CANADIAN GEESE MANAGEMENT METHODS IN INDIAN LAKE

An Interactive Qualifying Project Report Submitted to the faculty of Worcester Polytechnic Institute in partial fulfillment of the requirements for the Degree of Bachelor of Science in cooperation with the Indian Lake Watershed Association. Submitted 5/12/2020

Submitted By:

Perla A Wehbe

Project Advisor:

Dr. Aaron Sakulich

ABSTRACT

Indian Lake, located in Worcester, Massachusetts, has been struggling with nuisance Canadian Geese for the past few years. Resident geese have inhabited the parks, waterways, and residential areas. This project focuses on delivering an effective plan of management to reduce the Canadian Geese population. Recommendations were provided to support the successful delivery of various methods.

ACKNOWLEDGMENTS

I would like to express my deep and sincere gratitude to my Project Advisor, Dr. Aaron Sakulich, for his brilliant constructive suggestions and patient guidance in planning the research work.

I would also like to pay my special regards to Beth Proko, the President of Indian Lake Watershed association, for her assistance in keeping the progress of my research and gaining the knowledge of the lake and its neighboring communities.

I would like to recognize the invaluable assistance of Christina Puleo, Executive Director of the YMCA of Central Massachusetts, for providing helpful insights of the management plans utilized by the YMCA.

I would like to thank Michael Berberian, Principle Sanitary Inspector, for providing the successful and unsuccessful methods applied at the lake.

TABLE OF CONTENTS

TABLE OF FIGURES AND TABLES

EXECUTIVE SUMMARY

This project focuses on Indian Lake, located in Worcester, Massachusetts. Indian Lake struggles to control its Canadian Geese population. Geese waste has been remarkably increasing in the watershed leading to a rise in harmful pathogens. Residents near the lake are also in conflict with the geese due to their abundance, waste, and extreme adaptation when finding food and other resources. The strategy is to gain knowledge about Canada Geese and their behavior and study and evaluate various methods of management. The methods of management are divided into five sections: habitat modification, exclusion, harassment, chemical repellents, and lethal control. Each section will assess certain methods and provide a precise overview of operation. Some methods were evaluated by communicating with the companies manufacturing them. Then, with the assistance of the President of Indian Lake Watershed Association, I learned about the techniques already implemented on Indian Lake and its surroundings. I then created a table of variables to relate each method to different factors for a higher-quality comparison. Eventually, my goal is to recommend the best management plan to implement on the lake to lessen the impact of nuisance geese population.

1. INTRODUCTION

Canadian geese are a natural resource that provide recreation and enjoyment to bird watchers, hunters, and the public throughout. However, they create a nuisance in our public parks and their surroundings. Geese can damage the property, compromise the overall quality of life, and have the potential to pose serious health threats due to the presence of disease-causing organisms in their droppings. Indian Lake suffers from a growing population of geese that have become one of the factors promoting high levels of cyanobacteria. This has resulted in the closing of the lake several times and the prevention of all sort of activities related to humans, dogs, and other animals.

Long-term solutions to geese problems are complex and often difficult to fully implement but will cause reduction in damage. There are many effective non-lethal techniques, including hazing methods, visual deterrents, chemical repellents and more. There are also lethal techniques like hunting, egg addling, and euthanasia. The challenge is that geese are prolific and adaptable. Using the same method will only make it less effective over time. Also, using only non-lethal techniques will essentially move the problem from one area to another. At Indian Lake, hunting is prohibited and until today, geese problems are still recurring.

In this project, I am going to provide methods of recommendations to control geese at Indian Lake that would benefit both the residents near the lake and the lake itself. The methods will be evaluated by various steps involving the YMCA, the person in charge of the City of Worcester's geese program, and the Indian Lake Watershed Association. The strategies provided are compared to several variables that would enable us to determine the best implementation to reach a specific goal.

2. BACKGROUND

Canadian geese are considered a nuisance in many communities. In the 1960s, after wildlife managers captured Canadian geese, they bred them and relocated them throughout the U.S. The geese settled in cities and suburbs where there is a presence of ponds, lawns, and parks. By the mid-1980s, the growth of their population reached a point where the authorities called for killing them (Solving Problems with Canada Geese, n.d.).

Migratory Canadian geese are not the same as resident geese. Migratory geese nest in Canada and will not migrate. Resident geese generally fly no more than 100-200 miles to find food and safety. Geese live about 20 years, start to nest after about three years, and lay on average five eggs each year. They have a very strong tendency to return to where they were born to nest. Left unchecked, their population will double every five years. While feeding, geese defecate every seven minutes. Each goose produces one to three pounds of waste per day. In addition to phosphorous, goose waste contributes pathogens such as e-coli and bacteria that cause swimmer's itch, as well as giardia, cryptosporidium, and campylobacter. Studies show that waterfowl can produce 25% to 34% of the total phosphorous budget in a watershed. Phosphorus is a natural element and an essential nutrient to plant growth, but it is only found in small amounts in lakes and streams. Geese are also one vector for the spread of invasive plants such as milfoil and water chestnut (Geese, Three Lakes Council).

