Canada Goose

Management Strategy

for Mount Arrowsmith Biosphere Region

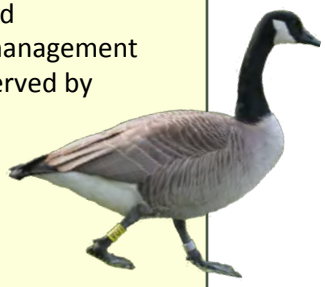
This management strategy outlines scientifically-based management solutions to reduce and control locally overabundant Canada Goose populations.

While it applies to an area of land and sea corresponding to the lower elevations of Mount Arrowsmith Biosphere Region on east-central Vancouver Island, British Columbia, Canada, the strategy may be a valuable resource for any jurisdiction struggling with 'too many', nuisance, or invasive Canada Geese.

Purpose

The primary focus of this strategy is to facilitate the restoration of high quality fish and wildlife habitat, and in particular, estuarine marsh habitats degraded by locally overabundant Canada Geese (*Branta canadensis*). Without goose management, restoration efforts will be short-term and limited to areas exclosed from geese.

Importantly, this strategy is *not a management plan.* The strategy provides the science to inform regional Canada Goose management, and introduces and recommends options for management. We hope those who are tasked with creating and implementing management plans are well served by the information herein.



THE GUARDIANS

Since 2002, members of the Guardians of MId-Island Estuaries Society have led efforts to reduce regional Canada Goose populations by addling eggs and promoting additional hunting. From 2008 to 2012, the Guardians and other volunteers banded and collared nearly 300 Canada Geese at the Englishman River, Little Qualicum River, and Craig Creek estuaries. Marked and unmarked Canada Geese in the region were surveyed to learn more about their seasonal abundance and use of the estuaries and other habitats. Today, we have sufficient knowledge to guide this science-based management strategy.

GUARDIANS OF MID-ISLAND ESTUARIES SOCIETY

MESSAGE FROM THE AUTHOR

I have written this document in the first-person, meaning that "I" is me (Holly), and "we" refers to all of the members of the Guardians of Mid-Island Estuaries Society (The Guardians). I am a member of the Society, a biologist, and a budding social scientist (DocSocSci Candidate, MA, BSc., Dipl. Renewable Resource Management). I became involved in this project because I like Canada Geese and I'm a huge fan of estuaries. I was eager to discover whether the two could peacefully coexist.

In 1987, I was hired by Alberta Fish and Wildlife to assess regional Buck for Wildlife projects, which included installing round hay bales to encourage Canada Geese to nest in prairie potholes. There, local biologists celebrated the discovery of every goose found nesting on a man-made structure. Twenty years later, I wandered mid-island estuaries to search for Canada Goose eggs, to prevent them from hatching. It was hardly cause for celebration.

'Too many geese' is a challenging problem. There are no magic formulas or quick and easy fixes. Recognizing that we still have much to learn about Canada Geese and their management, I welcome informed critiques and new ideas. I expect there are errors and omissions in this document, and certain statements and recommendations will be unpopular in some circles. When fingers are pointed, they are not meant to criticize, but to respectfully direct those with the power to fix this unsatisfactory situation. My wish is for users to select the types of management actions that will work best for their communities and for the health of estuaries and other sensitive and valuable ecosystems.

Whlle this document is scientific, it is not without colloquialisms. This is purposeful, to appeal to a broad spectrum of readers. Canada Goose management requires many types of expertise.

DISCLAIMER

This report and the publications cited and discussed herein are intended solely for information purposes. We accept no liability for the consequences of any actions taken on the basis of the information provided in this document.

CITATION

Clermont, H. 2015. Canada Goose (*Branta canadensis*) Management Strategy for Mount Arrowsmith Biosphere Region: Towards the Restoration of Goose-Damaged Estuaries. Prepared for the Guardians of Mid-Island Estuaries Society. Available from guardiansmie.org.

or

Guardians of Mid-Island Estuaries Society. 2015. Canada Goose (*Branta canadensis*) Management Strategy for Mount Arrowsmith Biosphere Region: Towards the Restoration of Goose-Damaged Estuaries. Prepared by H. Clermont. Available from guardiansmie.org.

ACKNOWLEDGMENTS

Goose roundup crew at Little Qualicum River estuary, July 2010

There were many people involved in the production of this strategy and the years of work leading to it. Please accept my apologies if I have missed anyone.

The Guardians Board has led the way since its inception in 2010. The Board consists of John Cooper, Tim Clermont, Craig Wightman, Doug Herchmer, Karen Barry, and Doug Janz, an outstanding group with a wealth of knowledge of wildlife biology and ecology. They were the primary reviewers of the strategy.

The banding crews were a courageous and cheerful lot. In alphabetical order, they were Karen Barry, Kirsti Brennan, Trudy Chatwin, Dawson Clermont, Holly Clermont, Jory Clermont, Tim Clermont, Adrian Cooper, John Cooper, Eric Demers, Bruce Cousens, Doug Herchmer, Charlene Lee, Lori Lynch, Shane Johnson, Joel McNeil, Donna Monty, Guy Monty, Rich Mooney, Danielle Morrison, Gabe Pakozdy, Aaron Ritchie, Shawn Stenhouse, and Craig Wightman.

The addling crews were fearless and had at least one strong arm. In alphabetical order, they were Terry Berkely, Bev Bravender, Ian Bryce, Owen Catheral, Holly Clermont, Tim Clermont, John Cooper, Selam Cooper, Kokeb Cooper, Neil Dawe, Steve Godfrey, Doug Herchmer, Lori Lynch, Donna Monty, Guy Monty, Danielle Morrison, Phil Morrison, Aaron Ritchie, and Kevin Robinson.

Monitoring of Canada Geese was led by Danielle Morrison, Aaron Ritchie, Phil Morrison, and Tim Clermont. Regular surveys were augmented by observations from Holly Clermont, Rhys Harrison, Mike Murphy, Mike Inglewood, and Dawson Clermont.

Winter survey participants included, in alphabetical order, Karen Barry, Suzanne Beauchesne, Lynne Brookes, Heloise Chenelot, Tim Clermont, John Cooper, Kokeb Cooper, Selam Cooper, Bruce Cousens, Neil Dawe, Eric Demers, Nadene Ebell, Dan Gray, Sandra Gray, Kevin Green, Maggie Green, Derrick Grimmer, Rhys Harrison, David Helem, Pat Herzog, Bob Hunt, Mike Ingledew, Doug Janz, Janet Jefferey, Charlene Lee, Elaine Lefebvre, Maggie Little, Danielle Morrison, Karen Morrison, Gary Murdock, Ronda Murdock, Andy Pearson, Margaret Pim, Aaron Ritchie, Jeanne Schippers, Rob Schippers, Pat Sears, Peggy Sowden, Howard Stiff, Roger Taylor, Catherine Watson, and Craig Wightman.

Danielle Morrison and Aaron Ritchie were tasked with most data entry. Heloise Chenelot set up our Access database, no easy feat. Howard Stiff, Tim Clermont, Danielle Morrison, and Aaron Ritchie patiently assisted with data cleaning. Howard and Danielle graciously shared their software skills and programming expertise. Howard performed most of the project's statistical analyses, and we are very grateful for his considerable skills in navigating challenging datasets. Mark Drever (CWS) conducted an early statistical analysis of current and historical data, and provided analytical assistance. Arco Van Strien provided the TRends and Indices for Monitoring (TRIM) software program and guidance for its use. Special thanks to Tim Clermont, Howard Stiff, and Danielle Morrison for many hours of mind-bending, brainstorming fun.

Thanks also to external reviewers David Bradbeer, Tom Reid, and Jack Evans.

The Guardians of Mid-Island Estuaries Society logo was created by the very talented Amy Hillaby. Many thanks to Guy Monty and Lyn Topinka who contributed amazing close-up photos. Thanks also to Doreen Bakstad, Trudy Chatwin, Tim Clermont, Charlene Lee, Neil Dawe, Mike Inglewood, and others who graciously shared photos. Most photos without credits were provided by Holly Clermont and Danielle Morrison.

Orthophotography was provided by Tom Sohier and Margaret Paridaen (Regional District of Nanaimo (RDN)). Mapping support was provided by Danielle Morrison and Dan Buffett (Ducks Unlimited Canada (DUC).

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Executive Summary

Beginning in the 1950s, enthusiastic wildlife managers across North America began relocating Canada Geese and enhancing potential goose habitats in a concentrated effort to grow their populations. This highly successful assisted migration led to many locally overabundant goose populations. Unwanted geese were transplanted to unfilled sites where their offspring would eventually become a problem for farmers or municipalities and the phenomenon would repeat.

Once a small population was established, site fidelity, a tendency to return again and again to the same places, ensured it would continue to grow. Young breeding females in particular precipitated exponential growth in local goose populations by returning to nest where they were hatched or reared. It is a myth that geese have become a problem because of a failure to migrate.

In fact, many geese in the area do migrate, if only for short distances (e.g., to the Saanich Peninsula or Washington State), debunking the notion that geese stay in the area because all of their needs are met right here. Fourteen different migrant types have been found among geese that were presumed resident, banded at the nest or during the moulting (or flightless) period. These ranged from local residents, present for all five seasons of the Canada Goose life cycle (i.e., spring migration, nesting, moulting, fall migration, and overwintering) to birds that flew long distances (e.g., to California, Alberta). Although local residents are the foundation of our year-round Canada Goose population, other migrant types are always present. Migrants are attracted to areas where local residents gather, and within a few days can have a major impact on those habitats.

Such findings are key to effective management decisions. Since 2000, members of the Guardians of Mid-Island Estuaries Society have helped manage Canada Geese to protect conservation lands damaged by burgeoning goose populations, and in 2008 began marking individual birds ahead of surveys to better understand their population dynamics and distributions. Birds were banded at the Little Qualicum River (LQRE), Englishman River (ERE), and Craig Creek (CCE) estuaries. More than 12,707 survey records, some dating back to 1989, as well as 1,663 nest records and 4,746 records of re-sighted marked birds were used to examine our regional Canada Goose population and develop this strategy.

Still, we were unable to determine whether the regional population is significantly increasing or decreasing. Comparable external datasets, such as those from Bird Studies Canada, showed weakly increasing or possibly cyclic trends. Notably, goose populations are unlikely to be limited by the ecological carrying capacity of the region. They were observed on only 232 of 342 sites identified as available goose habitat.

There were two times of year when large numbers of geese were observed. Overwintering and summer moult counts were higher than counts in other seasons, peaking at ~1,500 birds in 2014. These peaks, partly attributed to additional survey sites, may be of management concern. Only continued monitoring will determine whether these represent a new trend upwards, peaks in a recurring cycle, or standalone highs.

The least amount of mixing between local residents and other migrant types occurred during the nesting season. The maximum count during the nesting season was 443 in 2013, not including undetected nesting birds and geese that left the region to moult. If surveys of both breeding and non-breeding were conducted on and near the nesting grounds, a trend for local resident populations might emerge.

Across all seasons, goose counts were highest at the estuaries. During the moult, they concentrated on the estuaries and in marine and freshwater habitats, such as Hamilton Marsh. In fall and winter, estuaries were preferred roosting and loafing sites, and destinations when other areas were exposed to hunting pressure or were frozen. Our estuaries experienced a reprieve of sorts only after the moulting period prior to the first hunting season, when flocks tended to forage elsewhere.

Estuaries are critical and year-round habitats for Canada Geese, but they are also used by an estimated 80% of coastal fish and wildlife and provide many services to humankind (e.g., flood control, water filtration, carbon sequestration). Geese have overgrazed mid-island estuarine marshes, and grubbed the roots and rhizomes along channel edges, exposing the thick marsh platform to erosion. Built up over millennia, this platform has washed away in many areas, channels have become shallow, and productive habitats have been reduced to gravel. When a similar scenario occurred in northern salt marshes, primarily from overabundant snow geese, entire plant communities were eliminated and areas exclosed from geese remained denuded 20 years later.

Even without the additional burden of overgrazing geese, many mid-island marsh ecosystems are at-risk of extinction; at least four ecological communities are provincially imperiled, and another three are of special concern. Geese have also introduced invasive plants into imperiled Garry Oak ecosystems, and may be overgrazing eelgrass, a keystone species in estuarine and subtidal environments.

Urban and agricultural areas have also suffered. When the size of habitats were taken into account, goose densities were found to be highest in the Parksville Church Road and Parksville Bay/City areas, and on sites with access to freshwater in particular.

High concentrations of geese may lead to contamination of drinking water, and fouling of beaches, parks, school grounds, sports fields and other sites, all of which pose risks to human and animal health. Island Health inspectors have found no significant issues with water samples taken from Qualicum Beach, Parksville, or Rathtrevor Provincial Park's popular beaches. However, other areas remain unsampled. Young children playing in sand may have a greater exposure to goose-borne bacteria, as bacteria persist longer in sand than in water. Some dogs participating in hazing programs have become unwell. A 2010 health risk assessment, commissioned by the Canadian Wildlife Service (CWS), found there were insufficient data to conduct a meaningful assessment. It recommended fecal waste management, a working group to develop national standards for the management of peri-urban (or 'rurban') goose populations, and investments in monitoring and research.

Our survey of stakeholders identified many concerns. The Department of National Defense was concerned about bird strikes near its helicopter pad in Nanoose Bay. Local farmers had experienced crop damage. Some respondents suspected contamination of drinking water, shellfish beds, and areas used by farm animals. People complained about damage to landscaping, noise issues, and aggression towards people and pets. Many had incurred costs associated with goose control or damage. Importantly, the survey revealed Canada Geese had diminished the quality of life of area residents by keeping them from enjoying special places and activities. Some local businesses were affected by off-put tourists. Although it appears that our communities have exceeded our tolerance, or 'social carrying capacity' for geese, additional community members should be surveyed to augment our limited survey data.

In Canada, they may be an icon, but in many other countries Canada Geese are considered one of their worst invasive species and a serious threat to biodiversity. In some U.S. jurisdictions, they are classified as 'overly abundant'', although areas without this designation appear to have considerable latitude in dealing with nuisance geese. The U.S. Fish and Wildlife Service provides management support, including, among other things, capture and euthanasia, egg addling, and hazing. It maintains an e-permits website whereby anyone in the conterminous U.S. (i.e., the lower 48 States) can register for federal authorization to destroy Canada Goose nests and eggs. The U.S. Department of Agriculture (USDA) provides management services on a cost-reimbursable basis. There are also State-funded control programs. Due in part to the direct involvement of senior governments, culled geese suitable for human consumption are typically donated to food banks or other charitable organizations. USDA economists found that for every dollar spent controlling Canada Geese, U.S. $1.31 to $5.56 could be saved in damage and maintenance costs.

In general, a combination of hunting, egg sterilization, culling, and hazing are used to control Canada Geese. Elsewhere in B.C., organized hunts, kill permits, and large-scale egg addling programs have been used with some success. The first cull of geese on Vancouver Island was held in the Capital Region in the summer of 2015.

Hunting has been promoted as the best way to address nuisance geese. Twenty-one percent of our marked geese were shot by hunters, and 68% of these were killed within our region. Seventy-two percent of marked geese shot outside of the region had never been observed on huntable sites here. More than half of marked geese shot by hunters were banded at the Little Qualicum River estuary. All LQRE-banded birds had been observed on huntable sites in the region, whereas only one third of ERE-banded birds and two thirds of CCE birds were huntable.

If Canada Geese were designated as 'overabundant', exceptional hunting methods and equipment could be used. Hunting pressure may also be increased by opening new areas to hunting, even for a limited period, and by creating incentives for hunters, encouraging landowners with geese to allow hunters, and further reducing hunting restrictions. However, many studies have shown that hunting alone will not control goose populations.

Egg sterilization is a common management tool. The mid-island egg addling program has focused on the Englishman River and Little Qualicum River estuaries, and to a lesser degree on the Nanoose Bay unit of the Qualicum National Wildlife Area. Nest densities were highest at the Little Qualicum River estuary, however nest and egg numbers there are now trending downward. By contrast, the number of nesting geese at the other estuaries has increased. Despite these conflicting trends, we can unequivocally say the addling program has made a significant impact. From 2002 through 2014, it prevented at least 5,345 eggs from hatching, or at least 2,088 new breeding birds, despite a lack of consistent funding and personnel. Given an average clutch size of 5.8 eggs per goose, and using a very rough calculation, the addling program has prevented more than 6,000 additional eggs *per year*.

There are other ways to control geese, used with varying levels of success. What works well for one site may be unsuitable for another, and there is a legitimate concern that birds kept out of one area will wreck havoc elsewhere. Even hunting and egg addling move birds and impacts to other areas. Some survey

respondents had used damage or danger permits, however these are probably underutilized due to a lack of awareness that such permits exist, onerous permitting processes, and a reluctance to perform the tasks. A provincial compensation program for farmers was also underutilized; while compensation is not a control measure, it is a form of management.

Culling - the selective, lethal removal of wild animals, is a sensitive topic and has been considered a measure of 'last resort'. Yet, it has some distinct advantages over other types of control methods. Like hunting and permits to kill adult birds, it decreases the breeding population. However, it typically targets a larger number of birds at one time, can be applied directly to a problem population, its effects are obvious and immediate, and there are fewer risks that surviving members will cause problems elsewhere. Still, repopulation is anticipated, as individuals (e.g., moult out-migrants) that escaped the cull return, nearby populations continue to grow, and suitable habitats remain available.

Fewer people are opposed to culling of nuisance geese when they are utilized in some way. Other game animals have been culled, processed, donated, and even sold and exported, and our provincial agencies support the use of culled meat. There are revisions proposed to the *Migratory Birds Regulations* that would allow consumption of culled geese, requiring the development of standards with public health and food inspection agencies. A made-in-B.C. solution may also be possible, should the provincial inspection program take the lead and donated meat remain in the province.

Also anticipated are revisions to the *Migratory Birds Regulations* that allow First Nations to harvest migratory birds and their eggs throughout the year; to sell down and non-edible by-products; and to barter, exchange, trade, or sell birds and eggs with other Aboriginal communities. However, collaboration and consultation with First Nations is important for reasons aside from their potential contributions to goose management. Canada Geese frequent reserve lands and traditional use areas.

We encourage local governments and regulatory agencies to work together with affected landowners and land managers to reduce and control the regional Canada Goose population. It is appropriate that CWS leads a regional working group that dedicates and pools resources to address the full breadth of problems caused by geese. It is important that CWS, B.C. Ministry of Environment (MoE) and Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) develop a communications protocol to bridge the mostly-siloed goose management initiatives in B.C. so that efforts are cohesive, and experiences and expertise are shared. Some frank discussions should ensue, such as how CWS might set population objectives for Canada Geese based on the ability of habitats to support them, and the merits of an overabundance designation for temperate-breeding geese. The group should also develop a monitoring program in advance of predictive population modeling.

