fencing are expensive for anything other than relatively small areas, and they are not esthetically pleasing in appearance. The harassment techniques fare reasonably well, except for the remote control devices, which have not been proven as effective as dogs or people. Since these methods do not control the overall goose population, their overall effectiveness factors are limited.

4.6 Effectiveness Review (cont'd)

Category	Method/Tool	$EF_{PERFORMANCE}$	SF_{POLICY}	F_{COST}	QEF
Scarecrow	Decoys	1.0	2.0	3.0	6.0
	Noisemakers	1.0	1.0	2.5	2.5
	Artificial Devices	1.0	3.0	3.0	9.0
	Visual Deterrents	1.0	3.0	3.0	9.0
Harassment	Dogs	4.0	2.5	1.75	17.5
	People	3.0	2.5	1.5	11.25
	R/C Devices	2.0	2.5	1.25	6.25
Habitat Change	Fences & Wires	2.5	1.5	2.0	7.5
	Chemical Repellents	2.0	2.0	1.0	4.0
	Habitat Change	4.5	2.5	2.0	22.5
Predation	Birth Control	2.5	2.5	1.0	6.25
	Nest Disruption	3.5	2.5	1.5	13.125
	Egg Addling	4.0	2.5	1.5	15.0
	Hunting	4.5	2.5	3.0	33.75
	Lethal Removal	5.0	1.0	2.0	10.0

Table 1. Qualitative Effectiveness of Goose Management Methods

Based on this analysis alone, one could conclude that picking the top three to six scoring methods would be adequate for establishing the mechanisms for a comprehensive goose remediation plan. However, this would be ignoring the reality that the Cost Factor can have a strong influence on public support. A comprehensive plan with low public support is not likely to survive for long.

In the next section, a more serious economic evaluation is conducted that complements this analysis. Utilizing the results of both measurement techniques will help to determine the elements of a comprehensive plan that maximizes the plan's performance, public support, and affordability.

5. Economic Analysis

5.1 Measurement Methods

An economic analysis of the methods reviewed previously considers the cost of implementing and executing each method and its associated toolkit. A method that removes the maximum number of geese from a site for the longest period of time and for the least capital expenditure will be the method with the maximum economic benefit. For the purposes of this analysis, we will define a Cost Value (CV) Parameter shown as follows:

$$CV = \left(\frac{C_{METHOD}}{N_{MOVED} \cdot T_{GONE}} \right)$$

The Cost Value (in units of dollars per goose-year) for a unique method equals the annual cost of implementing and executing the method (C_{METHOD}) in dollars, divided by the product of the number of geese moved or removed (N_{MOVED}) and the time duration (in years) over which the geese have been moved (T_{GONE}).

If the management method is lethal then this number is equal to the median lifespan (10 years), which is assumed to be half of the maximum lifespan of 20 years. Further, a method that is lethal, such as hunting, when considering its impact over the lifespan of resident geese, actually eliminates future resident geese, which is taken into consideration when computing the total number of geese moved. It is assumed that approximately 1.12 geese are removed annually for each goose removed by a lethal method.

The cost of the method also accounts for the cost of consequences due to its implementation. For example, modifying habitat can reduce the recurring cost of maintaining an area of habitat; native trees and shrubs require much less maintenance than well-manicured grass fields. For consistency, this analysis is based on an assumed 200 geese intermittently invading a 30-acre parcel.

5.2 Economic Comparison

Table 2 below provides a summary of the economic analysis conducted on the hypothetical parcel.

Category	Method/Tool	C_{METHOD}	CV	Notes/Comments
Scarecrow	Decoys	$1100	143	Excludes all labor costs.
	Noisemakers	$2000	130	Excludes all labor costs.
	Artificial Devices	$1800	234	Excludes all labor costs.
	Visual Deterrents	$2000	173	Excludes all labor costs.
Harassment	Dogs	$15,000	150	Effort for 6 months.
	People	$20,700	276	Effort for 6 months.
	R/C Devices	$17,000	340	Effort for 6 months.
Habitat Change	Fences & Wires	$37,000	247	Assumes 5 acres wired and 5 acres fenced.
	Chemical Repellents	$165,600	828	Applied to all 30 acres
	Habitat Change	$1667	16.67	Modify 15 acres and includes maintenance savings payback.
Predation	Birth Control	$180,000	669.6	Applied to all 30 acres
	Nest Disruption	$30,000	111.6	Assumes all nests located
	Egg Addling	$6000	22.3	Assumes all nests located
	Hunting	$100	20.3	Assumes 19% harvest rate
	Lethal Removal	$2500	1.25	Nominal cost.

