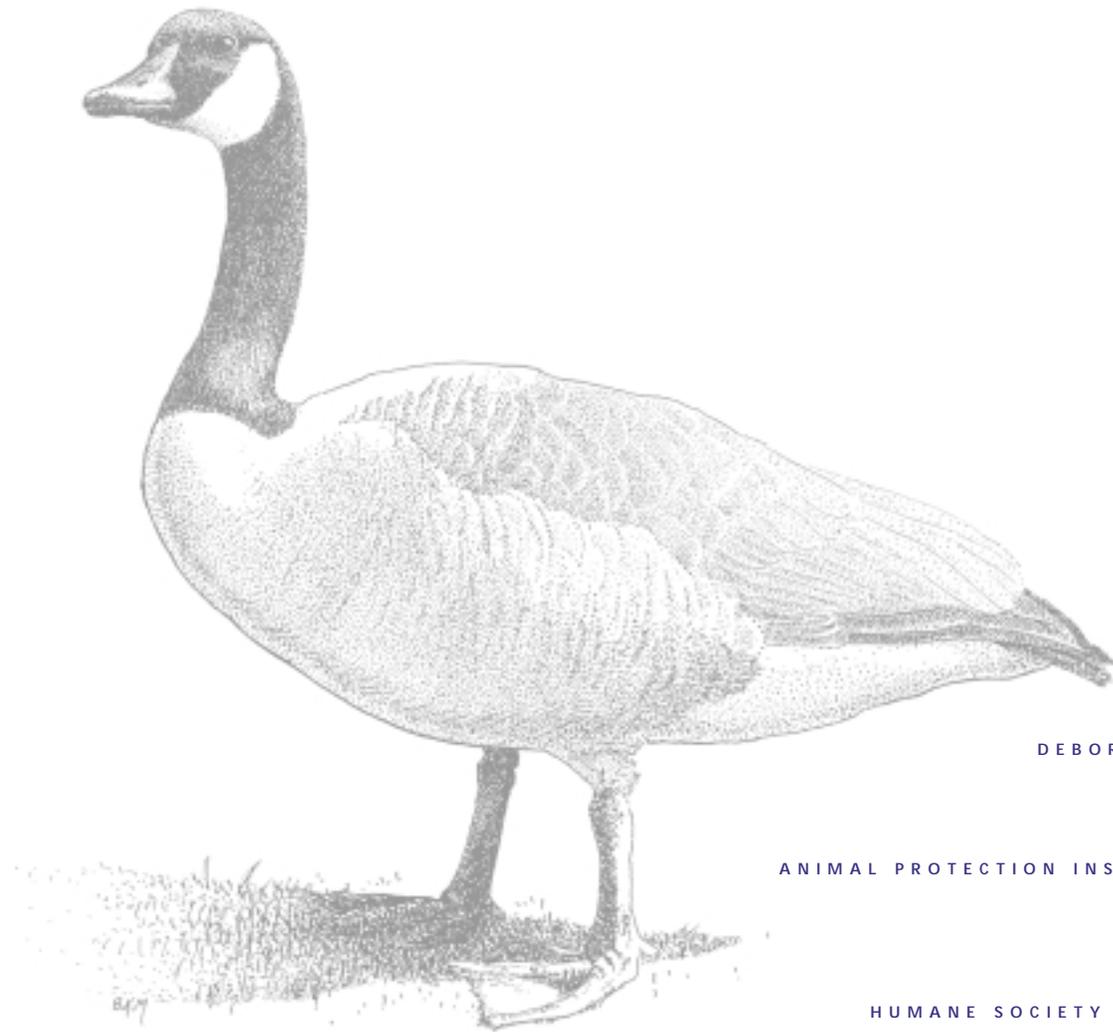


A S O U R C E B O O K

HABITAT MODIFICATION & CANADA GEESE

TECHNIQUES FOR MITIGATING HUMAN/GOOSE CONFLICTS
IN URBAN & SUBURBAN ENVIRONMENTS





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Purpose and Intent

The purpose of this manual is to provide parks and wildlife personnel, government officials as well as advocates of wildlife preservation and restoration ecology with information relating to the habitat needs and deterrents of Canada Geese in urban environments (particularly those environments along the Mississippi and Atlantic flyways).

The information in this manual has been compiled and developed by Dr. Jeff Keller (B.Sc., P.h.D. Wildlife Ecology), Deborah Doncaster (B.A., M.A., M.E.S. Wildlife Planning and Ecological Restoration in Urban Environments), and Getanjali Guill, (B.A., M.A. London School of Economics)

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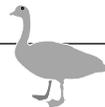
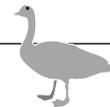


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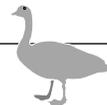
Purpose & Intent

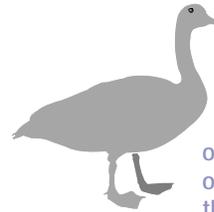
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Introduction

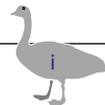
Canada goose populations have increasingly densified and localized in urban and suburban environments throughout North America. Attracted to open expanses of turf grass, preferably adjacent to a water-body, Canada geese and human beings often occupy public green spaces at similar times of the year. Many citizens enjoy the presence of geese in urban and suburban environments, although others do not. Habitat modification as a means of reducing human/goose conflicts works on a site specific basis. It offers a choice between eliminating the use of the site by geese altogether, and accommodating the geese in such a way as to not cause conflict. People who enjoy the geese can thereby visit sites where geese have a continued presence. People who would prefer to avoid geese can visit sites where goose presence has been eliminated or isolated to specific areas of a site.

Habitat modification through natural landscaping techniques offers both an ecological and humane means of reducing human/goose conflicts in urban and suburban environments. The benefits of habitat modification through natural landscaping for human and ecological communities are discussed in Section 6 of this source book.

The chronology of this source book is important to follow. The Landscape Design Principles (Section 1) provide an important context for reading through the Case Studies. The Case Studies (Section 2) show that habitat modification has worked in a variety of different settings. Accompanying each Case Study is a related reference pulled from the Annotated Bibliography (Section 7). The Do's & Dont's (Section 3) offer a summary of the lesson's which can be learned from the Design Principles, Case Studies and Bibliography. The Application of the Approach (Section 4) provides a process by which to determine the habitat modification needs and potential for a specific site. The Concept Plan (section 5) depicts a before scenerio of an actual park with human/goose conflicts and a hypothetical scenerio of the same park after the application of some modest habitat modification techniques.

Defining Habitat Modification

Habitat Modification means changing or altering the habitat, although the term does not suggest a specified amount of change. Within the context of managing habitat to control nuisance levels of Canada geese, however, it does not mean simply repairing existing features of a landscape. This amounts to treating the symptom rather than the cause. For example, reseeding an entire site with perennial rye grass to "fix" or "upgrade" the lawn denuded due to goose depredation will not solve the problem of goose depredation. Rather, to effect a change in the level of site use by geese it is necessary to replace portions of those features that are contributing to the problem initially. Thus, Habitat Modification with respect to Canada Geese in urban environments, means making one's site unattractive to geese by changing the habitat from goose friendly to goose unfriendly through modification of those features or the configuration of those features that attract geese.



Habitat Preferences: Implications for Urban Green Space

Evolutionarily, Canada geese are tundra nesters that prefer low vegetation adjacent to open water. From a landscape perspective, this arrangement of habitat components is exceedingly simple and lacks any significant vertical elements. The created landscapes typical of many parks, corporate campuses and golf courses (i.e., open water adjacent to mowed lawn) are human-made versions of these naturally occurring open, structurally simple landscapes.

In contrast, most naturally occurring ecotypes in the East and mid-West United States and Southern Ontario (i.e., landscapes with trees - forest cover, shrubs or meadow/prairie) provide unsuitable habitat for nesting and foraging Canada geese. Human-made landscapes are generally biologically depauperate/degraded because they are highly simplified. Viewed as potential wildlife habitat, the same attributes that make human-made landscapes so attractive to Canada geese render them unsuitable as habitat to all but a few other species. These landscape typically comprise:

A limited number of predominantly non-native (ornamental) plant species (e.g., turf grasses, scattered trees, and a few shrubs).

No well developed layers of vegetation (i.e., mowed lawn has no vertical dimension per se, trees are often widely scattered and lolly-pop in form, and shrubs are frequently absent or scattered).

Habitat components such as trees and shrubs arranged in regular rather than clumped or random distributions such as occur in nature.

“Hard” edges (i.e., sharp discontinuities) between adjacent habitat components or plant communities rather than the “soft” edges (i.e., exhibiting gradual transitions) typical of natural landscapes.

For example, consider the rip rap interface between a human-made lake and adjacent mowed lawn. Such a landscape exhibits all four attributes listed above and is favoured by geese but used by few, if any, other wildlife species. Contrast that shoreline with the emergent aquatic/shrub-scrub ecotone (edge) between a natural water-body and an undisturbed, terrestrial plant community. This type of interface is frequently among the most biologically diverse in nature and is entirely unsuitable to nuisance levels of Canada geese. Viewed in this holistic context, the resolution of human/ goose conflicts may provide an outstanding opportunity to increase overall biological diversity by naturalizing portions of human-made environments.

Habitat Modification and Ecological Restoration

Due to extensive urban and agricultural development, high quality natural communities cover minute percentages of land and water in many states and provinces in North America (for example, only .07% of Illinois' land and water, according to the Illinois

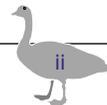
Natural Areas Inventory). As a result, many plants and animals have lost the habitats they need for survival. The consequence of this habitat loss for our urban and suburban green spaces is that rather than supporting a diversity of species, these simplified landscapes support large numbers of a few species. In addition to reducing biodiversity, the abundance of monolithic landscapes, characterized by intensively managed and manicured lawns with few, if any, trees and shrubs (“open space”), jeopardizes the integrity of our ecosystems. The fertilizers, pesticides, herbicides and hydrocarbon-driven lawn maintenance equipment further degrade the quality of the soil, water and air, affecting the health and well-being of humans and those non-human animals who have adapted to this environment.

Canada geese are a visible testament to the expanse of habitat simplification and environmental degradation in our urban environments. We cannot see greenhouse gas emissions (although we can see smog on a hot summer day), we cannot see the chemicals in our storm-water runoff, and we often don't see what we are missing, such as the diversity of species that once were a part of our ecosystems. But what we often do see are a large number of Canada geese. The geese provide a very visible indication of the environmental problems associated with the design and maintenance of our urban green space. Canada geese are not the problem, per se, rather, they are symptomatic of a broader/deeper problem - ecological degradation.

Habitat modification through ecological restoration provides a variety of desirable benefits:

- It can reduce or change the use of a landscape by Canada geese.
- It can reduce the excessive use of chemical fertilizers and pesticides.
- It can improve the soil, water and air quality of the immediate and surrounding environment and hence, the health of the human and nonhuman animals that live there.
- It can provide appropriate conditions for the re-establishment of native plant species and associated wildlife populations.
- It can provide increased opportunities for human enjoyment and interaction with the natural environment.

This source book attempts to provide habitat modification prescriptions that are ecologically based. The recommendations made, in terms of types of species and configuration of landscapes useful in mitigating human/goose conflicts, are intended to reflect an understanding of current approaches to ecological restoration. Hence, along with the primary objective of reducing human/goose conflicts, the habitat modification prescriptions made in this document have the added benefits of biodiversity enhancement, recreational diversification, beautification, CO2 reduction, smog reduction, and riparian rehabilitation.

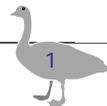


1

Landscape Principles to Decrease Habitat Suitability

Based on a literature review, discussions with numerous wildlife professionals and parks personnel, and the personal experience of the authors, we identified the following five (5) landscape principles that, among many landscape modification approaches, have demonstrated effectiveness in mediating human-geese conflicts:

- 1. Reduce sightlines at access points to and within foraging or nesting areas** As noted above, suitable goose habitat generally consists of large areas of low vegetation, typically grass, adjacent or close to open water, where sightlines are long and early predator detection and escape are facilitated. Reducing sightlines to the point where geese are uncomfortable (<9m) is the most general landscape principle that can be applied to reduce the attractiveness of an area to geese. Remember, THINK LIKE A GOOSE! For a goose, the critical question is, "Can a predator sneak up on me in this landscape?" Or, "am I perfectly safe here?"
- 2. Physically reduce /impede access to foraging areas via water or air** In some cases where sightline reduction is insufficient to deter use, it may be necessary to employ landscaping approaches that physically reduce access to areas attractive to geese.
- 3. Reduce actual size of foraging areas** In some cases where sightline reduction is insufficient to deter use, it may be necessary to employ landscaping approaches that actually reduce or eliminate the extent of areas attractive to geese.
- 4. Reduce forage palatability** Young grass shoots, particularly those of finer-bladed species such as Kentucky bluegrass, are the preferred food of geese. Any techniques that reduces the proportion or availability of young shoots of finely bladed species within a foraging area will reduce the attractiveness of that area to geese.
- 5. Provide preferred grazing areas** Geese not yet habituated to an area for nesting or grazing are more easily deterrable. Habitat modification and natural landscaping techniques in conjunction with harassment immediately before the nesting and/or molting season should help to ensure that a goose problem does not develop. Where geese are already habituated to an area, habitat modification techniques work best to mitigate human/goose conflicts through structural segregation. Providing areas of preferred habitat, for example, a well maintained, cut and fertilized expanse of Kentucky Blue grass near a body or segment of open water used for drinking and resting purposes can be effective in keeping the geese away from certain areas of a site.



Landscaping Techniques

The following landscape modification techniques can be used to implement the foregoing design principles. Although landscape modification costs are frequently high, they usually represent the best long-term value and the most permanent solution to human-goose conflicts.

Shoreline Treatments

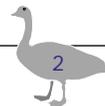
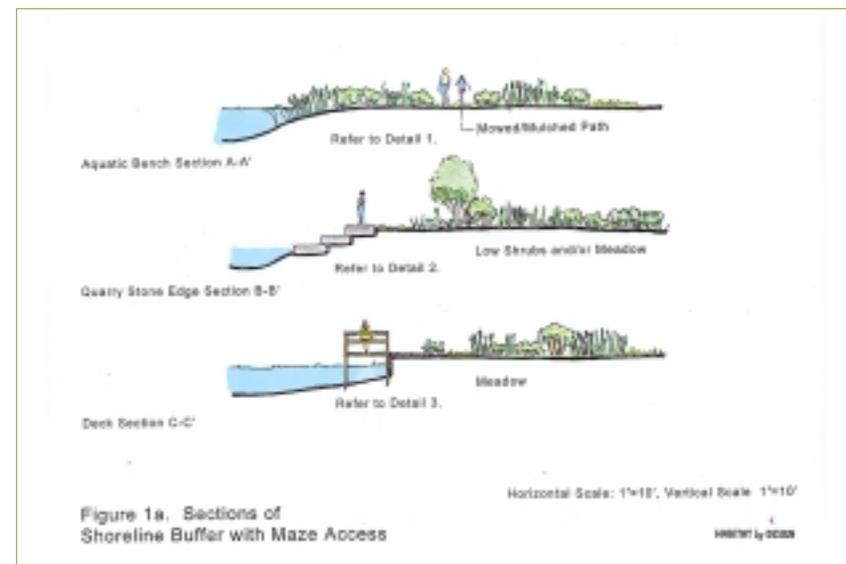
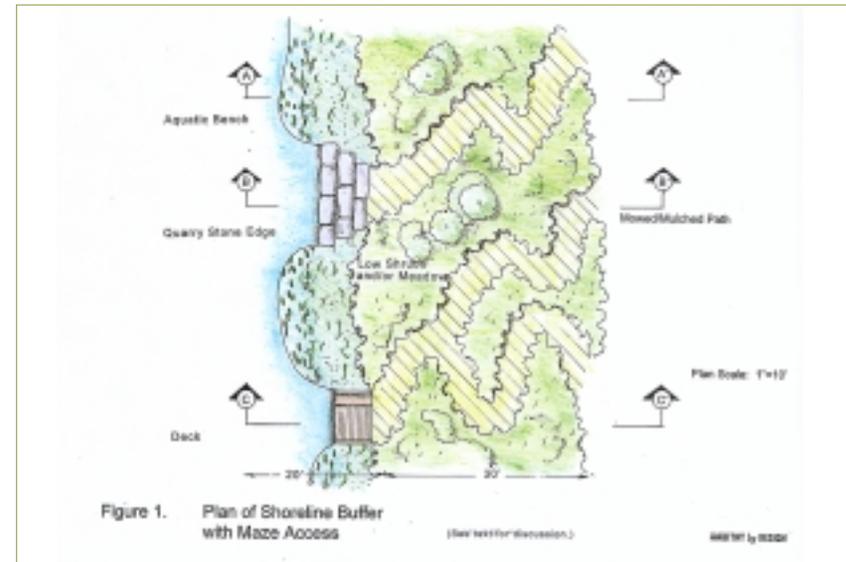
Geese often gain access to their preferred foraging habitat, mowed lawn, by simply hauling out onshore from the adjacent body of water on which they have landed. Therefore, it's logical to introduce habitat modifications along the shoreline that can be coupled with those on land. Shoreline treatments typically exhibit the first two principles described above. That is, they can both reduce sightlines and impede access.

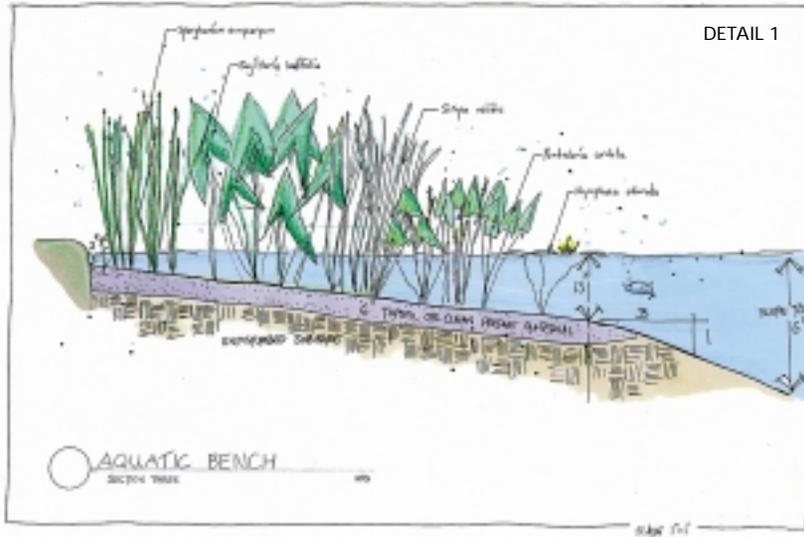
Aquatic Bench

The installation of aquatic emergent vegetation along the shoreline of a waterbody can create a physical as well as a visual barrier to geese. Aquatic benches are typically shallow immediately adjacent to the shoreline and should grade out to a depth of 12-15" before sloping more rapidly to deeper water (**Figs. 1 and 1a, Detail 1**). Wider benches (20-30') that include taller (> 30") material such as giant burreed (*Sparganium eurycarpum*) and river bulrush (*Scirpus fluviatilis*) are more effective than shorter plantings alone such as pickerelweed (*Pontedaria cordata*). It should be noted that aquatic plantings may not be sufficient without companion buffer plantings on the landward side of the shoreline.

Aquatic benches are highly favored by other species of wildlife such as wading birds and dabbling ducks, and provide excellent nursery habitat for fish. In addition, the selection of appropriate plants can provide a succession of attractive flowers throughout much of the growing season, while the lush vegetation conceals fluctuations in water levels and reduces shoreline erosion. Aquatic benches also serve as important filters for nutrient runoff typically generated by highly managed lawns. A list of some useful species native to the Great Lakes region and the eastern United States is included in **Appendix 5**.