This strategy has been designed to serve individuals and groups coping with nuisance geese and/or tasked with creating and implementing management plans. There were three mostly distinct, but sometimes overlapping subpopulations in the region, corresponding to geese banded at the LQRE, ERE, and CCE. These subpopulations merit individual management plans, as they are composed of unique blends of migrant types, experience different levels of hunting pressure, and pose challenges that may not be relevant across the entire region. Recommendations for each plan are provided in Chapter 14.

Table Of Contents

Acronyms and Abbreviations

CAGO	Canada Goose/Canada Geese
CBC	Christmas Bird Count
CCE	Craig Creek Estuary
CDC	B.C. Conservation Data Centre
CFIA	Canadian Food Inspection Agency
CFMETR	Canadian Forces Maritime Experimental and Test Ranges
CRD	Capital Regional District
CREC	Campbell River Environmental Committee
CWS	Canadian Wildlife Service
DDT	dichlorodiphenyltrichloroethane
DND	Department of National Defense
DNR	Department of Natural Resources (U.S.)
DUC	Ducks Unlimited Canada
ERE	Englishman River estuary
GM	gentically modified
LQRE	Little Qualicum River estuary
MABR	Mount Arrowsmith Biosphere Region
MoE	B.C. Ministry of Environment
MFLNRO	B.C. Ministry of Forests, Lands and Natural Resource Operations
MVIHES	Mid-Vancouver Island Habitat Enhancement Society
NBE	Nanoose Creek/Bonnell Creek estuary
PQBWMA	Parksville - Qualicum Beach Wildlife Management Area
PCB	polychlorinated biphenyl
PECP	Pacific Estuary Conservation Program
RDN	Regional District of Nanaimo
ToR	Terms of Reference
TNT	Nature Trust of British Columbia
UBCM	Union of B.C. Municipalities
UNESCO	United Nations Educational, Scientific and Cultural Organization
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service

Chapter 1 - Background
Highlights

The problem of local overabundance, or simply 'too many Canada Geese', stems largely from exuberant wildlife management. Beginning in the 1950s, Canada Goose transplant and habitat enhancement projects spread like a wave across North America, rolling out along the Atlantic, Mississippi, and Central Flyways, and later in the Pacific Flyway, in a concerted effort to grow goose populations.

B.C. Ministry of Environment's 1979 *Preliminary Canada Goose Management Plan for British Columbia* sought to: increase B.C.'s breeding population from 25,000 to 40,000; develop major concentrations of migrating Canada Geese in several parts of the province to provide wildlife spectacles for public viewing; develop programs to reduce or prevent conflicts between geese and agriculture; and provide 45,000 sport-hunting days and an annual sustained harvest of 20,000 birds. Four types of conflict were identified, with agriculture, recreational areas, aircraft, and hunting near urban areas. At the time the plan was written, transplanted geese from Victoria had already made their way to Duncan, and 'less migratory' populations had established on the Lower Mainland.

Prior to the late 1960s, Canada Geese were considered migrants and temporary visitors throughout all of southern Canada. By the 1980s, geese were nesting in the region and trending upward. From 1989 to 1993, autumn surveys showed a 92% increase in Canada Goose populations.

Efforts to manage expanding Canada Goose populations began with the Nature Trust of British Columbia, on concerns for its holdings in the Cowichan Valley, Englishman River, and Nanoose Bay. A series of meetings over several years, with representatives from all levels of government and farmers, prompted an egg addling program on estuarine conservation lands. Addling, a form of egg sterilization, was initiated at the Cowichan River estuary in 1999, at the Englishman River estuary in 2002, at the Nanoose and Bonnell estuaries in 2003, and at the Little Qualicum River estuary in 2004.

From 2002, members of the Guardians of Mid-Island Estuaries Society led efforts to reduce regional Canada Goose populations through egg addling and by promoting additional hunting days and bag limits. Outreach by the Guardians and others included presentations to local governments, television appearances, production and dissemination of videos and brochures, news articles, seminars, meetings, and poster presentations. To better understand abundance and distribution, the Guardians banded and collared nearly 300 Canada Geese at the Little Qualicum River, Englishman River, and Craig Creek estuaries from 2008 to 2012, and conducted goose surveys from 2011 to 2014.

Citations, excluded here for brevity, can be found in the text of the document's chapters. Please do not cite highlights without consulting the chapters.

1.1 Problem Origins

Collared Canada Goose at her nest in Maple Ridge, B.C., May 1979 (the same year the Preliminary Canada Goose Management Plan for B.C. was drafted). Photo by John Cooper.

A Canada Goose is sometimes referred to as a *Canadian Goose.* Canada Goose is the accepted common name for the species *Branta canadensis.* It is found in many countries outside of Canada. The term *Canadian goose* more appropriately refers to any goose in Canada, regardless of species.

The problem of 'too many Canada Geese (CAGO)' is wide-ranging, extending far beyond Parksville, Qualicum Beach, Oceanside, or the lowlands of Mount Arrowsmith Biosphere Region. The source of the problem is also widespread, stemming largely from exuberant wildlife management across North America.

Canada Geese are known to migrate along four 'flyways' in North America; westernmost is the Pacific Flyway that includes our region. During the 20-year period from 1955 to 1974, the combined population of all races (and/or subspecies, see Chapter 3.1, Taxonomy) of Canada Geese in the Pacific Flyway declined by more than 10%. Yet, during the same period, populations in the Atlantic, Mississippi and Central Flyways increased by 138%, 169% and 70%, respectively, in "one of the more spectacular accomplishments of wildlife management" (Bellrose 1976, p. 142). Western wildlife managers and interest groups soon joined the quest to grow Canada Goose populations.

Despite their propensity to form highly localized populations, Canada Geese were successfully relocated from other areas, with high nest success and brood survival "even on areas subject to considerable human disturbance" (Bellrose 1976, p. 143). The relocations and introductions often occurred with enhancements to goose habitat and restrictive hunting regulations (cf. Ankney 1996; Smith 2000). This concerted effort to increase Canada Goose populations in North America carried on until at least 1987.

PRELIMINARY CANADA GOOSE MANAGEMENT PLAN FOR BRITISH COLUMBIA

A *Preliminary Canada Goose Management Plan for British Columbia* was drafted in 1979. It described the Canada Goose as "prized by sportsmen for its wariness, size and table quality", as well as "highly adaptable", and able to "reproduce prolifically in close proximity to man when habitat is available" (BC Ministry of Environment (MoE) 1979, p. iii). At that time, the Ministry aimed to:

1) increase B.C.'s breeding population from 25,000 to 40,000;
2) develop major concentrations of migrating Canada Geese in several parts of the province to provide wildlife spectacles for public viewing;
3) develop programs to reduce or prevent conflicts between geese and agriculture; and
4) provide 45,000 sport-hunting days and an annual sustained harvest of 20,000 birds.

It would achieve these objectives by protecting and enhancing breeding and staging habitats, establishing sanctuaries to attract concentrations of Canada Geese, and restricting hunting to allow transplants to thrive. "Advice will be provided to people who wish to attract geese to their property", stated the author (MoE 1979, p. 10). Expecting some of the birds would be harvested south of the border, the Ministry sought to produce more birds than would be killed in the province (MoE 1979).

Notably, in this 1979 plan, four types of conflicts were identified: with agriculture, recreational areas, aircraft, and hunting near urban areas. "In urban areas with excessive numbers of birds, the solutions are often costly (provide alternate land for the birds) or are publicly unacceptable (destroy many of the birds). The best way is often to prevent populations that are likely to cause problems from becoming established" (MoE 1979, p.11).

By the time the plan was written, Western Canada Geese (*Branta canadensis moffitti*) transplanted years before to a site near Victoria had already expanded north to Duncan. Five hundred breeding pairs of Vancouver Canada Geese (*B. c. fulva*) on Vancouver Island and the south coast, acknowledged to be 'less migratory' than other subspecies, were spending their winters in Washington and Oregon. And approximately 2,000 breeding pairs of non-migratory, hybrid Canada Geese had successfully established on the Lower Mainland from deliberate introductions (MoE 1979). It would not be amiss to say the plan was well underway.

"Canada geese breeding in southern Canada are not northern geese that stopped migrating, they are the result of the natural increase of populations that were re-introduced or introduced for the first time" (CWS 2010).

1.2 From Rare Migrant To Locally Overabundant

Before people began moving Canada Geese, they are believed to have nested on Vancouver Island only north of Great Central Lake (Dawe & Stewart 2010). This breeding population was probably of pure race, i.e., the 'less migratory' Vancouver Canada Goose (*B. c. fulva*) (MoE 1979; Dawe & Stewart 2010).

Small populations were established from game farm releases in the Victoria area in the 1920s and '30s, and in the Parksville and Nanaimo areas, possibly as early as 1946 through the early 1970s. Most introductions occurred in the 1970s and '80s, first to enhance wildlife viewing and hunting opportunities, and later to relocate problem birds (CWS 2010; Dawe & Stewart 2010).

Prior to the late 1960s, Canada Geese were considered migrants and temporary visitors throughout all of southern Canada (CWS 2010). In our region, there were few Canada Geese until the early 1980s, evidenced by several bird surveys conducted by CWS. Weekly surveys at the Englishman River estuary conducted from 17 June, 1979 to 29 June, 1980 found Canada Geese on only three occasions; eight was the greatest number of birds recorded. By contrast, geese were recorded at each weekly survey from 3 November, 1988 to 24 May, 1989, with a high count of 233 birds (Dawe & Stewart 2010).

During weekly bird surveys from January, 1975 to May, 1979 at the Little Qualicum River estuary, Dawe and Buechert (1995) observed Canada Geese only 8 times. Most were seen on a single occasion during the autumn migration in 1976 (Figure 1-1).

At the Nanoose unit of the Qualicum National Wildlife Area (which includes the Nanoose and Bonnell Creek estuaries), there were two records of Canada Geese: 1 bird on 9 November, 1978 and 1 bird on 16 May, 1979. This area was surveyed monthly from December, 1974 to 31 August, 1976, and weekly from August, 1976 to September, 1977 (Dawe & Lang 1980).

By the 1980s, Canada Geese were nesting in the region. During a breeding waterbird survey of 31 wetlands in 1981, a single nesting pair was discovered at Enos Lake (Dawe & Stewart 2010). A nesting pair was documented on the Little Qualicum River estuary in 1984 (Dawe & Buechert 1995) and on the Englishman River estuary in 1989 (Dawe & Stewart 2010).

Generally, the number of bird surveys, as well as birdwatching and reporting, have increased over time. It is important to keep this in mind when using historical data to examine growth in bird populations, as the populations may appear to be growing faster, when in fact they are merely being seen and reported more often.

In 1988, a pair and 3 goslings were sighted at Hamilton Marsh (RBCM files in Dawe & Stewart 2010). During the spring of 1995, members of the Parksville Qualicum Fish and Game Club observed up to 10 nesting pairs, some only 100 feet apart.

While geese nested on the hummocks in the marsh, they did not stay to raise their young there (Cousens, Lee, & Blood 1996; C. Lee and B. Cousens, pers. comm. 2014). Cousens and Lee (pers. comm. 2014) attributed this to a lack of food suitable for goslings and to the threat of predation by raptors in the marsh. They suspected the families moved to nearby wetlands and adjacent agricultural fields, or possibly to saltwater. Near this time, local naturalist K. Fortune documented 120 Canada Geese at Hamilton Marsh during the winter (B. Cousens and C. Lee, pers. comm. 2014).

As early as 1989, populations were trending upward. From 1989 through 1993, CWS and MoE conducted autumn surveys of Canada Geese from Victoria north to Courtenay-Comox on Vancouver Island. They discovered populations in the Parksville-Qualicum area expanded from 497 to 953 (a 92% increase) during that four-year period (Dawe & Morrison 1989, 1990, 1994).

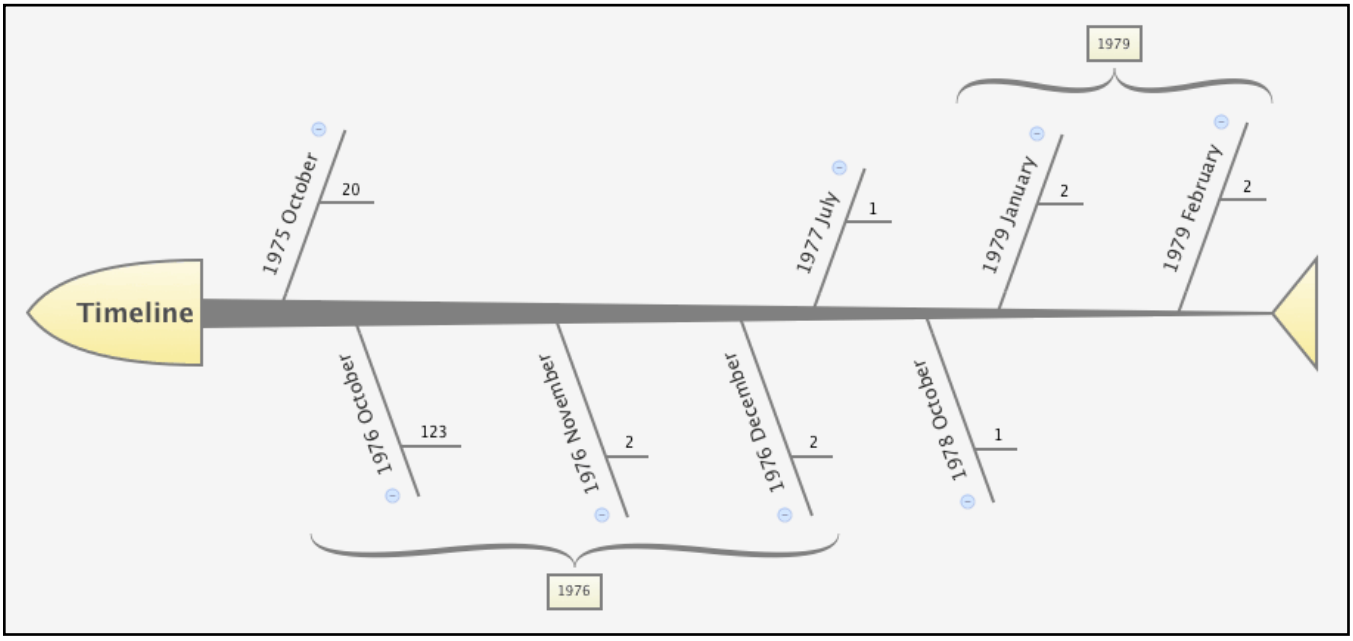


Figure 1-1. Canada Goose observations at the Little Qualicum River estuary, 1975-79. During weekly bird surveys, Dawe and Buechert (1995) found Canada Geese only 8 times.

1.3 First Management Efforts

In 1999, the Nature Trust of British Columbia (TNT) initiated discussions with stakeholders, concerned about the negative impacts of Canada Geese on its lands along Cowichan Bay, Nanoose Bay and the Englishman River. Meetings were held in 2000 and 2001 with provincial wildlife and agriculture ministries, farmers, and the District of North Cowichan, and with City of Parksville staff and councillors in 2003, in an effort to develop a coordinated goose management plan. City of Parksville staff admitted to being “inundated with political pressure to do something” about the geese in the community park (email, September, 2003).

The Pacific Black Brant is 'a friendly little sea goose', a blue-listed, migratory goose that is sometimes confused with the Canada Goose. Photos by Guy Monty.

Local government representatives and the public were confused about the difference between nuisance Canada Geese and Pacific Black Brant *(Branta bernicula nigricans)*, a goose requiring protection from harassment while staging on the Parksville-Qualicum Beach Wildlife Management Area (PQBWMA).

Central to stakeholder discussions were concerns that localized harassment efforts (e.g., in city parks) using dogs or raptors would concentrate Canada Geese on vulnerable conservation lands (email, September, 2003).

TNT developed and gradually expanded an egg addling program to reduce the number of Canada Geese recruited into local populations. The program first began in the Cowichan Valley, then included the Englishman River estuary in 2002, and the Nanoose and Bonnell estuaries in 2003 (Manning, Cooper and Associates 2003), and Little Qualicum River estuary by 2004. Also in 2003, Fairwinds Golf Course in Nanoose Bay was reported to have contributed funding for addling on small islands nearby (email, September, 2003). The responsibility for the egg addling program transitioned to the Guardians of Mid-Island Estuaries (The Guardians) when the society was formed in 2010.

1.4 Guardians Of Mid-island Estuaries Society

The Guardians of Mid-Island Estuaries Society (www.guardiansmie.org) was created to: 1) implement a pilot project that would increase the primary productivity of the Little Qualicum River and Englishman River estuarine marshes; 2) help agency partners effectively manage Canada Goose populations to enable the marshes to recover; and 3) support local communities in developing management plans and actions to reduce goose popuations.

Since 2002, members of the Guardians have led efforts to reduce regional Canada Goose populations by addling (i.e., sterilizing) eggs and promoting additional hunting days and increased bag limits. From 2008 to 2012, the Guardians and other volunteers banded and collared nearly 300 geese at the Englishman River, Little Qualicum River, and Craig Creek estuaries. We then surveyed both marked and unmarked Canada Geese in the region, to learn more about their seasonal abundance and use of the estuaries and other habitats.

The Guardians, on the heels of work completed by the Mid-Vancouver Island Habitat Enhancement Society (MVIHES) and retired CWS biologist Neil Dawe, have raised awareness of the adverse effects of Canada Geese on estuarine habitats.

As a result of presentations to local governments, television appearances, videos, newspaper articles, seminars, meetings, poster presentations, and brochures, local communities are now much more informed of the impacts of Canada Geese. Chapter 5.1, Questionnaires and Interviews, describes the stakeholder consultation conducted in the preparation of this strategy. While this communication was not comprehensive, lacking both First Nations and public consultation, it demonstrated that numerous stakeholders, representing a variety of sectors, are aware of the need for a comprehensive Canada Geese management strategy.

1.5 Study Area

Part of the study area at French Creek, during the peak of the Pacific Herring spawn. Photo by Maggie Henigman and Rick Guthrie, March 6, 2009

This management strategy covers an area of land and sea corresponding to the lower elevations of Mount Arrowsmith Biosphere Region on east-central Vancouver Island, hereinafter referred to as the 'region' or our 'area'.

The boundaries of the study area roughly correspond to the lower elevations of Mount Arrowsmith Biosphere Region (MABR). This area is sometimes referred to as Oceanside, or the Parksville-Qualicum Beach area. MABR encompasses the islands of the Ballenas/Winchelsea Islands archipelago, a marine area to approximately 300 m below sea level, and several complete watersheds with headwaters on Mount Arrowsmith, Mount Moriarty, Mount Cokely, and the Nanoose peninsula (Clermont 2011) (Figure 1-2). The Little Qualicum River, Englishman River, and other streams meet the saltwater of the Strait of Georgia/Salish Sea in estuaries. The marshes of these estuaries are the focus of our study, although Canada Geese have been observed throughout much of the marine area and terrestrial lowlands.