Table 2. Economic Analysis for Methods Applied on a 30-Acre Parcel

In general, we want to select the methods with the minimum Cost Value, for an optimal economic solution. However, from the effectiveness evaluation, and the known long-term response of the geese to the scarecrow methods, we recognize that these are not good choices for even a medium-term plan of only a few months' duration. Although the harassment methods do not have the best Cost Values, the earlier analysis shows that these have the most immediate (short-term) positive results.

5.3 Recommended Methods

In general, the preferred methods are those with the largest Effectiveness Factor and the lowest Cost Value. To select the preferred methods to be considered as part of a Comprehensive Goose Remediation Plan, we dismiss the scarecrow methods since they have only a very short period of effectiveness. For the remaining three categories, we pick the six methods with the highest Qualitative Effectiveness Factor and the six methods with the lowest Cost Value Parameter. The data is summarized in Table 3 below, with the six largest values for our two evaluation parameters in underlined text.

Also, the methods that have both the QEF and CV highlighted are identified with *bold italicized* text. The methods that are selected by either the QEF or the CV, but not both, are indicated by underlined and *italicized* text.

5.3 Recommended Methods (cont'd)

Category	Method/Tool	QEF	CV
Scarecrow	Decoys	6.0	143
	Noisemakers	2.5	130
	Artificial Devices	9.0	234
	Visual Deterrents	9.0	173
Harassment	***Dogs***	**17.5**	**150**
	People	**11.25**	276
	R/C Devices	6.25	340
Habitat Change	Fences & Wires	7.5	247
	Chemical Repellents	4.0	828
	Habitat Change	**22.5**	**16.67**
Predation	Birth Control	6.25	669.6
	Nest Disruption	**13.125**	**111.6**
	Egg Addling	**15.0**	**22.3**
	Hunting	**33.75**	**20.3**
	Lethal Removal	10.0	**1.25**

Table 3. Identification of Preferred Management Methods

The economic and effectiveness analyses, used together, identify 5 optimal methods to employ in a comprehensive plan:

- Harassment with Dogs
- Habitat Modification
- Nest Disruption
- Egg Addling
- Hunting

The analyses also suggest two potential methods: harassment by people and lethal removal of unwanted geese. Lethal removal is the best dollar value, but the public perception and opinion causes the effectiveness score to be lower than expected. Harassment by people is more expensive than using dogs (higher CV) and less effective (lower QEF), since the use of people is constrained by the minimum wage laws, and they aren't as fast as dogs. However, if the plan over the long term cannot adequately manage the resident population, then the lethal removal may be the only effective tool. The use of people, if done on a volunteer basis, could be an attractive short-term strategy.

Nest disruption is significantly less effective, and more expensive than egg addling. This is due to its labor-intensive effort (multiple returns to each nest site) and long-term returns (coercing the geese to move elsewhere to nest). Egg addling does not require as many returns to the nest sites, and the addling also has an effective near-term impact on the local population. For this reason, egg addling is recommended in preference to nest disruption for affecting the nesting activities of the geese. Hunting is a very affordable method, and should be encouraged so that harvest rates can be increased. Habitat modification will provide a mid-term return on investment by both causing geese to re-locate and also reducing maintenance costs for the modified open space (natural plants require less maintenance than turf).

6. Conclusions

This analysis provided insight into the existing impacts of resident geese, identified the necessity of a long-term comprehensive remediation plan, and provided a rationale for selection of tools to effectively and affordably execute a plan. The plan should consist of short-term solutions for an immediate impact, a long-term component to address the population density issues, and integrate methods applicable to the public and private sectors. The following sections summarize the strategies and overall plan recommended for managing Broome County's resident goose population.