If bathymetry (i.e., underwater contours) is currently inappropriate to support the installation of aquatic plantings, it may be possible to create appropriate grading. In manmade waterbodies, this is most easily accomplished by first identifying the required combination of cutting and filling to achieve a stable substrate on which to plant. The water level of the impoundment is then lowered to allow construction of





the aquatic bench and the water level is returned to its normal pool elevation. Along natural waterbodies construction of an aquatic bench can be more problematic.

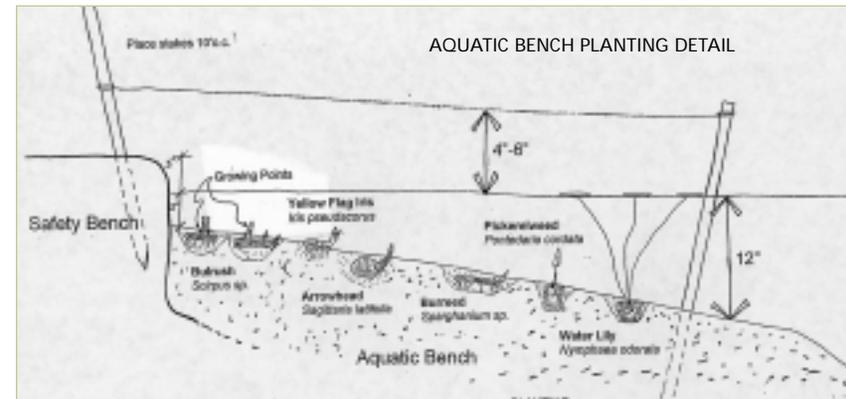
Here, it is frequently best to cut back the bank and do minimal filling to achieve appropriate grades. This is because manipulation of water levels may not be possible and attempts to create shallow areas by merely filling deeper water are more likely to create unstable, slump-prone substrates than useful planting zones. Regardless of the origin of the waterbody, if the shoreline is straight and uninterrupted for any distance, it is desirable to cut and/or fill during creation of the aquatic bench to create a more curvilinear edge that will further reduce sightlines for geese. Boulders also can be used for this purpose and may be less expensive to install than the earthmoving required to reduce the linearity shoreline.

Finally, in areas of established goose use, plantings should be protected during establishment by the installation of goose enclosure fences (see Aquatic Bench Planting Detail 4) Note: The enclosure depicted in the referenced detail is a simplified, one-layer version. Additional layers of string can be added at increasing heights depending on the anticipated level of goose intrusion and the areal extent of the plantings. The use of bare root cuttings is also recommended since, unlike potted plants, the entire vegetative structure is placed below the surface of the substrate at planting, thus making it less vulnerable to uprooting by geese and other waterfowl.

Aquatic benches, however, may be attractive to Muskrats if they are abundant in the areas. They can denude an aquatic bench and use a portion of the uneaten clippings to build their mound-like lodges. These lodges in turn can provide nesting sites for geese. In the more rural portions of suburbia, populations of natural predators such as mink may be sufficient to keep muskrats in check. However, another form of habitat modification (such as those below) may be more appropriate if muskrats are a concern.

Hard Edges (Rock Barriers, Decks and Boardwalks)

The aesthetics of lakes and ponds make them every bit as attractive to people as they are to geese. Thus, in parks or other human use areas, it is not desirable to create shoreline barriers that completely eliminate access to the water. The objective then becomes one of providing physical and visual access to the water for humans while simultaneously precluding access for geese. This can be accomplished in several ways.



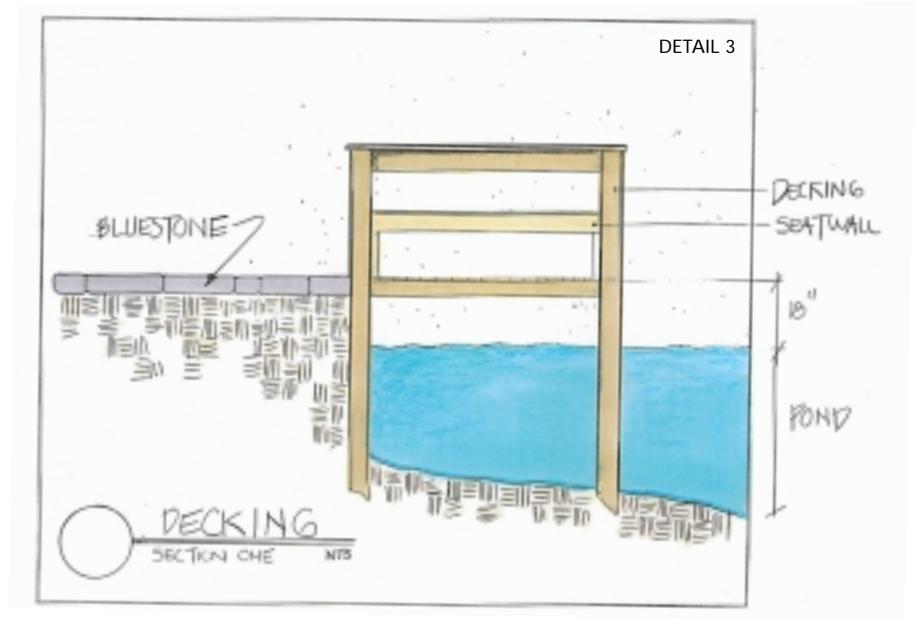
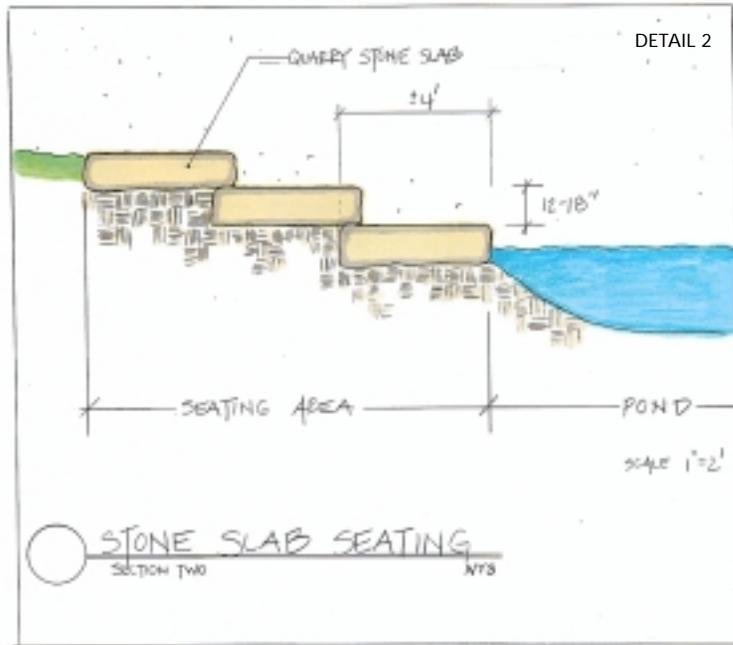
Geese leaving the water typically do so at locations with clear sightlines and easy egress from water to land. The use of aquatic emergents and complimentary shoreline plantings can substantially address the issue of sightline reduction. Egress from water to land at unvegetated locations can be curbed by creating shear vertical faces on structures installed to provide physical and visual access for humans (Figs. 1 and 1a, Details 2 and 3).

Rocks, decks, and boardwalks with sufficient (typically > 12-18') shear vertical rise from the water to any surface on which geese can stand are particularly effective in limiting goose access to the shore. Quarry stone with a sufficiently high vertical face above the water (**Detail 2**) is more likely than piles of irregularly shaped stones to simultaneously provide safe human access to the shoreline while limiting goose egress.

Among other activities, the interspersion of "hard edge" access points with aquatic emergent plantings, as depicted in Fig. 1, can create highly desirable fishing locations along the shoreline. In larger bodies of water, these access points can be combined with the offshore placement of fish attractant devices (FADs) such as clusters of sunken tires to further enhance recreational fishing opportunities.

Terrestrial Treatments

As noted above, in-water and water's edge shoreline treatments are most effective when combined with landward vegetative barriers. Whatever vegetation type is used as a barrier, follow the simple rule that it should be tall enough (> 30') and dense enough to disrupt goose sightlines.

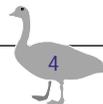


Low Shrubs and Meadows

Native grassland / wildflower meadows and low shrubs (0.8-2m) used in combination or as separate plantings can be very effective in reducing nuisance levels of Canada geese, especially when combined with other landscape treatments. The use of meadow and low shrub plantings in conjunction with aquatic plantings is illustrated in (**Figs. 1 and 1a**). Visual access to the water for humans is maintained by using low shrubs and/or low to medium (1-2m) height herbaceous (meadow) plantings within the buffer zone adjacent to the shoreline.

Physical access to the water for humans can be maintained by creating 1) a maze of trails or a single serpentine trail to the water and 2) a hardscape edge treatment at desired points of access (**Fig. 1, Sections 1 and 2**). When using predominantly shrubs, if a more open matrix to the water is desired, install the shrubs in overlapping drifts with greater distances between shrub clusters. Remember, however, to a goose looking toward the shoreline from the water, the plantings should present a solid mass.

Furthermore, if the goose comes ashore and enters the buffer planting, no sightline should present a clear view of more than 9m. A list of useful native shrubs, native grasses and wildflowers is included in Appendices X, Y and Z respectively.



Barrier Fences

Where space is limited and barrier width is critical, one or two rows of shrub plantings can be combined with a barrier fence. The fence should be a minimum of 30" high and provide openings no larger than 3", regardless of the material used to construct it. Ideally, the fence should be installed first and the shrubs planted as closely as possible to it so that as the shrubs grow, they envelope the fence. This will increase the effectiveness of both elements (fence and shrubs) as well as reduce the risk of the fence being damaged or ensnaring the occasional small child.

Again, whatever vegetation treatment is used adjacent to the shoreline, it should be tall enough (> 30") and dense enough to disrupt goose sightlines and if used as a physical barrier, shrubs should be dense enough to dissuade geese from attempting to fit between adjacent shrubs. When using native meadows as a barrier, leave the meadow growth from the previous year uncut until just prior to or slightly after the onset of new growth in the current year.

Grazing Area Treatments

The following actions all contribute to reducing the attractiveness of an area for grazing:

- *reduce the area of lawn*
- *reduce or eliminate mowing*
- *reduce or eliminate fertilizer application*
- *stop watering the lawn*
- *plant less palatable plants*

Guidelines 1-4 of the above list can all be accomplished by following guideline #5 and installing native grassland / wildflower meadow to replace areas of mowed lawn.

As with shoreline buffers, low shrubs also can be used in combination with meadows to reduce the size of grazing areas. Typically, meadows are the most economically feasible alternative; however, the addition of shrub clusters adds to reduction of sight lines. Meadows should consist predominately (75-80%) of native, warm season grasses (**Appendix 7**). Warm season grasses as a group tend to be coarser and less palatable than most turf (cool season) grasses, and they require only annual mowing

once established (2-4 years), no fertilizer, and are extremely drought tolerant. Native meadows also provide habitat for a wide variety of species not associated with mowed lawns.

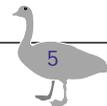
Figure 2 illustrates the creation of an alternative landscape within a foraging area to reduce both the overall size of the area and sightlines within it. If practical, clusters of taller trees should be added to this landscape to disrupt flightlines (see following section).

Lastly, where space is available, it may be feasible to create an alternative feeding area(s) in which the congregation of large numbers of geese does not generate human - goose conflicts. This approach may be particularly useful as part of a habitat modification program to promote the establishment of installed plantings by relieving a problematic area of unwanted geese, at least temporarily. Once established, the installed plantings will provide a more permanent solution.

Trees

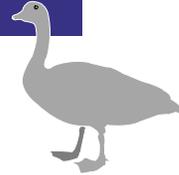
Several researchers have noted that barriers created by stands of tall trees can effectively prevent geese from landing in grazing areas by increasing the angle of ascent (also known as the flight clearance angle) to >13 degrees. However stands must be dense enough that geese cannot maneuver through the canopy. Stands of trees that meet these criteria are usually those that have been in place for some time. Thus, creation of tall tree barriers must be considered as a long-term objective in an overall habitat modification program.

Additionally, geese actually prefer areas with some shade for loafing. Therefore, the presence of scattered tall trees in a grazing area can actually serve to attract geese if they have walking access to the site. This reinforces the principle of disrupting goose sightlines using low shrubs and meadows either within or adjacent to grassy areas, whether or not they contain scattered tall trees. Again, because instant development of a forest is not possible or, in many cases desirable, focus on development of early successional stages with sufficient height (>30 inches) and density (20-30' +) to reduce sightlines to less than 9m. This will reduce safe physical access for geese.



2

Case Studies



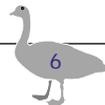
Site Types

Housing Projects with Storm Water Detention Ponds
Golf Course
Corporate Campuses
Marinas
Parks & Recreational Facilities
Agricultural Property
Salt Marsh Restoration Site

Legend — Human/Goose Conflict Resolution success rates

- [+] Landscaped with geese in mind - successful results.
- [-] Landscaped with geese in mind - unsuccessful results.
- [*] Landscaped for ecological reasons and had an unintended, but positive impact on reducing goose complaints.
- [i] Landscaped with geese in mind but is incomplete.

The purpose of the green box on the subsequent pages is to highlight pertinent information from the annotated bibliography as it relates to the Case Study.



Housing Projects with Storm Water Detention Ponds

1. [*] Cobblers Crossing - Greater Chicago Area [Figs. #1-9]

This site is significant because at one end of the pond (Area A) where the grass is mowed right to the edge of the pond, there are geese, goose feces and algae blooms throughout and quite a strong smell of decay, whereas at the other end (Area B), where there is a continuous 12-15m buffer of aquatic emergents and shoreline vegetation, the grass is clean, there are no geese, and the residents have a significant amount of green space and there is no smell.

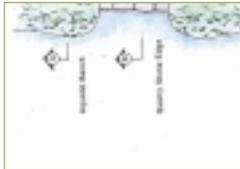


Fig. #1
Cobbler's Crossing Housing Development



Fig.#2
Foreground - Area A
Background - Area B



Fig.#3
Foreground - Area A
(Notice the water quality and goose feces.)



Fig.#4
(Note water quality - Area A.)



Fig.#5
Canada Geese - Area A



Fig.#6
Area B
(Notice the 12-15m buffer of aquatic emergents.)



Figs.#7-8
Vegetative buffer strip



Fig.#9
Area B
(Regard the quality of the turf grass as compared to Area A.)

Barrier fencing is a very effective method for excluding walking geese from yards. This may consist of placing a physical barrier that geese cannot pass through between the water and the area to be protected. The fence should be made from a durable material and be at least 30 inches high, with openings no larger than 3 inches by 3 inches. It may be necessary to extend the fence line along property line to prevent geese from walking around the fence. (Minnesota Department of Natural Resources:1996)



Note: Area A - Some residents chose to put up a barrier fence to debar geese. This fence was unique as it was hidden by an ornamental shrub.

2. [+] Lake Charlemaine - Greater Chicago Area
[Figs.#10-16]

This site is interesting because the wetland serves a storm water retention function and provides a natural park setting for its residents. It serves as a nice contrast to Cobble's Crossing in that the former represents an artificial environment with all the attendant problems identified in the introduction of this source book, whereas the latter is an example of a restored site complete with a wetland, species diversity, relatively clean water and an interesting recreational space.

Three years prior to 1998, the Home Owners Association of Lake Charlemaine asked for advice from the Humane Society of the United States and the United States Fish and Wildlife Service in Chicago on how to reduce their goose numbers. This, along with other factors, contributed to the ecological rehabilitation plan.



Fig.#10
Sign "From Puddle to Pond" - explaining the restoration initiative.



Fig.#11
Lake Charlemaine

Fig.#12 (Left)
Housing and walking path



Fig.#13 (Left)
Walking path and shoreline vegetation



Fig.#14 (Right)
Shoreline vegetation



Fig.#15 (Left)
Terrestrial vegetation



Fig.#16
Waterfowl- One of the reasons for the ecological restoration work was to reduce goose numbers and to increase species diversity. There are still a few geese at this site, but in manageable numbers, and there are also Great Blue Herons and Blue-winged Teal Ducks.

Geese prefer to eat younger grass shoots found on mowed lawns. As grass is allowed to grow, the younger shoots become harder to find. Reducing fertilizer use may also reduce the area's attractiveness to feeding geese. If watering is reduced or stopped, grass growth will slow and new, tender shoots will not be produced as frequently. Geese show a preference for Kentucky bluegrass, and tend to feed less on tall fescue. Unpalatable ground covers can also be planted. (Smith and Craven:1998)

Golf Courses & Corporate Campuses

1. [i] Pinchbrook Golf Course -- New Jersey [Figs.#17-23]

This golf course has two primary objectives in terms of natural landscaping: to get Autobaun certification, and to reduce human/goose conflicts. Through naturalization and overseeding with a wildflower mix, many of the no-play areas have been beautified and have consequently provided less grazing area for geese, thereby reducing goose numbers. Some of the ponds have been modified so as to prevent goose use and as a result geese grazing in the adjacent fairways.



Figs.#17-18
One of the no-play areas that has been modified through a no-mow policy and overseeding with a wildflower mix.



Fig.#19
Wildflower meadow that has been established in one of the no-play areas.



Fig.#20
A no-mow area, in the ruff, running alongside a fairway.



Fig.#21
Pond near a fairway that has been modified with a 3 m barrier of shoreline vegetation to deter geese from walking to and from the pond and the fairway, thereby reducing the habit of geese grazing in this vicinity. The plantings were established in "biologs" which eventually biodegrade once the plants have grown. They provide a dense barrier while allowing the vegetation to establish and still allow golfers to retrieve their balls.



Fig.#22 (Right)
Vegetation in the biologs around the pond serving as a barrier.

Fig.#23
On one of the other ponds, a horizontal fencing serves a similar function to a cattle-grate making geese wary or uncomfortable while allowing the shoreline vegetation to grow through it.

Landscape modification is one of the most effective and environmentally sound methods for reducing goose damage to lawns and yards. It can restrict the ability of geese to move between water and lawn without flying, reduce the nutritional value of the lawn, or make the site appear to be unsafe for geese. For example, golf courses can be designed in a "link-style" to incorporate pre-existing natural areas into the course. (Gosser and Conover:1997)

Overhead wire grids can be very successful at substantially reducing the number of Canada geese grazing, loafing and nesting proximate to water bodies. (Lowney:1995)

2. [+] Ameritech - Greater Chicago Area [Figs.#24-27]

Many sites have reduced their goose numbers through natural landscaping techniques. The less turf grass there is, the fewer numbers of geese there will also be. Ameritech has some geese, but also a number of other species given the amount of land they have converted to meadow and tall grass prairie.



Fig.#24
The Ameritech Campus is quite vast, in fact there are four storm-water ponds and acres of meadow and turf grass. There are geese on this site, however, the human/goose conflicts are minimal, if non existent, given the location and landscape design of the human use areas.



Fig.#25
Walking and jogging paths, for example, are a far enough distance away from the ponds and goose grazing area to avoid conflict.



Fig.#26
Head Office - this picturesque landscape is visible from the Head Office windows.



Fig.#27
Outside is this three dimensional landscape with trees, shrubs and meadow which deters geese from grazing or loafing while providing the workers with a tranquil and inviting environment.

3. [+] Sears - Greater Chicago Area [Figs.#28-31]

The Sears Campus is dominated by a large restored wetland and also has two ponds - one relatively naturalized, the other artificial with rip rap banks. Throughout the site are tall grass meadows, wildflower meadows, walking and jogging paths. The United States Fish and Wildlife Service advised Sears on how to renaturalize their site and to mitigate human/goose conflicts.



Fig.#28
The large wetland immediately adjacent to the Head Office.



Fig.#29
A walking/jogging path around the large wetland.



Fig.#30
Vegetation surrounding the large wetland.



Fig.#31
Another pond which is relatively naturalized.