MABR is one of sixteen biosphere reserves/regions in Canada and one of 631 worldwide. Designated by the United Nations Educational, Scientific and Cultural Organization (UNESCO), biosphere reserves are mandated to test and demonstrate new and optimal practices to manage nature and human activities. Biodiversity and functioning ecosystems are considered fundamental to healthy communities and prosperous economies (Clermont 2011; UNESCO n.d.). In the spirit of biosphere scholarship, this document examines Canada Goose issues respecting the 'ecosystem approach' and its long-range, balanced view of management practices, policies, and legislation (cf. UNESCO, 2000).

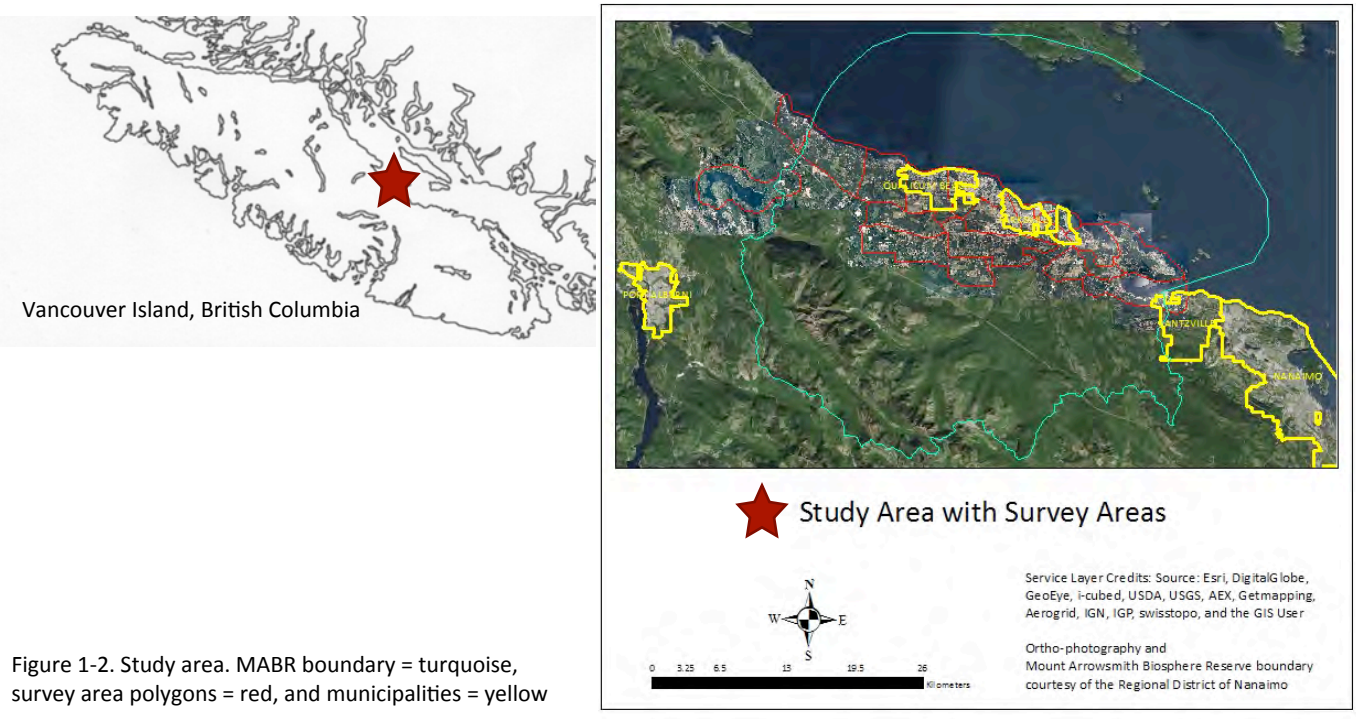


Figure 1-2. Study area. MABR boundary = turquoise, survey area polygons = red, and municipalities = yellow

Chapter 2 - Strategy Purpose and Goals
Highlights

Purpose: To develop scientifically-based management solutions that reduce and control locally overabundant Canada Goose populations, thereby enabling the recovery of degraded estuarine marshes on mid-Vancouver Island.

Goal 1. Characterize Canada Goose populations and migrant types, and examine population trends to set population objectives.

Goal 2. Delimit Canada Goose 'seasons' and seasonal distributions to set temporal management objectives.

Goal 3. Define habitat types and identify Canada Goose hotspots to set spatial management objectives.

Goal 4. Examine management of Canada Geese in other jurisdictions and identify options appropriate for this region.

Goal 5. Integrate population, temporal, and spatial information and objectives into a strategic direction to inform management planning for the region.

2.1 Overview

While most other regional goose management strategies have been developed to reduce direct impacts to human habitats (e.g., damage to agricultural crops, clean-up of feces in urban green spaces, contamination of public swimming areas, hazards to aviation), the primary focus of this strategy is to facilitate the restoration of high quality fish and wildlife habitat. It aims to help estuarine marsh habitats degraded by the grazing and grubbing of locally overabundant geese.

Estuaries are naturally rare, comprising less than 3% of B.C.'s coastline (Pacific Estuary Conservation Program (PECP) 1999), and due to a variety of threats, several estuarine ecosystems are provincially ranked as imperiled (S2) or of special concern (S3). There are at least 3 red-listed and 2 blue-listed ecosystems, or *ecological communities*, at the Little Qualicum River estuary, and at least 3 red-listed and 1 blue-listed communities at the Nanoose/Bonnell estuary (Dawe & White 1982; Kennedy 1982; Dawe & White 1986; B.C. CDC 2014, January; Clermont 2014). Red-listed Lyngbye's Sedge Herbaceous Vegetation (*Carex lyngbyei* Herbaceous Vegetation) ecosystems have been heavily impacted by Canada Geese (MVIHES 2009; Clermont 2011; Dawe et al. 2011).

Recovery of at-risk mid-island estuarine marsh communities is simply not possible without significantly reducing or controlling Canada Geese.

2.2 Purpose and Goals

The purpose of this strategy is to develop scientifically-based management solutions to reduce and control Canada Goose populations to halt degradation and support the recovery of mid-island estuarine marshes. There are five goals:

Goal 1. Characterize Canada Goose populations and migrant types, and examine population trends to set population objectives.

Goal 2. Delimit Canada Goose 'seasons' and seasonal distributions to set temporal management objectives.

Goal 3. Define habitat types and identify Canada Goose hotspots (i.e., areas where geese are frequently present or in high densities) to set spatial management objectives.

Goal 4. Examine management of Canada Geese in other jurisdictions and identify options appropriate for this region.

Goal 5. Integrate population, temporal, and spatial information and objectives into a strategic direction to inform management planning for the region.

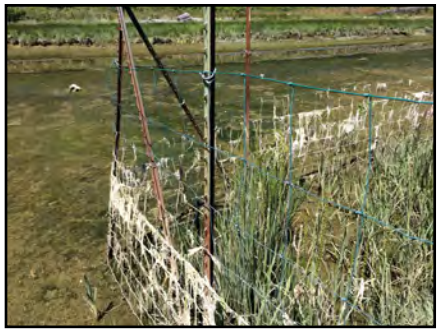
A STRATEGY IS NOT A MANAGEMENT PLAN

It is important to note that this management strategy is not a management plan. A management plan is developed to gain approval by CWS prior to receiving permits to relocate or kill birds, or dispose of carcasses. A management plan should identify a specific site or sites, set a population target, outline an approach to achieve and maintain target numbers, and address public opinion. Although it has some attributes of a management plan, this management strategy provides the science for informed regional Canada Goose management, and introduces and recommends options for management.

We hope that the agencies, private landowners and others tasked with creating and implementing management plans are well served by the strategy.

Management plans are described in CWS' *Best Practices for Management Plans - Canada Goose and Cackling Goose Management*, at https://www.ec.gc.ca/mbc-com/default.asp?lang=en&n=80E1F5DD-1.

2.3 Towards an Estuarine Marsh Restoration Plan



Exclosures enable growth of Lyngbye's Sedge *(Carex lyngbyei)* and Seaside Arrow-grass *(Triglochin maritima)*, species preferred by geese (upper).
Sedges planted in denuded areas were protected from grazing with snow fencing (lower).

Implementation of this Canada Goose management strategy is necessary prior to the development of a comprehensive restoration plan for the area's estuaries. A draft plan was developed in May 2011 that outlined a framework of restoration principles and experimental design to rehabilitate the mid-island estuaries (Clermont 2011). Its goal was to increase the primary productivity of the Englishman River estuary (ERE) and Little Qualicum River estuary (LQRE), by re-vegetating denuded areas of the marshes with native species providing high quality habitat for rearing juvenile salmonids and wintering waterfowl. Later, the Craig Creek estuary (CCE) south of the ERE was found to be degrading as well. Restoration and data collection are well underway at the LQRE, and limited efforts have been made on the periphery of the ERE marsh. There have been no attempts to restore the CCE.

Eighteen 50 and 100 m2 fenced exclosures were installed on the LQRE and ERE in 2010, to isolate areas from Canada Goose herbivory, and data were collected to quantify whether and how vegetation might recover if geese were excluded. At the LQRE, the exclosures appeared to screen the areas behind them, effectively protecting open areas from herbivory. In 2013 and 2015, sedge plugs were transplanted from healthy areas to denuded areas of the estuary and protected with snow fencing. During the Canada Goose moulting period, additional snow fencing was installed to screen and protect other parts of the estuary.

Early observations on the LQRE support the findings of MVIHES (2009) and Dawe et al. (2011) that areas outside of exclosures are subject to Canada Goose herbivory. Existing and future data will suggest the extent of recovery once Canada Geese are excluded, and the conditions (e.g., elevations, soil salinities) that are necessary to allow sedges and other vegetation to establish and spread in denuded areas. Additionally, an assessment of our restoration techniques may help evaluate the efficacy of various Canada Goose management alternatives (e.g., barriers to site lines and access to water, size of area needed to lift off).

A comprehensive restoration plan is needed, describing what has been learned and outlining next steps for estuarine marsh recovery at all three estuaries. Other local estuaries, including the French Creek estuary, and Nanoose Creek/ Bonnell Creek estuaries (NBE) should be examined for damage and restoration potential.

Rehabilitation is the action of improving from a degraded state, while restoration is frequently defined as the act of restoring to an original state or an unimpaired condition. This strategy uses the definition of restoration provided by the Society for Ecological Restoration International (2004), i.e., the process of assisting the recovery of ecosystems that are damaged, degraded or destroyed.

Chapter 3 - Introduction to the Canada Goose

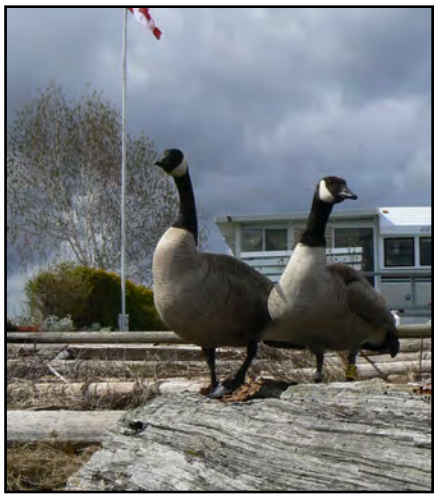
Highlights

Prior to 2004, there were 11 recognized subspecies of Canada Goose in North America. They were subsequently split into 7 subspecies of large-bodied Canada Geese and 4 subspecies of small-bodied Cackling Geese. One of the large-bodied subspecies, the Dusky Canada Goose (*Branta canadensis occidentalis*), is provincially red-listed (ranked S2M). Cackling Geese (*Branta hutchinsii*) are a species of special concern (ranked S3M). The identification of distinct subspecies is difficult, complicated by numerous translocation programs and hybridization.

CWS and B.C. Ministry of Environment require assurance that efforts to control nuisance Canada Geese do not adversely affect vulnerable lookalike species. Migratory Dusky Canada Geese are believed at risk mainly due to earthquake-induced changes on their Alaskan nesting grounds, however not all Dusky Canada Geese are northern-breeding migrants. In the 1950s, Dusky Canada Geese were transplanted to Washington to establish a breeding population; some birds were moved to Oregon in 1971. There are now three types of Dusky Canada Geese recognized in Washington State: migrants, residents, and hybrids. In recent years, the populations and ranges for Cackling Geese have increased dramatically. No Dusky Canada Geese and few Cackling Geese were observed in our surveys from 2011 through 2014. Management of nuisance geese should have no significant impacts on these at-risk species.

Citations, excluded here for brevity, can be found in the text of the document's chapters. Please do not cite highlights without consulting the chapters.

3.1 Taxonomy



Pair of Canada Geese on the Englishman River estuary. The goose is often smaller than the gander.

Members of different species or subspecies of Canada Geese may look the same. CWS and B.C. Ministry of Environment required assurance that management action for nuisance Canada Geese would not affect vulnerable lookalike subspecies.

Our study was partly motivated by concerns for the Dusky Canada Goose (*Branta canadensis occidentalis*), a subspecies of Canada Goose that is threatened with extinction. Kereki (2007) had identified our mid-island estuaries as important stopover sites for migratory Dusky Canada Geese that begin migration in poor condition, based on computer models that recognized the conservation designation of these estuaries.

The provincially red-listed Dusky Canada Goose is one of 7 taxonomically recognized subspecies of Canada Geese, which also includes Atlantic Canada Goose *(B. c. canadensis)*, Hudson Bay Canada Goose *(B. c. interior)*, Giant Canada Goose *(B. c. maxima)*, Moffitt's (also called Western or Great Basin Canada Goose) *(B. c. moffitti)*, Lesser Canada Goose *(B. c. parvipes)*, and Vancouver Canada Goose *(B. c. fulva)* (Banks et al. 2004, Sibley et al. 2010). Of these, Dusky, Vancouver, the Pacific population of Moffitt's, and the occasional Lesser Canada Goose may be found in our region.

In 2004, 11 subspecies of North American Canada Goose were split into two species: the large-bodied group described above, and a small-bodied group now recognized as a separate species, the Cackling Goose *(B. hutchinsii)*. Cackling Geese are blue-listed in B.C. There are currently four subspecies of Cackling Goose, including one formerly known as the Cackling Goose, now the Cackling Cackling Goose, *B. h. minima*. Other Cackling Goose species include Richardson's Cackling Goose *(B. h. hutchinsii)*, Taverner's Cackling Goose *(B. h. tavernii)*, and Aleutian Cackling Goose *(B. h. leucopareia)* (Banks et al. 2004). Cackling, Taverner's, and Aleutian Cackling Geese may be found in our region.

Banded Dusky Canada Geese may have green or red collars, Moffitt's Canada Geese may have white or black collars, and Lesser Canada Geese may have blue or grey collars. Banded Cackling Geese may have yellow collars, and Aleutian Cackling Geese may have blue or grey collars (Warren 2006).

The Dusky Canada Goose is designated S2M, an imperiled migrant. Cackling Geese are designated S3M, a migrant of special concern (B.C. Conservation Data Centre 2014).

Cackling Geese are generally smaller than nuisance Canada Geese, which are typically descendants from large-bodied subspecies. Photo by Guy Monty.

Dusky Canada Geese can often be distinguished from nuisance Canada Geese by their dark breast.
Photos by Lyn Topinka, A Photographic Journal, Ridgefield National Wildlife Refuge, at http://ridgefieldbirds.com/TheRefuge/Birds/ridgefield_NWR_canada_goose.html.

The distinctions among these subspecies can be so subtle that few people can discern one from another (Howard Breen 1990). For example, Dusky Canada Geese share the dark colouration of Vancouver Canada Geese but are smaller. They are slightly larger than the Taverner's Cackling Goose, and have a broader wing. There is considerable variation within subspecies as well; for example, Dusky Canada Geese may be quite light to very dark (Warren 2006).

The Washington and Oregon Departments of Fish and Wildlife require hunters to take a goose identification course prior to permitting in certain areas, to ensure they can distinguish Dusky Canada Geese from other subspecies (see http://wdfw.wa.gov/hunting/canada_goose/). If they kill a Dusky Canada Goose, their permits will be confiscated (Washington and Oregon Departments of Fish and Wildlife n.d.; Warren 2006).

However, the recognition of distinct subspecies has been clouded by numerous translocation programs. It is well established that hybrid geese, derived from stocks of several different races, were introduced to Vancouver Island and the Lower Mainland (MoE 1979; Dawe & Stewart 2010). In B.C., relocations of Canada Geese were taking place as late as 1991 (Campbell et al. 1990; Dawe & Stewart 2010). Genetic mixing may have occurred to such an extent that only long-distant migrants (i.e., those that nest in northern B.C, the territories, or Alaska) may be considered pure subspecies.

Range and seasonal distribution are often used to tell one subspecies from another. Yet, for some subspecies, distribution has never been clearly defined (cf. Subcommitee on Pacific Population of Western Canada Geese 2000). The distributions of Canada Geese and Cackling Geese are dynamic, shifting frequently and rapidly in response to climate, food supplies, and alterations to habitat (Howard Breen 1990; Sibley et al. 2010). The winter range of Cackling Cackling Geese shifted northward in the 1990s from California to western Oregon, for example (Sibley et al. 2010).

The Pacific Flyway Council (2008) described the effort to protect Dusky Canada Geese while managing other, abundant subspecies on the wintering grounds as time-consuming, controversial, and expensive. Restrictive hunting seasons implemented in the U.S. since the 1980s are believed to have dramatically reduced the mortality rate of Dusky Canada Geese, but also increased survival rates for other geese (Washington and Oregon Departments of Fish and Wildlife n.d.).

3.11 Dusky Canada Goose *(B.c. occidentalis)*

Dusky Canada Geese breed and moult in Alaska, and migrate through southeastern coastal Alaska and coastal B.C., to and from wintering areas in Washington and Oregon. There, they mingle with up to seven subspecies of Canada Geese and Cackling Geese that look

similar (Bromley & Rothe 2003; Oregon and Washington Departments of Fish and Wildlife n.d.; B.C. Conservation Data Centre 2014). Dusky Canada Geese rely on estuarine and freshwater habitats during migration and agricultural crops in winter (Bromley & Rothe 2003). They readily use small fields, even those enclosed by trees.

Dusky Canada Geese are commonly less wary than other subspecies, adding to their vulnerability (Washington and Oregon Departments of Fish and Wildlife n.d.; Warren 2006).