6.1 Comprehensive Strategy

The proposed strategy consists of the following components:

1. **Utilize harassment, in the short term, to force geese away from locations where they create the greatest problems.**

   For sites covering several acres, harassment using professional dog services is an effective short-term solution. Using professional services for this effort is the most economical. Acquiring publicly-owned dogs would be expensive as a minimum of 4 to 6 dogs are required for the sites currently employing this service. Further, there is a liability associated with this activity, requiring insurance of underdetermined cost at this time. A minimum of 2 full-time employees during the 6 months of peak nuisance adds additional cost, and half-time employment for the remainder of the year to work and maintain the dogs will do so also. People may be able to accomplish adequate harassment on smaller sites. The necessary level of harassment should decrease in time if the other elements of the comprehensive plan are executed.

2. **Utilize egg addling to control the juvenile goose (goslings and yearlings) population.**

   Egg addling should be well coordinated so that time investments and other costs may be minimized. Further cost savings can be accomplished by organizing a volunteer core to assist in this activity. Mapping and acquiring access to private land should be major elements of an addling plan.

3. **Utilize habitat modification to encourage natural re-location of the resident geese to other regions.**

   An evaluation of all potential goose habitats should be conducted in the near term. Open space that can be modified to discourage geese should be identified, and a long-term plan enacted to affect the habitat changes. Space that provides the geese easy access to larger tracts of open space, or is open space with minimal human utilization, should be targeted for habitat modification. The Animal Alliance of Canada has published an excellent treatise, titled "A Source Book – Habitat Modification and Canada Geese. Techniques for Mitigating Human/Goose Conflicts in Urban & Suburban Environments.", on this topic. (Refer to the first reference of the bibliography.) Further, it may be beneficial to take an inverse approach in some situations: modifying areas to attract the geese so that they leave areas where they are a problem is also an option. The County's Agricultural Plan could be a means for attracting geese to more

6.1 Comprehensive Strategy (cont'd)

hunt-able locations, and potentially compensate farmers for participating in the goose management program.

4. **Utilize hunting to control the adult resident goose population.**

   Outreach to encourage hunting should be maximized during the early (resident) goose hunting seasons. Coordination between hunting and harassment activities would be helpful, so geese can be directed to regions where safe hunting can occur. Further, incentives to permit hunter access to more land should be considered.

5. **Create a central management organization to act as the liaison between public and private entities.**

   Central oversight will help ensure that the plan's implementation is coordinated, and help maximize the plan's coverage while minimizing its costs. Involved entities include County Parks, the County Landfill, the County's airports, public schools, commercial businesses (golf courses, etc.), local municipalities, and the public at large. This organization could also evaluate the necessity for a quick-turn lethal removal action plan, and an associated implementation/action plan, in the event that external influences cause the plan to under-perform.

6.2 Summary of Plan Recommendations

Due to the complex nature of goose behavior and population dynamics, and with artificial and natural habitats in close proximity, there is not one management strategy that can succeed by itself. A broad-based plan using multiple strategies and a commitment to its success will be required to avoid continued growth of the goose population and an increasingly negative impact on the community.

7. Bibliography

Animal Alliance of Canada. (Date Unknown). "A Source Book – Habitat Modification and Canada Geese. Techniques for Mitigating Human/Goose Conflicts in Urban & Suburban Environments". Retrieved from: www.animalalliance.ca/projects in December 2005.

Bosque del Apache Federal Wildlife Refuge Staff. (2006). Personal Correspondence. January 2006.

Broome County Agricultural and Farmland Protection Board and Shepstone Management Company. Broome County, New York Agricultural Economic Development Plan. (August 2001). Cornell Cooperative Extension of Broome County, and Broome County Department of Planning and Economic Development.

Cody, D. (2006). Broome County Parks & Recreation. Personal Correspondence. March 2006.

Cunningham, W.P., Cunningham, M.A., & Saigo, B. (2005). Environmental Science. A Global Concern. 8th Edition. ISBN 0-07-243956-4. McGraw Hill.

Donovan, C., Ha, J.H., Kowalchyk, H., Lombardo, M.J., & Tkach, J. (2005). Policy Analysis on Goose Management for the Environmental Management Council of Broome County, New York. Management of the Resident Canada Goose Population. Environmental Policy Class at Binghamton University, December 6, 2005.

Gansowski, J. (2006). United States Department of Agriculture. Personal Communication. March 2006.

Kras, M. (2006). Take Flight Goose Management. Personal Communication. February 2006.