A small increase in phosphorus to these waterbodies can have a devastating impact on water quality. It can cause a dangerous form of pollution known as eutrophication that overstimulates the growth of algae, phytoplankton, and simple plants in lakes. When these organisms die and decay, they deplete oxygen levels, creating ‘dead zones’ of hypoxic, or oxygen poor, water. Few aquatic animals can survive in these conditions, which poses a huge threat to biodiversity in aquatic ecosystems.

3. METHODOLOGY

Throughout the research made about different methods to prevent geese damage, it is noticeable that talking about controlling the damage is very easy in the short term. However, producing the necessary efforts on a long-term basis is challenging. If the effort is minimal, there will be no change in the damage, and the money and time spent will be wasted. Canadian geese migrate from one area to another contaminating the environment. Therefore, working on one area will not give the preferred outcome. It is best to always work with neighboring communities.

Based on the knowledge acquired from reading research papers, evaluating the cities currently dealing with the geese population and their management plans, my next step was to research all the different methods used to prevent the growth of geese population. Then, I connected with the companies supplying equipment to regulate geese nuisance. I was able to contact various sellers asking them the following:

- What is the story behind your invention?
- How does it work?
- Where would it be best applied? Near the pond or in residential areas?
- The amount of area it covers.
- Is it waterproof or weatherproof?
- Does the system require power?

Later, I communicated with Beth Proko, the President of Indian Lake Watershed association. The association contributes to the community by protecting the lake, preserving the environmental quality, and leading the community members to reduce the damage of Canada geese.

Following, I produced a table of variables stating the differences of each method and the best ways to apply them.

- Effectiveness: certain methods' effectiveness reduces due to the geese's ability of adapting to their certain patterns. Other methods are more effective when they are unpredictable.

- Cost: the cost is also an important factor. For example, several methods are expensive and deliver a high level of effectiveness, while others might provide the same level of effectiveness with a better cost.
- Maintenance: some products consist of continuous maintenance, protection and cleanup and some products will not require regular maintenance.
- Durability: durability relates to maintenance. If the product is not well maintained, it would fail to do the intended task. Hence, its durability will decrease. Also, some products would get effected by the harsh weather, causing their material to deteriorate.
- Moved regularly: geese adapt to the pattern of the tactic implemented if it remains performing the same tasks at a specific location. One way to prevent this, is to regularly move the product to different locations.
- Practical in residential: shows which methods are more effective employed near the houses.
- Practical near pond: shows which methods are more effective employed near the lake.
- Aesthetically pleasing: some methods will not please the sight or the hearing.
- Labor: various methods are applied or regularly maintained by professionals which will require a high labor. Other methods can be bought and applied easily without any assistance.
- More effective if: few methods would be more effective with the intervention of human efforts or combined with other methods of management.

Eventually, all the information procured from the previous steps helped gain a better understanding of which methods are best implemented on the lake that would benefit both the residents and the lake itself.

4. RESULTS

4.1 SEASONS FOR CANADA GEESE

To begin with, after learning about geese and understanding Seasons for Canada Geese table, I concluded:

- From December to march: a great time to develop a plan and identify nesting sites.
- From February to March: train volunteers to addle (details about the methods will be shown)
- From late March and April to early May: time to locate nests and addle.
- From mid-May to midsummer: Harass the adult geese. (harassment methods will be introduced)
- From late June to August: geese are molting. No harassment (Repellents may be effective).
- In Fall: begin harassment if needed.
- From February to March: if harassment resumed in fall, stop it while geese establish nest sites. Harassing geese away from nest sites can result in goslings hatched nearby who contribute to the overall population and interfere with pre-molt harassment.

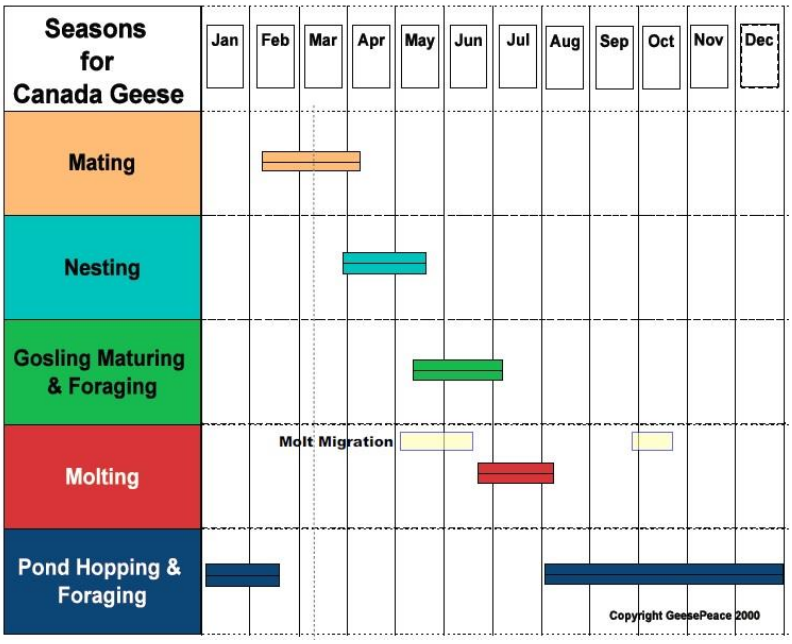

Table 1: timeline above is commonly used to control geese damage.