Over the years, some Dusky Canada Geese collared in Alaska were discovered on Vancouver Island in autumn. Many wintered on the Saanich Peninsula (Macgregor 1993, Vanderpol 1997 in Bromley & Rothe 2003; Pacific Flyway Council 2008). In the late 1950s, Dusky Canada Geese were transplanted to Willapa Bay, Washington to establish a breeding population at the wildlife refuge there; some of these birds were moved to Oregon in 1971. Three types of Dusky Canada Geese are now recognized in Washington State: migrants, residents and hybrids (Bromley & Rothe 2003). Given this history, some Dusky Canada Geese likely pass through or linger in our area, although none were documented in our surveys.

The red-listed status of Dusky Canada Geese is primarily due to reductions in nesting habitat resulting from an earthquake in 1964. Subsequent predation had a major impact on Dusky production (Warren 2006). Increasing competition from other geese, and hunting mortality on the wintering grounds are also cited as contributing factors (Bromley & Rothe 2003). The global (G5T3, T for intraspecific taxa) and provincial (S2M) ranks were assigned in 2008 and 2009, respectively (B.C. CDC 2014).

3.12 Vancouver Canada Goose *(B.c. fulva)*

Vancouver Canada Geese breed along the coast from southeastern Alaska to northern B.C. (Campbell et al. 1990). Some breed on northern Vancouver Island (G. Monty, pers. comm. 2008). They winter mainly in B.C. and Washington (Washington and Oregon Departments of Fish and Wildlife n.d.).

Many are non-migratory or migrate only short distances (Campbell et al. 1990; Howard Breen 1990; Washington and Oregon Departments of Fish and Wildlife n.d.).

3.13 Moffitt's (Western) Canada Goose (*B.c. moffitti*)

The Pacific population of Moffitt's Canada Geese nests and winters west of the Rocky Mountains from northern Alberta and B.C. through the Pacific Northwest to California (CWS Waterfowl Committee 2013). Non-breeding birds are known to moult-migrate as far as the Northwest Territories (Subcommittee on Pacific Population of Western Canada Geese 2000).

The Pacific population has dramatically expanded its breeding range, and its size continues to increase; it was estimated at 221,600 geese in 2012, 11% higher than the year before (Subcommittee on Pacific Population of Western Canada Geese 2000; USFWS 2013).

Moffitt's Canada Geese are comprised of migratory and non-migratory elements. The non-migratory segment, now concentrated in Greater Victoria and the Lower Mainland, probably spread from more eastern habitats or were introduced (CWS Waterfowl Committe 2013; Warren 2006).

Moffitt's Canada Geese tend to occur in groups apart from other subspecies (Warren 2006). Aside from this, this subspecies is probably indistinguishable from the offspring of introduced Canada Goose hybrids, many of which have arisen from Moffitt's Canada Geese (G. Monty, pers. comm. 2008). (Canada Geese have also been known to hybridize with domestic geese (cf. Ray 2011).)

3.14 Lesser Canada Goose *(B.c. parvipes)*

Lesser Canada Geese nest in the Yukon and Alaska. They are common in winter in eastern Oregon and Washington, but less abundant along the coast (Washington and Oregon Departments of Fish and Wildlife n.d.). They are highly adaptable and can be found in urban areas (Warren 2006).

3.15 Cackling Cackling Goose *(B.h. hutchinsii)*

Cackling Cackling Geese breed in western Alaska (Campbell et al. 1990; Warren 2006). In recent years, there has been a pronounced northerly shift of wintering birds away from California into Oregon and

Washington (Washington and Oregon Departments of Fish and Wildlife n.d.). Although populations have been stable for a few years, they have fluctuated dramatically since the 1960s (Warren 2006).

Most spring migrants pass through B.C. between mid-April to mid-May. Most autumn migrants bypass the B.C. coast entirely (Campbell et al. 1990). A few winter locally (G. Monty, pers. comm. 2008). They have been recorded in B.C. from August 8 to June 5 (Campbell et al. 1990). Cackling Geese are wary, preferring open areas. They will, however, use urban park habitats (Warren 2006).

3.16 Taverner's Cackling Goose *(B.h. tavernii)*

Nesting Taverner's Cackling Geese are broadly distributed across western Alaska. They winter in northwest Oregon and southwest Washington. Occasionally, Taverner's Cackling Geese will winter in our area. One individual was reported in Parksville Community Park in January 2008; it was very small and easily differentiated from other geese (G. Monty, pers. comm. 2008). In Washington and Oregon, the subspecies increased from fewer than 2,000 in the 1970s to more than 50,000 [no date provided]; Northwest Oregon and southwest Washington are now wintering more Canada and Cackling Geese than at any other time in recorded history (Washington and Oregon Departments of Fish and Wildlife n.d.).

3.17 Aleutian Cackling Goose *(B.h. leucopareia)*

Aleutian Cackling Geese nest on the Aleutian Islands in Alaska, and winter mainly in California. Small populations winter along the Washington and Oregon coasts; they are commonly found with Cackling and Taverner's Cackling Geese (Washington and Oregon Departments of Fish and Wildlife n.d.; Warren 2006). Aleutian Cackling Geese have been seen locally in the fall and winter, but only rarely (G. Monty, pers. comm. 2008).

Canada Goose and smaller Cackling Goose, Englishman River estuary.
Photo by Tim Clermont.

3.2 Food Preferences

Canada Geese are selective herbivores. They alter their feeding behaviour to meet seasonal nutritional requirements through habitat selection, and more specifically, by discriminating among plant species, among individual plants of the same species, and among different parts of the same plant (Conover 1991; Winn 2001). There is considerable evidence that local foraging and migration patterns closely track plant growth and phenology (e.g., moving from a pasture to a salt marsh when availability of protein on the marsh equals or exceeds that of the pasture) (cf. Winn 2001).

Some authors believe Canada Geese select plants that supply high levels of protein, carbohydrates, or fats, depending on their needs at the time (USDA 1999; CWS 2010). In general, they seek protein in spring and summer, and carbohydrates and fats in autumn and winter (Winn 2001). However, several studies suggest that selection is not always correlated to nutritional characteristics, but to palatability. They prefer plants which can be pulled apart with little force, have a high water content, and a low ash content (Conover 1991). In other words, they like plants that taste good, and are easy to eat and digest.

Lyngbye's Sedge (*Carex lynbyei)*

The quantity and quality of dietary protein are often considered limiting, because the availability of protein-rich foods fluctuates during critical periods (such as during egg formation), and geese are unable to store protein in a concentrated and labile (i.e, easily altered) form. Geese obtain protein for reproduction primarily from the foliage of grasses, sedges, and forbs, but also from the roots and rhizomes of wetland plants (Krapu & Reinecke 1992).

Geese have an inefficient digestive system; vegetation passes through the gut in two to four hours, leaving large fragments intact (potentially spreading seeds). Time spent feeding is a function of both forage quality and foraging opportunity. Studies show geese spend, on average, 60-70% of their time feeding. Night feeding is particularly evident during periods of disturbance (Winn 2001).

In the course of our study, Guardians personnel observed grazing Canada Geese in local estuaries during spring and summer and documented what they were eating. Geese chose young, tender Lyngbye's Sedge *(Carex lyngbyei)* and Seaside Arrow-grass *(Triglochin maritima)* along the edges of the channels. If these were absent or too tall, they progressively selected less palatable species. On the Englishman River estuary, in areas where Lyngbye's Sedge and Seaside Arrow-grass have been absent for many years, geese grazed on Dunegrass *(Leymus mollis)* in late summer; this grass is coarse, offers comparatively little nutritional value, and often grows to 150 cm in height. Canada Geese also grubbed rhizomes, roots, and seeds along the channel edges.

Family of Canada Geese exiting a Lyngbye's Sedge channel edge community.

In nearshore marine habitats, eelgrass *(Zostera spp.)* was favoured whenever it was accessible, generally at lower tides or if found floating. Along the wrack line, geese chose eelgrass and Sea Lettuce *(Ulva lactuca)*. They did, however, eat many other types of aquatic plants.

Away from the estuaries, geese flocked to fertilized, mowed, and watered grassy areas. Less often, they fed in less manicured areas. In the spring, recently planted hayfields or pasture, cereal and legume crops, and some types of vegetable crops were also favoured. In the fall and winter, they fed on grains, forage crops, and corn (survey respondents; cf. CWS 2010).

While geese may favour certain plants, they also avoid others. After the City of Parksville replaced the grass on one of its sports fields with grass turf over a sandy substrate, use by geese plummeted (A. Metcalf and W. Payne, pers. comm. 2014). In feeding trials with captive geese, Conover (1991) found that geese refused to eat Common Periwinkle *(Vinca minor)* and English Ivy *(Hedera helix)*, invasive ground covers. He attributed this avoidance to the presence of secondary metabolites. (Note: we do not recommend planting invasive species to control geese.)

3.3 Habitat Preferences

Canada Geese occupy habitats on and near tidewater and freshwater, from temperate regions to tundra (Banks et al. 2004). Their large body mass allows them to reside in moderately cold climates, year-round (USDA 1999). They regularly use agricultural lands, pastures, and meadows (Granholm 1988). They make use of many man-made structures, including dykes, irrigation ditches, and sewage lagoons. Canada Geese are increasingly found on lawns, golf courses, parks, and sports fields in urban areas (Campbell et al. 1990; USDA 1999; Banks et al. 2004). Areas without hunting, near large fields for feeding, and fresh water for drinking are ideal (Howard Breen, 1990).

As a rule, Canada Geese are highly adaptable (MoE 1979). A nest found in the Nanoose Bay area, far from open water on a stump at the edge of a forestry road, is testament to this versatility. However, geese will more typically choose to nest in secluded areas near water, preferably on sites with partial concealment for the incubating female, space for the gander to loaf, and good visibility (Granholm 1988). On the estuaries, geese consistently nest on stumps and other large woody debris just out of reach of tidal action. Islands often have high densities of ground nests, as they offer additional protection from predators and disturbance.

In *Birds of British Columbia*, 62% of 1,244 reported nests were found on islands, and 27% were on the edge of other waterbodies, most notably marshes, lakes, or slow-moving rivers. Almost all nests were within 60 m of water, but one nest was 1.6 km from water (Campbell et al. 1990).

Most nests (64%) were built on the ground. Others were in former raptor nests, on muskrat or beaver lodges, on artificial nesting structures, or on other man-made structures such as pilings, bridges, and buildings (Campbell at el. 1990). Nests can be a metre in diameter, and usually consist of grasses with other vegetation (CWS 2010).

Whereas good visibility is a prerequisite for nesting birds, adults with goslings screen themselves from predators by vanishing into tall grasses and other vegetation.

Canada Geese prefer feeding and loafing areas with unobstructed views, adjacent to water.

Canada Goose nest on the Englishman River etsuary. Nests were often partly concealed by logs, stumps, and other Large Woody Debris (LWD).

Outside of the nesting season, both land and water are used for loafing and sleeping; resting on the water protects geese from terrestrial predators.

During the moult, when Canada Geese are growing new flight feathers and cannot fly, geese gather in small and large flocks in estuaries, along the foreshore, and on larger freshwater bodies where they can more easily escape terrestrial predators and other threats. They rest on adjacent fields, tidal flats, gravel bars, or expanses of bedrock that are usually free of dogs and other perceived threats. When the birds are able to fly, some will feed in upland areas during the day or early evening, returning to roost on or beside the water.

The perceived threat of disturbance is fundamental to their use of habitats. Disturbances, particularly new ones - such as the onset of a canine control program, cause geese to move from one site to another. They readily adjust to regular disturbances once they understand them to be of little threat, but will never completely lower their guard. For example, moulting geese may rest in busy resort areas, but only where there is a clear escape route.

Canada Goose nest adjacent to tidewater

Chapter 4 - Current Regulatory and Policy Framework

Highlights

The Pacific Flyway Council has prepared management plans for Pacific populations of most Canada Goose subspecies (i.e., Dusky, Vancouver, Aleutian, Lesser, Taverner's, Western) and Cackling Geese. Some plans are long outdated (e.g., 1979). The 2000 Western (Moffitt's) Canada Goose plan, which may best reflect the composition of our regional population, set 3-year population index objectives and advocated for stable funding for landowner assistance programs, and urban management plans with community input and population monitoring components. CWS does not use Pacific Flyway groupings for management purposes, and it remains unclear whether any of these plans are appropriate for managing hybrid Canada Geese, which probably make up most of our regional population.

In this strategy, Canada Geese are described as 'locally overabundant' because 'overabundance' is a legal term in the *Migratory Birds Regulations*. In Canada, Canada Geese have not been designated as overabundant or even formally evaluated. During the evaluation process, distribution and abundance are compared to CWS objectives for the species, and damage and risks posed by the species are assessed. Although population objectives refer to temperate-breeding Canada Geese, an overabundance designation would apply to the entire species, including Dusky Canada Geese.

Snow Geese and Ross's Geese were designated as overabundant when overgrazing and grubbing caused changes in salt marsh plant communities. The *Migratory Birds Regulations* were amended to enable the use of exceptional hunting methods and equipment. The growth of Greater Snow Goose populations were quickly halted, although the special measures did not reduce the size of populations. It is too soon to tell whether the designation has affected Ross's Goose population growth and abundance.

In the U.S., resident Canada Geese in the Atlantic and Mississippi Flyways are designated as 'overly abundant (OA)' and 'Birds of Management Concern'. Canada Geese along the Pacific Flyway are not designated overly abundant, but are still 'Birds of Management Concern' as 'high priority gamebirds'.

Since 2011, CWS is more apt to issue damage and danger permits to landowners and land managers experiencing problems with Canada Geese. This is a departure from earlier policies that required applicants to exhaust all other avenues of control.

Permittees or their designates generally cannot use decoys, calls, blinds, or bait, because the killing of birds under most damage and danger permits is to reinforce the scaring of birds, not to reduce the population. Decoys, calls, blinds and bait are hunting methods that entice birds, rather than scare them away.

Citations, excluded here for brevity, can be found in the text of the document's chapters. Please do not cite highlights without consulting the chapters.

Chapter 4 - Current Regulatory and Policy Framework

More Highlights

For CWS, relocation remains an acceptable option for goose management, despite its role in creating the current situation. Relocation permits may be allowed to move birds from non-huntable to huntable areas, after alternative methods of control have been attempted. Permit holders are required to find landowners who will accept the birds.

The Province has a somewhat ambiguous role with respect to Canada Goose management. Federal Migratory Game Bird Hunting Permits and Canadian Wildlife Habitat Conservation Stamps to hunt Canada Geese are dispensed by the Province and licensed vendors. Provincial wildlife staff are rarely involved in issuing other types of permits for Canada Geese, deferring to CWS. However, the Province may choose to become involved where staff are subject to public enquires or for other reasons, and the provincial wildlife veterinarian must be included in any plans to cull geese.

Using a firearm, aircraft, or bird of prey to scare Canada Geese requires a permit from CWS. However, other scare techniques do not need a permit, including the use of supervised dogs. To avoid injury to flightless birds, dogs should not be used from May 1 through July 31. Depending on the scare technique and the bylaws of the jurisdiction, municipal permits may be needed also.

CWS requires local governments and other organizations to complete Canada Goose management plans prior to the issuance of some permits. While management plans may be helpful for many reasons, they are a policy tool, rather than a legislated requirement.

The *Migratory Birds Convention Act, 1994* requires hunting for migratory game birds to be closed from March 10 to September 1, and further restricts hunting to a period not exceeding 3.5 months, or 107 days. To increase the harvest of Canada Geese, hunting seasons were adjusted from two to three seasons in 1998-99, and from three to four seasons in 2007-08. Larger bag and possession limits were implemented in 2012.

The migratory game bird hunting regulations are reviewed every second year. Individuals and groups interested in amending the regulations, (including designating Canada Geese as overabundant), may submit proposals or requests to CWS or the Province. Contributions submitted in 2015 will be considered for inclusion in the 2016-17 regulations.

Citations, excluded here for brevity, can be found in the text of the document's chapters. Please do not cite highlights without consulting the chapters.

Chapter 4 - Current Regulatory and Policy Framework

More Highlights

In general, provincial legislation closes all cities, municipalities, and regional district parks and trails to the discharge of firearms unless specifically exempted. CWS encourages regulators to enable hunting wherever geese are a problem and public safety is not an issue.

Fewer people are opposed to culling of nuisance geese when they are eaten by humans or other animals. Canada Geese culled in the U.S. are routinely provided to food banks. Although other game animals have been culled, processed, donated, and even sold and exported, and our provincial agencies support the use of culled meat - particularly by disadvantaged individuals, there have been several barriers preventing the consumption of non-hunted Canada Geese in Canada. CWS has claimed that by not allowing the birds to be eaten, birds are killed because they are causing damage and not for the purpose of providing hunting opportunities outside of the regular hunting season. Where appropriate, people are encouraged to leave carcasses in the open as a deterrent to other geese, although this is not a regulatory requirement. There are now revisions proposed to the *Migratory Birds Regulations* that would allow consumption of culled geese, requiring the development of standards with public health and food inspection agencies. A made-in-B.C. solution may also be possible, should the provincial inspection program take the lead and donated meat remain in the province.

The Parksville Protocol amended the *Migratory Birds Convention Act* to enable First Nations to harvest migratory birds and their eggs throughout the year; to sell down and non-edible by products; to barter, exchange, trade birds and eggs with other Aboriginal communities; and to sell birds and eggs to other Aboriginal communities. The *Migratory Birds Regulations* have not yet been changed to reflect the amendments to the *Act*, however proposed changes are currently in revision, and contemporary treaty agreements reflect this wording. Under an agreement between senior governments and the Maa'nulth First Nation on Vancouver Island, a person exercising the right to harvest must not waste the edible and usable parts of any migratory bird.

Citations, excluded here for brevity, can be found in the text of the document's chapters. Please do not cite highlights without consulting the chapters.

4.1 Jurisdiction

As migratory birds, Canada Geese are under the jurisdiction of the Government of Canada and more specifically CWS, in accordance with the *Migratory Birds Convention Act, 1994* and other international agreements. Canada Geese are also managed within the purview of the provincial *Wildlife Act, 1996*; i.e., its definition of wildlife includes game, and migratory birds generally. Provincial regulations for migratory birds may be more, but not less, restrictive than federal regulations. Generally, the Province does not alter federal regulations (S. Pendergast, pers. comm. November 24, 2014). The Pacific Flyway Council works with federal bodies (i.e., CWS and USFWS) to review data and set regulations and policies for migratory birds in western North America.

4.2 Pacific Flyway Council

The Pacific Flyway Council contributes to annual hunting regulations and other management initiatives. The Council includes one representative from each state and province along the flyway, and an ex-officio federal representative for each country (i.e., U.S., Canada and Mexico). There are also two technical committees with a similar structure, for game and non-game birds. The public can contribute to Pacific Flyway Council activities through provincial or state representatives. Currently, the Ministry of Environment's Provincial Bird Specialist is B.C.'s representative, and CWS' Wetland Bird Biologist is Canada's representative.