Raising the height setting on the mower will reduce the attractiveness of the area for feeding geese. A mowing height of 6 inches will make finding tender young shoots more difficult for geese and will reduce the abundance of young tender shoots preferred by geese. (Whitford:1998)

4. [*] Willow Creek Church - Greater Chicago Area [Figs.#32-36]

The Church is situated on a large acreage of land with a large naturalized wetland, a mixture of meadows and turf grass as well as a more traditional storm-water treatment pond. This combination of ornamental and natural landscaping helps to reduce the carrying capacity of lands available to geese for grazing and loafing, thereby keeping the numbers of geese down.



Fig.#32
The church and the storm-water pond immediately in front.



Fig.#33
Geese grazing adjacent to the storm-water pond in front of the Church.



Fig.#34
No-mow area which serves as a buffer between the mowed area and wetland. In the background to the left is the Church and to the right is the large wetland.



Fig.#35
No-mow area.



Fig.#36
Large wetland.

- Geese prefer to eat younger grass shoots found on mowed lawns. As grass is allowed to grow, the younger shoots become harder to find. Reducing fertilizer use may also reduce the area's attractiveness to feeding geese.

If watering is reduced or stopped, grass growth will slow and new, tender shoots will not be produced as frequently.
- Geese show a preference for Kentucky bluegrass, and tend to feed less on tall fescue.
- Unpalatable ground covers can also be planted. (Smith and Craven:1998)

Marinas & Reservoirs

1. [-] Bussby Park and Marina - Oakville, Ontario [Figs.#37-43]

This site was landscaped with geese in mind. The idea was to reduce the grazing area by replacing most of the turf grass, which at one time constituted most of the passive surface area of the site, with a variety of shrub and flower beds (some of which are raised), a gazibo and interlock.

The problem, however, is that the habitat was modified to discourage grazing behaviour, and indeed managed to do so, but the modifications also had the unintended effect of encouraging roosting behaviour. The interlock running along the channel serving as a path from which to access the boats heats up during the day and provides a warm surface, in an open and therefore safe environment, for resting.



Fig.#37
One of the shrub beds intended to reduce grazing areas.



Fig.#38
Another shrub bed intended to reduce grazing areas.



Fig.#39
Another shrub bed, and an interlock path leading to the boat path running alongside the boating channel.



Fig.#40
Raised flower beds intended to reduce grazing surface, an inter-lock path in the foreground.



Fig.#41
The interlock boat path - the prime roosting area.



Fig.#42
The boat ramp/launch which is the likely point of access from the water to the roosting area.



Fig.#43
The interlock boat path and a finger slip.

One might ask how the habitat could be further modified so as to further reduce the use by geese? It is unlikely given the limited open surface area that geese are flying into the site. It is also unlikely that the geese are hoping up onto the interlock boat path or the finger slips given that the former is far too high (over three feet) and the latter are floating docks which stand over a foot above the water's surface, despite fluctuating water levels. The most likely point of access is the boat launch which could be gated to allow boat access but which would preclude goose access.

Note: geese often roost on paved surfaces - interlock, paved roads not heavy with traffic, parking lots etc. A sign that geese are roosting on these surfaces are "roosting piles" - piles of goose feces, rather than a scattering of goose feces normally associated with grazing.

Canada geese select foraging sites which provide the greatest degree of visibility so that they can see anything approaching them. Geese avoid small lawns and lawns with hedges, shrubs or other obstacles large enough to hide a predator (Conover:1991a)

2. [-] Fishermen's Bay - Oakville, Ontario [Figs.#44-47]

This site was modified with geese in mind. It was largely unsuccessful given that access from the water to the shore was not sufficiently barred off.



Fig.#44

Despite the expanse of turf grass, the hard edges around the bay are sufficiently high enough to make walking to and from the lake impossible. Geese, however, can easily fly onto the turf given the lack of vertical vegetation (trees and shrubs), except during the molting season when flight is impossible.

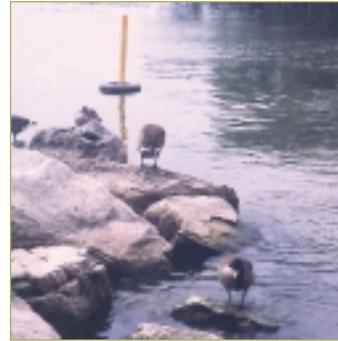
The path running alongside the shoreline serves as excellent roosting habitat. A more impermeable and coarser service would not only be more environmentally friendly to the site hydrological cycle, but would also prevent geese from roosting.



Fig.#45

In order to reduce the frequency and numbers of geese grazing around the picnic area, flower beds were established to reduce the surface area and to provide a barrier between the roosting area and the picnic area.

Trees were planted to beautify the park and to discourage geese.



Figs.#46-47

Despite the hard edges around the bay which make access to and from the lake impossible, this group of rocks serves as a break wall as well as an access point for geese to enter the roosting and grazing areas at all times of year including during the molting season.

Canada geese prefer to feed, roost, and loaf near water where they can escape to if threatened. Restricting a goose's ability to move between water and land will deter geese from an area, especially during the moulting season. However, to be effective, pond edges should be completely barred off. Fencing can also be used to protect lawns or other areas where geese forage. Short fences, vertical banks, or hedges at least 1 ft. high around ponds will work. Also, geese which have to fly constantly between lawns and ponds will often leave the area. (Gosser and Conover:1997)

3. [+] Kensico Reservoir - White Plains New York [Figs.#48-54]

In order to comply with the water quality standards of the New York City Department of Environmental Protection and the requisite level of bacteria, the Kensico Reservoir has implemented an extensive, non-lethal goose management program using habitat modification and harassment as the two principle means.

Rather than spending 6-8 billion dollars on a new filtration facility, which would incur about 400 million dollars in annual operating expenses, Kensico Reservoir has opted for an annual 75 thousand dollar waterfowl management plan. The central problem was that geese were grazing, and therefore defecating, on the property immediately above and adjacent to the two main inflow pipes leading water from the reservoir into the treatment facility.

In order to reduce the amount of fecal matter, hence, bacteria coming into the treatment facility, the reservoir has renaturalized a significant amount of the property on either side of the facility.

The landscaping techniques employed include:

- *Planting trees and bushes in any open spaces where geese congregate.*
- *Converting certain lawn areas into wildflower/wild grass meadows.*
- *Instituting a strict lawn mowing policy (allowing grass to grow longer) in areas where geese prefer to graze.*
- *Erecting an 18 inch high fence at the water mark around areas where geese are a problem.*
- *Digging a ditch through the mowed area (necessarily mowed because this area is used for specific events) in order to carry fecal matter away from the inflow pipes on rainy days. The grade is sufficient to carry the fecal matter away from the area of the inflow pipes into the forest.*

According to the waterfowl biologist from the Waterfowl Management program for Kensico Reservoir, prior to 1991, over 5000 geese, gulls and ducks would be in the reservoir. In 1998, less than 100 birds were found.

The following are comments taken from various documents where the effectiveness of habitat modification and other non-lethal methods of goose control are mentioned.

"The preliminary success in discouraging the Canada geese from the effluent areas with noisemakers (i.e., bangers and screamers) and alternative landscaping suggests that these two relatively simple control measures should, with some refinements, be developed into routine programs." Dr. L. Janus J. Mayfield, Kensico Watershed Study 1991-1993, p.155, March 1993.

"The lack of grass mowing combined with the plantings of native forbs and trees and the installation of the fence around the cove appears to have produced positive results." Chris A. Nadareski, Wildlife Biologist, DEP, from Memo to Dr. L. Janus, Deputy Chief, Drinking Water Quality Control, Aug. 7, 1992.



Fig.#48

The main treatment facility in the background to the left and the mowed area immediately adjacent to the building. The fence is 18" high fence is meant to prohibit access to geese; the wire grid keeps geese away from this area of the water, and; the hay bails absorb the rainwater running down from the mowed area which carries fertilizers and goose feces not caught by the ditch hidden by the hay bails.



Fig.#49 (Left)

Close-up of the wire grid to prevent geese from landing or swimming in this area.



Fig.#50

Ditch on the other side of hay bails which carries water from the mowed area toward the no mow area and forest on the left.

A wire grid is believed to be effective because it restricts the use of water resources for escape and reduces the required long take-off and landing zones of Canada geese. One study suggests that overhead wire grids were successful at substantially reducing the number of Canada geese grazing, loafing and nesting proximate to water bodies. When access to water bodies was denied, the local goose populations abandoned the area, was substantially reduced or shifted activities to nearby water bodies. (Lowney:1995)



Fig.#51
The no mow area and forest to the immediate left of the mowed area.



Fig.#54
The other side of the treatment facility.



Fig.#52
Shoreline vegetation immediately below the no mow area which serves as a buffer cutting off goose access from water to land.



Fig.#53
The other side of the treatment facility.
This shoreline does not allow goose access and the tall grass meadow discourages geese from landing.

A continuous band of emergent aquatic plants such as cattails or bulrush in the water in front of the shoreline can also reduce geese. An un-mowed shoreline buffer of native grasses and wild flowers that grow 20-30 inches tall in a strip 20-30 feet wide along a shoreline can also discourage geese. (Minnesota Department of Natural Resources:1996) (Smith and Craven:1998)

Barrier fencing is a very effective method for excluding walking geese from yards. This may consist of placing a physical barrier that geese cannot pass through between the water and the area to be protected. The fence should be made from a durable material and be at least 30 inches high, with openings no larger than 3 inches by 3 inches. It may be necessary to extend the fence line along property line to prevent geese from walking around the fence. (Minnesota Department of Natural Resources:1996)

Parks & Recreational Facilities

1. [+] McFaul Environmental Centre - Wycoff, New Jersey [Figs. #55-60]

Prior to 1962, this site was a pig farm. In 1965 it was opened as a park. It had all the typical features of a suburban park - an artificial pond amidst 81 acres of well fertilized and mowed Kentucky blue grass turf, asphalt and a small patch of forest off to one side. This habitat attracted over 500 geese annually.

This site is particularly interesting because it proves that reducing the amount of available grazing area (turf grass) through natural landscaping has a direct impact on reducing numbers of Canada geese. Approximately 45% of the turf area has been converted into meadow, shrub and tree cover. At this site Canada goose numbers have dropped by approximately 50%.

This suggests that on a site specific basis, reducing the carrying capacity of geese can be determined by the amount of available grazing area.

Peter Both, Director, McFaul Environmental Centre, has successfully controlled Canada geese using several methods which have reduced the goose population by half (from 500 to 210):

- *Reducing grassy expanses by planting trees and shrubs and allowing some areas to turn into meadows.*
- *Establishing large areas of ground cover.*
- *Establishing shrubbery, trees and ground cover around the pond.*
- *Installing vertical walls and fencing to deter pond access.*
- *Using plastic filament fencing and plastic reflective tape to keep geese off the herb garden.*
- *Restricting public picnicking to a pavilion.*
- *Enforcing non-feeding legislation.*



Fig.#55

In order to reduce the carrying capacity for Canada geese and to provide recreational opportunities for visitors to the centre, the McFaul centre created an herb garden.



Fig.#56

Garden is beside the pond and so has an 18" fence running along the pond side of the garden to prevent access by geese.



Fig.#57

Grounds- foreground is a turf area of perennial rye that is mowed to a length of no less than 5 inches, allowing for a maintained turf look but is less preferable to geese. Background shows a bed of plant materials (shrubs, groundcovers, wildflowers and small trees) used to reduce the carrying



capacity of available grazing material (turf grass) to geese.

Fig.#58

Plant materials.



Fig.#59

One of the no-mow areas - not mowed specifically for the purposes of deterring goose use.

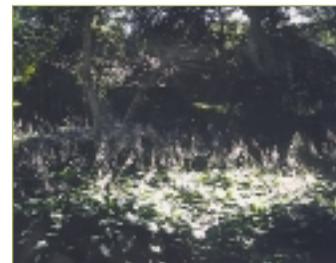


Fig.#60

Flower beds planted to reduce the carrying capacity of grazing area available to geese.

2. [+] Lena Park Trap and Skeet Range - New Jersey [Figs. #61-62]

This site was typical of most urban/suburban parks - open fields of turf grass with a small water body (i.e., a small, sinuey river running through it). This landscape was very attractive to Canada geese. In order to deter the use of the land for grazing by the geese, the Parks department allowed for the renaturalization of a 40-50m riparian buffer strip, between the river and the trap and skeet ramps.



Fig.#61
Two trap and skeet ramps with the buffer riparian habitat in the background to the left.



Fig.#62
The buffer riparian habitat. The river is situated just before the forest.

An un-mowed shoreline buffer of native grasses and wild flowers that grow 20-30 inches tall in a strip 20-30 feet wide along a shoreline can also discourage geese. (Minnesota Department of Natural Resources:1996)
(Smith and Craven:1998)

3. [-][i] Too Good Pond - Markham, Ontario [Figs. #63-66]

This park and rehabilitation project was planned with geese in mind. The landscape architects considered the behaviour and ecology of Canada geese in order to reduce human/goose conflicts. It is not yet completely finished in that there are plans for more extensive plantings around the pond, however, the rip rap and discontinuous plating beds around the pond have proven to be inefficient in terms of affecting a barrier between the turf grass and the water.



Fig.#63
Down one side of the pond is an expanse of turf grass. While the trees reduce the ability of geese in flight to land on the grass, they can easily land in the water and move to the adjacent grass for grazing.



Fig.#64
Notice the discontinuous plant beds and the relatively small rip rap - neither of which is sufficient to debar access.



Fig.#65
The rip rap and the obvious ability of geese to tread right through. This rip rap is neither high nor dense enough to prevent geese from moving from the water to the grass.



Fig.#66
A planting bed and the edge of the pond. This vegetation is neither tall nor dense enough to serve as a barrier between the water and grazing area, although such plant beds reduce the grazing surface area.

4. [+] [i] Lewis Morris Park (Sunrise Lake) - New Jersey [Figs. #67-70]

This site speaks to the point that reducing the land available to geese for grazing reduces the numbers of geese at the site generally. This site is used principally as a swimming hole. The primary objective at the site was to reduce the overall numbers of geese visiting the site so as to reduce the overall amount of goose fecal matter in the water.



Fig.#67 (Left & Inset)
The swimming hole and a small beach. The fence is used to prevent geese from walking to the water and interfering with human use of the beach and water.



Fig.#68
The swimming hole to the left and a renaturalized area to the right. A bridge separates the two and the water from the swimming hole outflows to a small tributary which runs through one side of the renaturalized area.



Fig.#69
Small tributary. It is very unlikely one would find geese in such a water course that was so densely vegetated.



Fig.#70
Renaturalized area— it used to be all open turf. The area was converted to a wildflower/wild grass meadow to reduce the carrying capacity of geese, because the primary recreational activity to protect was swimming, and not an activity requiring an expanse of turf grass.

5. [+] Lake Terracotta - Mississauga, Ontario [Figs.#70-73]

This award winning wetland was once a quarry, became a swimming hole and then a swimming pool. When it was a swimming pool, it was surrounded by typical park features such as expanses of turf grass with a few clumpings of trees and shrubs, and of course, Canada geese. Now that it is a wetland, there are few geese (and certainly no human/goose conflicts) and rather than a swimming pool, the public now comes to visit a wetland.



Fig.#70
Site when it was a swimming pool.

Fig.#71 (Left)
The wetland. In the background is a shelter for picnickers on a rainy day.



Fig.#72
The wetland and picnic shelter.



Fig.#73
Wetland.

Reduce proximity of ball fields to open water. Original design or modification of current park layout that locates playing fields at a distance of more than 400 meters from the water can potentially have the effect of reducing the goose grazing/dropping problem since geese will rarely walk that far to feed. (Whitford: unpublished 1993)

6. [i] Holmdel Park - New Jersey [Figs.#74-78]

This site has just recently undertaken some habitat modification initiatives to reduce their numbers of geese grazing and roosting on a regular basis. This is a popular goose feeding area, although people have been encouraged to discontinue this activity.

One side, Side A, of the pond has established shoreline barrier plantings and large canopied trees which greatly reduce the frequency of geese grazing on the grass. The side of the pond directly access from Side A, Side B, is attempting to establish shoreline vegetative barriers. A fence continues to enclose the plant beds on three sides. The side bordering the water was, until recently, enclosed with an electronic fence, partially submerged and partially emerged. The far side of the pond, Side C, is forest and the final side of the pond, Side D, has been rehabilitated with a continuous shoreline of vegetation.



Fig.#74
People feeding the geese with the forest, Side C, in the background.



Fig.#75
Side A, the shoreline vegetated barrier plantings in the background, and Side B.



Fig.#76
Side B, the plant beds enclosed by snow fencing. If you look closely you can see a couple of geese inside. To be effective, the plant beds should be fully enclosed for at least 2 years until the vegetation gets established. (Also, the vegetation should be far more dense than this).



Fig.#77
Side B.



Fig.#78
Fully vegetated shoreline, Side D.

Landscape modification is one of the most effective and environmentally sound methods for reducing goose damage to lawns and yards. It can restrict the ability of geese to move between water and lawn without flying, reduce the nutritional value of the lawn, or make the site appear to be unsafe for geese. (Gosser and Conover:1997)

7. [+] [i] High Park - Toronto, Ontario
[Figs.#79-86]

High Park has undertaken a number of habitat modification initiatives to reduce their human/goose conflicts. Most of the work has been done around Grenadier Pond, the main pond at the south-west corner of the park.



Fig.#79
In the centre of the park, there are a number of open fields designated for various ball games. In order to maintain the turf, a number of segments of snow fencing have been erected which serve to deter the geese from landing and/or feeling comfortable while feeding. A Border Collie augments the fence's effectiveness by keeping geese wary of the area.



Fig.#80
Around 1993, the south-west side of Grenadier pond was rehabilitated. Extensive plantings of aquatic emergents and shoreline vegetation were established to deter geese from the adjacent turf area near a number of residential properties. This photo was taken in 1998.



Fig.#81
Vegetation planted in 1996, on the very south-west corner of Grenadier Pond.



Fig.#82
The south-east side of Grenadier Pond has also been planted and protected with snow fencing.



Fig.#83
The south edge of the pond, between the south-east and south-west corners presently being rehabilitated, is a stretch that allows geese access to and from the water and the turf grass.



Fig.#84
The south-east side of Grenadier Pond has been left to renaturalized and is no longer mowed regularly. Geese do not appear to habituate this area.



Fig.#85
The mid-east side of Grenadier pond was also recently planted in 1996. The vegetation is quite dense, although the snow fencing needs to be maintained in order to completely prevent geese from accessing the vegetation.



Fig.#86
Beyond the mid-east side of Grenadier Pond is an expanse of turf grass the geese particularly favour. Because there are breaks in the vegetative barriers being planted along the east side, geese continue to frequent this area. If the barriers were contiguous, it is unlikely the geese would graze here since the tree canopy is sufficient to prevent geese from landing here (rather than on the water and walking over)comfortably.

Barrier plantings will require protection during establishment.
(Smith and Craven:1998)

8. [+] [*] Colonel Samuel Smith - Etobicoke, Ontario [Figs.#87-93]

This park was designed with geese in mind. There is virtually no grass in this park, and, as a result, virtually no geese. It is situated on Lake Ontario and is characterized by wetlands, wildflower and prairie grass meadows, bike and pedestrian paths, mud flats, viewing decks and a wide variety of native trees and migratory birds.



Fig.#87 Sign welcoming people to Colonel Samuel Smith Park.



Fig.#88 A view looking out onto Lake Ontario from a meadow in the park.



Fig.#89 A close-up of one of the wildflower/wild grass meadows.



Fig.#90 One of the wetlands.



Fig.#91 A perspective shot of the above wetland. Note the island in the middle. It would not be surprising to find geese nesting on such an island. To eliminate nesting, the island should either be removed or planted with higher and denser vegetation.



Fig.#92 Signage indicating the variety of native bird species one could find in this type of habitat.