4.2 CONTROL METHODS:

Researching the different methods used to reduce goose damage, it was best to place the methods encountered in five categories:

- Habitat modification
- Exclusion
- Harassment
- Chemical repellants
- Lethal control

Habitat Modification	**Exclusion**	**Harassment**	**Chemical Repellants**	**Lethal Control**
Stop feeding	Girds	Dogs	Methyl Anthranilate	Hunting
Domestic waterfowl	Fencing	Lasers	Anthraquinone	Egg - Addling Program
Ponds and Creeks	Mylar tape	Exploders		Capture and Euthanasia
Grass and Plants		Flagging and Balloons		
Water		Lawn Sprinklers		
		Controlled Boats		

Table 2: different methods of geese control.

HABITAT MODIFICATION

Discontinue feeding:

Many people enjoy feeding geese whether it is in the parks, beaches, or private properties. This contributes to many problems that people should be aware of. First, whenever we try to feed one goose, we realize that it causes large number of geese to congregate to the specific area. A well-fed goose will act as a decoy and attracts other birds to that location, which will eventually lead to a greater mess. Second, by feeding the waterfowl, they start to become unafraid of humans and aggressive towards them. Therefore, the control measures used will become less effective. Third, Canada geese find nutritionally appropriate food for themselves

even in severe weather. They do not need human food. Whenever they are fed inappropriate diet, the geese are prone to develop a wing deformity called angel wing along with many other health issues. This causes them to become flightless. Fourth, once they adapt to human food and it gets suddenly discontinued, geese will revert to higher quality natural foods.

Other domestic waterfowl:

It is preferred to remove domestic waterfowl such as mute swans. They are capable of attracting geese to the area they are residing in.

Ponds and Creeks:

Canada geese prefer short grass and water. Whenever they are near ponds, it is easily for them to walk into and out of the water to feed. If we limit their access to the water, they will choose to leave and reside somewhere else. This can happen by steepening the shoreline, building a seawall 3 feet above the surface of the water. However, to make it more effective, it is required to allow vegetation to grow tall along this slope which will protect it from erosion and prevent the geese to get out of the water. Riprap is also mentioned to be effective on steeper slopes.

Mowing:

Studies shows that frequently mowed and fertilized grass is an excellent source of proteins and carbohydrates for geese. Geese will feel safe when the grass is short, they can easily watch the predators from distance. However, they will feel threatened if we let the grass grow about 20 feet from pond shorelines and decide to leave to safer location. The grass should be 10 to 14 inches tall to scare the geese away.

Plants:

Geese prefer specific type of plants and dislike others (Table 3). Growing these not preferred plants around the pond will prevent geese from approaching. It is recommended that a twenty or thirty-foot-wide strip maintained around the pond.

Preferred plants:	**Not preferred plants:**
Kentucky bluegrass	Mature tall fescue
Brome grass	Periwinkle
Canary grass	Myrtle
Colonial bent grass	Pachysandra
Perennial ryegrass	English ivy
Quack grass	Hosta or plantain lily
Red fescue	Ground juniper and Switch grass

Table3: states the geese preferred and not preferred types of plants.

Water:

Allowing water to freeze will discourage the geese from staying and will encourage them to migrate to find better water sources. However, geese will stay in the water even when the temperature is below its freezing point which will prevent the water to freeze. Therefore, some harassment techniques need to be employed to scare the geese for a lengthy amount of time.

EXCLUSION

Grids:

Grids are used to keep the geese off the ponds and lakes. It is required to keep the wires 12 to 18 inches above the water. One source stated that “Grids can be made of single strands of #14 wire or 80 to 100-pound monofilament line arranged in 10 to 15-foot squares’ . Note that grids are less effective on ducks.

Fences:

As we mentioned before, geese prefer water and adjacent grassy areas near them. Also, geese are flightless during summertime. Fencing should occur before the flightless period and should completely enclose the area to treat. There should not be any available entrance for geese. It is provided to let the fences be at least 30 inches tall and steadily constructed. Plus, to make the fencing quite aesthetically pleasing, place boxwood hedges or large rocks.

The most preferred fences to detract geese are stated:

- Chicken wire (2" x 2" mesh) - very durable.
- welded wire fencing (2" x 4" mesh) – very durable.

- Nylon fencing – light weight, nearly invisible but need to be replaced often.
- Low voltage electric fencing.
- Two parallel monofilament fish lines. “twenty-pound test strung six inches and twelve inches above ground level and secured by strong stakes of six-foot intervals “. Note that these need to be secured properly and regularly checked due to reported bird mortality.

Mylar tape:

Mylar tape is half inch wide, red on one side and shiny on the other. It is an effective method to scare away geese because of its following characteristics:

- It reflects sunlight and produce a flashing effect.
- It produces a loud noise when the wind stretches it.

The tape is used as a fence near the shoreline. We need to make sure that the tape would rotate when the wind hits so it can both reflect light and create the noise. Therefore, it is preferred to leave some looseness in the tape and twist the material as we string it from one side to another.