McCoy, N.H. (Date Unknown) Economic Tools for Managing Impacts of Urban Canada Geese.

"Migratory Bird Hunting Permits; Regulations for Managing Resident Canada Goose Populations; Final Rule." Federal Register Vol. 71 No. 154 (10 August 2006): 45964-45993

Smith, A.E., Craven, S.R., & Curtis, P.D. (1999). "Managing Canada Geese in Urban Environments. A Technical Guide." 1999. Ithaca, N.Y.; Cornell University Cooperative Extension.

Swift, B. (2006). NYS Department of Environmental Conservation. Personal Communication. February 2006.

United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. (2004). Environmental Assessment: Canada Goose Damage Management in the State of New York. March 2004.

United States Fish & Wildlife Service. (2006). Personal Communication. January 2006.

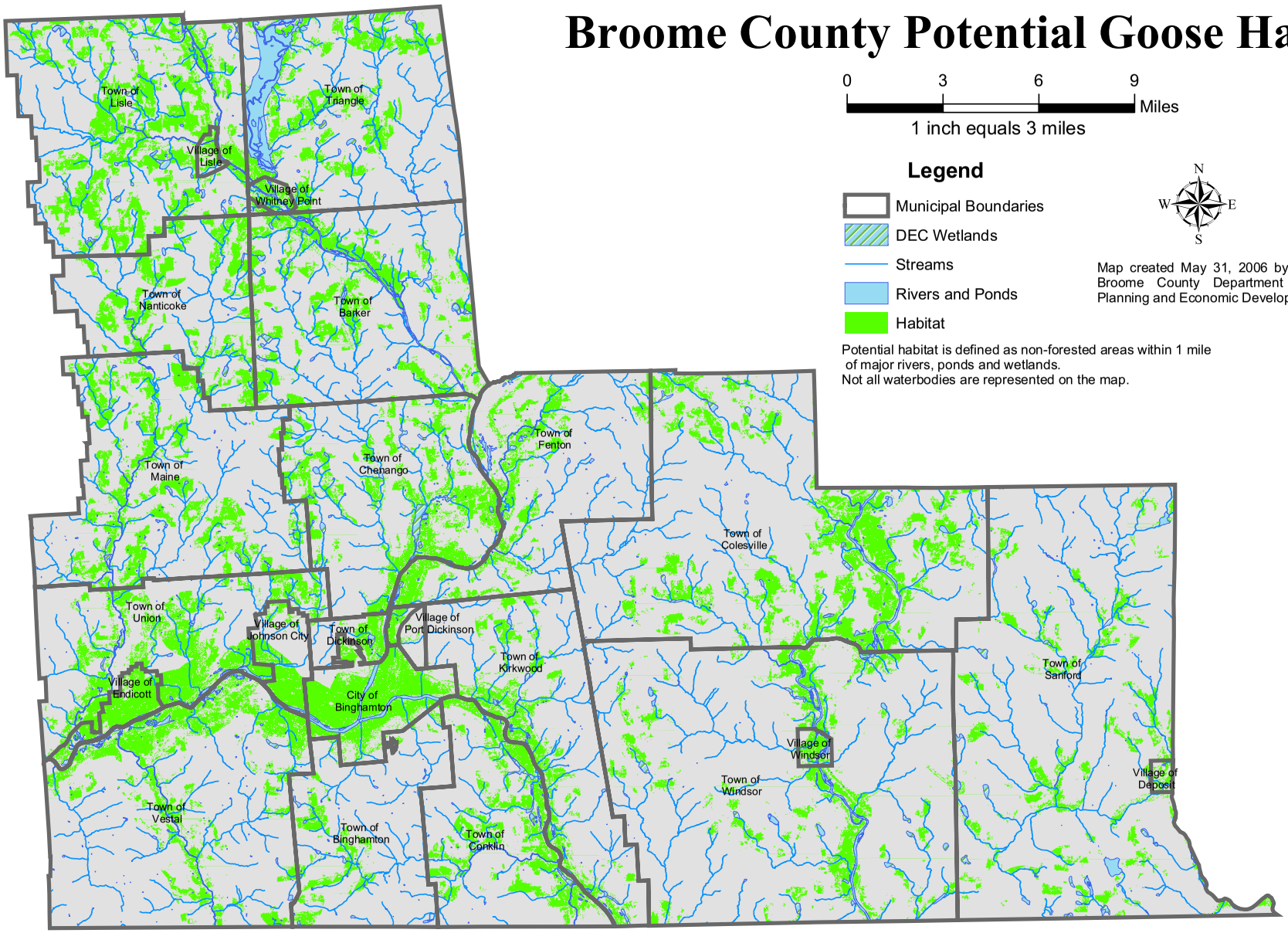
Appendix 1

Map of

Potential Resident Goose Habitat

in Broome County

Broome County Potential Goose Habitat



0 3 6 9 Miles

1 inch equals 3 miles

Legend

- Municipal Boundaries
- DEC Wetlands
- Streams
- Rivers and Ponds
- Habitat

N W E S

Map created May 31, 2006 by the Broome County Department of Planning and Economic Development

Potential habitat is defined as non-forested areas within 1 mile of major rivers, ponds and wetlands.
Not all waterbodies are represented on the map.

Appendix 2

Goose Management

Methods and Tools

Appendix 2 – Summary of Goose Control Methods and Tools

Category	Method/Tool	Effective Range	Goose Response	Level of Public Support	Disadvantages	Implementation Cost
Scarecrow	Decoys	3 acres 150 yd.	Geese become acclimated after about 2 weeks	High	Effective only for a short duration. Vulnerable to vandalism. Not preferred for use in public parks.	1 device per 3 acres, $55.00 each
	Noisemakers	5 acres 250 yd.	Geese become acclimated after about 4 weeks	Low	Effective only for a short duration. Also disruptive to nearby human population.	1 device per 5 acres, $300.00 each
	Artificial Devices (Mylar tape, balloons, etc.)	1 acre 50 yd.	Geese become acclimated after about 2 weeks	High	Effective only for a short duration. Vulnerable to vandalism.	3 devices per acre, $10.00 each
	Visual Deterrents	2 acres 100 yd.	Geese become acclimated after about 3 weeks	Medium	Effective only for a short duration.	1 device per 2 acres, $1000.00 each