The Council has prepared management plans for Pacific populations of most Canada Goose subspecies (i.e., Dusky, Vancouver, Aleutian, Lesser, Taverner's, Western) and Cackling Geese, as well as a *Northwest Oregon/ Southwest Washington Canada Goose Agricultural Depredation Control Plan*. Many plans are outdated.

CWS treats most Vancouver Island birds as Moffitt's (or Western) Canada Geese or hybrids of these (M. Chutter, pers. comm. February 2, 2015). In the Western Canada Goose management plan, there were 3-year population index objectives specifying the level below which harvest restrictions should be considered, and the level above which harvest rates should increase (Subcommittee on Pacific Population of Western Canada Geese 2000). The plan advocated for stable funding for landowner assistance programs, and urban management plans with community input and population monitoring components.

Management plans and other documents are available at http://www.pacificflyway.gov/Management.asp. However, CWS staff asserted that Canada does not recognize or use Pacific Flyway groupings for management purposes (A. Breault, pers. comm. February 2, 2015). It appears they are a U.S. construct.

4.3 Migratory Birds Convention Act

The *Migratory Birds Convention*, a 1916 treaty between Great Britain (for Canada) and the U.S., was the precursor to the present *Migratory Birds Convention Act, 1994*. The *Act* protects and conserves Canada Geese and other waterfowl, and authorizes Environment Canada's CWS to establish regulations in cooperation with provincial governments.

Article IV authorizes "such measures as may be necessary to control the introduction of live animals... which could disturb the ecological balance of unique island environments", in this case the estuarine marshes of Vancouver Island.

4.4 Migratory Birds Regulations

The *Migratory Birds Regulations* delimit specific requirements of, and exceptions to, the *Migratory Birds Convention Act, 1994.* Schedule I identifies seasons, bag and possession limits, and measures for overabundant species. Schedule II identifies the types of permits available and their costs. For some, the permitting processes are onerous (interviewees, pers. comm. 2014).

4.41 Overabundance

In this strategy, we use the term 'locally overabundant' (rather than 'overabundant') to describe our problem of 'too many geese'. We do so because 'overabundance' is a legal term in the *Migratory Birds Regulations*.

CWS (2011, p. 11) noted that "In the United States, resident Canada Geese have been declared overabundant", however this is only partly accurate. The U.S. Fish and Wildlife Service (USFWS) designates a subset of the species protected by the *Migratory Bird Treaty Act, 1918* as 'Birds of Management Concern'. "To be of management concern, a bird must be a high priority gamebird, on the Birds of Conservation Concern 2008 list [for which Canada Geese are not eligible, as they are a hunted gamebird (USFWS 2008)], a federal threatened or endangered species listed in the U.S., or overly abundant (OA) leading to management conflicts" (USFWS 2011). Only Canada Geese in the Atlantic and Mississippi Flyways are designated as 'overly abundant', while the Pacific Flyway geese are not; Pacific Canada Geese are, however, a high priority gamebird (J. Sands, pers. comm. February 17, 2015).

In Canada, Canada Geese have not been designated as overabundant or even formally evaluated. During the evaluation process to establish overabundance, distribution and abundance are examined and compared to CWS objectives for the species. Damage and risks posed by the species are assessed (CWS 2011). When a species is injurious to, or threatens, environmental, agricultural, or other similar interests, and is designated as overabundant, additional opportunities for harvest can be explored. For example, new hunting seasons and additional hunting methods or equipment may be allowed.

Presently, Canada Goose numbers exceed population objectives in several parts of Canada (CWS 2011). The 'regional' population objective for temperate-breeding Canada Geese in southern B.C. was 10,000 to 15,000 geese in 2011-2012, based on an estimated 17,000 geese (Lok 2011; Hughes 2012).

Regional population objectives for temperate-breeding geese must meet Environment Canada's conservation goals, be consistent and integrated with existing Canada Goose management programs, be measurable, have clearly defined spatial boundaries, be completed at a provincial scale (i.e., not more than one objective per province), and consist of a range of acceptable values - recognizing there is a level of scientific uncertainty inherent in population estimates. Population numbers are expected to fluctuate for reasons within and beyond the control of wildlife managers (E. Lok, pers. comm. December 1, 2014).

The *Migratory Birds Convention Act, 1994*, Article II, recommends the "management of migratory birds on a population basis". Regional population objectives are determined for the Maritime provinces, southern Quebec, southern Ontario, southern prairie provinces and southern B.C. Yet, this begs the question, 'what is a population?' For all intents and purposes, Canada Geese in these regions do not comprise a single goose population; rather, many populations of various subspecies, hybrids, and area-based subpopulations are included. CWS asserts that broad population objectives are an advantage for managing large goose populations; if Environment Canada's conservation objectives are met by having plenty of birds to sustainably hunt, then it is easier to argue for higher bag limits or to consider permit applications to remove or kill birds. If population objectives were developed on a finer scale, Canada Geese would be more difficult [and expensive] to monitor and evaluate.

CWS suggested developing more specific objectives in local management plans that work within the Environment Canada population objective and management framework (E. Lok, pers. comm. December 1, 2014).

Under the *Migratory Birds Convention Act*, all Canada Geese are considered the same species, with no regard for subspecies or subpopulations. The population objectives refer to 'temperate-breeding Canada Geese', but an overabundance designation would apply to all Canada Geese in Canada (E. Lok, pers. comm. December 1, 2014).

Notably, Snow Geese *(Chen caerulescens)* and Ross's Geese *(Chen rossii)* were designated as overabundant when overgrazing and 'over-grubbing' caused changes in salt marsh plant communities to such a degree that they could not be restored (Batt 1997; Calvert et al. 2007).

Canada amended the *Migratory Birds Regulations* in 1999 and created special conditions within which hunters could use exceptional methods and equipment such as electronic calls and bait to take more Snow Geese. Habitat management regimes on some refuges were changed to increase exposure to hunting. The special measures were first implemented in selected areas of Quebec and Manitoba, then expanded into Saskatchewan and Nunavut in 2001, and into southeastern Ontario in 2012 (CWS 2013, November, December).

The Greater Snow Goose Working Group found the overabundance designation and subsequent liberalization of hunting rules quickly halted the growth of Greater Snow Goose populations (Calvert et al. 2007). However, the special measures did not reduce the size of the population (Anonymous 2013).

CWS proposed the federal government designate the Ross's Goose as overabundant in June, 2013, although the U.S. applied a similar designation to the species in 1999 (McConnell 2013). In 1999, the Animal Alliance of Canada, Animal Protection Institute, Canadian Environmental Defence Fund, Dene Nation, and Zoocheck Canada won a court decision to protect Ross's Geese from overabundance regulations, as it had not been sufficiently demonstrated that this species was contributing to habitat damage [Animal Alliance of Canada v. Canada, 1999]. This decision effectively delayed the implementation of controls and led to more habitat damage (CWS 2013, December).

To date, environmental damage has been the only rationale successfully used to apply the designation. "Although there is evidence that Canada Geese are causing ecological damage in B.C. (mid-island estuaries, Gulf Islands etc), this is not necessarily the case in all places where Canada Geese occur. Given these challenges, the process [of designating Canada Geese as overabundant] hasn't been initiated. There is also the consideration that there are other regulatory tools (damage and danger permits for example) that might be more applicable on a regional/local scale" (E. Lok, pers. comm. December 1, 2014).

CWS biologists believe that the special measures enabled by an overabundance designation would do little to address Canada Goose impacts, as large scale patterns across BC. and more generally throughout North America show that the numbers of hunters and the areas where people are allowed to hunt are declining (K. Fort, E. Lok, pers. comm. November, December 2014).

Nonetheless, individuals and groups interested in amending the regulations for Canada Geese may submit proposals or requests to CWS and/or the Province through their regional biologists. Contributions submitted in 2015 will be considered by the B.C. Waterfowl Technical Committee for inclusion in the 2016-17 regulations. The process is described at http://www.ec.gc.ca/rcom-mbhr/default.asp?lang=En&n=6DE5A330-1#ee.

4.42 Airport Permits

Permits are readily available, on request by airport owners and managers, to reduce the risk of Canada Goose collisions with aircraft. Permittees may scare or kill geese, and destroy eggs to reduce numbers of nesting geese on airport property. CWS recommends airport authorities develop a Canada Goose management plan in cooperation with local government(s) (CWS 2011).

4.43 Damage or Danger Permits

Prior to 2011, CWS resisted aggressive management of temperate-breeding Canada Geese, to rigourously protect the Dusky subspecies. In 2011, a website, handbook, and best practices guidelines were developed. Although concerns for the vulnerable subspecies remain, better data for both temperate-breeding and Dusky Canada Geese now support decision-making processes, including the distribution of damage and danger permits (E. Lok, pers. comm. December 2, 2014). For example, in 2010, applicants wishing to obtain a kill permit were required to demonstrate the persistence of the problem after all other reasonable management options had been attempted (CWS 2010). Today, damage permits may be issued to landowners and land managers suffering serious property or crop damage from Canada Geese, if scaring has been unable to prevent such damage. Danger permits may be issued to minimize a danger to health or safety, e.g., to prevent contamination of drinking water sources.

There are 4 types of damage or danger permits: 1) scare using a firearm or aircraft; 2) kill to scare; 3) kill; and 4: relocation. Kill permits allow the destruction of eggs or killing of birds.

For damage permits, areas must be open to, or the permittee must have received an exemption for hunting and/or discharge of firearms.

CWS strongly recommends using a damage permit in conjunction with a hunting permit when feasible, and only use the damage permit when hunting is not available (E. Lok, pers. comm. February 2, 2015).

The landowner or manager may name other individuals or companies to carry out the activities specified in the permit. In general, permittees or their designates cannot use decoys, calls, blinds, or bait, nor can they discharge firearms within 50 m of any water area. The killing of birds under most damage or danger permits is to reinforce the scaring of birds, not to reduce the population, and blinds and calls are hunting methods that entice birds, rather than scare them away.

CWS permit applications are available at http://www.ec.gc.ca/nature/default.asp?lang=En&n=677AEBD4-1. Permittees are required to report their activities to Environment Canada (CWS 2010).

Prior to submitting any permit application, CWS urges people to consult the *Handbook - Canada and Cackling Geese: Management and Population Control in Southern Canada*. This is a how-to manual designed to help landowners and others manage conflicts with geese. Permit applicants are asked to review *Best Practices for Destroying Eggs or Preventing Hatching - Canada Goose Management*, and *Best Practices for Killing Birds and Disposing of Carcasses - Canada Goose Management*. These documents may be accessed at http://www.ec.gc.ca/mbc-com/default.asp?lang=En&n=6D2B893B-1.

Given the origins of the Canada Geese problem in this region, it is inconceivable to us that relocation of birds may be entertained as a management option. However, relocation permits for birds causing damage or danger are still available. Importantly, the MFLRNO does not consider relocation a suitable option for goose management (S. Pendergast, pers. comm. December 2, 2014).

Relocations often lead to nuisance problems in new areas, and may introduce or spread disease. Birds may simply return (Subcommittee on Pacific Population of Western Canada Geese 2000; CWS 2010). Still, *Best Practices for Capturing, Transporting and Caring for Relocated Canada Geese - Canada Goose Management* is available to help potential applicants understand whether relocation is a viable alternative. According to CWS, relocation permits may be allowed to move birds from non-huntable to huntable areas. Prior to any relocation, alternative methods of control must be attempted. Permits holders are required to find someone who will accept the birds, which has been an increasingly difficult challenge (E. Lok, pers. comm. December 1, 2014).

Some time ago, provincial permits were also required for destroying, possessing, and transporting geese or goose eggs, however this is no longer the case. The MFLNRO now sends all permit requests for Canada Geese to CWS. Provincial staff become involved in cases where staff may be subject to public enquires or questioned as to their stance on a specific issue (e.g., participating in group discussions where culling of geese is being considered). The provincial wildlife veterinarian must be involved in such cases, to ensure appropriate handling and euthanasia protocols are used, and all standards of animal care are met (S. Pendergast, pers. comm. November 24, 2014).

4.44 Scare Permits

To use a firearm (even with cracker shells or screamers) or aircraft (including drones and remote-controlled hobby planes or helicopters) for the purpose of scaring Canada Geese, a CWS damage or danger permit is required.

If the intent is to kill, and not scare Canada Geese, then a kill permit is required. Kill permits are also required when using birds of prey to scare geese, as these birds have the instinct to kill. It is not permissible to kill or wound birds while scaring them (CWS 2010).

However, any person may, without a permit from CWS, scare migratory birds that are causing or are likely to cause damage to crops or other property, using equipment other than firearms or an aircraft.

An applicant need not be a landowner or land manager to be issued a permit to scare Canada Geese. Applicants may name assistants to carry out hazing activities.

CWS does not issue permits to use dogs to scare geese. However, if a bird is injured or killed by a dog, it must be reported to Environment Canada. To avoid potential injury, dogs should not be used from May 1 through July 31, as birds may be flightless or a less mobile family group. To use dogs during this period, a provincial permit may be required; a regulation to enable this is under development (S. Pendergast, pers. comm. February 3, 2015). At other times of year (August 1 through April 30), provincial permits are unnecessary, but the dogs must be kept under constant supervision. There are also special restrictions in the Parksville - Qualicum Beach Wildlife Management Area.

Municipal permits may be required to disturb Canada Geese, depending on the bylaws of the jurisdiction and the type of disturbance.

4.45 Management Plans

Although CWS has stated it may require a management plan prior to issuing permits (CWS 2010), management plans are not legislated requirements of any permitting process, i.e., they are not specified in the *Act* or regulations as prerequisites for permits to control geese. However, CWS, as a policy measure, may require a management plan, particularly if large numbers of geese are expected to be killed (CWS 2011). A plan may also streamline the permitting process for large landowners with Canada Goose conflicts on several sites. Recommended for local governments, golf courses, and large farms undertaking multiple goose control activities, management plans are noted to improve implementation efficiency, facilitate evaluation and adaptive management, and reduce administrative challenges (CWS 2011).

Best Practices for Management Plans - Canada Goose and Cackling Goose Management was published by CWS in 2011 (see http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=7C6E31D5-B9F7-4717-A0E5-FC64B0217154). Best Practices is a six-page document with a template. Applicants are asked to set a population target, and outline approaches to maintain target numbers and address public opinion. “Killing is not to be the primary management approach” (p. 1).

4.5 Wildlife Policy for Canada

The Wildlife Policy for Canada, 1990, is a national policy and framework for federal, provincial, territorial, and non-governmental policies and programs affecting wildlife. A guiding principle was that "all Canadians share the costs of conserving wildlife [and] those whose actions result in additional costs should bear them" (p. 9). The policy asserted, "wild animals that cause unacceptable risk to people; damage to crops, aquaculture, or livestock; or pressure on habitats or other wildlife populations should be controlled only on the basis of long-term, scientifically sound, and economically justified programs. Such programs should be developed in close consultation with public and private interests; should employ only the most safe, efficient, economical and humane methods; and should be subject to regulation. Lethal methods should be used minimally and only when preventative measures fail. In certain cases of crop damage, compensation may be paid" (p. 22-23, Wildlife Ministers' Council of Canada 1990). The policy is not widely cited or used (K. Brock, pers. comm. November 17, 2014).

4.6 Hunting Regulations

According to the *Migratory Birds Convention Act, 1994*, the closed season on migratory game birds is between March 10 and September 1 (with exceptions for subsistence purposes). The season for hunting any species within a given region is further restricted to a period not exceeding 3.5 months, or 107 days.

Until recently, CWS had reviewed migratory game bird hunting regulations every year, with input from the provinces and interested organizations and individuals. Three documents were developed in this process: 1) *Population Status of Migratory Game Birds in Canada,* 2) *Proposals to Amend the Canadian Migratory Birds Regulations (including Regulation Proposals for Overabundant Species)*, and 3) *Migratory Birds Regulations in Canada.* The proposals to amend are created in accordance with the *Objectives and Guidelines for the Establishment of National Regulations for Migratory Game Bird Hunting*. The final document summarizes the regulations for the upcoming hunting season. The timing of the reports allowed Canadian representatives on the international Flyway Councils to report on already-legislated changes (CWS Waterfowl Committee 2011).

From the 2014-15 hunting season, the regulations will be established in two year intervals. To ensure new regulations can become law by early June, the timing of the reports has been adjusted. The status report is completed from September through November and posted in early January. The proposal to amend, including any designation of overabundant species, is posted by mid-January. These are completed in consultation with the Province and stakeholders. In early July, the *Migratory Birds Regulations in Canada* report is posted, containing the approved hunting regulations (CWS Waterfowl Committee 2013). (See Chapter 4.41, Overabundance, to learn how to request or propose changes to the regulations.)

The Province may accept or strengthen the annual federal regulations. The *Hunting and Trapping Regulations Synopsis,* available at http://www.env.gov.bc.ca/fw/wildlife/hunting/regulations/, summarizes B.C. hunting regulations made under the *Wildlife Act, 1996*. The Synopsis includes important hunting regulations and defines open seasons with maps indicating no hunting, no shooting, and other closed areas. Our region is included within Provincial Management Units 1-5 and 1-6, which are part of District 1, a federal management unit encompassing Vancouver Island.

To hunt Canada Geese, hunters must possess a valid federal Migratory Game Bird Hunting Permit with a Canadian Wildlife Habitat Conservation Stamp. Hunters under the age of majority are afforded the opportunity to hunt without permits during Waterfowler Heritage Days, while accompanied by a licensed mentor.

HUNTING SEASON BAG AND POSSESSION LIMITS 2014-2015

Waterfowler Heritage Days October 4 - 5, 2014

Open Season for Canada Geese - September 6 - 14, 2014 (b)(c)(d) (9 days); October 11 - November 23, 2014 (b)(c)(d); December 20, 2014 - January 11, 2015 (b)(c)(d); February 10 - March 10, 2015 (b)(c)(d). (b) includes 1-5 and 1-6. (c) provincial regulations. (d) Canada Geese and Cackling Geese only.

Daily bag limit = 10 (any combination of Canada Geese and Cackling Geese)

Possession = 30 (any combination of Canada Geese and Cackling Geese)

Hunting seasons were adjusted from two to three seasons in 1998-99, and from three to four seasons in 2007-08. The total number of hunting days stayed the same. Larger bag and possession limits were implemented in 2012 to increase harvests of Canada Geese (Table 4-1).

Table 4-1. Hunting Seasons and Bag Limits for Management Units 1-5 and 1-6, 2008-2015.