HARRASSMENT

Dogs:

Dogs are considered one of the most powerful methods to alert the geese and scare them away. Some businesses use highly trained border collies. Border collies are considered the breed of choice for geese. They are athletic, obedient, and easy to train. Because of their high intelligence and eagerness to please, they strongly respond to commands. They quietly stalk and then pursue the geese until they flee the spot. Because of the way they move and their wolf-like appearance, the geese perceive them as a predator and a threat. Plus, geese encounter humans and their pet dogs mostly everywhere they migrate and learn to stay away for them. It is legal to chase geese without a state or federal permit if the geese are not touched or harmed. The dog chasing method needs to be actively and regularly continued. When the geese move from grassy areas to the pond, it is also required to use other harassment methods in the water bodies to warn the geese that it is not safe. A full evaluation and development plan need to take place to address all the possible conflicts. It is a daily intense period of chasing and the process may take several weeks or months. During molt season or when goslings are present, dogs should not be used.

This method has proven effective. However, it is often expensive and labor intensive. Fees range from $500 to $2,800 per month, depending on a property's size, location, water features and ease of access

Lasers:

Lasers are a silent, humane, and environmentally friendly way to remove geese from a pond or a field. They perceive them as a threat as the light moves towards them. To avoid getting hit by the laser beams, they fly away. After repeated use, the geese will become aware of the threat and would avoid the area. Unlike decoys and loud noises, the geese would not become accustomed to the presence of lasers. Lasers are not safe if pointed directly at people, roads, or aircrafts. They are effective from sunset through dawn. They are expensive and range from $1,000 and up. Through my research, I came across a company that invented a flashing light called "Away with Geese".

Away with Geese:

Tom Wells, the inventor of Away with Geese, was able to solidify a solution for geese problems that was both humane and extremely effective. Geese carefully choose their location of hangout. At night, geese sleep in or near water areas where they feel secure from the predators. They tend to stay close to their secure areas during daylight hours to minimize the distance they travel each day.

Tom invented a flashing light that aggravates the sleeping pattern of the geese. It is a solar-powered light that is barely noticeable to humans but is very disruptive to the sleep of the geese. They will force them to choose another location to sleep in. The light charges each day and flash 360 degrees, every two seconds from dusk to dawn, at eye-level of the geese. The product requires no maintenance and the durable ABS plastic of their bases will withstand any weather conditions. It is environmentally friendly and humane. Each unit covers a 75-yard radius and there is a unit for every type of landscape.

The residential unit is designed for private lawns, fields, and gardens. It is easily installed and moved, if desired. The industrial unit is designed for public area such as athletic field, industrial area, and parks. It contains a steel auger that twists into the ground to avert theft.

The water unit, designed for ponds, lakes, retention areas and any waterway. It does not tip or gets affected by the elements in the water. It can stay in the water year-around.

The dock unit is designed for docks where geese congregate and to control geese on the land and water immediately around the dock. It can be easily taken on and off.

The roof unit is designed for flat rooftops of commercial buildings. It is a wide and weighted base that keep the light in its place without penetrating the roof.

The industrial cage is designed for locations where a person abusing the unit is of concern. It is a heavy-duty steel cage that protects the unit. The product's success rate is stated to be 97%.

After engaging with the company to understand more about their product, they provided me with some interesting information:

- The company uses Google Earth. They take a snapshot if the problem area, measure it and recommend the unit model, quantity, and their most effective placement. The recommendation is free of charge.
- The light automatically recharge itself in sunlight and will keep its charge for up to six days without sunlight.
- Mother geese will not forsake their gosling under any circumstances. However, after thirteen to fourteen weeks the goslings are weaned of their mother and capable of flight. At the point, the product will influence both the mother and the developed goslings.
- The light will not bother other birds.

Therefore, I was able to request a placement study for Indian Lake property and I have received the following:

- The picture below shows the amount of water units we need to cover all the lake and the location of each unit.
- The company quoted the below property with nine AWG Water Units. The grand total came up to $3,411.