Fig.#93 Signage indicating the variety of native tree species one could find in this part of southern Ontario.

Islands are prime nesting areas for geese, and they also prefer long, straight, uninterrupted shorelines for loafing. These areas make the geese feel more secure. Eliminating islands and peninsulas, and modifying a straight, uninterrupted shoreline with vegetative clumps or boulders obstructs their view and will reduce an area's attractiveness to geese. (Smith and Craven: 1998)

In one study, nests tended to be located on islands 0.5 to 1.4 m in height, close to open water, and in shorter vegetation for enhanced visibility. Lack of vegetation did not appear to inhibit nesting by geese. (Reese, Kadlec and Smith: 1987)

9. [+] Urquhart Butterfly Garden - Dundas, Ontario [Figs.#94-99]

This site had difficulties keeping geese away from the plantings established to provide habitat for butterflies. The butterfly garden is adjacent to a significant water body, Cootes Paradise, which is an inlet of Hamilton Harbour and Lake Ontario. The geese would travel past the butterfly garden, and graze en route, to the Kentucky blue grass on the other side. In order to prevent geese from walking through the garden and thereby grazing en route, a buffer or barrier planting of shoreline vegetation was planted.



Fig.#94
A sign for the butterfly garden and a close-up of the vegetative buffer.



Fig.#98
A perspective shot of the adjacent water-body where geese tend to congregate. The geese are in the background and the vegetative barrier in the foreground.



Fig.#99
A perspective shot of the vegetative barrier preventing the access of geese from the water to the butterfly gardens and beyond to the turf grass.



Figs.#95-97
Butterfly gardens.

Urban geese will feed in areas with the most nutritious grass (i.e. lawns that are mowed and fertilized regularly). Therefore, geese can be discouraged from foraging at a particular site by: 1) mowing and fertilizing the lawn as infrequently as possible as it is difficult for geese to access young shoots if the grass is tall, dense, and rank 2) planting a less-palatable grass species such as tall fescue, and 3) replacing lawns with an unpalatable ground cover such as common periwinkle, Japanese pachysandra, and English ivy. Lawns bordering ponds could be turned into a Japanese garden, a natural meadow, or wildflower area. (Gosser and Conover:1997)

Agricultural Property

1. [+] A Farm - Waterloo, Ontario [Figs.#100-102]

This farm served as a test site for one of Ducks Unlimited's goose crop damage reduction project - a project developed by DU under the Wetlands/Woodlands/Wildlife program of the Canada-Ontario Agricultural Green Plan.

To reduce or eliminate Canada goose depredations on farmers' crops, DU suggests maintaining an expanse or strip of turf grass, that is fertilized and mowed regularly, in order to provide alternative and preferential feeding habitat.

According to Ducks Unlimited Canada, Canada geese are a concern in wetland areas adjacent to farming enterprises. One of DU's large projects is the restoration and conservation of wetlands throughout North America. Some farmers have been wary of signing up for wetland conservation initiatives on or around their property for fear of Canada goose depredation.

Ducks Unlimited has attempted to help farmers find solutions, including, experiments concerning the concept of lure grazing sites. According to a DU study, establishment of lure sites is seen as having some potential. (*Impact of Grazing on Annual Seeded Crops by a Breeding Population of Canada Geese at Saskatoon, Wildlife Technical Report 91-2, June 1991*).

Observations from this study suggest that ryegrass might be an excellent species in such a lure site. At one site, plantings of alfalfa, brome grass, sweet clover, slender wheatgrass and Russian wild rye were also effective in holding geese. It is suggested that species which mature quickly and form tall dense cover types should be avoided in lure site plantings.

The study states that proper management of lure grazing sites might also improve efficiency and that geese, in a previous study (Owen:1975), geese significantly preferred fertilized grasslands to infertilized ones. Owen also found that cutting was a more cost effective management alternative since geese preferred grazing sites with good visibility and had difficulty manipulating long pieces of vegetation.

In this experiment, a plastic ribbon fence was erected between the turf grass and the corn field. According to the report, "[T]he plastic ribbon fence was effective for the period of the test and its usefulness could undoubtedly be extended through proper maintenance." (*Impact of Grazing on Annual Seeded Crops by a Breeding Population of Canada Geese at Saskatoon, Wildlife Technical Report 91-2, June 1991*).

Specific Recommendations:

- *DU recommends, in terms of the grass buffer strip, that a farmer place a 40 x 600 ft. (or 24,000 ft²) [12.2 m x 182.8 m (2,230 m²)] buffer strip between the crop land and the water body where the geese are exiting to access the emerging crop. If placed and managed correctly, a 1/2 acre buffer strip will provide enough forage for +/- 50 geese.*
 - *Seed mixture should have at least 50% Colonial Bentgrass by volume, and 45% of a standard blend of Perennial Rye/Creeping Red Fescue and Kentucky Blue Grasses. For diversity and nitrogen fixing capability, the remaining 5% should be White Clover.*
 - *For quick germination and even coverage, apply 17 lb. of seed blend in the recommended zig-zag pattern on a well prepared/smooth seed bed. Fertilize with at least 21-7-7 each spring. Mow every 10-12 days from May to Mid July with a sharp blade. This will encourage a healthy, lush and nutrient rich buffer strip.*
- Cost:**
- | | |
|------------------------------|--------|
| Seed = 17lb. x +/- \$3.00/lb | = \$51 |
| Fertilizer (per season) | = \$40 |
| | \$91 |
- Mowing \$ Fertilizing = \$ +/- 30 hours per season**
- *Geese tend to forage on Perennial Rye + Creeping Red Fescue + Kentucky Blue Grass in the early spring since it greens up the fastest. Towards the end of May, beginning of June, the preference switches over to Bent Grass since it is at peak growth stages. The palatability of Bent is much preferable to any other grass/legume in the mix and those another project experimented with.*
 - *Due to different seed size and weights, all three must be seeded individually for even dispersal. For a high success rate in germination and plot coverage, seed in the recommended zig-zag patterns on a well prepared/smooth seed bed. Use some type of roller to press the seed in better contact with the soil.*

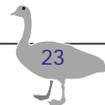




Fig.#100

A farm in the Waterloo, Ontario region which served as a test site for one of DU's goose crop damage reduction project - a project developed by DU under the Wetlands/Woodlands/Wildlife program of the Canada-Ontario Agricultural Green Plan. This photo shows the state of the crop land before the project started.



Fig.#102

The grass buffer strip and crop 13 months later.



Fig.#101

The grass buffer strip and crop 12 months later.

The idea behind an ecological approach to managing urban Canada geese is to make the geese stop using the problem site by making the site less attractive than alternate feeding locations. (Conover:1992)

Canada geese select foraging sites which provide the greatest degree of visibility so that they can see anything approaching them. Geese avoid small lawns and lawns with hedges, shrubs or other obstacles large enough to hide a predator (Conover:1991a)

Salt Marsh Restoration Site

1. [+] Staten Island - New York, New York [Figs.#103-109]

The New York Parks Department's Salt Marsh Restoration Team, in their on going efforts of restoring salt marshes damaged by the 1990 Exxon Oil Spill, has also encountered problems with goose exclusion from their plantings of tender young Smooth Cordgrass seedlings (*Spartina alterniflora*), along the west shore of Staten Island. The team has encountered problems with Canada geese and have been dealing effectively with it by constructing what they have labelled "goose fence".

Goose fencing is an exclusion system erected around a site soon after it has been planted. It consists of 8 foot, 2x2 stakes each pounded approximately 2 feet into the ground and 8 feet apart. Each stake has nails hammered halfway into it lengthwise about 10 inches apart.

Once a perimeter of stakes have been placed around a planting, nylon twine is then strung from each stake, from one nail to another of equal height on the next stake. Once this has been completed for each of the next 5 nails up each stake, a rather simple but effective exclusion fence has been created around the site. To keep geese from flying over the fence into the planting area we routinely run fence lines directly through a planting to break the site into smaller cells and severely decrease the landing area potential for geese who typically need about 20 feet to take off and land.

Unfortunately during the 1995 planting season this method needed to be improved. The location where the team planted was home to an innovative and adaptable group of about 30 Canada geese which were finding ways of getting through the fence.

The modified and current technique still retains the original goose exclusion type fencing and placement, however, it now additionally contains a 2 foot wide strip of sturdy orange construction fencing nailed to the bottom perimeter of the existing goose fence.

This has not only proven to be effective at excluding this group of geese from the planting, but it has also shown usefulness in keeping small debris and wrack out of the planting site as well. Fencing is only effective if it receives routine maintenance for missing nails, torn fence or removing large debris it may trap.



Fig.#103

Goose Fencing developed by the NY City Parks Department's Salt Marsh Restoration Team. (The modified and current technique)



Fig.#104

Goose Fencing - A perspective shot showing the overhead grid or aerial wire.

Most sites where the geese are causing problems are used by the geese as feeding sites. An ecological approach to urban goose problems assumes alternate forage sites are available. The idea behind an ecological approach is to make the geese stop using the problem site by making the site less attractive than alternate feeding locations. (Conover:1992)

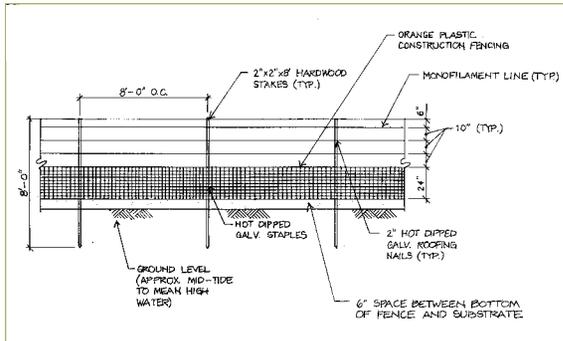


Fig.#105
Ink drawing of modified and current "goose fence".

CONSTRUCTION NOTES FOR AERIAL WIRE - GOOSE SCARE FENCE

- MONOFILAMENT LINE TO BE FASTENED SECURELY TO FENCE POSTS WITH A KNOT AFFIXED TO 2" GALVANIZED ROOFING NAILS.
- 6" X 6" BLACK PLASTIC FLAG PANELS HAVE A ONE INCH WIDE FOLD AT THE TOP AND BOTTOM OF PANEL (ACTUAL SIZE 6' X 8'). FOLDED ENDS WRAP AROUND THE TWO PARALLEL AERIAL MONOFILAMENT WIRES. THEY ARE ATTACHED VIA HEAT SEALING, CRIMPING, OR BY ADHESIVE.
- BLACK PLASTIC FLAG PANELS EACH HAVE A HALF CIRCLE CUT AT THE CENTER WITH A TWO INCH RADIUS. THIS IS TO BE DONE TO REDUCE WIND RESISTANCE.

AERIAL WIRE - SCARE FENCE ELEVATION

NOT TO SCALE

Fig.#108
Aerial wire-scare fence elevation.

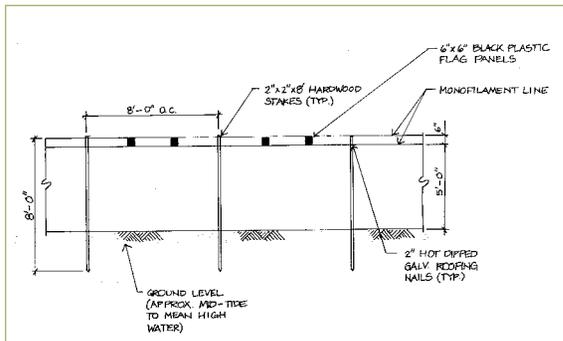


Fig.#106
Ink drawing of aerial wire.

**COST ESTIMATE FOR MATERIALS AND ASSEMBLY
GOOSE EXCLUSION FENCE**

PREPARED BY: Carl Alderson for the NYC Department of Parks & Recreation, Natural Resources Group - Salt Marsh Restoration Team.

DATE: February 11, 1997

SUBJECT: Cost Estimate for Construction of Goose Exclusion Fence, including all materials necessary to construct one panel = 8.0ft in length, but not including mylar scare flags or overhead cross wiring. All prices current as of October 1995.

A. MATERIALS NEEDED PER ONE COMPLETE SECTION 8.0' IN LENGTH.

ITEM	QUAN	PRICE
2.0" H.D. Galvanized Roofing Nails	4	.051
1.0" H.D. Galvanized U-Nails	3	.038
Nylon Chord	38ft	.28
Diamond Mesh Safe-T-Fence 4'x 50' Manufactured by Volta S.P.C. Cat.#SND 2550	2'x 8'	2.56
2"x 2"x 8' Spruce or Fir Stakes pointed(four corner)	1	2.63
Total Material Cost Per One 8.0 ft Panel		\$5.56
Total Material Cost Per 1.0 linear foot		\$.695

B. LABOR COSTS: ASSEMBLY FOR ONE COMPLETE SECTION 8.0' IN LENGTH.

2 person team x \$ x/hr wages can construct one 8.0' panel in 10 minutes or less. \$

TOTAL MATERIALS & LABOR \$

Fig.#109
Cost estimate for material and assembly of goose exclusion fence (US funds).

CONSTRUCTION NOTES FOR GOOSE EXCLUSION FENCE

- BOTTOM OF THE FENCE PLACED AT A HEIGHT OF SIX INCHES ABOVE THE GROUND PLANE TO ALLOW FOR PASSAGE OF MARINE ANIMALS.
- ORANGE PLASTIC FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH 2" GALVANIZED STAPLES.
- APPROVED FOR USE AS ORANGE PLASTIC CONSTRUCTION FENCING: BX 205/TENSAR SAFETY GRID (SG) FENCING WITH APERTURE OF 1.3" X 1.3". 4'X 50' ROLL CUT LONGITUDINALLY TO CREATE 2'X 50' LENGTHS.
- MONOFILAMENT LINE TO BE FASTENED SECURELY TO FENCE POSTS WITH A KNOT AFFIXED TO 2" GALVANIZED ROOFING NAILS.
- MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN DEBRIS COLLECTS ON THE FENCE.

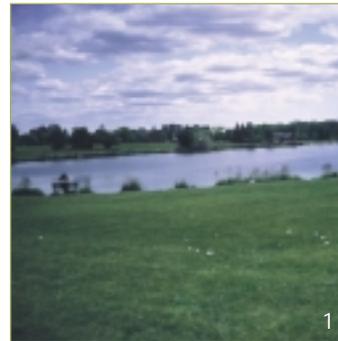
GOOSE EXCLUSION FENCE ELEVATION

Fig.#107
Goose exclusion fence elevation.

3 Do's & Don'ts

According to experts, geese select forage sites based primarily on safety considerations. Almost every nuisance site has a lawn that abuts a body of water so that a foraging goose could seek refuge on the water if disturbed. (Conover:1991a)

Don't scalp your lawn!



This park could be anywhere - Toronto, New Jersey, Chicago. Most urban/suburban parks are a four star hotel for geese.

Such parks have typical features: a pond or waterbody; an open expanse of turf grass mowed extremely short; turf grass mowed right up to the water's edge; little to no tree or shrub layer; little to no wildlife species other than generalists, and; little to no vegetation cover for predators.

DO let the green grass grow!

Renaturalizing your site by letting the grass grow in certain low human use areas will reduce the attractiveness of your site to geese. In one case study, renaturalization reduced the numbers of geese at the site by over 70%.



Simply letting the grass grow can produce wonderful results.



Don't allow access to geese through breaks in your barrier plantings!

Breaks in the barriers allow geese to access. Restricting a goose's ability to move between water and land will deter geese from an area, however, to be effective the barrier (consisting of fencing, a thick buffer of vegetation or both), must be continuous.



To debar access to geese, but to maintain human access for boating, fishing swimming etc, a deck/dock could be built and would be effective so long as the vegetation immediately abutted the dock.



Don't use rocks or boulders < 2 feet in diameter!

Large boulders placed along a shoreline can create a visual and physical barrier to discourage use by geese. The boulders should be at least 2 feet in diameter. A rock barrier with plants above will enhance the effectiveness. It should be noted that geese are able to climb up smaller boulders. (Smith and Craven:1998)



Do try to establish a barrier that is > 12 inches in height.

Various efforts at creating a buffer have been effective at many of the sites we visited.

Boulders, rip rap of various sizes, and hard concrete edges are popular ways of restricting movement of geese from water to adjacent land. When compared to soft, slopey edges, hard edges with significant vertical drop and over at least 12 inches in height are far more effective at deterring geese.



Do make sure barrier fencing is safe to wildlife, that it is well maintained, that it is made from a durable material, and that it is at least 30 inches in height.

Barrier fencing is a very effective method for excluding walking geese from yards. This may consist of placing a physical barrier that geese cannot pass through between the water and the area to be protected. The fence should be made from a durable material and be at least 30 inches high, with openings no larger than 3 inches by 3 inches. It may be necessary to extend the fence line along property line to prevent geese from walking around the fence. (Minnesota Department of Natural Resources:1996)



Not well maintained



Not high enough, posts spaced too far apart

Don't use this type of fencing, it can be fatal to wildlife



This fence has two wires, one strung at approximately 6 inches from the ground, the other at approximately 12 inches. Although effective if kept taut, geese and other waterfowl, as well as some mammals have been injured and even killed with this type of fencing.

Do vegetate a shoreline to make the site less attractive to geese.

Landscaping a shoreline to make it less attractive for Canada geese is the most effective long-term method of reducing goose problems to lawns and yards.

Canada geese will avoid areas where plants obstruct their view of the surrounding area. Fencing or repellents may be necessary to use while landscape is being established. A hedge with a gate can be effective, though the gate should be 30-36 inches tall and thick enough to exclude geese. (Minnesota Department of Natural Resources:1996) (Smith and Craven:1998)

A dense strip of naturally occurring trees and shrubs (20-30 feet wide) should be left along the shoreline. An unmowed shoreline buffer of native grasses and wild flowers that grow 20-30 inches tall in a strip 20-30 feet wide along a shoreline can also discourage geese. A narrow S-shaped footpath can still provide access to the lake. A continuous band of emergent aquatic plants such as cattails or bulrush in the water in front of the shoreline can also reduce geese. (Minnesota Department of Natural Resources:1996) (Smith and Craven:1998)

Shoreline vegetation planted 5 years ago (in 1993) and (Right - 3 years ago, 1995).



Note: Shoreline vegetation should be dense and thick enough to discourage nesting. Sparse shoreline vegetation may attract geese, particularly if it is a point of land which juts out into the water.

Do reduce proximity of ball fields to open water.

Whitford (unpublished 1993) found mean dropping densities of 14-18 per meter squared in random sampling on playing fields where the playing fields were located less than 200 meters from ponds frequented by geese. These were far greater than dropping densities on non-fertilized adjacent grassy areas.



Both these sites have had to resort to fencing and a buffer strip to debar geese.



According to Dr. Whitford, original design or modification of current park layout that locates playing fields at a distance of more than 400 meters from the water can potentially have the effect of reducing the goose grazing/dropping problem since geese will rarely walk that far to feed (especially if the fields are separated from the water by high and/or dense vegetation and especially during the molting season when geese are more reluctant to venture too far from the safety offered by the water). (Whitford:1998)

Do maintain or establish tall vegetation, particularly trees!

Trees in the flight path between water and grassy areas can prevent geese from landing, however the trees should be both dense enough to prevent geese from flying through the canopy, and tall enough to increase the angle of climb or ascent above 13 degrees. This will only prevent geese from flying into an area, and not from walking, in which case trees are attractive for their shade. (Smith and Craven:1998)



At this site, the geese do not habitually land or take off from the land beneath the trees, probably due to the tree cover, although geese do graze beneath the trees due to easy (unobstructed and close) access to the waterfront.

Do maintain or build a path for recreational use along the shoreline!

At park sites where there is a high use walking or jogging path that hugs the shoreline (and lacks projections people don't use) there is a major reduction in goose presence.