Harassment	Dogs	9 acres 440 yd.	Move to neighboring sites outside effective range when confronted	Medium – High	Very high recurring, labor intensive cost and very site specific.	$20,000.00 per 40 acres
	People	9 acres 440 yd.	Move to neighboring sites outside effective range when confronted	Medium – High	Very high recurring, labor intensive cost and very site specific.	$18,000.00 per 26 acres
	Remote Control Devices	4 acres 200 yd.	Move to neighboring sites outside effective range when confronted	Medium – High	Very high recurring, labor intensive cost and very site specific.	1 device per 2 acres, $100.00 each (plus labor)
Habitat Modification	Fences & Wires	Applied Area	Geese avoid modified area	Low	Fairly expensive to implement, labor intensive, very site specific, susceptible to damage, and may be dangerous to people.	For fencing, $1.08 per linear foot, which equates to $900 to fence 1 acre. For wire barrier, $6500 per acre (assumes 3 foot spacing.)
	Chemical Repellents	Applied Area	Geese avoid area with fresh chemical applied	Medium	Extremely expensive, labor intensive and requires re-application after significant rainfall.	$230.00 per acre per application, assume 24 applications per season
	Habitat Alterations	Applied Area	Geese re-locate to preferable habitat, can reduce long-term site maintenance costs	Medium	High non-recurring cost, applicable only to low-utilization sites.	$1000.00 per acre
Predation	Birth Control	"Infinite"	Stops population growth	Medium	Very expensive, labor intensive and unproven.	$1000.00 per acre per application
	Nest Disruption	"Infinite"	May reduce population growth, and may encourage geese to re-locate in an attempt to find more favorable and successful nesting regions.	High	Very expensive, labor intensive and requires long-term commitment. Geese may re-nest locally.	$30,000.00 per season (assumes 6 people full-time for 2 months at $16.00/hr.)
	Egg Addling	"Infinite"	Reduces population growth, and may encourage to re-locate in an attempt to find more favorable and successful nesting regions.	High	Modestly expensive and labor intensive.	$10.00 per egg (assumes no volunteer support)
	Hunting	"Infinite"	Eliminates a portion of existing population, which helps reduce future growth.	Medium – High	To maximize effectiveness, need to improve harvest rates.	Minimal?
	Lethal Removal	"Infinite"	Eliminates a portion of existing population, which helps reduce future growth.	Low	Expensive and highly controversial.	$1000.00 to $4000.00 per site