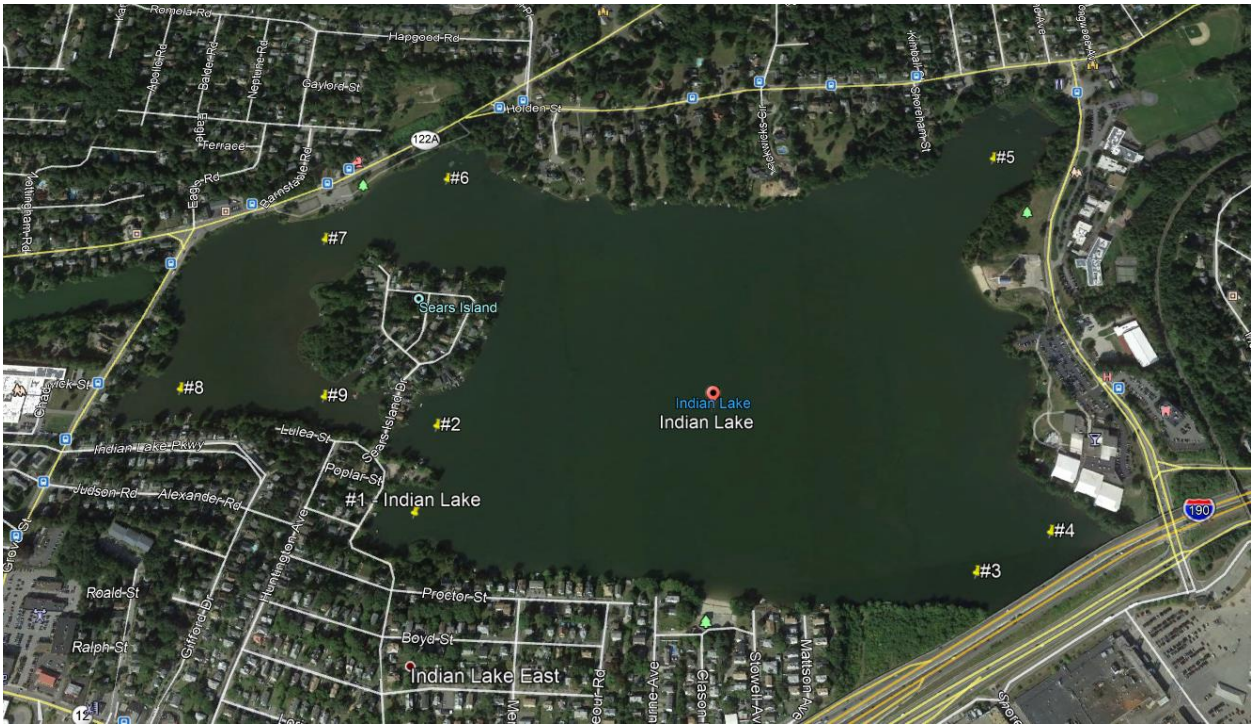

Figure 1*: Away with Geese placement study for Indian Lake.*

Exploders:

They are machines that produce loud explosions that frighten geese. They may be disturbing to human neighbors and they work best when used along with other techniques such as flagging or balloons. Propane cannon are the most known automatic exploders. They are more effective if multiple cannons are used and moved regularly every three to five days. They should be set at different intervals because the length of time between explosions is constantly changing. Pyrotechnics like whistlers, noise bombs, shellcrackers, etc. are also ignited to create loud noise. Those methods may require a permit since there is some fire hazard. They are not practical in residential settings and they are best placed when people are not present.

Flagging and Balloons:

Objects that move in the wind can scare away geese. However, geese tend to remain in their location when there are objects hovering above them. In this case, flags and balloons require a high length when they are placed. Large colored balloons filled with helium, preferably containing a graphic on them of a predator, would keep the geese away. Obviously, to cover a large area of open lawn, numerous balloons and flags need to be employed. Plus, periodic relocation is recommended.

Goose Cop:

The “Goose Cop” is an inflatable design that is proven to be effective in controlling geese problems.

Jack O’Shea, the inventor of the “Goose Cop”, encountered the geese problem in his Michigan lake home. Geese always left a mess behind which creates health hazards from the residual fecal matter that posed a threat to the kids and pets. He experimented with motion and microwave radar sensors along with light beam fences. He created a wireless motion technology that activates when geese are detected.

“Unpredictable random undulations, reflective hair, crazy eyes, mean looking scowl, internal lightning like effect of the strobe light combine with the noise of the fan make the Goose Cop a truly effective goose deterrent”. Thus, geese will not be able to adapt to a certain pattern, and the sound of the device inflating can mimic hissing or predatory warning signs.

It is an inflatable design that will operates when geese or other wildlife are detected. It uses motion activation to sense when there are unwanted geese. It spots them up to 100x50 ft per sensor and it immediately inflates for five minutes. This will also save on costs being inactive.

The Goose Cop is mostly effective for the dock, shoreline, or garden property. It is easy to set up which reduces hassle. Plus, it is weatherproof and would stay intact through inclement weather. It has adjustable sensitivity and runtimes.

Up to eight sensors can be bought to increase effective area for added protection. This will reach up to 500 ft of covered area. It is not a cheap product but also not too expensive in comparison with its effective technology.

Important questions asked and answered:

- Its overall height is a little over seven feet.
- It must be plugged into ground fault interrupter protected circuit. It would pose an electrocution hazard to swimmers if it were to fall into water.
- Though the unit is made with non-conductive materials and is suitable for damp and rainy conditions
- An optional motion sensor dock is offered if shore-based sensors are out of range.

- Soon, they will offer a low voltage model for use on docks and piers.
- It is not waterproof and should not be placed in the direct path of sprinkler systems.
- An Owner's Manual is available with full description about the system and its safety measures.

I was able to get in contact with Jack O'Shea, the creator of the Goose Cop. After gathering all the information that he gladly provided, he was generous enough to offer a Goose Cop.

Lawn Sprinklers:

Using lawn sprinklers can be effective in small areas. The noise created by the sprinklers and the water sprayed would frighten the geese from using the lawn.

Remote-controlled boats:

It is recommended for small ponds and it can be effective to repel geese. However, it needs to be used on a regular basis and controlled by a specific person who is willing to help and protect the pond. One of the most effective remote-controlled boats I came across was the "Goosinator".