Year	Seasons	Bag Limit	Possession Limit
2014-15	Sep 6-14 (9 days), Oct 11-Nov 23 (44 days), Dec 20-Jan 11 (23 days), Feb 10-Mar 10 (29 days) = 105 days	10	30
2013-14	Sep 7-15 (9 days), Oct 12-Nov 24 (44 days), Dec 21-Jan 12 (23 days), Feb 10-Mar 10 (29 days) = 105 days	10	30
2012-13	Sep 1-9 (9 days), Oct 6-Nov 18 (44 days), Dec 15-Jan 6 (23 days), Feb 10-Mar 10 (29 days) = 105 days	10	30
2011-12	Sep 3-11 (9 days), Oct 8-Nov 20 (44 days), Dec 17-Jan 8 (23 days), Feb 11-Mar 10 (29 days) = 105 days	5	10
2010-11	Sep 4-12 (9 days), Oct 9-Nov 21 (44 days), Dec 18-Jan 9 (23 days), Feb 10-Mar 10 (29 days) = 105 days	5	10
2009-10	Sep 5-13 (9 days), Oct 10-Nov 22 (44 days), Dec 19-Jan 10 (23 days), Feb 10-Mar 10 (29 days) = 105 days	5	10
2008-09	Sep 6-14 (9 days), Oct 11-Nov 23 (44 days), Dec 20-Jan 11 (23 days), Feb 10-Mar 10 (29 days) = 105 days	5	10
2007-08	Sep 8-16 (9 days), Oct 6-Nov 23 (49 days), Dec 15-Jan 6 (23 days), Feb 16-Mar 10 (24 days) = 105 days	5	10
2006-07	Sep 15-Oct 22 (38 days), Dec 15-Jan 25 (42 days), Feb 14-Mar10 (25 days) = 105 days	5	10
1997-98	Sep 15-Oct 25 (41 days), Nov 20-Jan 25 (67 days) = 108 days	5	10

Our bag and possession limits in the early September season were twice that of Washington State's Whatcom County, where some of our marked geese have been observed or shot (Table 4-2). Their early season was 3 days shorter, and there were only 74 total hunting days, compared to 105 days here. There were an average of 952 geese (all species) harvested in Whatcom County each season, from 2009 through 2013 (Washington Department of Fish and Wildlife 2014), compared to an average of 1,515 geese (all species) harvested in Vancouver Island management units 1-5 and 1-6 over the same period.

Table 4-2. Washington State Hunting Seasons and Bag Limits, Goose Management Area 3 (including Whatcom County)

Year	Seasons	Bag Limit	Possession Limit
2014-15	Sep 10-15 (6 days)	5	15
2014-15	Oct 11-23 (13 days), Nov 1-Jan 25 (55 days)	4	12

4.7 B.C. Wildlife Act Permits

Pursuant to the *Wildlife Act, 1996*, permits are required for possessing or transporting dead wildlife or wildlife parts; capturing and possessing live wildlife; killing wildlife for crop protection, population control, scientific research, public safety, ceremonial, educational or humane purposes; possessing or distributing game meat for sustenance (e.g., food bank); trafficking in wildlife or wild meat; and operating a commercial hunting club. However, most permits related to Canada Geese are issued by CWS, not the Province. This is not a exhaustive list; see http://www.env.gov.bc.ca/pasb/fw_permreg.html and the *Act* for regulated activities and permitting instructions.

4.8 Firearm Regulations

It is beyond the scope of this document to describe all of the rules which govern the use of firearms in the control of Canada Geese. This section is a general overview; it is the responsibility of each individual to understand the laws and regulations for gun ownership, transport, and use.

The federal *Firearms Act, 1995;* provincial *Firearm Act, 1996*; B.C. *Wildlife Act, 1996*, section 108 (2); various regulations associated with these Acts; and municipal bylaws collectively determine where and how firearms may be discharged. The *Migratory Birds Regulations* also require a permit when firearms are proposed for scaring or killing migratory birds causing damage or danger (CWS 2011).

In general, provincial legislation closes all cities, municipalities, and regional district parks and trails to the discharge of firearms unless specifically exempted. Discharge of shotguns may be permitted in certain areas, such as agricultural zones. Municipal bylaws affecting discharge of firearms are not included in the B.C. *Hunting and Trapping Regulations Synopsis*.

The City of Parksville's *Bylaw to Regulate and Prohibit the Discharge of Firearms and the Use of Bows (Bylaw No. 1458), 2010*, is available at https://parksville.civicweb.net/document/1130/Bylaw%201458%20-%20Firearms%20Regulation%20Bylaw.pdf?handle=B334153A7907462B9640889AF9BA01D2. The bylaw

prohibits firearm discharge within city limits with certain exceptions. Peace officers, conservation officers, Fisheries and Oceans Canada enforcement officers, CWS employees, and bylaw officers enforcing an animal control bylaw are allowed to discharge firearms within the city, in the lawful performance of their duties. On farmlands larger than 2 ha, a landowner or another with permission from the owner can discharge firearms to protect agricultural crops, livestock or domestic animals from wildlife.

The Town of Qualicum Beach Parks Bylaw No. 551 also prohibits the discharge of firearms (D. Marshall, pers. comm. November 12, 2014).

CWS encourages provincial and municipal regulators to enable hunting where geese are a problem, by allowing firearms to be discharged in areas that do not require prohibitions to protect public safety (CWS 2011).

4.9 Processing Non-hunted Wild Game for Consumption

In a June, 2014 meeting in Parksville, a CWS biologist suggested that attendees not spend time and effort trying to change firmly written legislation prohibiting the consumption of non-hunted Canada Geese (I. Whitehorne, pers. comm. June 18, 2014). A few months later, CWS reported there were revisions proposed for the *Migratory Birds Regulations* that would allow consumption of culled geese, requiring the development of standards with agencies responsible for public health and food inspection (E. Lok, pers. comm. December 1, 2014).

4.91 Consumption of Non-hunted Wild Game in Canada

Various literature (cf. Keefe 1996; Coluccy et al. 2001) and local comments suggest that fewer people are opposed to the culling of nuisance geese when they are used to feed the homeless and others. Per the *Migratory Birds Regulations*, birds killed under such permits cannot be traded, bartered, or sold. CWS reasoned, "by not allowing birds to be eaten we help to ensure that the birds are being killed because they are causing damage, and not for the purpose of providing hunting opportunity outside of the regular hunting season" (CWS 2011). The spread of disease was another issue of concern (I. Whitehorne, pers. comm. June 18, 2014).

Yet the *Migratory Birds Regulations* state, "a person may give a migratory game bird to another person for... human consumption... if the bird was killed under the authority of a migratory game bird hunting permit". It does not say this may occur under the authority of a damage or danger permit, but it doesn't say it cannot, either.

There is sometimes a misconception that geese killed to prevent further damage must be left where they are killed (S. Pendergast, pers. comm. November 2014). However, leaving the birds in the field is not a regulatory requirement; the recommendation that carcasses be left as visual deterrents and to attract scavengers are disposal best practices (CWS 2011b; E. Lok, pers. comm. December 19, 2014).

CWS' *Best Practices for Killing Birds and Disposing of Carcasses* include discarding, burning, burying, landfilling, and incineration as methods of Canada Goose disposal. These Best Practices are appended to CWS permits issued under Section 26.1 of the *Migratory Birds Regulations, 1994* (i.e., permits to reduce damage and danger-causing Canada Geese). A commercial poultry processor is recommended as one of five methods to kill Canada Geese prior to disposal (CWS 2011b), as opposed to a route to human consumption.

Nonetheless, Canadian wild game have in fact been culled, processed, donated, and even sold and exported. Canadian Food Inspection Agency (CFIA) food inspectors have monitored caribou harvesting in Nunavut,

for example (A. Messner, pers. comm. November 6, 2014). The Southampton Island harvest began in 1994 as a cull to protect habitat. An annual harvest is now operated by a company that ships the meat to Rankin Inlet for final processing, distribution and sale. The harvest employs Aboriginal Canadians and provides a regular boost to the local economy (Greer 2003).

However, CFIA perceives the Nunavut example as a very special case. A temporary federal inspection plant was established, and federal veterinarians and inspectors were flown in, at great expense. The carcasses were managed and inspected in the same manner as any other type of meat destined for export, in compliance with international standards for trade (K. Roblesky, pers. comm. February 12, 2015).

In a Quebec pilot project, wild deer, squirrel, muskrat, hare, and beaver were being served in some Quebec restaurants. Abundance and food safety were considerations for the choice of species (CBC News 2014).

In B.C., trappers can use their quarry as they please, and people who have nuisance issues with furbearers can hire trappers to get rid of them (S. Pendergast, pers. comm. November 2014).

CFIA regulates birds for which an inspection system has been established. Currently, there is no inspection system for wild geese (J. McClendon, pers. comm. February 11, 2015).

In general, wild game is not permitted in processing plants and some abattoirs/ slaughterhouses because they are not raised according to health standards or inspected prior to killing, and because there is a risk of cross-contamination and transmission of diseases, pathogens, and even chemical residues to humans (cf. Ontario Ministry of the Attorney General 2004).

Importantly, "if the [Province] took over the cull bird slaughter under [its inspection] program, the federal system would not require any change. The only stipulation would be that the meat could not move out of B.C." (J. McClendon, pers. comm. February 11, 2015). Therefore, a made-in-B.C. solution is possible.

4.92 Consumption of Non-hunted Canada Geese in the United States

In the past, CWS asserted that Canada Geese, as migratory birds, cannot be managed in the same way as one might manage ungulates, for example, due to strict provisions in the *Migratory Birds Convention Act* (CWS, pers. comm. 2008). In other words, Canada's treaty with the United States prevents certain management techniques, including culling Canada Geese for human consumption.

More recently, CWS acknowledged that culled geese are used for human consumption in the U.S., but this varies from state to state (E. Lok, pers. comm. December 1, 2014).

In 1996, Keefe published the *Feasibility Study on Processing Nuisance Canada Geese for Human Consumption* for the Minnesota Department of Natural Resources. Orchestrated trials demonstrated that capturing, holding, and processing Canada Geese from the Twin Cities region for human consumption was an economical ($18-25/goose), operationally feasible, and socially acceptable method of controlling nuisance populations. Birds that were held and pastured or fed for a few months after capture appeared to yield a better product, when compared with birds processed immediately after capture during the moult.

A concurrent study by Cooper (1995) showed there was no evidence in the literature to suggest that geese captured on non-industrial sites, including golf courses, parks, and other turf grasses, were unfit for human consumption due to potential or realized exposure to herbicides, insecticides, or fungicides. A health assessment of nuisance geese in Lansing, Michigan revealed detectable levels of various contaminants, including PCBs and DDT, but none were at levels deemed to pose a risk to children or adults (U.S. Department of Health and Human Services 2008).

These studies laid the foundation for many jurisdictions to cull and donate captured geese to food banks (Keefe called them 'food shelves'). In the St.Paul - Minneapolis area, 16,551 geese were trapped and processed in licensed facilities

from 1995 to 2005. A 1999 white paper explored the use of goslings for human and animal food; a third option to kill, landfill and incinerate them would only be considered if avian influenza became an issue. In 2006, the animal food option was approved by the USFWS and DNR. Geese were donated for human consumption and goslings were provided to a Wildlife Science Center to feed captive wolves and bears (City of Eden Prairie 2008).

In Wisconsin, Canada Geese that are captured and processed are sampled for contaminants known to be harmful to human health, prior to distribution to food pantries (Wisconsin DNR 2000 in USDA 2000).

In Missouri, distribution for human consumption through charitable organizations occurs when other techniques have been unsuccessful and where local communities formally support and pay for capture and processing (USDA 2002). Affected property owners typically pay a fee to offset the costs of trapping and transportation to the processor. Food banks pay for transportation from the processor to their facilities (Missouri Dept. of Conservation 2002).

4.93 B.C. Rules for the Sharing of Game

In effect, there are few provincial barriers to donating geese to food banks. The B.C. *Wildlife Act* prohibits the possession of wildlife except as authorized under a license or permit or as provided by regulation. Communities may obtain a permit from MFLNRO to cull, i.e., hunt or humanely kill wild ungulates as a means of population management or control, and MFLNRO may also permit these jurisdictions to donate the meat; the permit details directions for transportation and transfer of ownership (B.C. Centre for Disease Control 2012).

While wild animals cannot be processed in a provincial plant (due to federal regulations), problem deer have been captured, humanely euthanized, field dressed under the supervision of an inspector or transported to a butcher. The processed meat was then donated to local food banks or to First Nations (K. Roblesky, H. Schwantje, pers. comm. February 12, 2015). In other words, there is precedence for salvage and donation of culled meat in the province.

In addition, road killed ungulates are routinely salvaged, dressed, processed, and provided to needy individuals (cf. B.C. Wildlife Federation 2012). Legally harvested wild game is often donated to non-profit groups for fundraising dinners.

In 2012, B.C. Centre for Disease Control, B.C. Ministry of Health, and the five regional Health Authorities published *Standards for the Donation of Culled Game Meat*. The meat must be from carcasses that are inspected in the field by individuals that have completed the one-day MFLNRO training program and are deemed fit for human consumption. Donation of game must comply with B.C.'s *Food Safety Act, 2002* and *Public Health Act, 2008*, and corresponding sections of the *Meat Inspection Regulation* and the *Food Premises Regulation* pertaining to sanitation and food hygiene. Game must be processed by approved facilities and donated to food banks or to individuals and families for their personal consumption. As the *Food Premises Regulation* requires that foods come from an approved source, and be slaughtered in a federally or provincially inspected facility, game meat cannot be donated to soup kitchens, charitable organizations or any facility in which compliance with the Food Premises Regulation is required (B.C. Centre for Disease Control, Food Production 2012).

> *"Economically disadvantaged individuals and families may have challenges in obtaining high quality nutritious food. Donated food, particularly the high protein and low fat meat obtained from game animals, can greatly increase the diversity and nutritional quality of recipients' diets.... The benefits of donating wild game meat to economically disadvantaged individuals and families can outweigh any disadvantages or costs such a program may entail"*
>
> (B.C. Centre for Disease Control, Food Protection 2012, p. 2).

In essence, if the provincial approach to wildlife handling could be applied to geese, permittees who destroy geese to prevent damage to their lands would be required to make all attempts to provide the meat to people in need, if they did not consume it themselves (S. Pendergast, pers. comm. June 14, 2014).

4.10 Aboriginal Rights

4.101 Parksville Protocol

The Parksville Protocol is an amendment to the *Migratory Birds Convention Act* that recognized and endorsed traditional Aboriginal harvesting rights, signed in 1995 between Canada and the U.S., and brought into force in 1999 as an addition to the *Act* schedule. Subject to existing Aboriginal and treaty rights under section 35 of the *Constitution Act, 1982*, relevant treaties, land claims agreements, self-government agreements, and co-management agreements, the Protocol enables First Nations to harvest migratory birds and their eggs throughout the year. Down and inedible by-products may be sold, and birds and eggs can be offered for barter, exchange, trade, or sale among Aboriginal communities.

4.102 Proposed Changes to the Migratory Birds Regulations

While the *Act* was changed to accommodate the Parksville Protocol, the regulations were not. CWS has proposed the following changes to the regulations, currently in revision, to bring them in line with the current legal environment:

An Aboriginal person of Canada with treaty or aboriginal harvesting rights may domestically harvest migratory birds for food, social or ceremonial purposes in the area where those rights are derived: without a migratory game bird hunting permit, throughout the year, and with no bag or possession limit. The Aboriginal peoples of Canada may barter, exchange or trade, but not sell, migratory birds domestically harvested under aboriginal or treaty rights within or between Aboriginal communities. The Aboriginal peoples of Canada may sell inedible parts of migratory birds domestically harvested under aboriginal or treaty rights (Teillet 2013).

4.103 Contemporary Treaty Agreements

While none of the First Nations in our region currently have settled land claims or other agreements affecting Canada Goose management at this time, such agreements are expected in future. To date, agreements in other parts of the province have been mostly consistent with the wording and spirit of the Parksville Protocol and subsequent proposed changes to the regulations.

Some self-governing First Nations have jurisdiction over wildlife conservation and management on their lands. Notably, the Westbank First Nation's jurisdiction includes any individual harvesting migratory birds on Westbank Lands, not just its own citizens. Nisga'a Lisims Government may make laws requiring that any wildlife or wildlife parts that are transported outside Nisga'a Lands for the purpose of trade or barter be identified as such (Wilson-Raybould 2011).

The final agreement signed by Canada, the Province, and the Maa'nulth First Nation on Vancouver Island in 2008 may provide some insight as to what a future agreement in this area might entail. The federal Minister retains authority for managing and conserving migratory birds and migratory bird habitat. Migratory birds can be harvested within a designated Migratory Bird Harvest Area. Maa'nulth Tribe and Nation members may barter and trade migratory birds and bird parts among themselves and with other Aboriginal people in Canada. The *Wildlife and Migratory Birds Regulation* was brought into force by one of the member nations/ tribes, the Uchucklesaht Tribe, in 2011 (see http://www.maanulth.ca/laws/uchucklesaht/ut_wildlife_migratory_birds_regulation_(00307386).pdf). A utilization of animals provision states, "A person who is exercising the right to harvest... must not waste the edible parts of any... migratory bird or any reasonably usable part of any... migratory bird".

Chapter 5 - The Need for Action
Highlights

We administered a questionnaire and conducted interviews to investigate the socio-economic impacts of geese on our communities. Problems identified included fouling of grassy areas (reported by 85% of respondents); damage to landscaping (54%); contamination of water in recreation areas (46%); damage to crops or hayfields (38.5%); degraded water quality (38.5%); invasive or weedy plants arising from feces (38.5%); contamination of shellfish beds (23%); noise issues (23%); aggression towards people or pets (23%); and contamination of drinking water sources (8%). Reports of contamination of water and shellfish had not been confirmed by testing. Respondents and interviewees also noted damage to fish and wildlife habitat, possible cross-contamination/spread of disease between geese and grazing livestock, loss of playing areas for children, unpleasant playing conditions for golfers, and threats to aircraft. On average, survey respondents rated the severity of their Canada Goose problems at 7.5/10. Ninety percent of respondents had incurred goose-related damages.

Estuaries are critical and year-round habitats for Canada Geese. They are also rare and sensitive ecosystems that provide many local services to humankind (e.g., flood protection, water treatment) and support an estimated 80% of all coastal fish and wildlife. In the region's estuaries, there are at least four different imperiled ecological communities (i.e., provincially red-listed, ranked S2), and at least three communities that are of special concern (i.e., provincially blue-listed, ranked S3); the red-listed Lyngbye's Sedge Herbaceous Vegetation community has been heavily impacted by Canada Geese. While this channel edge community is important for many reasons, it is arguably most valuable in providing shade for salmonids, as water temperatures in channels without overstream sedges have reached lethal levels as early as May in recent years.

Estuaries accumulate nutrients and sediments from the sea, streams, and uplands, which combine to form a 'platform' of rich substrates and organic materials that support prolific plant growth. When Canada Geese are locally overabundant, they overgraze emergent vegetation and grub roots and rhizomes along the channel edges, exposing the thick marsh platform to the tides. The platform, built up over thousands of years, washes away, leaving behind gravelly substrates that can no longer support lush emergent plant communities. The loose material infills the dendritic channels on the higher parts of the marsh with a deep layer of fine sediment, clogging waterways and feeding areas for fish and wildlife.