Appendix 3

Summary of

Federal Register Notice RIN 1018-AI32
August 10, 2006

US Department of Interior, Fish and Wildlife
Migratory Bird Hunting Permits; Regulations for Managing Resident Canada Goose Populations; Final Rule

Considerations and Strategies for Managing Broome County's Resident Goose Population

Summary of Federal Register Notice RIN 1018-AI32, August 10th, 2006 - Department of Interior, Fish and Wildlife
Migratory Bird Hunting Permits; Regulations for Managing Resident Canada Goose Populations; Final Rule - Effective: September 11th, 2006

Description	Component One			
	Airport Control Order	**Nest and Egg Depredation Order**	**Agricultural Depredation Order**	**Public Health Control Order**
What	Authorizes airport stakeholders to manage resident Canada geese to protect public safety	Authorizes stakeholders "to destroy resident Canada goose nests and take resident Canada goose eggs."	Authorizes the State wildlife agency (NYS Department of Environmental Conservation) to implement a program to allow agricultural stakeholders to conduct direct damage management actions.	Authorizes the State wildlife agency (NYS Department of Environmental Conservation) to conduct resident Canada goose control and management activities including direct control strategies.
Where	Actions must take place within a 3-mile radius of commercial, public, and private airports.	Actions must take place on property under the jurisdiction of the authorized stakeholders.	Action must occur on land which an agricultural producer personally controls and where geese are committing depredations to agricultural crops.	Resident Canada geese can be taken only within the specified area of the direct threat to human health.
When	Necessary to protect public safety and allow the resolution and prevention of safety threats from Canada geese	When necessary to "resolve and prevent injury" to people, property, agricultural crops, and other interests.	When necessary to prevent or stop the injury and depredation acts of geese on agricultural crops.	When resident Canada geese are posing a direct threat to human health. This order cannot be used if resident Canada geese are merely causing a nuisance.
Who	Authorized stakeholders include airport managers, and their employees or agents	Authorized stakeholders include "private landowners and managers of public lands."	Authorized stakeholders include landowners, operators, and tenants actively engaged in commercial agriculture.	NYSDEC officials, their employees, and their agents have the power to conduct control activities, once local health departments bring the problem to their attention.
Methods	Egg oiling (100% Corn Oil); egg and nest destruction; shooting; lethal and live traps; nets; registered animal drugs, pesticides, and repellants; cervical dislocation; and Carbon Dioxide asphyxiation.	Egg oiling (100% Corn Oil); and removal or disposal of egg and nest material.	Egg oiling (100% Corn Oil); egg and nest destruction; shooting; lethal and live traps; nets; registered animal drugs, pesticides, and repellants; cervical dislocation; and Carbon Dioxide asphyxiation.	Egg oiling (100% Corn Oil); egg and nest destruction; shooting; lethal and live traps; nets; registered animal drugs, pesticides, and repellants; cervical dislocation; and Carbon Dioxide asphyxiation.
Time Limits	Management and control activities must take place between April 1st and September 15th. The destruction of nests and eggs must take between March 1st and June 30th.	The destruction of nests and eggs must take place between March 1st and June 30th.	Management and control activities must take place between May 1st and August 31st. The destruction of resident Canada goose nests and eggs must take place between March 1 and June 30.	Management and control activities must tale place between May 1st and August 31st. The destruction of resident Canada goose nests and eggs must take place between March 1 and June 30.
Registration	*Not finalized by the NYSDEC.*	http://www.fws.gov/permits/mbpermits/gooseeggregistration.html	*Not finalized by the NYSDEC.*	*Not finalized by the NYSDEC.*
Tracking	Airports using control methods "must submit an annual report summarizing activities, including the date and numbers and location of birds, nests, and eggs taken, by December 31 of each year to the Regional Migratory Bird Permit Office."	Must complete an annual report summarizing activities, including the date, numbers, and location of nests and eggs taken by October 31 http://www.fws.gov/permits/mbpermits/gooseeggregistration/report.	Must maintain a log that indicates the date and number of birds killed and the date and number of nests and eggs taken for three years. The log must be made available upon request.	"States and Tribes exercising the privileges granted by this section must submit an annual report summarizing activities, including the numbers and County of birds taken, by December 31 of each year to the Regional Migratory Bird Permit Office."
Terms of Disposal	Disposal of resident Canada geese taken under this order may be by donation to public museums or public institutions for scientific or educational purposes, processing for human consumption and subsequent distribution free of charge to charitable organizations, or burial or incineration.			
Terms of Revocation	Fish and Wildlife reserves the right to revoke a stakeholder's authorization of any part of this component, should it be demonstrated that the conditions and stipulations of that order were not adhered to. Additionally, should resident Canada goose populations no longer pose a threat, Fish and Wildlife reserves the right to terminate any or all parts of the program.			
Further Restrictions	The NYSDEC must accept terms of each order before it can be implemented. Operators must attempt to minimize lethal take. Operators must act in accordance with national, state, and local laws. Actions may not be taken that jeopardize the welfare of any other migratory bird, endangered or threatened species. All persons using shotguns must use nontoxic shot. Persons oiling eggs must use 100% corn oil. Decoys, calls, and other luring devices may not be used to lure birds into gun range.			
Controlling Body	US Fish and Wildlife oversees this regulation. Where stated, the NYSDEC will oversee registration of operators and tracking of birds.			