Goosinator:

Mike and Randy, the creators of the Goosinator, worked on a tool that would last for years and do nothing but scare the geese off. They developed it in a way that everybody could run it. One of the bird's main characteristic is that they can see colors very well. It is why this product's color is orange, silver and yellow causing a lasting impression on the migratory birds.

The Goosinator is a remote-controlled, space aged design. Its characteristics were researched by Cornell University. It acts like a predator that is stalking the geese and scaring them to get them flying. The Goosinator runs on all types of surfaces and it can keep the lake or pond clean and free.

The research studies concluded that a combination of a Border Collie and remote-control boat was the most effective eliminating over 90% of the geese. The Goosinator is a combination of both and can also go on ice and snow.

It is important to really start to chase them after the molting season starting August. Following the recommended program, they offer, it can keep the geese away and cut down on massive amount of costs.

They offer Goosinator decoys, but like any other decoys, they need to be moved daily. Plus, it is important to use the decoys after one to two weeks after putting the Goosinator in action. I was able to get in contact with Randy and he explained the following:

- The difference between trained dogs and the Goosinator is that the dog service usually cost $300-$500 per week which is more in a month that the initial price of the Goosinator.
- Using dog service must be done continuously from several months which is expensive.
- The yearly maintenance for the Goosinator is $300 or less.
- Dogs can't go in cold water and can't go on thin ice while the Goosinator can do both.
- Repellents always have ongoing costs of reapplying the extract, the retardant for the grass plus the labor-hour to finish the job.
- In most states, there are numbers of rules and regulations to follow and money spent to be capable of capturing geese

"The Goosinator is very effective but It's got a propeller on the front and it could really hurt the geese. Plus, someone has to be available to manage it." Goose Cop creator Jack O'Shea.

CHEMICAL REPELLENTS

The number of chemical repellents for wildlife management is limited. In the USA, only two registered chemical bird repellents are available. Methyl Anthranilate and anthraquinone

The use of chemical products does not guarantee success if not used in a management plan. The drawback is that its effect does not last for a long time and there is the need for repeated applications. Plus, they come at high cost specially when we need to cover large area. They should be applied every five days.

They are preferred by homeowners and they are not dangerous to geese. Both the chemicals that we will be talking about are naturally occurring without hazardous residue and they are not washed off by rain.

Starting off with Methyl Anthranilate, it works through affecting the taste of the grass, so the geese will not eat it. Its disadvantage is that it produces an unpleasant odor. Most used and

known product containing this chemical is Avian Migrate™ Goose and Bird Repellent. It does not harm humans nor animals nor vegetation. It also contains a technology that uses a special colorant, visible only to birds, to notice that the area has been treated. Unfortunately, this product received more bad reviews than good. It is most practical and cost-effective for homeowners with only small areas to cover.

Second, Anthraquinone, targets digestion causing stomach discomfort and cause the grass to appear unnatural and uninviting due to the presence of ultraviolet spectrum scaring the birds away. Several studies have indicated the Flight Control Deterrent to be very effective.

Goose will eat up to 3lbs of grass in one day and leave up to 2 lbs. of droppings. When geese eat the grass treated with Flight Control deterrent, they experience a strong, but harmless, digestive irritation. The ultraviolet marker will make the geese notice that the area is treated and will learn to stay away from it. Flight Control advantages:

- No odor
- Undetectable by people
- Works 24/7 at repelling geese
- No harm to pets, people, or environment.
- Affordable
- Provides step-by step application/instructions
- Works on small properties (homeowner kit) and ponds.

Flight Control disadvantages:

- Needs to be reapplied after 2-3 mowing cycles. However, adding a growth regulator can keep the grass from growing as rapidly.

LETHAL CONTROL

Hunting:

Hunting geese is the most effective and preferred management tool and it would reduce nuisance problems. However, geese problems mostly occur in suburban and urban areas which makes it difficult because of city limits. Hunting in Massachusetts is allowed, and it requires licenses and permits for Massachusetts residents and non-residents. Hunting should be

encouraged. It limits the growth of resident goose flocks and discourages others from returning to the area. It also increases the effectiveness of management tools containing loud noises. Referring to Massachusetts fishing and hunting regulations and season dates catalog, Worcester is in the Central Zone where Late Canada Goose can be hunted during specific times of the year (Jan 18 – Feb 15). The catalog also includes all the regulations to follow for a legal hunting. By looking at Mass Wildlife Lands Viewer, we can check the areas where hunting is permitted along a description of the variety of species it includes.

Egg-Addling Program:

A wildlife management method to control the population of the geese. It requires long-term commitment to have a significant impact. Geese return to nest where they hatched. The method will prevent geese from nesting at the given site in the future which will convince them to leave. Addling means "loss of development", it commonly refers to any process by which an egg ceases to be viable. "Anyone seeking to addle the eggs of any bird is responsible for complying with all applicable laws and regulations including registering with appropriate agencies and obtaining any necessary permits before proceeding**".**

For an addling program to be successful, it is essential to understand:

1) The species biology
2) Nesting chronology
3) Locating nests
4) The egg development
5) How to approach the nest
6) Marking and recoding the nest site
7) Fending geese off nests
8) Marking eggs and data collection
9) Determining incubation
10) Determining egg age
11) Addling procedures
12) Revisiting nests and sites
13) Cautions for operators

14) Record keeping and reporting
15) Public education

The advantages of the egg-addling program are that public attitudes may prohibit conventional control methods such as hunting from being implemented. The public may accept nest and egg destruction as opposed to lethal techniques.