Generally, geese are made uneasy by even slow walking approach of humans to within distances of 10 meters or less. Thus, placement of walking paths at roughly 12 meters from the water's edge forces the geese to move at least 24 meters from the waters edge to rest and avoid constant disturbance. (Whitford:1998)



At this site, the proximity of the walking path to the shoreline, along with the significantly reduced turf area has effectively limited the numbers of geese and debarred access to remaining geese from high human traffic areas on this site.

Don't Feed the Geese!

Messages which admonish people who like and care for the geese are not likely to be an effective way to stop people from feeding geese. Many people feel as though they are protecting the geese from starvation or malnutrition and many want to show their support for the geese by feeding them.

Messages should be consistent with the sentiments of the people who feed the geese and should be in a variety of languages.

Admonitory Signage may only be appropriate in areas with a local ordinance or bylaw.



Two young men feeding the geese despite the no feeding sign. Both suggested english was their second language. Speaking with them highlighted the point that signage should be in a number of languages and should be more educational in nature. Once I spoke to them and told them of the current problems associated with feeding the geese (I mentioned the three above) they agreed to stop feeding the geese (and even further,

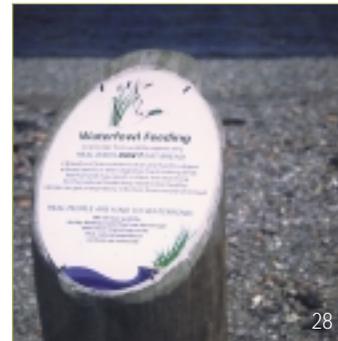
asked for information on how they could become involved with local residents wanting to reduce goose complaints through more environmentally sound means).



Signs could include the following points:

1. Feeding geese is dangerous to the well being of the geese. Geese can choke and die on many of the types of food people feed to them (bread, crackers, tacos etc.)
2. Feeding geese may increase pressure on municipalities to cull or relocate the geese.
3. Feeding and thereby encouraging concentrations of geese at specific locations may affect serious soil erosion and therefore poor water quality.

A more positive, and I would suggest, effective, type of signage:



At one park in New Jersey, parks personnel were testing the ability of endophyte-infected creeping red and chewing fescue, and blue azur for their ability to discourage depredation by a number of wildlife species, including geese.

Don't infect your grass with endophytes unless researched



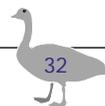
The effects of Canada geese grazing on endophytic grasses. The results of one study indicate that Canada Geese who grazed in plots of tall fescue infected with endophytic fungus *Acremonium coenophialum* lost mass while those grazing in control fescue plots gained mass. Hence, the former may be less able to survive periods of feed deprivation. When put on a grain diet during the winter, fungus geese regained their lost mass, indicating that the ill effects of grazing infected fescue can be reversed.

4

Application of the Approach

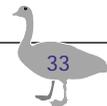
While there are a number of general landscape rules or principles that can be applied to most all situations involving Canada geese in urban and suburban environments, not all sites have the same habitat features or combinations of features which attract geese. As well, each site will have a unique set of human use patterns and requirements in terms of recreational preferences. Hence, the principles and lesson's offered by this Source Book are based upon some general trends which may or may not be applicable to every site.

We have, therefore, developed a set of questions and prescriptions to be considered when assessing the suitability of habitat modification for your site (or areas within your site), as well as determining what types of habitat modification techniques are appropriate or relevant to your site (or areas within your site).



A Guide to Developing A Site Specific Habitat Modification Plan

1. Gather information on use patterns of geese and humans (to determine habitat preferences and access points for geese as well as habitat or user preferences of humans).
2. Identify other park/facility/site objectives (other than reduction of usage by Canada geese) and prioritize them. Determine whether or not your site can accommodate some geese and if so, how many and where?
3. Use information from the previous two steps to divide the park/facility/site into management subsections.
4. Prioritize use objectives (both human and goose) within each subsection.
5. Identify an overall goose management scenario that is consistent with objectives for each subsection of the site.
6. Prioritize an implementation sequence (i.e., order the subsections) to address the most critical areas first should budgetary constraints dictate a phased approach.
7. Develop a Conceptual Plan (Master Plan) for the entire site based on the prioritized objectives.
8. Review and modify the Concept Plan to remain consistent with identified/ prioritized objectives.
9. Develop cost estimates for implementation of the Conceptual Plan with in each of the subsections of the site.
10. If implementation of the entire plan within all the subsections simultaneously appears cost prohibitive, follow the previously identified implementation sequence to most cost effectively achieve the goose habitat modification objectives.
11. Develop a Final Plan with planting specifications to implement the approved Conceptual Plan. (Note: If a phased approach is dictated by cost considerations, develop Final Plans sequentially for each subsection of the park).
12. Select species appropriate for site conditions within each identified planting zone (e.g., consider soil pH, and type [including hydrology], slope aspect, exposure to wind, etc.).
13. Develop a cost estimate for actual installation.
14. Protect installed material until sufficiently established.



5

Concept Plan (illustrated)

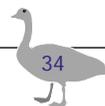
In this section, we have provided you with a Concept Plan which illustrates an application of the landscape design principles to a real life situation - a suburban park with significant goose concentrations. The Concept Plan shows the site before and after habitat modification techniques were implemented. The after scenario is a representation of an application of the principles as well as a representation of "An Application of the Approach". A group of people, including a planner, a number of parks department personnel and a few people representing local stakeholder interests met to go through this list in order to provide a context for the design of the Concept Plan.

A Park in the Greater Toronto Area

1. Human and Goose Use Patterns

Human uses: the stakeholders are: 1. The residents who live near by; 2. dog walkers; 3. Cyclists, roller-bladers etc. since there is a paved path running through the park and along the shoreline; 4. Families who picnic from April to October (this is, however, infrequent); 5. There is a small/toy boat club which meets at the pond about once a month to float their boats.

Goose use: every year there are from 10-50 geese at this park. They usually nest in the adjacent property - an oil refinery lot - which was abandoned over 15 years ago. There is often also a pair of mute swans every year. The geese are almost always found in the lake, particularly the harbour (the far right of the map directly below the apartment building) or grazing to the immediate left of the pond and in the pond. Sometimes they will graze along the shoreline south of the bike path. Running through this park is a little tributary that is fed/moved by a pump house on the left side in between the two parking lots. Its outflow is just south of the apartment building. It is here where the geese are accessing the park. Yes they can fly in given the lack of tall vegetation and trees - but most of the conflicts occur from June - August when the geese are moulting. So they access this park through the out flow area of this tributary. I doubt they could ascend the shoreline given the size of the riprap, but maybe.



2. Park Objectives

1. To attract large numbers of people because of its proximity to the commercial district; 2. To maximize fishing opportunities along the southeast and southern shoreline; 3. To build an amphitheatre for music festivals - people thought the best location would be in the centre of the park, just above and to the left of the pond. People felt that its back should be to the North in order to block residents from the potential noise; 4. To reduce goose numbers and/or goose conflicts; 5. To keep a bike path as part of the waterfront trail system; 6. to maintain a picnic area; 7. To do some ecological rehabilitation work (mind you this park is built on landfill); 8. To provide shade, although given its location, this park does tend to be cold and windy. Trees along the southern and south eastern shorelines could provide shade for fish spawning as well as block some of the wind coming in off the lake; 9. Beautification; 10. Increased bird watching opportunities; 11. safety and lighting concerns

3. N/A

4. Prioritize Use Objectives

The above are not ranked in terms of priorities. The amphitheatre development was something people felt would be costly and therefore left until a future date so long as the more recent changes did not create any further obstacles to its construction. It was decided that this park would do all of its habitat modification changes at once and that costs should be minimized.

5. Goose Management Scenarios

It was decided that the 10-50 geese who normally habituate this site should be accommodated. Three areas were considered by the landscape designer. A, B, C shown on the map are the possible areas where geese could be accommodated.

Area A was a possibility because this is where the geese are coming in during the conflict season and presently is an expanse of grass not used by humans. It is quite large and could potentially be linked to the existing pond. The one potential problem was that blocking the goose area off from humans by planting shrubs would in effect enclose them on three sides. This might make the geese nervous particularly in the event access to the water (either the pond or the lake) in any way restricted or streamlined. It was suggested that something else could act as a barrier that would prevent the geese from moving but would be low or transparent enough for them to not be nervous.

Area B was appealing because it is an area is where the geese already congregate and it gives them access to the pond. Goose access via the outflow of the tributary would have to be maintained, however, since geese could only fly into the pond in Area B when not moulting.

Area C, if the access point at the outflow of the tributary were blocked off and a new access point were created somewhere along the southern shoreline, could be a candidate. The picnic area could be moved to Area A and then Area C could be used for loafing and grazing which would be south of all the human activity and the bike path (accept for fishing) and therefore might work best to mitigate conflicts. Also, the lake is there to provide them an escape route so if barriers were created just south of the bike path the geese might not feel so threatened.

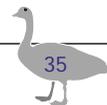
In whichever scenario - goose feces will be an issue. Whichever area is chosen, it should be maintained so as to be as attractive as possible to geese. A staff person or some volunteers may be needed to rake or sweep feces often and may need to oversee and maintain the grass in order to lure and keep the geese in the designated area as opposed to some other park or nearby site

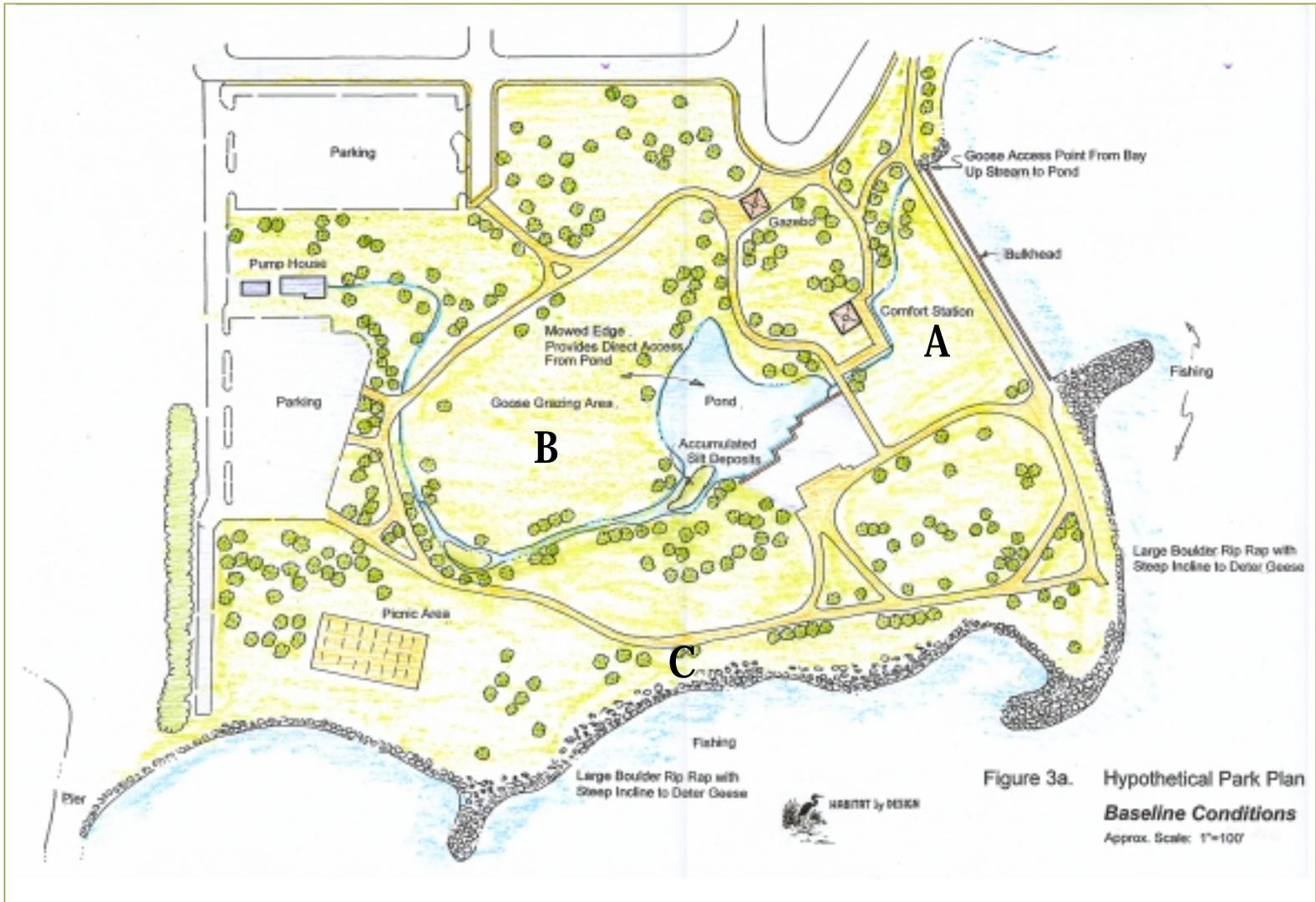
6. Implementation Sequence

The habitat modification components were considered the first step/priority. It was decided that the amphitheatre would be built at a later date.

7. Develop a Concept Plan - See Figures 3a & 3b.

8,9,10,11,12,13,14. N/A.







6

The Benefits of Natural Landscaping for Human and Natural Communities

Habitat Modification and Ecological Health

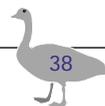
This Source Book provides habitat modification prescriptions for resolving conflicts with Canada geese, which are ecologically based. The recommendations made in terms of types of species and configuration of landscapes useful in mitigating human/goose conflicts reflect an understanding of ecological restoration and rehabilitation work.

As has been mentioned in the introduction, Canada geese can be viewed as a visible testament to the extent of environmental degradation in our urban environments. The geese provide a very visible indication of the environmental problems associated with the design and maintenance of our urban green space.

Canada geese are not the problem, per se, rather, they are symptomatic of a broader/deeper problem - ecological degradation.

Our urban and suburban green spaces are not biologically diverse and therefore, rather than supporting a diversity of species, support large numbers of a very few species. The abundance of monolithic landscapes characterized by intensively managed and manicured lawns with few, if any, trees and shrubs reduces biodiversity and jeopardises the integrity of our ecosystems. The fertilizers, pesticides, herbicides and chemically driven lawn maintenance equipment further degrade the quality of the soil, water and air effecting the health and wellbeing of humans and those non-human animals who have adapted to this environment.

Due to extensive urban and agricultural development, high quality natural communities cover minute percentages of land and water in many states and provinces in North America. With this decrease of habitats, many plants and animals have lost the special conditions and requirement they need for survival.



Habitat modification through ecological rehabilitation serves several functions:

- *It can reduce or change the use of a landscape by Canada geese*
- *It can reduce our dependency on chemical fertilizers and pesticides*
- *It can improve the soil, water and air quality of the immediate and surrounding environment*
- *It can improve the health of the landscape and surrounding environment, hence, the health of the human and non-human animals who interact with it*
- *It can increase the diversity of plant and animal species*
- *It can attract native species and re-establish a natural balance between wildlife and the natural cycles within which they thrive*
- *It can provide increased opportunities for wildlife watching*
- *It can diversify urban green space, hence, public recreational activities*

Gardening and Birdwatching - North Americas Favourite Pass-times

The author of Boom, Bust and Echo, David Foot, a new publication on demographic trends, states with respect to recreational trends, that gardening is the most popular past time and bird watching is the fastest growing past-time. Community gardens, butterfly meadows, songbird habitat, wetlands etc., all provide venues for these ever more popular activities while reducing the amount of habitat available to Canada geese.

Educational and Recreation Benefits of Natural Landscaping

In terms of **environmental education**, natural landscaping puts people in touch with a variety of plants, and if the plants are native to the area, people can gain a sense of being in a unique and special place. Natural landscapes are an invitation to appreciate plant diversity, seasonal flowering cycles, sustainability of native landscapes and wildlife habitat, all of which are absent or diminished in conventional urban landscapes. (Natural Landscaping for Public Officials, Northeastern Illinois Planning Commission, May 1997.)

Natural landscapes provide recreational opportunities such as bird watching and photography. The diverse colours, shapes, sounds, textures, odours and tastes found in the natural environment provide the viewer with sensory experiences impoverished in more sterile, traditional landscapes. Nature offers both tranquillity and excitement.

Recreational activities such as cycling, walking, running, bird watching, gardening and skating are extremely popular. Increasingly local and regional trails and greenways accommodate these activities. Natural landscaping in greenways can help create new attractive recreation areas, rejuvenate others and provide connecting corridors.

Increasing the biodiversity within and around urban/suburban environments not only improves the integrity of the ecosystem, it provides the basis for diversified recreational activities. Parks are typically characterized by expanses of turf grass monocultures, as well as, monocultures of ball or sports field and/or picnic tables, swing sets etc. Why should all public parks look the same or play the same role in terms of satisfying society's public recreational needs? Surely some parks are necessary for such activities, but given the cultural diversity and demographic trends of the present and near future (for example, our ageing population currently comprises < 5% of the total population, by 2013 it will comprise 20%) we should seriously consider a diverse array of publicly owned recreational activities, hence, green spaces.

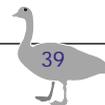
The environmental benefits of naturalization and ecological rehabilitation cannot be over-emphasized, both in terms of the bad practices they replace, as well as the ecological, social and economic opportunities they create.

Lawn Care

Lawn care chemicals are not benign. The Toronto Department of Health has declared, "children are especially vulnerable to the toxic effects of pesticides due to the incomplete development of their immune and central nervous system."

Pesticides may kill "weeds" on lawn, but they fail to address the real problem - the condition of the soil. Applying pesticides further degrades the soil by disrupting the natural functioning of beneficial organisms. Depleted, lawns become dependent on the artificial support of synthetic fertilizers and pesticides. The cycle of chemical dependence is expensive, environmentally unsound, unnecessary and leads to a lifeless soil.

In response to greater pesticide use, insects are becoming increasingly resistant to the products designed to kill them. In 1990, over 500 insect species were known to be pesticide resistant, including most of agriculture and gardening's major pests. The following are common pesticides used on lawns in urban environments - sold in household products and used by parks departments. They risk not only the health of children and adults, but family pets and wildlife species, such as Canada geese, who eat and loaf on the grass.



2,4-D (Killex) - Exposure has been linked to non-Hodgkin's lymphoma and prostrate cancer in humans and canine malignant lymphoma in dogs. It is an endocrine disrupter, a chemical that interferes with hormone functions, and an irritant to eyes, skin and mucous membranes. Acute exposure causes chest and abdomen pains, vomiting, dizziness and muscle twitching.

Glyphosate (Round Up) - Exposure is linked to eye and skin irritation, nausea, dizziness, headache, diarrhoea, blurred vision, fever and weakness. The surfactant used in Round-up is more toxic than glyphosate. Glyphosate has been detected in run-off four months after application.

Chlorpyrifos (Dursban) - Highly toxic to bees, birds, mammals and aquatic life. Acute exposure can result in nausea, stomach cramps, headaches, vision disturbances, muscle twitching and in extreme cases, cardiac arrest. Infant exposure through inhalation and/or skin absorption may be more than five times the official threshold for safe human use.

Diazinon (Basudin, Spectracide) - Irritates the eyes and skin. It causes birth defects in chick embryos and is toxic to ducks, geese and other birds. Since July 1990, it has been banned on golf courses and sod farms throughout the U.S., following numerous bird kills following application.

If you feel you must have a lawn — Don't scalp it! Mow to a height of at least three inches and try for up to six. This will help it shade out weeds and stimulate deep root growth. Never cut off more than the top third of each grass blade in a single mowing. Make sure your mower has sharp blades to minimize damage to grass. Mowing to a height of > 3 inches will help reduce grazing by Canada geese who are attracted to shorter fertilized grasses whose enzymes and rhimezones are more exposed and therefore accessible as well as higher in nutrients.