Although the mid-island estuarine marshes are the first in B.C. to succumb to overgrazing and grubbing by geese, this is not a new phenomenon. A similar situation has occurred in northern coastal marshes, where several species of geese (including Canada Geese, but predominantly Snow Geese) have altered and eliminated entire plant communities, and decreased and changed the composition of soil invertebrates, among many other things. Areas exclosed from geese remain denuded 20 years later. Marsh degradation eventually led to measurable declines in goose productivity and survival rates. Additional hunting opportunities facilitated by an overabundance designation suppressed the growth of Snow Goose populations, but have been mostly ineffective in decreasing them.

Citations, excluded here for brevity, can be found in the text of the document's chapters. Please do not cite highlights without consulting the chapters.

Chapter 5 - The Need for Action
More Highlights

Canada Geese have an inefficient digestive system whereby vegetation passes through the gut quickly, potentially leaving seeds and fragments of invasive plants intact for propagation. Several studies in imperiled Garry Oak ecosystems point to Canada Geese as the vector for invasive grasses outcompeting plant species at risk of extinction.
Canada Goose feces have contributed to phosphorus loading, eutrophication, and algae blooms in nearby jurisdictions. This type of impact has not been examined locally.
Canada Geese consume and may overgraze eelgrass, a keystone species in estuarine and coastal marine habitats. Such concerns have been raised in our area, and along the Gulf Islands. There is empirical evidence in other jurisdictions that seagrasses overgrazed by Canada Geese do not recover.
Canada Geese are contributing to climate change by decreasing the productivity of estuarine marshes and eelgrass beds. These ecosystems store and sequester vast amounts of 'blue carbon'.
Aircraft can be downed by bird strikes, and most airports have kill and hazing programs. Locally, staff at the Department of National Defense Canadian Forces Maritime Experimental and Test Ranges in Nanoose Bay were concerned with growing populations of Canada Geese on the property, and geese nesting near the helicopter landing pad in particular. At the Qualicum Beach airport, the goose problem is "unremarkable", although there are plans to fill a depression to avoid ponding and attracting waterfowl.
Our surveys included responses from five local farmers, all experiencing annual crop damage. Some had lost nearly entire crops to geese. To mitigate losses, farmers had over-seeded, replanted, repaired/'re-pastured', drained wet areas, and altered their farming practices and crops. Aside from grazing, geese trampled and disturbed soils, deposited weed seeds, and pulled out young plants without eating them. For some farms, most depredation occurred during spring and autumn migration periods, while others experienced problems year-round. Nonetheless, two of the five cited the potential benefits of geese, and one was willing to attract Canada Geese if he could legally harvest and market them.

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Chapter 5 - The Need for Action
More Highlights

Contamination of drinking water, and fouling of beaches, parks, sports fields and other areas by goose feces, feathers, etc. pose risks to human and animal health. In response to increasing complaints by parks departments and other agencies, and media attention to H5N1 and other pathogens, CWS commissioned a risk assessment. However, the Canadian Cooperative Wildlife Health Centre found insufficient data were available to conduct a meaningful assessment. Recommendations included improving traditional water quality indicators, mitigating risks through fecal waste management and other strategies, investing in monitoring and research to develop an evidence-based risk assessment, and forming a working group to develop national standards for the management of peri-urban goose populations.

Risks to health may be higher in aquatic areas, and in areas where geese are congregating in proximity to children or people who are immunocompromised. Young children playing in sand may have greater exposure to goose-borne bacteria, as bacteria persist longer in sand than in water. Notably, water tested at popular beaches has been unremarkable.

Our survey respondents suspected drinking water contamination; infections in dogs frequenting fouled lawns, paths, and roadways; contaminated water in recreation areas; and contaminated shellfish beds. Children were often exposed to large amounts of goose feces on school grounds and sports fields.

Fouling of grassy areas deterred youth from playing sports, discouraged golfers from playing preferred courses, and dissuaded tourists from return visits. For some, clean-up was time-consuming and expensive. The City of Parksville purchased a machine to sweep goose feces from parks, sports fields, other grassy areas, and hardscapes; however, the sweeper was ineffective when the fields were wet.

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5.1 Few Benefits, Many Problems

Who among us has not been reminded of the changing of the seasons with the chatter and honking of migrating geese in characteristic V formation? Or gazed fondly at soft, yellow goslings trotting along with their parents? Canada Geese are truly a Canadian icon. Their image adorns signage and advertising in nearly every jurisdiction. At the time of this writing, they were running 4th in a competition for national bird (Canadian Geographic 2015). Perhaps it is no surprise that wildlife enthusiasts once sought to increase wildlife viewing and hunting opportunities of Canada Geese, or that some local residents appreciate the geese and even feed them, despite the known problems.

The literature associated with the management of nuisance Canada Geese is voluminous and repetitive, peppered with studies and policy documents. There are many government and company web pages dedicated to reducing the impacts of Canada Geese.

Our questionnaire respondents provided a snapshot of the problems associated with geese in our area (Table 5-1). In addition to these, respondents noted damage to fish and wildlife habitat (estuaries, floodplains, eelgrass meadows), possible cross-contamination/spread of disease to and from grazing livestock, loss of playing areas for children, and unpleasant playing conditions for golfers.

On a scale of 0 to 10, where 0 is trivial/not concerned at all, and 10 is critical/very concerned, survey respondents reported that their Canada Goose problems were 7.5, on average (n=13). Responses ranged from 0 to 10, and 3/4 of respondents rated their problems 8 or higher. Respondents had different views as to whether goose problems were increasing, decreasing, or static (e.g., over the past 5 years). City of Parksville staff believed that some problem areas in the city had improved, others had worsened, and some had stayed the same. Most problems were seasonal. For owners and managers of mostly terrestrial landscapes, the moulting period offered a short reprieve from goose management.

Questionnaires and Interviews

To investigate socio-economic impacts of geese on our communities and explore management initiatives adopted by those having problems, a questionnaire was administered to 35 people, representing local governments, farmers, golf course operations, resorts, airports and airlines, residents groups, schools, and community groups. Dismal response rates led to follow-up calls and interviews. While far from comprehensive, the results provided a snapshot of the nature and extent of Canada Goose-related issues experienced by various sectors.

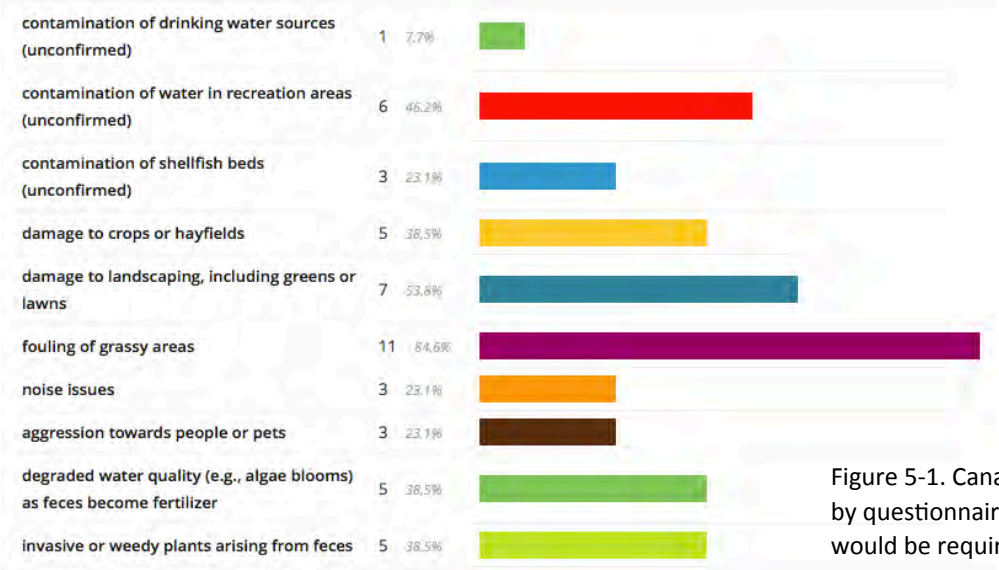


Figure 5-1. Canada Goose problems experienced by questionnaire respondents. Positive lab tests would be required to confirm contamination.

5.2 Impacts to Estuaries

Vegetative changes at the Little Qualicum River estuary. Upper photo August 1978, Lower photo August 2005. Photos by Neil K. Dawe.

In contrast to other jurisdictions, Canada Geese have caused significant and long-lasting damage to mid-island estuaries. They overgraze emergent vegetation and grub roots and rhizomes along channel edges, exposing the thick marsh platform to the tides. The platform, built up over thousands of years, washes away, leaving behind gravelly substrates that can no longer support lush emergent plant communities. On the higher parts of the marsh, the loose sediment infills the dendritic channels, clogging waterways and feeding areas for fish and wildlife with a deep layer of fine sediments. Seeds, concentrated along the channel edges by winds and currents, are consumed or lost to subsequent erosion (Krupu & Reinecke 1992).

In 2009, MVIHES published *Caring for the Englishman River Estuary* (available at http://www.mvihes.bc.ca/newsroom/published-documents/119-publisheddocuments), which mapped dramatic changes in estuarine vegetation and substrates between 1976 and 2008 (Kennedy 1976; MVIHES 2009). In the same year, the Guardians began planning the restoration of the Little Qualicum and Englishman River estuarine marshes. Dawe et al. (2011) quantified changes in estuarine vegetation at the Little Qualicum River estuary, by comparing data collected in 1978 and 2005. MVIHES (2009) and Dawe et al. (2011) attributed most of these changes to Canada Goose herbivory. Similar changes have occurred in the Campbell River estuary, possibly due to moult migrants (Dawe et al. 2015).

Estuaries accumulate nutrients and sediments from the sea, streams and uplands, which combine to form rich substrates that support prolific plant growth. These highly productive habitats are used by an estimated 80% of all coastal wildlife (Pacific Estuary Conservation Program 1999). For many species, estuaries are critical habitat - without it, they could not survive. They may rely on estuaries for at least one stage in their life cycle, or use them when other habitats are unavailable. For example, waterbirds depend on estuaries for survival when other habitats are frozen (Dawe et al. 1998).

A healthy, productive Little Qualicum River estuary, 1996. Photo by Tim Clermont

Nesting Canada Goose on a remnant of marsh platform at the Englishman River estuary (upper)

Canada Goose tracks at the Little Qualicum River estuary. Heavily grazed sedges, a grubbed and eroding marsh platform, and channels infilled with silt are prevalent (lower)

Estuarine marshes are also valuable for the local services they contribute to humankind. They provide food, by supporting fin fisheries and shellfisheries. Many of the intertidal and marine species that we eat depend on estuaries for some part of their life history. Estuaries also protect the coastline from flooding and storm damage, by storing water and dampening wave action; maintain water quality, by naturally treating storm water and other types of runoff; and offer recreational, social and spiritual opportunities that contribute to health and well-being. Increasingly important is their role as indicators of cumulative environmental change; problems arising in estuaries may signal unnoticed or underestimated natural and anthropogenic impacts in linked freshwater, marine and terrestrial ecosystems (D'Alpaos 2011; Clermont 2014).

LGL and B.C. Conservation Foundation (2012) found the ERE was used for rearing by juvenile Coho and Chinook Salmon from April to at least late August, by Coho smolts in May and June, and by Chum fry from April to June. They also found salmon preferentially selected habitats with overstream edge vegetation and large woody debris. Aside from escape cover, such vegetation helps maintain the cool temperatures salmon need to survive. Wightman (pers. comm. 2013) found temperatures in channels lacking overstream vegetation at the LQRE reached 25 degrees Celsius by May in 2011 and 2012; this is the lethal threshold for migrating and holding adult Chinook and Coho Salmon, as well as for juvenile growth and rearing. Sub-lethal temperatures, which are considerably lower, may block migration and lead to reduced growth, among other things (Carter 2005).

At the LQRE, which currently is in far better condition than the ERE, the estuarine detrital food web was shorted by at least 22 tonnes of above-ground biomass from 1978 to 2005, primarily a result of Canada Goose and swan grazing and grubbing of channel edge plant communities (cf. Dawe, Boyd, Buechert, & Stewart 2011). Detritus supports invertebrates, which salmonids depend upon for food. It is extremely likely that the lack of vegetation in the estuary due to Canada Goose grazing and grubbing significantly limits salmonid productivity.

In the subarctic, the degraded state of coastal marshes was probably initiated by foraging damage from an exceptional stopover of staging Snow Geese and Canada Geese, followed by foraging pressure of relatively small numbers of nesting and migrant geese (Kotanen & Abraham 2013). Snow Geese in particular overgrazed and grubbed salt marshes, precipitating a cascade of adverse changes in marsh substrates that led to alteration and elimination of entire plant communities and a persistent, alternative state (Jeffries, Rockwell, and Abraham 2003; CWS Waterfowl Committee 2013). These included, among other things, losses of organic matter and nutrients, depletion of the seed bank, the

Eroding marsh platform at the Englishman River estuary. Much of the central marsh is now bare gravel and mudflat.

development of a hardened thick algae crust, and hypersaline conditions, all of which inhibited vegetative regrowth. There were also declines in the abundance and composition of soil invertebrates, important sources of food for many species. Experimental plots, exclosed after being denuded, were devoid of vegetation more than 20 years later. The long-term decrease in available, high quality forage caused declines in goose clutch sizes, and in survival and body mass of goslings. In stark contrast, areas experiencing low-density goose grazing had increases in primary production, probably due to additional nitrogen from fecal matter (Jeffries, Rockwell, & Abraham 2003).

In Maryland, Canada Goose herbivory was deemed responsible for a major decline in natural wild rice *(Zizania aquatica)* in the Patuxent River tidal marshes (Haramis & Kearns 2006).

Other studies have shown that geese affect primary production, nutrient flows, and invertebrate production. The susceptibility of plants to grazing depends in part on their stage of growth (e.g., their nutritive value determining whether geese will choose to feed on them, their height controlling whether they are accessible), and how well they rebound from grazing pressure (Kadlect & Smith 1992).

5.3 Other Ecological Impacts

Concerns that Canada Geese were impacting critically imperiled Garry Oak and associated ecosystems on the Gulf Islands prompted several studies. Best and Arcese (2009) and Isaac-Renton et al. (2010) discovered that selective herbivory by geese on exotic grasses, common in urban feeding areas, likely precipitated an introduction of invasive grasses to sensitive small island habitats through defecation, fertilization, and grazing. The Winchelsea Islands, offshore from Nanoose Bay, were included in the study areas.

In large quantities, goose poop is known to contribute to phosphorous loading and eutrophication in waterbodies. For example, in Washington State's Puget Sound area, fecal matter from geese created algae blooms, depleted dissolved oxygen, degraded water quality, and reduced habitat for fish and invertebrates in area lakes (USDA 1999). In Missouri, goose fecal deposits on lakes resulted in algal blooms, oxygen depletion, and fish kills (USFWS 2002). No studies have been undertaken to assess whether eutrophication is occurring locally as a result of goose excrement.

Eelgrass *(Zostera marina)* is a keystone species and a favoured food item; Canada Goose flocks consume large amounts of it during the moulting period. A seagrass ecosystem that grows in estuaries and along low wave shorelines, eelgrass meadows support complex food webs, serving as 'salmon highways' and nurseries for invertebrates, shellfish and juvenile fishes (Wright et al. 2012). Although seagrasses may recover from annual grazing events, Rivers & Short (2007) found that Maine-New Hampshire eelgrass beds grazed by ~100 Canada Geese from January through July did not recover. Wright et al. (2012) identified overgrazing of eelgrass by Canada Geese as a growing concern along the Gulf Islands.

It may seem like a stretch to say that Canada Geese are contributing to climate change, but this is indeed the case. Estuarine marshes and seagrass meadows store and sequester vast amounts of 'blue carbon' in anaerobic sediments, where it can remain for millennia. Rates of carbon sequestration are comparable to those in tropical rainforests and

Canada Geese feeding in eelgrass beds in Craig Bay

peatlands (Sifleet, Pendleton, & Murray 2011; Blue Carbon Portal 2013; Crooks et al. 2014).

These coastal ecosystems can become carbon sources, as marsh vegetation and eelgrass beds are lost, and biomass and organic substrates are oxidized (Blue Carbon Portal 2013).

Rebuilding the marsh platform to support emergent vegetation, which will trap additional sediments, will help restore carbon stocks. Protecting existing marsh vegetation from grazing Canada Geese will help mitigate climate change and preserve valuable ecosystem services.

5.4 Socio-economic Impacts

"Although the amount of suitable habitat is a key factor governing the number of geese in a given area, the number of geese considered "problem birds" will be determined by how they are perceived by property owners and property users" (CWS 2010, p. 7). The social license to implement sensitive management solutions will depend upon the nature and severity of the problem as perceived by various stakeholder groups.

In the Puget Sound area, survey respondents to an environmental assessment for the management of conflicts associated with Canada Geese described a general decline in their quality of life. Most felt unable to use their properties and public areas (e.g., parks, piers, beaches, foot paths) due to contamination and fouling from feces (USDA 1999). We found similar results from our questionnaire. For example, an elementary school principal spoke of slippery, unsanitary school fields and walkways, and fields rendered unusable for activities as children were not allowed near the geese.

5.41 Transportation Safety

Most airports pay for hazing programs to protect aircraft from Canada Geese and other birds (CWS 2011). The USDA (1999) reported an estimated 7 fatalities and $245 million damage to civilian and military aircraft each year, with only 20-25% of all bird strikes reported. The most published collision event occurred In January 2009, when U.S. Airways Flight 1549, carrying 155 passengers, was forced to make an emergency landing in the Hudson River, after striking a flock of Canada Geese during take-off from LaGuardia Airport. The event prompted plans to gas 2,000 geese in New York City (Caruso 2009). At Vancouver's YVR in 2013, there were 199 bird strikes involving 254 birds. YVR has an extensive wildlife management program that includes wildlife patrols, border collies, and trained raptors; in 2013, an estimated 544,561 birds were moved away from aircraft operating areas, and 209 birds were killed (Vancouver Airport Authority 2013).

Locally, staff at the Department of National Defense (DND) Canadian Forces Maritime Experimental and Test Ranges (CFMETR) in Nanoose Bay have significant concerns with a growing population on the property, and Canada Geese nesting in proximity to the helicopter landing pad in particular.

By contrast, the manager of the Qualicum Beach airport described the goose problem at the airport as "unremarkable" (B. Weir, pers. comm. November, 2014). The airport has a wildlife management plan. A Town of Qualicum Beach employee inspects the airstrip daily and drives the perimeter. A KD Air employee with one year experience reported no problems with Canada Geese; however, a plane recently collided with a gull (pers. comm. November, 2014).