However, the disadvantages of the program are that it requires large amount of time, personnel, and continued annual expenditures for permits and processing fees. It is labor intensive, expensive, and controversial.

Capture and euthanasia:

It is illegal in Massachusetts to catch and euthanize geese. The method, however, has been used in the United States where they would capture geese in their molting season and send their meat to local food banks. Some states facing overpopulation of geese applied this method after all nonlethal methods have been exhausted.

4.3 WORKING WITH BETH PROKO

Throughout my research, I was communicating with Beth Proko, Indian Lake Watershed Association's President. Her cooperation was greatly appreciated. She introduced me to Mike Berberian and informed me about the YMCA. She mentioned that the lake association has not employed any methods. However, volunteers have assisted in locating nests for the city's egg addling program. She also guided me through how to deliver my project and the important points to discuss.

The city of Worcester helps with controlling the geese throughout a program called Worcester Canada Geese Program. I was able to get in contact with the person who is in charge with the program, Michael Berberian. He provided that, they used two methods of control at Indian Lake, the egg addling, and the goose-herding dogs. He mentioned that they recently located a nest. Using the egg addling technique, the nest was no longer present. The use of the dogs has been successful as well. However, the use of two methods only at the lake would not contribute to long-term results.

In my meeting with the assistant director of the YMCA, I had the opportunity to visit the site where most geese are attracted to, which is the lawn space and the shoreline behind the building. They use the lawn for kids to camp and enjoy the splash pad. However, I have noticed a massive amount of geese droppings on the lawn. Plus, they have used fake swans to scare away geese which is one of the least effective method of control. Also, I have noticed a built-up fence around a small area of the shoreline. Unfortunately, as we seen before, the fence only works by enclosing the whole area specified preventing the geese to enter. The assistant mentioned that they have used “Liquid Fence” goose repellent and stated that they had a temporary success. He mentioned that the product washes away with rain and it had to be reapplied. The product contains methyl anthranilate, it is indicated that the chemical will not wash off after rain if allowed to dry first. Nevertheless, it is mentioned that heavy rains may wash off the product during the night following the initial spray. I had the chance to offer the “Goose Cop” sent to me for testing. There are no geese present at this time, but the assistant will gladly send me updates and footage of the “Goose Cop” in action recording the success or failure of the product.

4.4 TABLE OF VARIABLES

The previously stated methods of management are presented in the table below and evaluated compared to significant variables. Effectiveness, cost, maintenance, and durability are rated on a scale of five. Moved regularly, practical in residential, practical near pond, and aesthetically pleasing are assessed with yes/maybe/no. Labor is estimated by low/medium/high.

Variables / **Methods**	Effectiveness	Cost	Maintenance	Durability	Moved regularly	Practical in residential	Practical near pond	Aesthetically pleasing	Labor
Discontinue feeding	5	0	5	5	no	yes	yes	yes	low
Ponds and creeks	3	2	4	3	no	yes	yes	maybe	Medium
Mowing	3	1	3	1	no	yes	yes	yes	Medium /low
Plants	3	3	3	3	no	yes	yes	yes	Medium
Water	2	1	1	3	no	yes	yes	maybe	Low
Grids	2	2	1	4	no	no	yes	no	Low
Fences	2	2	1	4	no	no	yes	no	Low
Mylar tape	2	2	4	1	no	yes	yes	no	low
Dogs	4	5	4	4	no	no	yes	yes	High
Lasers	3	4	2	3	no	maybe	yes	maybe	low
Away with Geese	4	4	1	4	no	no	yes	yes	low
Exploders	2	3	2	2	yes	no	yes	no	Medium
Flagging and balloons	2	3	3	2	no	no	yes	maybe	medium
Goose Cop	4	3	2	4	no	yes	yes	maybe	Low
Lawn sprinklers	2	2	2	3	no	yes	yes	yes	low
Remote-controlled boats	3	3	3	3	yes	no	yes	maybe	Medium
Goosinator	4	5	3	4	yes	no	yes	maybe	Medium
Anthraquinone repellents	4	3	2	3	no	yes	yes	yes	Medium /low
Methyl Anthranilate repellents	3	3	4	2	no	yes	yes	yes	Medium /low
Hunting	5	4	3	4	no	no	no	no	high
Egg-Addling	4	5	4	4	no	yes	yes	no	high
Capture and euthanasia	4	5	4	4	yes	no	no	no	high

Table 4: Table of variables for geese control methods.

5-CONCLUSIONS AND RECOMMENDATIONS

Implementing program management at Indian Lake requires more than studying and delivering various methods of effectiveness. One valuable component to ensure the success of a management plan is simply a well-established professional team, working together to overcome all the challenges that the geese provoke. Dealing with Canadian Geese is a long-term continuous effort. Essentially, studying their behavior in the area they populate is ideally the first step to encounter. Subsequently, team members would establish sections in that area to examine and provide the best methods of implementation. Furthermore, when working with neighboring communities, it is critical to take into consideration their assessment of any procedures available. Plus, communities must be well-educated about the reasons why feeding geese is prohibited. Public education programs for anti-feeding the geese should be put in place to provide awareness. A law should be enforced, and a sufficient penalty would be required to deter the activity. Also, signs and flyers are always important and effective.