Environmental Benefits of Natural Landscaping

Natural landscaping, in many ways, reduces the stress that the "weed-free" lawn places on clean air, clean water, soil stability and other environmental qualities of life. Natural landscaping has distinct advantages over conventional turf grasses in stabilizing easily erodible soils. The roots of native prairie plants, for example, are very dense, fine and often very deep (in some cases, 5 to 10 feet in mature plants) and hold soil

well. By contrast, typical turf grass root systems are only 4-6 inches deep. (Natural Landscaping for Public Officials, Northeastern Illinois Planning Commission, May 1997.)

Wetland vegetation provides effective **soil stabilization** along streambanks, shorelines and ponds by absorbing some of the erosive energy of flowing water and waves. A recent project (in the Chicago Botanic Garden along the Skokie River) for shoreline stabilization demonstrates the use of native species such as prairie cordgrass and various willow species. (Natural Landscaping for Public Officials, Northeastern Illinois Planning Commission, May 1997.)

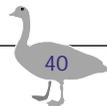
Natural landscaping plays an important role in attracting native animals and re-establishing natural wildlife populations and the natural cycles within which they thrive. In addition, natural landscaping can be used to create buffers which reduce urban stresses and proximity of exotic species to high quality natural areas. Buffers of vegetation between lawn/prairie and water-bodies are extremely useful for reducing human/goose conflicts.

Native insects, including butterflies and moths, attract a wide array of songbirds, who eat the insects and plant seeds. If a restored prairie is large enough, it might attract nesting grassland birds such as meadowlarks and bobolinks, birds whose habitat is decreasing in most parts of their range in Illinois. Songbird species such as the song sparrow, the Savannah sparrow, the Eastern towhee and the spotted towhee would all benefit from restored prairie landscapes throughout Canada and the US. (Natural Landscaping for Public Officials, Northeastern Illinois Planning Commission, May 1997.)

Native vegetation in naturalized drainage ways **enhances the infiltration of contaminated stormwater.**

Natural landscaping **helps reduce air pollution.** Standard lawn maintenance equipment creates significant amounts of air pollution. Equipment such as lawn mowers, chain saws, leaf vacuums, blowers, and other fossil fuel lawn maintenance equipment emit high levels of carbon monoxide, hydrocarbons (VOCs) and nitrogen oxides, which contribute to the formation of ground level ozone (smog), toxins and other particulates.

The United States Environmental Protection Agency estimates that a gasoline-powered lawn mower emits 11 times the air pollution of a new car for each hour of operation. Gasoline lawn and power equipment, on average produces 5% of "smog" forming VOC in non-attainment areas (such as the North-eastern Illinois region).



Smog is a noxious irritant, which impairs lung function and inhibits plant growth. In addition, the "driver" of such equipment is typically positioned where exposure to such carbon monoxide and toxic emissions is greatest. (Natural Landscaping for Public Officials, Northeastern Illinois Planning Commission, May 1997.)

Small gasoline spills evaporate and pollute the air as well. The United States Environmental Protection Agency estimates that every summer, the few ounces spilled during each refuelling of lawn and garden equipment adds up to 17,000,000 gallons of gasoline nation-wide.

Natural landscaping can significantly reduce the need for fossil-fuelled lawn and garden equipment and this reduces the associated air pollution and health risks. In addition, the native plants themselves can help to improve air quality by reducing particulates and gaseous air pollutants.

Natural landscaping **can reduce the greenhouse effect**. Natural vegetation can help combat global climate change by removing carbon dioxide (CO₂) from the atmosphere. Plants remove CO₂ from the atmosphere and store the carbon in the body of the plant, the root system and the soil.

Planting native plants can facilitate this CO₂ removal. The soils beneath the tall-grass prairies can contain an immense amount of soil organic matter and nitrogen. Studies have indicated that temperate prairie grasslands are superior soil carbon sinks when compared to forests of similar climatic. It is the combination of fire, plants, root depth distributions and microbes that produce the large amount of soil carbon. (Natural Landscaping for Public Officials, Northeastern Illinois Planning Commission, May 1997.)

Potential Funding Sources

Canada has a 10 million dollar per year budget for 3 years ending in 2001 available in the Climate Change Action Fund.

Canada has committed to a 6% reduction in CO₂ by 2008-2012 (from 1990 levels) by the year 2000. Ontario Hydro has a voluntary agreement to stabilize CO₂ emissions to 1990 levels by the year 2000 and to reduce CO₂ emissions by 10% by the year 2005. The City of Toronto's goal is a 20% reduction by the year 2005. The Canadian Federation of Municipalities has over 60 cities across Canada signed on to a **Climate Change Action plan**.

Pesticides, herbicides, fungicides and fertilizers are related to air quality (directly and indirectly). The application of nitrogen fertilizers, lawn mowers and leaf blowers use fossil fuels (carbon intensity), fertilizers, pesticides and herbicides produce green house gas when lawns are cut and as they are being produced. The cessation of lawn care through eliminating our dependence on fertilizers, mowing and pesticides and the replacement with more environmentally sound practices and/or landscapes, therefore, is related to federal CO₂ reduction schemes.

Natural landscaping can significantly reduce the need for fossil fuelled lawn and garden equipment and this reduces the associated air pollution and health risks. In addition, the native plants themselves can help to improve air quality by reducing particulates and gaseous air pollutants.

Native landscaping with trees, shrubs and tall grasses and forbes can sequester CO₂. CO₂ capture/sequestration is an increasingly important area of study regarding Climate Change initiatives.

Municipalities can potentially apply for funds for ecological restoration initiatives, particularly those involving the cessation of traditional lawn care practices and the planting of native trees and other vegetation as part of the Canadian Federal CO₂ reduction scheme. Don Strange, with the Climate Change Action Fund Secretariat in Ottawa (613-943-2688) has maintained that municipalities, either individually or collectively, say representing a region such the Greater Toronto Area or even Southern Ontario, could apply for funds to do natural landscaping in order to reduce (by the cessation of lawn care practices) and sequester (through plantings) CO₂ as well as to implement habitat modification techniques to reduce human/goose conflicts. [see Appendix for information regarding the application for funds process. Relevant to Canadian Municipalities and Communities Only.]

Municipalities across Canada and the United States should contact their Federal Governments for further information on Climate Change and potential funds available to local governments and communities to do natural landscaping in order to reduce and capture CO₂ and at the same time reduce human/goose conflicts.



Annotated Bibliography

General Topic Areas

- I Habitat Modification Studies & Articles
- II Habitat Preferences & Site Selection Studies
- III Management Documents (Techniques, Strategies & Plans)

I Habitat Modification Studies & Articles

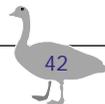
Introduction

Michael R. Conover is one of North America's experts on Canada geese. He has written extensively on various management options for urban and suburban management techniques for conflicts associated with Canada geese including habitat modification. Conover sees habitat modification as an ecological approach to resolving human/goose conflicts. According to Michael R. Conover,

Most sites where the geese are causing problems are used by the geese as feeding sites. An ecological approach to urban goose problems assumes alternate forage sites are available. This assumption appears to be valid for most cities because urban geese forage primarily on the grass in lawns - and lawns are a ubiquitous feature in metropolitan areas... The idea behind an ecological approach is to make the geese stop using the problem site by making the site less attractive than alternate feeding locations. (Conover:1992)

Conover claims that geese select foraging sites based on an assessment of risks to their safety, food quality, and energetic costs of reaching the site. Conover and Kania (1991) found that urban Canada geese selected foraging sites which provided the greatest degree of visibility so that they could see anything approaching them. Geese avoided small lawns and lawns with hedges, shrubs or other obstacles large enough to hide a predator. Geese also avoided sites that required a steep angle of ascent to leave. (Conover:1991) In other words, geese did not use lawns that were surrounded by tall trees or buildings that might impair the birds' ease in flying away. According to Conover, these results indicate that geese can be discouraged from using a foraging site by planting hedges and bushes and by surrounding the area with tall trees.

In Ontario and some of the Northern United States within the Great Lakes Basin, municipalities are also concerned with molting geese. The habitat preferences/ requirements and deterrents for molting geese are similar to those of foraging geese and therefore Conover's prescriptions are applicable to a site where geese are molting.



Sites immediately adjacent to a waterfront may require different prescriptions that a landlocked site with a small pond or tributary. For example, an area with planted with tall trees adjacent to a waterfront in order to reduce the flight clearance angle may not be sufficient since geese could potentially escape a threat by actually running, as opposed to flying, to the water. Waterfronts which provide an unobstructed escape to a lake or even a very large pond renders the tree planting idea insufficient. The addition of plantings around or alongside the shoreline of the lake or large pond, in order to obstruct their escape, would likely be necessary.

Many agree that habitat modification is the most suitable, effective, holistic, ecological, long term and/or humane way to resolve human/goose conflicts in urban environments. The main conclusion of the Canada Goose Committee of the DuPage Environmental Commission, for example, is that the most suitable way to reduce goose populations is to change the environment so they will not find the area as attractive for nesting and feeding. The position adopted by the Commission is that, “[T]his can best be accomplished by reducing large lawn areas and increasing the use of natural landscaping with native trees, shrubs, prairie and wetland grasses and wildflowers.”

The DuPage Commission offers the following summary of habitat modification measures,

Shrubs, trees and taller vegetation like cattails and prairie grasses tend to limit visibility for the geese and provide places where predators might hide. Geese are much less likely to frequent lawns broken up by tall plantings than open mowed lawns. Therefore, it seems, we have created the perfect habitat for Canada geese by eliminating most large predators and by providing countless acres of lawn on which to graze. Hundreds of ponds (retention reservoirs), many of which are kept open all winter, are places for geese to sleep safely. In general, the larger the amount of mowed lawn located within convenient flying (or walking) distance from open water, the greater the number of geese. (Italics added). [A Report Adopted by the DuPage Environmental Commission, November 4, 1998. Title: A Natural Approach to Goose Mitigation]

According to the Commission, geese prefer lush, fertilized grassy lawns. As lawn areas are reduced and more native vegetation and “wilder” habitats are created, goose predators (including small mammal and avian egg predators) should increase, allowing goose populations to come into balance with the environment. They suggest that tall vegetation around ponds provides hiding places for predators. Pond construction with steep and tall banks (an 18 to 24 inch vertical bank) so geese can’t go in and out of the water easily, strings across the water and 30 to 36 inch high fences around ponds will help to reduce goose activity by interfering with take off and landing space. [See *Appendix for a survey of methods which worked and did not work in DuPage County*]

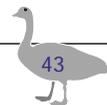
The following articles provide information on habitat modification and Canada geese. Some of the authors have done extensive general surveys on the behaviour and location of Canada geese upon which they make general habitat modification prescriptions. Others have done site specific studies and provide information relating to their findings.

1. Buchsbaum, R., & I. Valiela. 1987. “Variability in the chemistry of estuarine plants and its effect on feeding by Canada geese”, *Oecologia (Heidelberg)*. 73(1):146-153.

There are seasonal variations in plant chemistry on food choices by adult and gosling Canada geese. The geese fed primarily on abundant marsh grasses (*Spartina*), and rushes, early in the growing season, and then switched to eelgrass later. Submerged angiosperm, *Zostera marina* was also eaten later. Forbs were avoided all season, and this was related to their low abundance and their high concentrations of deterrent secondary metabolites. The effects of plant chemistry and the nutritional needs of geese on food choices were modified by the need to select a safe feeding site. The open water habitat in which *Z. marina* grows is a refuge from predators and other forms of disturbance, and this may be a highly desirable feeding site. In contrast, geese try to avoid areas of tall grass as found in marshes in mid to late summer, because they cannot survey their surroundings as well. The diets of goslings may be affected by the distance of the vegetation from the security of the water. To conclude, geese select feeding sites where their favourite foods are most abundant and where they are moderately safe from disturbance. They avoid plants that have chemical deterrents.

2. Cleary, Edward C., USDA-APHIS-Animal Damage Control. 1994. “Prevention and Control of Wildlife Damage: Waterfowl”, Ohio.

Waterfowl can be difficult to disperse once they become established on a pond or feeding site. Frightening devices and repellents should be in place before damage starts to prevent the geese from becoming acclimated to the site. Habitat modification as a waterfowl control method would include: vertically straightening pond banks, allowing ponds to freeze in winter, eliminating vegetation in and around ponds, and reducing or eliminating fertilizer use around ponds. Some exclusion methods are: installing fencing around ponds, gardens, and yards; and installing overhead grids or netting on ponds, reservoirs, and fish raceways. Canada geese normally will not nest in areas where they cannot easily walk in and out of the local pond. New ponds should be constructed with an 18 to 24 inch vertical bank at the water’s edge. Large boulder rip-rap could be placed in levees and banks to prevent geese from climbing over.



3. Conover, Michael R., & Gary S. Kania. 1991a. "Characteristics of Feeding Sites used by Urban-Suburban Flocks of Canada Geese in Connecticut", *Wildlife Society Bulletin*. 19:36-38.

One possible method for reducing goose problems is site modification. An objective of this study was to identify characteristics of nuisance sites that could be modified to make these sites less acceptable to geese. Nuisance sites were contrasted with sites that geese either avoided or frequented in small numbers.

Another study has shown that Canada geese feeding in a Massachusetts estuary selected feeding sites where their favourite foods were abundant and which were safe from disturbances. In this study, Canada geese selected lawns for foraging sites that had the least flight clearance angle and the highest detection index. Every nuisance site had a lawn that abutted a body of water so that a foraging goose could seek refuge on the water if disturbed. These results show that geese are selecting foraging sites primarily based on safety considerations. The body of water could be drained or the lawn replaced with unpalatable vegetation to reduce goose problems.

Less drastic steps include landscape modification such as: planting tall trees around the lawn and body of water to increase the flight clearance angle to > 13 degrees; and by providing more bushes and hedges to reduce the goose's ability to detect approaching predators at distances > 9 m. The effect of landscape modification and the use of fear-provoking stimuli may be additive because habitat modification may make the geese more wary when at a site.

4. Conover, Michael R. 1991b. "Herbivory by Canada Geese: Diet Selection and Effect on Lawns", *Ecological Applications*. 1(2):231-236.

All of the nuisance sites studied had surface water (pond or lake) on the property, and the area of greatest goose activity was usually on the turf closest to the water. The palatability of different grass species to Canada geese was examined by allowing captive birds to feed in plots of five turf grass species: colonial bentgrass (Highland), Kentucky bluegrass, a tall fescue (K-31), perennial ryegrass, and red fescue. The geese spent more time feeding in plots of Kentucky bluegrass and less time feeding in plots of tall fescue (*Festuca arundinaceae*). Feeding preferences for grass species were negatively correlated with the ash content of the leaves and with the amount of force required to sever a specific leaf mass. Another study found that Canada geese avoided eating a very coarse grass, *Elymus arenarius*.

Captive Canada geese would not feed on common periwinkle (*Vinca minor*), Japanese pachysandra (*Pachysandra terminalis*), or English ivy (*Hedera helix*). The captive geese

exhibited feeding preferences among grass species, however, there was no grass species that geese refused to eat. When a less-palatable grass is planted in order to alleviate a nuisance goose problem, it will have to be combined with other abatement techniques. Also, the degree of success will depend on the availability of alternate foraging sites. In contrast, they refused to eat common periwinkle, Japanese pachysandra, and English ivy. This suggests that Canada goose numbers can be reduced at sites where they are foraging on turf if lawns are replaced by an unpalatable ground cover, or to a lesser extent, with a tough-leaf grass species such as tall fescue.

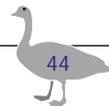
5. Conover, M.R. 1985. "Management of Nuisance Canada Goose Flocks", *Proceedings of the Eastern Wildlife Damage Control Conference*. 2:155.

A potential solution to urban geese at nuisance sites is to discourage geese from nuisance sites by planting them with some type of grass or cover that geese do not like to eat. Captive geese were given the opportunity to feed on plots of Kentucky bluegrass, colonial bentgrass, perennial ryegrass, red fescue, and tall fescue. When given a choice, the geese fed significantly more on Kentucky bluegrass and significantly less on tall fescue than any of the other grasses. Hungry geese, however, grazed on any of the grasses if no choice was provided. Hence, discouraging geese from problem sites by planting these areas in a fescue may work, but only if there are good alternative sites available to the geese. Even more effective would be to replace the grass with another type of ground cover, such as *Pachysandra* or English Ivy, which geese find unpalatable.

6. Conover, M.R., & Terry A. Messmer. 1996. "Feeding Preferences and Changes in Mass of Canada Geese Grazing Endophyte-Infected Tall Fescue". *The Condor*. 98:859-862.

This study addresses the questions as to whether avian herbivores that graze infected grass will suffer ill effects and whether avian herbivores can discriminate between infected and uninfected fescue. These questions are addressed in the current study using Canada Geese as grazers. The experiment was conducted from June 1992 until October 1993.

The results of this study indicate that Canada Geese who grazed in plots of tall fescue infected with endophytic fungus *Acremonium coenophialum* lost mass while those grazing in control fescue plots gained mass. Hence, the former may be less able to survive periods of feed deprivation. When put on a grain diet during the winter, fungus geese regained their lost mass, indicating that the ill effects of grazing infected fescue can be reversed.



Because no fungus goose or control goose attempted to breed during this experiment, they were unable to evaluate whether grazing on infected fescue plants caused any reproductive problems for Canada Geese. Zavos et al. (1993) reported a 10% fertility reduction in Japanese Quail fed a diet of 45% infected fescue seed. Other studies showed that eating infected fescue caused a reduction in reproductive performance in livestock (Aldrich et al. 1993, Schmidt and Osborn 1993), laboratory rats (Zavos et al. 1986, Varney et al. 1987, 1988) and laboratory mice (Zavos et al., 1987, 1988a, 1988b).

Upon first exposure to fescue, Canada Geese did not discriminate between infected and uninfected grass. After consuming fescue for several months, Canada Geese showed a preference for grazing control plots over fungus-infected ones during choice tests. This aversion may be based more on post-ingestion feedback than on a disagreeable taste.

7. Cornell Cooperative Extension, Rockland County. "Canada Goose Management: Promising Strategies".

In order to design landscapes less attractive to geese: eliminate any feeding of the geese by the public; reduce lawn area and if possible leave it unmowed or plant wildflowers; plant tall fescue instead of tender Kentucky bluegrass; plant unpalatable groundcovers such as pachysandra, vinca, english ivy, myrtle, and hosta (they should be protected the first year); place large stones and tall grass around the edge of a pond to keep geese from stepping up; geese select foraging sites primarily based on safety considerations, so plant trees around a lawn or small body of water to increase the flight clearance angle to > 13 degrees; and provide more bushes and hedges to reduce the goose's ability to detect predators (geese are uncomfortable when they cannot see at least 9 meters ahead), and to deter geese from walking between ponds and feeding areas.

8. Ducks Unlimited, Wildlife Technical Report 91-2, June 1991, "Impact of Grazing on Annual Seeded Crops by a Breeding Population of Canada Geese at Saskatoon".

According to Ducks Unlimited Canada, Canada geese are a concern in wetland areas adjacent to farming enterprises. One of DUs large projects is the restoration and conservation of wetlands throughout North America. Some farmers have been wary of signing up for wetland conservation initiatives on or around their property for fear of Canada goose depredation.

Ducks Unlimited has attempted to help farmers find solutions, including, experiments concerning the concept of lure grazing sites. According to this DU study, establishment of lure sites is seen as having some potential.

Observations from this study suggest that ryegrass might be an excellent species in such a lure site. At one site, plantings of alfalfa, brome grass, sweet clover, slender wheatgrass and Russian wild rye were also effective in holding geese. It is suggested that species which mature quickly and form tall dense cover types should be avoided in lure site plantings.

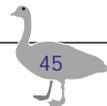
The study states that proper management of lure grazing sites might also improve efficiency. It also states that geese in a previous study (Owen:1975), it was found that geese significantly preferred fertilized grasslands to infertilized ones. Owen also found that cutting was a more cost effective management alternative since geese preferred grazing sites with good visibility and had difficulty manipulating long pieces of vegetation.