Considerations and Strategies for Managing Broome County's Resident Goose Population

Summary of Federal Register Notice RIN 1018-AI32, August 10th, 2006 - Department of Interior, Fish and Wildlife
Migratory Bird Hunting Permits; Regulations for Managing Resident Canada Goose Populations; Final Rule - Effective: September 11th, 2006

Description	Component Two **Expanding Hunting Measures**	Component Three **Management Take Program**
What	Provides additional hunting methods and times to increase the sport harvest of resident Canada geese.	Management take is defined as a special management action needed to reduce certain wildlife populations when traditional management programs are unsuccessful in preventing injuries from overabundance of the population.
Where	This action would occur on permitted hunting areas.	This action would occur on permitted hunting areas.
When	Additional hunting methods will be permitted once the NYSDEC has approved this action. The demonstration of a minimal impact to migrant Canada goose populations would be required.	Following the conclusion of the first full operational year of this rule, any wildlife agency from a State or Tribe could request approval for this population control program. The request must be approved by the director.
Who	Only State wildlife agencies (NYSDEC) and Tribal entities can authorize the use of the additional hunting methods for resident Canada geese.	All participant hunters must be registered, for this specific program, with the state.
Methods	Expanded hunting methods include electric calls and unplugged shotguns. Expanding shooting hours would be one-half hour after sunset, during existing, operational, and special September Canada goose seasons (i.e., September 1-15). The state can add additional experimental hunting seasons. These seasons would be authorized on a case-by-case basis through the normal migratory bird hunting regulatory process.	The program would authorize shooting "in a hunting manner" during the time period of August 1st – 31st. The NYSDEC can extend hunting hours to one-half hour before sunrise and after sunset; as well as removing bag limits on resident Canadian geese.
Time Limits	All expanded hunting methods and opportunities must be conducted outside of any other open waterfowl season.	Control activities may only be conducted between August 1st and 31st.
Registration	Standard hunting permits.	The state or tribe's request for this program "must include either a discussion of the State's or Tribe's efforts to address its injurious situations utilizing the methods approved in this rule or a discussion of the reasons why the methods authorized by these rules are not feasible for dealing with, or applicable to, the injurious situations that require further action."
Tracking	Annual spring breeding population monitoring would be used to assess population status and provide for the long-term conservation of the resource.	States and Tribes must keep annual records of activities carried out under the authority of the program. Specifically, information must be collected on the number of individuals participating; the number of days individuals participated in; the total number of resident Canada geese shot and retrieved; and the number of resident Canada geese shot but not retrieved. "[Fish and Wildlife] will annually assess the overall impact and effectiveness of the management take program on resident Canada goose populations to ensure compatibility with long-term conservation of the resource."
Terms of Disposal	Disposal of resident Canada geese taken under this order may be by donation to public museums or public institutions for scientific or educational purposes, processing for human consumption and subsequent distribution free of charge to charitable organizations, or burial or incineration.	
Terms of Revocation	Fish and Wildlife reserves the right to revoke a stakeholder's authorization of any part of this component, should it be demonstrated that the conditions and stipulations of that order were not adhered to. Additionally, should resident Canada goose populations no longer pose a threat, Fish and Wildlife reserves the right to terminate any or all parts of the program.	
Further Restrictions	The NYSDEC must accept terms of each order before it can be implemented. Operators must attempt to minimize lethal take. Operators must act in accordance with national, state, and local laws. Actions may not be taken that jeopardize the welfare of any other migratory bird, endangered or threatened species. All persons using shotguns must use nontoxic shot. Persons oiling eggs must use 100% corn oil. Decoys, calls, and other luring devices may not be used to lure birds into gun range.	
Controlling Body	US Fish and Wildlife oversees this regulation. Where stated, the NYSDEC will oversee registration of operators and tracking of birds.	