After having the opportunity to work with Beth Proko, Christina Puleo, and Michael Berberian, I have evaluated two areas of study. One, the lawn area at the YMCA near Indian Lake and second, the lake in general. It is suggested for the YMCA to build a fence completely enclosing the treated area. Chemical repellents, recommending Flight Control deterrent, would provide remarkable results if managed correctly. If the Goose Cop presented produces an effective outcome, it is preferred to be used on the lawn area restricting access to kids when present. It also should not be in direct contact of sprinkle systems nor near the water. The grass should grow especially along shorelines and fertilization should be limited. For residents near the pond, the same methods previously stated are also recommended. As to the lake itself, Michael Berberian provides an effective egg-addling program and the use of goose-herding dogs. Both these methods are greatly effective. However, it is very recommended to use Flight Control deterrent on the lawn area of the lake. Also, Away with Geese management method is efficient, durable, low in maintenance and labor, but costly. It would scare away geese from approaching the watershed which will decrease the amount of geese waste in the water. To add up, growing plants disliked by the geese around the pond prevents the geese from traveling from the watershed to the shore and vice versa. The Goosinator is efficient but very expensive and require extended operation. I personally would not recommend the method due to its high cost, high labor, and uncertain success. Fences, grids and mylar tape are also an option around the pond.

Moreover, hunting is the essential factor in the decline of geese population. If allowed in distinct places, hunting is the most effective method for removing geese but not the most preferred way.

To sum up, conflicts between people and Canada geese can be resolved with persisted effort, patience, and well-organized management plans. Ultimately, towns need to cooperate to effectively reduce the urban goose population.

BIBLIOGRAPHY AND CITATIONS

Blackham, G. (2013, July 10). Goose Chase Methods for Effective Goose-Control [Web log post]. Retrieved from https://www.solitudelakemanagement.com/solitude-lake-management-blog/bid/321588/Goose-Chase-Methods-for-Effective-Goose-Control

Canada Goose Control with Trained Border Collie Goose Dogs. (n.d.). Retrieved May 12, 2020, from http://goose-masters.com/

Controlling Conflicts with Resident Canada Geese in Maryland. (n.d.). Retrieved May 12, 2020, from https://dnr.maryland.gov/wildlife/Pages/plants_wildlife/ResGeeseProblem.aspx

Castelli, P. M., and S. E. Sleggs, 2000. Efficacy of border collies to control nuisance Canada geese. Wildlife Society Bulletin 28: 385-392.

Division of Fisheries and Wildlife. (n.d.). Retrieved May 12, 2020, from https://www.mass.gov/orgs/division-of-fisheries-and-wildlife

Federal Register. 2006. Migratory Bird Hunting and Permits; Regulations for Managing Resident Canada Goose Populations. Final Rule. Federal Register 71: 45964- 45993.

Goose Control. (n.d.). Retrieved May 12, 2020, from https://www.birdbgone.com/bird/goose-control/

Goose Cop: Geese Deterrent: United States. (n.d.). Retrieved May 12, 2020, from https://www.goosecopinc.com/

Goose Control: Denver, CO. (n.d.). Retrieved May 12, 2020, from https://goosinator.com/

Get rid of geese and keep geese away: Away With Geese goose deterrent. (n.d.). Retrieved May 12, 2020, from https://www.awaywithgeese.com/

"Geese." *Three Lakes Council*, www.threelakescouncil.org/plants-and-animals/geese/.

Geese Repellent: Goose Deterrent: How To Get Rid of Geese. (2020, February 12). Retrieved May 12, 2020, from https://flightcontrol.com/

Goose Repellent (Concentrate): Liquid Fence. (n.d.). Retrieved May 12, 2020, from https://www.liquidfence.com/Products/Goose-Control/Goose-Concentrate.aspx

Hower, J. (2012, July 28). Effects of Goose Poop on Your Pond [Web log post]. Retrieved from http://www.ohiogeesecontrol.com/the-effects-of-goose-droppings-on-your-pond/

Indian Lake Watershed Association. (n.d.). Retrieved May 12, 2020, from https://www.ilwa.org/

Pacific Flyway Council. 2016. Management plan for the emperor goose. Pacific Flyway Council, care of U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Vancouver, Washington. 36 pp

(n.d.). Retrieved May 12, 2020, from https://www.lakeaccess.org/urbangeese.html

n.d. *Solving Problems With Canada Geese*. [ebook] Washington: The Humane Society of The United States. Available at: <https://www.humanesociety.org/sites/default/files/docs/canada-goose-guide.pdf> [Accessed 12 May 2020].

T., & B. (2009, December). CANADA GOOSE MANAGEMENT PLAN For The BEND METRO PARK AND RECREATION DISTRICT [Web log post]. Retrieved from https://www.bendparksandrec.org/wp-content/uploads/2016/06/CANADA-GOOSE-MANAGEMENT-PLAN-2010.pdf