To reduce or eliminate Canada goose depredations on farmers' crops, DU suggests maintaining an expanse or strip of turf grass, that is fertilized and mowed regularly, in order to provide alternative and preferential feeding habitat. In this experiment, a plastic ribbon fence was erected between the turf grass and the corn field. According to the report, "[T]he plastic ribbon fence was effective for the period of the test and its usefulness could undoubtedly be extended through proper maintenance.

Specific Recommendations:

- DU recommends, in terms of the grass buffer strip, that a farmer place a 40 x 600 ft. (or 24,000 ft²) [12.2 m x 182.8 m (2,230 m²)] buffer strip between the crop land and the water body where the geese are exiting to access the emerging crop. If placed and managed correctly, a 1/2 acre buffer strip will provide enough forage for +/- 50 geese.
- Seed mixture should have at least 50% Colonial Bentgrass by volume, and 45% of a standard blend of Perennial Rye/Creeping Red Fescue and Kentucky Blue Grasses. For diversity and nitrogen fixing capability, the remaining 5% should be White Clover.
- For quick germination and even coverage, apply 17 lb. of seed blend in the recommended zig-zag pattern on a well prepared/smooth seed bed. Fertilize with at least 21-7-7 each spring. Mow every 10-12 days from May to Mid July with a sharp blade. This will encourage a healthy, lush and nutrient rich buffer strip.

Cost: Seed	= 17lb. x +/- \$3.00/lb	= \$51
	Fertilizer (per season)	= \$40
		\$91
	Mowing \$ Fertilizing	= \$ +/- 30 hours per season



- Geese tend to forage on Perennial Rye + Creeping Red Fescue + Kentucky Blue Grass in the early spring since it greens up the fastest. Towards the end of May, beginning of June, the preference switches over to Bent Grass since it is at peak growth stages. The palatability of Bent is much preferable to any other grass/legume in the mix and those another project experimented with.
- Due to different seed size and weights, all three must be seeded individually for even dispersal. For a high success rate in germination and plot coverage, seed in the recommended zig-zag patterns on a well prepared/smooth seed bed. Use some type of roller to press the seed in better contact with the soil.

9. Gosser, A. L., M. R. Conover, & T. A. Messmer. 1997. Managing problems caused by urban Canada geese. Berryman Institute Publication 13, Utah State University, Logan.

Non-lethal techniques are most effective when 2 or more are used in combination. They include: elimination of food handouts, exclusion, landscape modification, removal/relocation, and the use of frightening devices, hazing, and repellents. Exclusion can be one of the most effective non-lethal techniques in controlling goose damage. Canada geese prefer to feed, roost, and loaf near water where they can escape to if threatened. Restricting a goose's ability to move between water and land will deter geese from an area, especially during the moulting season. However, to be effective, pond edges should be completely fenced. Fencing can also be used to protect lawns or other areas where geese forage. Short fences, vertical banks, or hedges at least 1 ft. high around ponds will work. Also, geese which have to fly constantly between lawns and ponds will often leave the area. The use of wires or lines strung across ponds may create a flight hazard to deter geese from using the pond.

Landscape modification is one of the most effective and environmentally sound methods for reducing goose damage to lawns and yards. It can restrict the ability of geese to move between water and lawn without flying, reduce the nutritional value of the lawn, or make the site appear to be unsafe for geese. For example, golf courses can be designed in a "link-style" to incorporate pre-existing natural areas into the course. A goose's access to the shore from the water can be restricted by physical barriers such as: a boardwalk or boulders over two feet in diameter bordering ponds; thick shrubs or hedges; and a short fence (1-2 feet high) in the water, surrounded by aquatic vegetation.

Urban geese will feed in areas with the most nutritious grass (i.e. lawns that are mowed and fertilized regularly). Therefore, geese can be discouraged from foraging at a particular site by: 1) mowing and fertilizing the lawn as infrequently as possible as it is difficult for geese to access young shoots if the grass is tall, dense, and rank

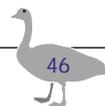
2) planting a less-palatable grass species such as tall fescue, especially varieties which contain an endophytic fungus that produces bitter-tasting alkaloids (i.e. K-31) and 3) replacing lawns with an unpalatable ground cover such as common periwinkle, Japanese pachysandra, and English ivy. Lawns bordering ponds could be turned into a Japanese garden, a natural meadow, or wildflower area. Geese avoid sites with bushes, hedges, or other objects that would allow a predator to approach without being seen. To make a lawn appear less safe to geese: shrubs or boulders could be placed close to foraging areas; tall-growing trees could be planted or left standing as they obstruct a goose's ability to fly. Geese gain altitude slowly when flying and require a low flight angle of approximately 13 degrees to take flight.

10. J.A. 1992. "Uninvited Guests". Horticulture, October 1992, pp.22-23.

This article summarizes advice offered by Dr. Michael Conover, of Utah State University Fisheries and Wildlife Department who has been "studying the habits of non-migratory Canada geese in hopes of alleviating the problems their feeding habits and droppings can have."

When choosing a place to land, geese look for certain features, Conover says. First, they like open, grassy areas where they have a complete view of their surroundings. This allows them to spot danger and escape quickly. They also like open space because it makes taking off and landing easier. In fact, Conover has found that Canada geese will avoid a site where they must climb at an angle greater than 6 degrees in order to clear any obstacles.

Finally, Conover's studies reveal that geese look for their favourite types of food when choosing the ideal rest stop. They can easily strip a lawn of Kentucky bluegrass (*Poa Pratensis*), their preferred variety, though they will also dine on colonial bent grass (*Agrostis tenuis*), perennial rye grass (*Lolium perenne*), and red fescue (*Festuca rubra*). Conover's findings indicate that those troubled by Canada geese should break up open areas with plantings of trees, hedges, shrubs and other tall vegetation to prevent the birds from landing. Such plating should be at least 3 feet high (as tall as a goose's head) so they obstruct the birds' vision and make arrival and departure difficult. Instead of planting Kentucky bluegrass, try tall fescue (*F. elatior*), , which Canada geese find particularly unpalatable. Planting certain groundcovers can also help discourage Canada geese. Conover found that the geese will not feed on English ivy (*Hedera helix*), Japanese pachysandra (*P. terminalis*), or vinca (*V. minor*).



11. Ketchik, "Goose-resistant Grass Being Studied", Alaska Magazine, October 1998.

Research associate from the University of Alaska Fairbanks' agricultural branch, Peter Scorup, was recently granted \$197,000 from the Alaska Science and Technology Foundation to test grass that might repel geese. Test plots were established in the summer of 1998 at four locations around Anchorage to study the effects of fertilizers and mowing heights on the growth of *Puccinellia arctica*. Scientists have previously observed, when this alkali grass was planted in order to restore habitat following the tans-Alaska pipeline's construction, that no animals ever appeared to graze on it.

Next summer (1999) goslings will be used to graze on test plots and be weighed. According to the Scorup, if the grass is indeed unappealing to geese, it could solve the burgeoning Canada goose problem in many cities along migration routes.

Apparently this alkali grass ranges in colour from dark green to almost yellow and is softer in texture than traditional lawn grass.

12. Lowney, Martin S., "Excluding Non-Migratory Canada Geese with Overhead Wire Grids", Pro. East. Wild. Damage Control Conf. 6:85-88. 1995.

A grid technique was modified and developed to discourage non-migratory urban Canada geese from using water sources and thus abandoning adjacent areas. The technique is believed effective because it restricts the use of water resources for escape and reduces the required long take-off and landing zones of Canada geese. The grid successfully reduced non-migratory Canada geese from using three sites in northern Virginia. Overhead wire grids were successful at substantially reducing the number of Canada geese grazing, loafing and nesting proximate to water bodies. When access to water bodies was denied, the local goose population abandoned the area, was substantially reduced or shifted activities to nearby water bodies.

Several grid configurations and types of materials are discussed. Stainless steel wire, kevlar line and polypropylene line have been tested. In a previous study (Terry, unpublished data) Terry reported difficulty handling 0.015 inch diameter stainless steel wire. The wires broke due to wind, bird strikes and unknown causes. The wire also tended to kink during erection of the grid which resulted in frequent maintenance. Polypropylene and kevlar were tested to overcome these difficulties.

Kevlar line (United Rope Works) has virtually no stretch with a durability estimated at a minimum of 10 years. Polypropylene stretches but fatigues due to ultra-violet light (National Netting Inc.), and has a life expectancy estimated at 3-7 years. The higher

cost of the kevlar line can be justified in its longer life expectancy, little to no maintenance, greater breaking strength and ease of handling. The smaller diameter of the kevlar line appears to put less strain on the posts from wind due to its smaller cross-sectional surface area compared to 12-gauge polypropylene line. Polypropylene line has deficiencies for grids, but its low cost and future technological advances make it worth considering.

The two-strand perimeter fencing (as opposed to no perimeter fencing) was found to be an integral part of the grid system to maximize the deterrence of Canada geese. Canada goose activity was found to be reduced even without the perimeter fencing, however, for maximum results, it is considered essential. A more durable line or wire than polypropylene is required for the perimeter fence if self-propelled lawn machinery is used proximate to the fence.

The success of the overhead wire grid system in this study is largely attributed to sturdy support posts and an adequate system to attach kevlar or polypropylene line. The author recommends the use of 5 foot heavy-duty steel fence posts over other posts tried. The use of eye-bolts and thimbles proved ideal in attaching the lines to the posts without causing fatigue in the line, thus keeping the rated breaking length of the line.

Management Implications - Overhead wire grids are most applicable over small bodies of water that have limited recreational use. The most ideal ponds are those at golf course and corporations. Larger ponds can be covered with a grid but this may preclude recreational opportunities such as fishing, swimming and boating.

13. Minnesota Department of Natural Resources. 1996. "Homeowners' Guide to Goose Problems".

Barrier fencing is a very effective method for excluding walking geese from yards. This consists of placing a physical barrier that geese cannot pass through between the water and the area to be protected. The fence should be made from a durable material and be at least 30 inches high, with openings no larger than 3 inches by 3 inches. It may be necessary to extend the fence line along property line to prevent geese from walking around the fence.

Landscaping a shoreline to make it less attractive for Canada geese is the most effective long-term method of reducing goose problems to individual lawns and yards. Canada geese will avoid areas where plants obstruct their view of the surrounding area. Fencing or repellents may be necessary to use while landscape is being established. A hedge with a gate can be effective, though the gate should be 30-36 inches tall and

thick enough to exclude geese. A dense strip of naturally occurring trees and shrubs (20-30 feet wide) should be left along the shoreline. A narrow S-shaped footpath can still provide access to the lake. A continuous band of emergent aquatic plants such as cattails or bulrush in the water in front of the shoreline can also reduce geese. An unmowed shoreline buffer of native grasses and wild flowers that grow 20-30 inches tall in a strip 20-30 feet wide along a shoreline can also discourage geese.

14. Phillips, Franklin Jr., & Brian Swift. 1998. "Proposed Canada Goose Management Plan for Nassau County Parks and Recreation", New York State Department of Environmental Conservation. February.

Resident geese in particular prefer low-cut, well-fertilized and manicured grass. Geese also have a strong affinity for water bodies. Using less fertilizer and allowing the grass to grow longer may reduce goose feeding. Conover (1991) has found that geese prefer grass species which are low in ash content and more easily severed, such as Kentucky bluegrass. Geese will not eat ground cover such as common periwinkle, Japanese pachysandra, or English ivy. For golf courses which are not used in the Winter, switching from rye grass to Bermuda grass (goes dormant in the winter) may help. For nesting, geese will look for areas where they will be safe from disturbances and predators, such as vegetated islands and peninsulas along water bodies.

Geese require a fairly long stretch of open runway to get off the ground or water and attain any altitude. Reducing the acreage of open water and lawn areas will decrease the attractiveness of the area to geese. Eliminating the long, unobstructed stretches will offer less security from predators, and make it more difficult for them to land and take off. The use of fencing and landscaping (shrubs or hedgerows) can be used as barriers. These methods are especially effective during the spring when adults are looking for nest sites, and in the summer moulting season. Access ramps to the water should be removed. The distance from the water to the land can also be modified so geese cannot jump from water to land (i.e. by dropping water levels or raising shoreline).

15. Quarles, William. 1995. "Managing Urban Canada Geese or The Geese That Wouldn't Leave", Common Pest Control. XI(3), Summer.

Although this article is a compilation of information on various goose deterrent techniques, the author argues that prevention is far the best solution to dealing with problems associated with Canada Geese. Preventing geese from nesting by altering habitats to remove nesting sites and preventing the formation of moulting flocks by diligent harassment programs are two of his key recommendations. He also states, "altering habitats or landscapes to make areas unsuitable for geese is the best long term strategy".

Nesting

Canada geese show a greater adaptability to nest sites than other waterfowl, however, the nesting site is almost always associated with water (be it a river, lake, artificial pond etc.). Hence, Canada geese nest near water and prefer somewhat secluded areas. Nests are usually located on the water's edge or a short distance from the shoreline.

The majority of geese nest in March, and by mid-May most eggs have hatched. Geese will remain close to the area they hatched until fledged (have attained the ability to fly), which takes about 60 days. Once geese successfully breed in an area, they become more difficult to discourage.

Moulting

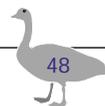
Moult of flight feathers occurs once a year between mid-May and late July. Adult geese will be flightless for a period lasting 4-6 weeks. Geese which successfully hatched goslings will stay with their young near their nesting area and will moult their flight feathers before their young can fly. Geese are extremely vulnerable to predation during moult and seek refuge in areas perceived by them to be safe.

Habitat Modification Option

Attractive nesting sites should be modified by the proper plantings. A dense ground hugging shrub layer around water bodies and other vegetative barriers between feeding and water areas will make the grassy feeding areas less attractive to geese. Taller vegetation around favoured goose nesting areas may be able to hide potential predators. Even if there are no predators, the potential threat will make the geese uncomfortable. One should avoid construction of islands in wetland areas or in artificial water bodies and nesting materials should be removed daily as nests are being built.

Planting tall trees around lawn feeding areas and water bodies also increases the flight clearance angle, making these areas more difficult for the geese to escape from or land in, as flight angles are too steep to clear surrounding obstacles.

Grass management also can be used to deter geese. Grazing geese prefer young shoots of newly sprouted grasses. If a more fibrous grass species is planted (e.g., winter dormant orchard grasses for cold climates, or tall fescues for mild climates) or the grass is allowed to grow taller it may become less desirable to the geese. Research is needed to determine which specific species or mixes of grasses could serve this purpose.



16. Smith, Art., & Scott R. Craven. 1998. A Techniques Guide for the Management of Canada Geese in the Urban Environment.

Large, unobstructed grassy areas close to open water are considered to be good goose habitat. The 3 basic ideas behind habitat modification are: to eliminate, modify, or reduce access to areas which attract geese. Habitat modification techniques used alone cannot usually prevent geese from using an area, especially once a flock of geese is already established. However, a combination of landscape modification and hazing may have additive effects. In the long term, habitat modification may be the most cost-effective solution. If nearby areas also host nuisance goose flocks, a co-ordinated effort will be necessary to solve the problem.

Islands are prime nesting areas for geese, and they also prefer long, straight, uninterrupted shorelines for loafing. These areas make the geese feel more secure. Eliminating islands and peninsulas, and modifying a straight, uninterrupted shoreline with vegetative clumps or boulders obstructs their view and will reduce an area's attractiveness to geese. The use of lines or grids strung above a site may prevent geese from landing on the water. Fences can prevent geese from walking from water to grazing areas. The openings should not be larger than 3 inches, and the fence should be at least 30 inches tall. The fence should be long enough to discourage geese from walking around the ends. Barrier fences can be enhanced with landscaping modifications.

A vegetative barrier can block favoured walking routes of the geese and/or obstruct their line of sight. Plants should be dense and high enough (minimum of 30 inches) to prevent adult geese from walking through the gaps, however, geese can often find ways to get through shrubs. The planting should be long enough to discourage geese from walking around the ends to reach the grassy area. Prairie grasses may provide an effective barrier as long as they are tall enough. Planting cattails, bulrush, or other tall aquatic vegetation along shorelines will create a visual barrier, and may prevent geese from coming ashore. Wide plantings (20-30 feet) at least 30 inches tall are most successful.

Mowed or cleared serpentine footpaths prevent a direct line-of-sight through the planted area for the geese yet still provide shoreline access for humans. Barrier plantings will require protection during establishment. Large boulders placed along a shoreline can create a visual and physical barrier to discourage use by geese. The boulders should be at least 2 feet in diameter. A rock barrier with plants above will enhance the effectiveness. It should be noted that geese are able to climb up smaller boulders.

Trees in the flight path between water and grassy areas can prevent geese from landing, however the trees should be both dense enough to prevent geese from flying through the canopy, and tall enough to increase the angle of climb or ascent above 13 degrees. This will only prevent geese from flying into an area, and not from walking, in which case trees are attractive for their shade.

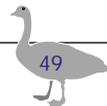
Geese prefer to eat younger grass shoots found on mowed lawns. As grass is allowed to grow, the younger shoots become harder to find. Reducing fertilizer use may also reduce the area's attractiveness to feeding geese. If watering is reduced or stopped, grass growth will slow and new, tender shoots will not be produced as frequently. Geese show a preference for Kentucky bluegrass, and tend to feed less on tall fescue. Unpalatable ground covers can also be planted.

17. US Department of Agriculture, APHIS (WS). 1998. "Controlling Canada Goose Damage", New Jersey, July.

Once geese become established, a combination of methods yields the best results. Where grass is allowed to grow long, geese will stop feeding. Grass should be grown longer along water bodies so that it is unpalatable to geese. Along water edges, unpalatable vegetation such as pachysandra, periwinkle, and Euonymus can be planted. Geese prefer to nest on islands, peninsulas, and undisturbed grounds, and in these areas in particular, habitat modification is necessary. A grid of suspended wires over water will decrease the attractiveness of a lake or pond. Fences, hedge rows and other physical barriers can control goose movement between water and lawn areas. Fences should completely enclose the site, with no breaks for geese to sneak through. They must also be at least 2 feet tall and solidly constructed. Fences may be hidden by planting hedges.

18. Whitford, Dr. Phillip, Draft Manuscript, "A Techniques Guide for the Management of Canada Geese in the Urban Environment", Personal Correspondence, June 1998.

Shoreline vegetation: According to Dr. Whitford, the idea of eliminating islands is good, although planting with dense vegetation or allowing natural vegetation to close the canopy and shrub layer, seems to work as well to reduce goose use of islands. He does not recommend using shrubs to break up the open appearance of shorelines for the reason that they are often the very sites geese choose to use as nesting cover. If however, the shoreline plantings are dense and wide enough to provide substantial predator cover and/or easy access to the water, geese would unlikely nest there. Shoreline vegetation otherwise works well in areas where nesting is not common and resting is the primary function of the shoreline in question.



Nest site selection: While Canada geese will occasionally nest some distance from ponds, they generally prefer to nest within several meters of open water (Brakhage 1965, Kossack 1950) and where there is both a loafing site for the male and partial concealment of the nest provided by vegetation. (Sherwood 1965, Brakhage 1965). As such, it is preferable to design or modify shorelines to provide a minimum of suitable nesting cover within 100 meters of the water's edge. Trees and shrubs which as sparsely planted provide shade, partial cover and allow access to the water. Geese will nest in cover as skimpy as a single large juniper, a small 2-3 square meter flower bed, or at the base of a mature tree with a relatively dense canopy to provide shade. (Whitford 1987) Providing a minimum of such sites near the water has the potential to significantly reduce nesting in municipal and industrial parks.

Note: Shoreline vegetation that is dense and wide can serve to deter nesting and loafing Canada geese. Hence, adding vegetation (as opposed to eliminating the vegetation) could also be effective in reducing nesting in municipal and industrial parks.