Note on Permits: This document authorizes the continued use of special and regular hunting seasons, issued under 50 CFR part 20, and the issuance of depredation permits and special Canada goose permits, issued under 50 CFR 21.41 and 21.26, respectively.

Appendix 4

Comprehensive

Goose Management Plan

Summary

Comprehensive Goose Management Plan Summary

Strategy	Timeframe	Recommended Tasks
Oversight	Near Term	1. Establish Oversight Committee 2. Identify and reach out to solicit involvement from all key players, public and private 3. Develop plan to identify and address all problem parcels 4. Develop tools to measure plan performance 5. Identify any necessary revenue streams (consider enforcing 'no-feeding' regulations and use funds for financing the plan)
Oversight	Long Term	1. Coordinate Plan Execution 2. Ensure that all plan methods are funded and supported 3. Re-evaluate plan as conditions change 4. Stay abreast of nation-wide activities in goose management, and watch for 'lessons learned' 5. Consider new management tools, should they be developed 6. Develop relationships and look for volunteer support to manage cost
Harassment	Near Term	1. Continue to Utilize Current Suppliers 2. Identify secondary problem sites created by harassment at primary sites, and develop a mitigation plan to address these secondary sites.
Harassment	Long Term	1. Expand harassment in coordination with hunting efforts to maximize hunter harvest
Habitat Modification	Near Term	1. Identify open spaces that can be modified to discourage geese 2. Define habitat types used to replace goose habitat, with a theme that will enhance habitat for more desirable species 3. Identify cost of individual habitat projects 4. Define priorities based upon level of goose activity and affordability of proposed habitat modification 5. Develop a time-line (long term schedule) for accomplishing habitat modification

Comprehensive Goose Management Plan Summary Con't

Habitat Modification	Long Term	1. Execute habitat modification plan to discourage geese 2. Look to develop public volunteer program (like 'Adopt a Highway' program) to accomplish habitat modification and future maintenance 3. Evaluate habitat modification at sites where it would be desirable to encourage the geese to reside (may be done in coordination with hunting efforts) 4. Coordinate volunteer-assisted programs 5. Develop agricultural incentives to plant goose-attracting vegetation in the outlaying regions of the county on underutilized farmland
Predation – Addling	Near Term	1. Obtain required Federal and State Wildlife Management Permits 2. Develop long-term plan for identifying specific regions to target for addling efforts 3. Develop training syllabus so that workers enter the field properly trained, for safety and for the addling effort 4. Maintain records of addling accomplishments (locations, egg counts, etc.)
Predation – Addling	Long Term	1. Solicit public support (land access, primarily) to expand addling activities, if required 2. Request expanded egg addling on future permits 3. Solicit greater volunteer involvement
Predation – Hunting	Near Term	1. Encourage hunter access during the resident goose season on property where significant numbers of geese reside (tax incentives, trespass fees, begging/pleading, etc.) 2. Solicit hunting data from volunteer hunters to better measure hunting impact
Predation – Hunting	Long Term	1. In conjunction with County Agricultural Plan, encourage hunting as a form of agricultural tourism or eco-tourism 2. With support of local hunting groups or national groups such as Ducks Unlimited, develop a responsible volunteer hunters certification to support the management plan, which can help to encourage land-owner support 3. Request out-of-season hunts if goose populations are not adequately reduced by current practices 4. Identify players for conducting lethal removal (i.e., Round-Ups) if the management practices cannot control the resident population