Peninsulas and shoreline projections: Dr. Whitford's research indicates that peninsulas or any projection of the shoreline that provides safe resting areas away from human traffic encourages geese to roost and rest thereon. He recommends the removal of small land projections that serve as resting sites for geese.

At park sites where there is a high use walking or jogging path that hugs the shoreline (and lacks projections people don't use) there is a major reduction in goose presence. Generally, geese are made uneasy by even slow walking approach of humans to within distances of 10 meters or less. Thus, placement of walking paths at roughly 12 meters from the water's edge forces the geese to move at least 24 meters from the water's edge to rest and avoid constant disturbance.

Based on his studies, Dr. Whitford suggests that geese appear to prefer to rest where they are undisturbed and where they have the option of quick and easy access to the water to avoid people and predators. He recommends the removal of small land projections coupled with intentional increase of human use patterns at the proper distance from the water's edge. Design of new parks or alteration of existing parks and business parks should maximize disturbance by human traffic to help to avoid or reduce human/goose conflicts.

Eliminate or reduce mowing: Dr. Whitford suggests that raising the height setting on the mower will reduce the attractiveness of the area for feeding geese. A mowing height of 6 inches will make finding tender young shoots more difficult for geese and will reduce the abundance of young tender shoots preferred by geese.

This method would be fully applicable to airfields without the possibility of obstructing vision along runways and taxiways and without attracting too many tall grass nesting species. It would also be applicable in the grassy areas immediately surrounding park ponds and once again reduce the attractiveness of the area to geese.

Note: In both cases presence of other suitable feeding areas within reasonable flight distance will enhance the effectiveness of this approach.

Reduce proximity of ball fields to open water. Whitford (unpublished 1993) found mean dropping densities of 14-18 per meter squared in random sampling on playing fields where the playing fields were located less than 200 meters from ponds frequented by geese. These were far greater than dropping densities on non-fertilized adjacent grassy areas.

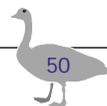
Whitford recommends that reduction in fertilizing and mowing may help to some degree, but states it is far more advisable to design parks so that playing fields are as far from the water as possible. Original design or modification of current park layout that locates playing fields at a distance of more than 400 meters from the water can potentially have the effect of reducing the goose grazing/dropping problem since geese will rarely walk that far to feed (especially if the fields are separated from the water by high and/or dense vegetation and especially during the molting season when geese are more reluctant to venture too far from the safety offered by the water).

II Habitat Preferences & Site Selection Studies

Introduction

The following articles are studies of Canada geese - their habitat preferences and site selection activities. Often the author's are concerned to attract Canada geese and therefore discuss habitat characteristics which are attractive to or are preferred by Canada geese. This information can be used, however, in order to identify habitat types on properties/sites of concern which may be attractive to Canada geese and which therefore should be modified.

As well, many of these studies highlight preferential habitat characteristics as opposed to necessary habitat characteristics which attract geese. For example, Canada geese may show a preference for Kentucky Blue grass over rye grass, or may prefer to nest on an island in an area of low and/or sparse vegetation over a roof top or forest, however, geese have been known, to eat rye grass and nest on roof tops and in forests. There is debate, however, concerning the circumstances which cause



geese to engage in behaviours which do not coincide with what we know about goose behaviour based on our knowledge of goose ecology. Many argue that when pressed or stressed, geese will do unexpected things like nest on roof tops. Others argue that geese are simply adapting to urban environments.

Irrespective of the debate, studies of preferred habitat and habitat features provide useful information in terms of: i) helping to predict where nests are for egg oiling/adding activities; ii) predicting the likelihood of geese habituating a site; iii) providing a baseline from which to assess properties/sites of concern - compare the site of concern to ideal goose habitat as seen where the similarities in order to determine the features on the site which are likely attracting geese, and; iv) providing information which can help attract geese to particular areas of the site away from human activity and discourage them from other areas which may cause a conflict with human use.

For example, overseeding or replacing an entire site planted with Kentucky Blue grass (the number one preferred grass of Canada geese), and replacing it with perennial rye (the number three preferred grass of Canada geese) may not have the effect of reducing or eliminating use by Canada geese, particularly if they are already habituated to a site. Such a strategy would likely have greater success if half the site continued to be seeded with Kentucky Blue in order to attract the geese to this area and was maintained as a grazing area for geese, and the other half was overseeded or replaced with perennial rye and was maintained as recreational space for humans.

According to Michael Conover, when a less-palatable grass is planted in order to alleviate a nuisance goose problem, it will have to be combined with other abatement techniques. Also, the degree of success will depend on the availability of alternate foraging sites.

1. Conover, M.R. 1985. "Manipulating Feeding Sites Reduces Damage Caused by Canada Geese", *Frontiers of Plant Science*.

Captive Canada geese were tested for feeding preferences of 5 different grasses: colonial bentgrass, Kentucky bluegrass, K-31 (a tall fescue variety), perennial ryegrass and red fescue. The geese showed a strong preference for Kentucky bluegrass and a strong dislike for K-31. When no choice was available, however, hungry geese fed on any of the five grasses. This suggests that planting K-31 instead of Kentucky bluegrass at a problem site may discourage geese from feeding there as long as other grass or food is available elsewhere.

The physical and nutritional properties of the 5 grasses were examined in order to

determine why geese disliked K-31. It was found that the feeding preferences related to the force required to sever a given amount of leaves (a measure of how tough or tender the leaves are). Feeding preferences did not relate to the amount of protein or carbohydrates in the grass. Hence, the data indicate that the geese selected grass with tender leaves and avoided grass with tough leaves.

2. Reese, Kerry P., John A. Kadlec, Loren M. Smith. 1987. *Characteristics of Islands Selected by Nesting Canada Geese, *Branta canadensis. *Canadian Field - Naturalist* 101(4): 539-542.**

The objectives of this study were to determine the environmental factors important to Canada geese in Utah when birds are selecting island nest sites, evaluate findings in relation to similar studies and to make recommendations for construction of artificial islands.

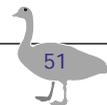
Characteristics of sites used by nesting Canada geese were determined at Ogden Bay, Utah, in 1983. Muskrat lodges were generally avoided in favour of larger, man-made islands. In comparison with unused islands, nests chosen by geese were well-spaced (in response to territorial behaviour) and tended to be located on islands 0.5 to 1.4 m in height, close to open water, and shorter in vegetation (for enhanced visibility). Islands > 1.4 m high were rarely used (1/6) and no islands under 0.5 m were used. Nesting islands tended to be nearer to open water (2.4 vs 4.9 m) and in shorter vegetation (53.3 vs 63.6 cm) than unused islands. Lack of vegetation on the islands did not appear to inhibit nesting by geese.

The author's suggest that although many of the sites were suitable for nesting geese but were unused, the reason is most likely that either the goose population was inadequate to use all sites or intraspecific competition. Hence, this study highlights preferential island characteristics as opposed to necessary island characteristics.

Comparisons with different races of Canada geese suggest that nesting islands are based on similar environmental cues. To increase use of earthen islands by nesting Canada geese in similar areas, the authors recommend construction of relatively flat islands, at 100m inter-island distances, 2 to 4.5 m in diameter, with a height of 1 m above water level.

3. Johnson, Gregory D., David P. Young, Jr., Wallace P. Erickson, M. Dale Strickland and Lyman L. McDonald. 1996. "Assessing River Habitat Selection by Waterfowl Wintering in the South Platte River, Colorado". *Wetlands*. Vol. 16, December, No. 4, pp. 542-547.

The authors assessed river habitat selection of waterfowl wintering in the South



Platte River to determine potential impacts of proposed river channel modifications. Daily mean number of waterfowl was 711 per km of river over the study area and 19 species of waterfowl were observed. Habitat selection indices indicated that Canada geese (*Branta canadensis*) used all habitats in proportion to their availability.

Habitat Types (Definitions)

River habitats were classified as primary channels or secondary channels; primary channels were defined as those channels with the greatest flows where the river was braided. Sub-habitat types within channels were pools, riffles, runs, islands and sandbars. Aquatic habitat units (pool, riffle, run) were defined according to the U.S. Forest Service (1995) and Schmal et al. (1990): pool - portion of river with reduced current velocity. Often with water deeper than surrounding areas; riffle - shallow rapids where water flows swiftly over completely or partially submerged obstructions to produce surface agitation, but standing waves are absent; run - calm water flowing smoothly and gently, with moderately low velocities and little or no surface turbulence. Islands - vegetated areas of land within the river that divided primary and secondary channels. Sandbars - unvegetated exposed sand extending into the river from banks or areas of exposed unvegetated sand within the river itself.

4. Reese, K. P., J. A. Kadlec, & L. M. Smith. 1987. "Characteristics of islands selected by nesting Canada geese, *Branta canadensis*", *Canadian Field-Naturalist*. 101(4):539-542.

Muskrat lodges were generally avoided in favour of larger, man-made islands. Nests tended to be located on islands 0.5 to 1.4 m in height, close to open water, and in shorter vegetation for enhanced visibility. Spacing behaviour of geese rendered many of the islands, which appeared acceptable on the basis of physical and vegetative characteristics, unsuitable as nest locations. Lack of vegetation did not appear to inhibit nesting by geese.

5. Harvey, William F., Richard A. Malecki, & Edward C. Soutiere. 1988. "Habitat Use By Foraging Canada Geese in Kent County". *Trans. NE Sect. Wildl. Soc. Vol. 45. pp.1-7.*

Many species of geese, including Canada geese (*Branta canadensis*), have altered their feeding habits from aquatic and moist-soil vegetation to agricultural crops while on staging and wintering areas. Geese commonly prefer green crops (e.g., winter wheat) during fall, but rely on energy rich foods such as corn during winter, particularly at northern latitudes. Green crops often constitute an important part of the diet in late-winter and spring when geese diversify their diets to include nutrients not found in grains.

Use of agricultural fields by foraging Canada geese was examined during October-February 1984-86 in Kent County, Maryland. Concurrent estimates of crop acreages

and progress of harvest and planting were used to determine habitat availability. In all months, corn stubble was the field type used most, and was preferred in October 1984 and October-December 1985. Standing corn was important in late-winter when snow covered waste grain. Geese never preferred harvested soybean fields, but use of these fields increased during late-winter. Hay-pasture fields were preferred in October of both years, but received limited use in later months. Winter wheat fields were seldom used and were often avoided in late-winter. Results indicate that geese did not diversify diets to include green crops before spring migration; they evidently rely on staging areas to obtain body reserves needed for reproduction.

III Management Documents (Techniques, Strategies & Plans)

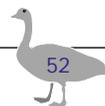
1. Cooper, James A., & Tom Keefe. 1997. "Urban Canada Goose Management: Policies and Procedures". *Trans. 62nd No. Am. Wildl. And Natur. Resour. Conf. pp. 412-430.*

This paper describes Minnesota urban goose management policies and presents data for the metropolitan Twin Cities Area goose population. Policies, Goose Population and Complaint Surveys, Evaluation of Management Procedures are discussed.

Extirpated during European settlement over most of its former southern breeding range, the Canada goose (*Branta canadensis*) was reestablished in the midwestern and eastern US and Canada. First released in urban/suburban environments in the 1940s, the species was breeding in several midwestern and eastern cities two decades later. Since then, Canada goose populations including metropolitan flocks have grown at phenomenal rates. Ankney (1996) reported breeding in Ontario geese grew from < 1000 in 1967 to 190,000 in 1994. Zenner (1996) estimated Mississippi Flyway giant Canada goose (*B.c. maxima*) numbers at 1 million in 1996, mostly from reestablished flocks.

2. Fairaizi, Steven D. 1992. "An Integrated Approach to the Management of Urban Canada Goose Depredations". *Proc. 15th Vertebrate Pest Conf. (J.E. Borrecco & R.E. Marsh, Editors) Published at University of Calif., Davis.*

Canada geese (*Branta canadensis*) in the Reno-Sparks, Nevada urban area have become a problem of increasing significance. Nuisance complaints from city parks, golf courses, and housing developments augment the bird hazard to aircraft operations at the local airport. A multi-agency task force, composed of federal, state, county, city and private (including animal welfare) organizations was formed to develop and implement an integrated management plan. Short-term controls included disruption of roosting and feeding sites adjacent to the airport, hazing, public education and gosling relocation. Development of a suburban goose refuge was proposed as a long term control. Long term management ramifications of this integrated approach were



improved agency services to constituents, vigor of the local goose population, and quality of life for people through mutual coexistence with the birds.

The annual number of urban Canada goose depredation complaints received in the Reno Animal Damage Control (ADC) office has increased from 3 to 47 over the past 5 years. Nuisance problems occur throughout the year but most complaints coincide with the arrival of migrant birds in November and December. The Reno-Cannon International Airport's goose problems were compounded by the creation of a lake (Casino Lake) adjacent to the airport on property owned by a prominent hotel and casino. The geese soon found this isolated lake and it became a major roost for migrant birds. Increased depredations have developed on turf and pastures located in the Reno-Sparks metropolitan area and in surrounding subdivisions of Washoe County (or Truckee Meadows).

In an attempt to eliminate the roost on Casino Lake the Hotel constructed an experimental wire grid designed by the ADC staff biologist. The entire grid was attached to the existing perimeter fence. A 61 m grid framework of 10 gauge solid plastic wire was constructed. A 9 m grid of 15 gauge plastic wire was attached to the top of the framework. Wires were approximately 6 m above the water at the shoreline and 1 m above the water at the lake's centre. The Hotel expended a total of \$ 11,050 to install the grid. Material and labour costs were approximately \$2,550 and \$8,500 (386 human hours) respectively. Construction began in December 1988, but completion was delayed by weather until April 1989. (The task force evaluated the stainless steel wire grid system proposed by Terry (1984) and decided that plastic wire was preferable because of its lower cost and elasticity.) No bird injuries, due to collisions with the grid, have been recorded during the 18 months that the grid has been in place.

The effectiveness of the wire grid was probably due to 2 factors: first, a perimeter fence prevented geese from landing on the shoreline and walking into the lake, and second, the birds using the lake were predominantly migrants which tend to respond better to exclusion devices.

Pyrotechnics and mechanical scare devices used to reduce urban depredations included: whistle bombs, bird bombs, cracker shells, plastic flags, mylar tape and eye-spot balloons. Migrant birds responded well to this harassment. Birds which had become accustomed to human interactions throughout the year responded well but required more persistence to achieve desired results.

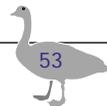
The primary long term objective was the development of a suburban goose refuge where birds from the metropolitan area could live undisturbed. Airport planners, assigned to the task force, became aware of a U.S. Army Corps of Engineers flood control and sediment retention project along a creek on the east edge of the Truckee Meadows. This project would provide an excellent opportunity to establish a goose refuge complete with feeding sites and a deep water roost. Geese from the urban area could be attracted to or hazed into this refuge. This suburban refuge could provide recreational and educational opportunities for Truckee Meadows citizens while minimizing depredations in urban areas.

An update - According to Norm Saake, State-wide Migratory Game Bird Co-ordinator for the State of Nevada, the long term objective of establishing a goose refuge in Truckee Meadows was never pursued. He insists, however, that refuges in urban areas, where people can come and feed the geese and whose habitat is made attractive to geese, in combination with hazing and scare tactics in adjacent human/goose conflict areas, such as parks, golf course etc., would be an effective means of addressing human/goose conflicts in urban environments. He can be contacted at the following number: (702) 688-1500. Please see DU for details on lure grazing sites.

3. Rockland County, Environmental Management Council, Executive Committee of the Canada Geese Citizens Advisory Committee, "Non-Lethal Controls for 'Resident' Canada Geese", July, 1996.

This report represents a factual documentation of information gathered since 1993. It fulfills the mission of the Canada Goose Citizens' Advisory Committee which was to 1) serve as an educational resource; 2) provide accurate, scientific information; 3) offer management options to concerned citizens and government leaders; 4) concentrate only on non-lethal Canada goose control methods, plus egg addling.

The Canada Goose Citizens' Advisory Committee was formed in the aftermath of a conference convened in the Legislative Chambers on September 22, 1993 to discuss Canada geese with a Blue panel of experts from across the country. In addition to information about the habits, habitat and methods of control of Canada geese, important and reassuring information came from Dr. Milton Friend, Director, Wildlife Health Research Centre, Water-Fowl Diseases, U.S. Fish and Wildlife Service, Madison, Wisconsin, who assured the assemblage that extensive research and records showed no documented human illness attributed to these birds. His is the largest program in the world dedicated to the study of waterfowl disease.



Under “Recommendations”, the Committee states that it is their opinion that the best and safest methods for people and geese are non-lethal controls, including the following:

1. Alter the Habitat

- A) **Grass:**
 - i) Reduce grassy areas by planting large borders of ground cover. Geese do not like to walk through such plantings
 - ii) Plant trees and shrubs. Geese tend to avoid lawns when they cannot see a water body for a quick getaway.
 - iii) Allow grass to grow taller. Geese do not like to walk through tall grass.
 - iv) Turn part of the lawn into a wildflower meadow.
 - v) At a golf course, increase the rough wherever possible.
 - vi) Plant grass less tasty to geese. Substitute fescues for Kentucky Blue Grass.
- B) **Water:**
 - i) Surround with trees and shrubs to obscure escape routes and to intercept the 6 degree takeoff vector of the geese.
 - ii) Install vertical rocks and fencing around ponds to limit access.
- C) **Zoning By-laws:**
 - i) Could require new developments to include landscape features that will help prevent or control problems with geese.

2. Encourage Geese to Feed From Nature:

- A) Discourage feeding by the public in nuisance areas. Such feeding attracts geese and encourages them to remain. Feeding also allows birds to become tamer than they should be for their own protection.
- B) Pass non-feeding legislation to discourage feeding in certain areas.
- C) Such legislation gives municipalities the freedom to continue in unimpacted areas and to use feeding to lure birds away from impacted areas.

3. Install Mechanical Barriers

- A) Fences, Hedgerows and other Physical Barriers - are effective tools to restrict movement. In most problem situations, Canada geese tend to walk, not fly, to and from water to feed. A low fence or other barrier to prevent access may be all that is needed to solve the problem.
- B) Electric fencing has been successful at corporate parks and large estates. A 12 inch high electric fence carries a 6 volt jolt, which deters geese, but does not hurt them.

4. Utilize Noise Makers - noisemakers used in conjunction with balloons and/or scarecrows will enhance the effectiveness of both.

- A) Auto-exploders, such as bottled propane gas, are relatively small, can be set to go off automatically, and can be used for years with proper maintenance.
- B) Shell crackers are special shells that project a firecracker up to 125 yards. By using them when geese first appear in an area, the birds can be persuaded to go elsewhere.
- C) Timed sirens can be combined with flashing lights.
- D) Bangers and screamers scare geese at dusk.
- E) Ordinary banging on pots and pans.

5. Methyl-Anthranilate - REJEX-IT

- A) Methyl-Anthranilate is a naturally occurring sweet flavoured substance in plants such as jasmine, concord grapes and orange blossoms.
- B) In one experiment, conducted by Dr. Curtis, Wildlife Specialist, Department of natural resources, Cornell Cooperative extension, REJEX-IT proved to have a strong impact on geese causing them to move off the test site immediately after application. A few applications were necessary. Overall, the number of geese found in the study area decreased consistently over time, eventually resulting in a total lack of birds on the treated areas by the last day of observations.
- C) This deterrent has won approval from the US EPA and the NYS Dec. For information call the manufacturer, RJ Advantage, 800/423-2473.

6. Use of Trained Dogs

- A) Border Collies have proven highly successful in herding geese out of ponds and grassy areas at golf courses and other facilities.
- B) Dow Jones and Company Inc. started using Border Collies in 1992 at their 175 acre corporate headquarters in NJ. The dogs herd the geese into the pond and keep circling it. The geese get frustrated because they can't waddle out and eat the grass, so they leave. The company is getting inquiries about the dogs from other corporations and golf courses.