Although Canada Geese do cross local roads, no complaints have been made.

Goose traffic in the City of Parksville, October 2014. Photo by Doreen Bakstad.

Although infrequent, Canada Geese have been known to act aggressively to cyclists and pedestrians. An Ontario cyclist was attacked by a goose with a brood. Despite wearing a helmet and sunglasses, she suffered a concussion, fractured cheekbone, face lacerations and loose teeth (Desjardins 2014).

5.42 Crop Depredation

During the spring and fall migrations, along migratory corridors that experience hundreds of thousands of northern-breeding waterfowl, crop depredation is a significant problem. Without crop depredation programs (e.g., scare cannons, bait pads to direct birds away from crops), some prairie farmers would have lost their entire harvest.

Here, five farmers rated their level of concern regarding goose depredation on a scale of one to ten. Their responses ranged from 7 to 10, with a mean of 8.2. Although CWS (2010) noted that crop depredation is accentuated on farms within communities where municipal bylaws prevent the discharge of firearms, hunting occurred on all of the farms that had experienced problems with geese. All experienced damage every year, to cereal, vegetable, or hay crops.

In addition to depredation in spring and fall, Canada Geese were found to trample and disturb soils, and deposit weed seeds which easily established in the disturbed soils. One corn farmer noted the geese pull out young plants, but do not always eat them. Some farms reported most of their problems occurred during the spring and fall migration, while others had Canada Geese on their properties year-round. A local hunter that helps farmers rid themselves of geese suggested that species other than Canada Geese, such as smaller-bodied cackling geese and Greater White-fronted Geese *(Anser albifrons)*, may be a significant part of the depredation problem during the fall migration.

In a Connecticut study, corn crops were most often depredated by geese, followed by grass/hay, and then rye and alfalfa cover crops. Most of the financial losses were on corn and rye fields; they ranged from $100 to $40,000, with an average loss of $4,000. Losses increased linearly with the acreage of the farm (Huang 2010).

The Errington farm that reported the greatest level of concern grew corn. Most damage occurred when geese pulled out corn seedlings in spring. Up to 20 acres of corn required replanting annually, at a cost of $500/acre.

Other local farms reported damage to hayfields and pasturelands, on newly seeded areas as well as established grasslands. “The geese eat germinating grass or the existing grass, right down to the soil, thus killing the grass. Large pockets of land are now unusable,” reported one farmer. Farmers lamented exposed soils in winter, and weeds establishing in bare patches.

One French Creek farmer reseeded 7 acres, with seed prices at $113/acre. She estimated spot damage over 100 acres, at costs of

A single flock of geese can destroy a newly planted pasture or cash crop in a short time, if allowed to graze without interference (CWS 2010).

more than $16,000 to repair. As she cannot afford to take 100 acres out of production at one time, the worst fields are chosen each year, and restored 30-40 acres at a time.

Another contracted a neighbouring farmer to 're-pasture' damaged lands at a cost of $4,000. She planted a fall wheat crop, only to have it "almost entirely eaten by geese", and has since struggled with weed control and germination of preferred species. In 2013 and 2014, more than 40 hours of work and $1,000 of expenditures were directed towards drainage and over-seeding.

Agricultural lands may benefit from fertilization by goose feces, and increased sprouting as a result of grazing (MoE 1979); one local farmer did not mind geese grazing his winter cover crops, precisely for these reasons. Another farmer was willing to attract Canada Geese if he could legally harvest and market them.

5.43 Contamination and Fouling

Contamination of drinking water, and fouling of parks, beaches, sports fields, playgrounds, and other areas by goose feces pose risks to human and animal health. Estimates of daily fecal output from a single goose range from 0.39 to 0.9 kg, and fecal matter is often deposited within 100 m of a waterbody (Filion et al. 2006; USDA 2004). Smith, Craven, & Curtis (1999) reported that 60 geese were the threshold for complaints about goose feces.

In Puget Sound, concentrations of geese and ducks precipitated coliform counts exceeding those found in raw sewage, making swimmers sick and closing beaches (USDA 1999).

New Zealand farmers lost sheep to Canada Geese carrying salmonella (Win 2001).

In Maryland, state officials were concerned when geese tested positive for duck virus enteritis, a disease highly contagious to other waterfowl (USFWS 2002).

Canada Geese in Georgia and North Carolina were identified as potential vectors of pathogens, including antimicrobial-resistant variants, affecting agricultural crops and water sources (Cole et al. 2005).

Kullas et al. (2002) found the prevalence of virulent strains of bacteria in goose feces in Fort Collins, Colorado was closely associated with increases in summer temperatures. Compared to migratory geese, resident geese were exposed to greater levels of environmental *Escherischia coli*, because of their use of easily fouled, small water impoundments and limited mobility in warmer months.

In Rochester, Minnesota, the idea of a large urban bird population in the midst of a possible avian influenza pandemic (H5N1) created sufficient alarm for some to suggest that the geese be immediately euthanized. At the same time, the U.S. Secretary of Health acknowledged that humans could become infected with H5N1 through contact with fecal matter, and that some birds could be carriers without showing any symptoms of illness. The first few results from a Mayo Clinic study of the geese were negative, but a pandemic plan was outlined nonetheless (Eckberg 2010).

In Canada, in response to increasing complaints by Parks Departments and other agencies, and media attention to pathogens such as H5N1 and West Nile Virus, CWS commissioned the Canadian Cooperative Wildlife Health Centre to perform a risk assessment. Fraser and Fraser (2010), on behalf of the Centre, found insufficient data were available to conduct a meaningful assessment. There were very large gaps in evidence with respect to the prevalence of pathogens and parasites in geese, epidemiological information to link pathogens in geese to cases in people or livestock, goose fecal distribution patterns, and the nature and extent of contact between geese and humans, or geese and livestock. Notably, data on *E.coli, Cryptosporidium*, and *Giardia* were more readily available (Fraser & Fraser 2010). Fraser and Fraser (2010) suggested traditional water quality indicators be improved, and risks mitigated through fecal waste management and other strategies. They also recommended that CWS invest in monitoring and research to develop an evidence-based risk assessment, and form a working group to develop national standards for the management of peri-urban goose populations.

Transmission of pathogens could occur along many pathways, such as: directly through feathers, skin, droppings or external lesions; contaminating water with feces and respiratory secretions; and also via intermediate vectors such as arthropods and insects (Fraser & Fraser 2010). Geese can also act as intermediate hosts in the life cycle of schistosome parasites that cause swimmer's itch (USDA 1999).

While the probabilities of exposure to pathogens and parasites were unattainable based on existing data, Fraser & Fraser (2010) acknowledged that risks to human health may be higher in aquatic areas, and in areas where geese congregate near people that are immunocompromised, such as in proximity to health centres. Similarly, risks to those with undeveloped immune responses, such as young children and animals would be higher in spaces shared with geese. Young children playing in sand will have greater exposure to goose-borne bacteria, as bacteria persist longer in sand than in water (Fraser & Fraser 2010).

Half of our survey respondents suspected contaminated water in recreation areas. Parksville Bay and Rathtrevor Beach are popular beaches frequented by geese; there are an estimated 11,500 visitors to Parksville in the peak summer period (B. Sepos, pers. comm. November 22, 2014), and there were 461,648 visitors to Rathtrevor Beach Provincial Park from January 1 - October 31, 2014 (D. Chapman, pers. comm. November 24, 2014).

Island Health/Vancouver Island Health Authority (VIHA) Health Inspectors test water at beaches that are formally recognized public recreational water bathing areas with lands and access controlled by a government agency; only beaches with high numbers of bathers are sampled (VIHA n.d.; G. Gibson, pers. comm. December 19, 2014). Sampling of indicator bacteria (i.e., *E.coli* for freshwater areas, and *Enterococci* for saltwater areas) typically occurs from May through Labour Day in September, at an intensity that is based on usage, previous sample results, and potential sources of contamination. A beach advisory may be posted by the Medical Health Officer if the average of several sample results exceeds 200 *E.coli* or 35 *Enterococci*, or a single sample exceeds 400 *E.coli* or 70 *Enterococci* (VIHA n.d.).

According to the Central Island Health Inspector, there have been no significant issues with samples taken from Qualicum Beach, Parksville, or Rathtrevor beaches (G. Gibson, pers. comm. December 19, 2014). In 2014, a single sample taken May 27 found 135 *Enterococci* on Parksville's northwest beach; this was the only sample that exceeded bathing beaches standards (VIHA 2014). Sources of contamination are generally not examined (G. Gibson, pers. comm. December 19, 2014).

In the summer of 2014, two teens were observed swimming with kickboards in the upper reaches of the Craig Creek estuary, among concentrations of goose feces and feathers. Such beaches would not be sampled, due to the low numbers of bathers known to use the area. Swimming in these conditions could result in gastroenteritis, and swimming with open sores could lead to skin infections (G. Gibson, pers. comm. December 19, 2014). There can also be increased risks of ear, nose, and throat infections (VIHA n.d.).

Goose feathers and feces in the water and intertidal areas of the Craig Creek estuary, summer 2014

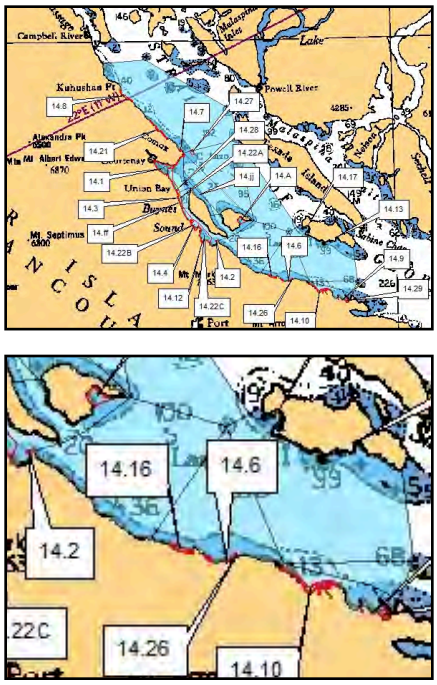


Figure 5-2. Sanitary shellfish closures. Regional context (upper) and specific beaches (lower) (Fisheries and Oceans Canada 2014)

Two survey respondents were concerned about the contamination of shellfish beds. Qualicum Beach, Wall Beach, Parksville Bay (Englishman River to French Creek), the mouth of the Little Qualicum River, and Northwest Bay are all closed for shellfish harvesting (Figure 5-2). Craig Bay is no longer closed (Fisheries and Oceans Canada 2014). Sanitary closures may be attributed to factors other than Canada Geese, such as failing septic systems.

Survey respondents and interviewees were concerned about contamination of other sites. One farmer suspected her drinking water was contaminated, although it was unclear whether this was drinking water for humans or livestock. Another respondent suspected infections in dogs due to fouling of lawns, roadways, and paths.

At Parksville Elementary School, geese often wandered on smaller grassy areas close to the school building and sandboxes. Staff occasionally raked the fields, and volunteers removed dried feces (survey respondent, 2014). Parents were very concerned about contamination and health risks; the soccer field was littered with goose feces while children played an inter-school soccer match, one day after a feces removal effort (J. Cooper, pers. comm. 2015).

5.44 Fouling and Grass Turf Management

Fouling of grassy areas was a concern of local governments, golf course and resort managers, farmers, a school principal, and a DND Environment Officer (survey respondents, 2014).

Many young soccer players have been reluctant to play on 'Poopsville's' (Parksville's) sports fields. City of Parksville staff were distressed to report "teams of youth sliding and slipping and rolling around in goose feces". Fortunately, players are more likely to be healthy and not immunocompromised, reducing health risks (Fraser & Fraser 2010).

The City purchased a machine to sweep goose feces from the parks, sports fields, other grassy areas, and hardscapes such as pavement. In smaller spaces, a blower is used. From 2007 through 2014, $102,633 was spent on sweeping. However, the sweeper is ineffective when the fields are wet (A. Metcalf, W. Payne, pers. comm. September 23 and October 6, 2014), i.e., most of the winter, when soccer, field lacrosse, and other sports are played.

Fouling of play areas at Ballenas Secondary School (left) and at Winchelsea Elementary School (right), Parksville

A sweeper is used to clean goose feces from the sports fields in Parksville Community Park.

A golf course manager reported losing revenue with golfers staying away because the course was "too messy". The course supports a resident Canada Goose population of 30-50 that is augmented by "transients... stopping by", resulting in total numbers of 150-200 geese. The manager noted that full moons resulted in more poop. Aside from cleanup, which takes 5-10 hours per week, time is spent removing goose tracks from sand traps.

In the Puget Sound area, the costs of re-establishing overgrazed lawns and cleaning droppings from sidewalks have been estimated at more than $60/bird (Allan et al. 1995). In Connecticut, Huang (2010) found the occurrence of goose problems on golf courses was highly, positively correlated with the presence and amount of water on the course. Costs for turf damage and cleanup of feces and feathers ranged from $0 to $15,000, with a mean of $2,800 (Huang 2010). The USFWS (2002), in an impact study for the conterminous U.S., recorded golf course damages of $20,000 per green, and individual municipal cleanup costs exceeding $150,000.

Turf management is made more complex and costly when geese overgraze and grub grassy areas and other landscaping, and compress and erode soils (USDA 1999; CWS 2010). So far, no one has explicitly identified these types of impacts in our area.

5.45 Distribution of Genetically Modified Seeds

Many plants propagate with the help of birds. Yet when Canada Geese were believed to have spread viable seeds of genetically modified (GM) wheat from one of Agriculture Canada's experimental farms, there were a flurry of responses from farmers and others concerned about mixing of ordinary crops with GM varieties, as GM products are more difficult to sell in certain markets (Spears 2013). This is probably a general bird issue, rather than a Canada Goose one, but still merits a note here. Farmers who have claimed their crops have inadvertently been cross-pollinated with nearby GM crops have been exposed to lawsuits from GM seed companies claiming they used the seed without paying necessary royalties (cf. Gillam 2013).

Canada Geese at Morningstar Golf Course

Chapter 6 - Population Structure
Highlights

This chapter characterizes the regional Canada Goose population by subpopulations and migrant types. Together with Chapter 10, Population Trends, it lays the foundation for Goal 1 (setting population objectives).

There appear to be three mostly distinct, but sometimes overlapping subpopulations in the region, corresponding to geese banded at the Little Qualicum River, Englishman River, and Craig Creek estuaries (LQRE, ERE, and CCE, respectively).

Resident' and 'non-migratory' have multiple meanings. In the U.S., resident geese are often defined as those that nest and reside predominantly within the conterminous United States. Geese nesting in southern Canada are often called 'temperate-breeding geese'. 'Northern-breeding' geese nest in northern Canada and Alaska, and tend to migrate greater distances than migratory, temperate-breeding geese.

Resident geese are not birds that have lost their ability to migrate. Canada Geese have a strong fidelity to nesting areas. When geese, particularly female geese, reach breeding age, they return to their birthplaces to nest. This repeats year after year. It is likely that the earliest residents were transplants from other regions, or the progeny of birds held in captivity.

Some say that resident Canada Geese do not migrate because all of their needs are met at home. However, we identified 14 migrant types among birds that were supposedly 'resident', captured during the nesting and moulting periods: local residents, local residents plus, moult and winter residents, moult migrants, migrants, dispersed juveniles, emigrants, returned juveniles, Vancouver Island migrant, Vancouver Island moult migrants, B.C. migrants, Alberta migrants, U.S. migrants, and U.S. moult migrants. We defined local residents as geese that were locally present in all five seasons of the Canada Goose life cycle - spring migration, nesting, moult, fall migration, overwintering. Although local residents are the foundation of the year-round regional Canada Goose population, other migrant types are always present.

The three estuary-based subpopulations were comprised of different blends of migrant types. The LQRE subpopulation had the most emigrants and Vancouver Island migrants but no moult migrants and the fewest number of local residents. CCE-banded birds had the highest proportions of moult migrants, moult-winter residents, and local residents plus (present for at least 6 months but absent for at least one season, over multiple years). ERE-banded birds had the highest proportion of U.S. migrants and local residents. Because our birds were banded at the nest and during the moulting period, and Canada Geese are known to migrate north to moult, none of our marked birds would have been northern-breeding migrants.

Local resident populations now rival or exceed long-distance-migrant populations in all flyways, likely because these migrants face a wide range of threats and energetically demanding activities (e.g., long flights, snow and ice-covered food and water resources), while local residents spend more time loafing/ resting, roosting, and grazing within familiar landscapes.

Citations, excluded here for brevity, can be found in the text of the document's chapters. Please do not cite highlights without consulting the chapters.

6.1 Banding

Two bands, a U.S. Fish and Wildlife Service (USFWS) metal leg band and a plastic black-on-yellow leg band, identified Canada Geese captured at their nests on the Englishman River estuary. Photo by Guy Monty.

Nesting Canada Geese on the Little Qualicum River estuary were banded with black-on-pink leg bands.

To characterize our regional Canada Goose population, we looked for marked (i.e., banded and collared) geese during regularly scheduled goose counts. It is assumed that the information gathered from re-sights of this marked sample can be extrapolated to the greater population.

The Canada Goose banding program began at the Englishman River and Little Qualicum River estuaries in 2008. Stealth and salmon nets were used to catch Canada Geese at their nests; plastic-coated nets did not get caught in the birds' feathers and were less stressful to use, for the geese and the banders. A total of 19 Canada Geese were banded at theirs nests at the ERE over 3 nesting seasons (i.e., 5 in 2008, 8 in 2009, and 6 in 2010) (Clermont 2010, June). At the LQRE, 3 Canada Geese were banded at their nests (1 in 2008, 2 in 2009). During the moult in July 2009, 9 flightless adults and juveniles were corralled and banded at the LQRE. These birds were marked with standard federal numbered aluminum alloy bands and plastic alphanumeric leg bands (e.g., A1F). ERE leg bands were black-on-yellow, and LQRE bands were black-on-pink.

The Guardians later purchased plastic neck collars to mark additional birds, as observers were challenged to see the leg bands when the birds were on the water or standing in tall grass. In July 2010, 85 moulting Canada Geese were trapped at the LQRE and marked with numbered K-series, black-on-white collars (e.g., K001), bringing the total number of geese marked at the LQRE to 97 birds (Clermont 2010, September). Also in July 2010, 70 moulting Canada Geese were trapped at the ERE and marked with numbered M-series collars (e.g., M001). In May 2011, four more birds were collared at the ERE, bringing the total number of geese collared there to 93.

In July 2012, 106 moulting Canada Geese were trapped and marked at the CCE with numbered T-series collars (e.g., 001T) (Morrison 2013). These collars were glued with E-6000 adhesive to prevent the collar loss experienced with the K and M-birds. In all, 296 Canada Geese were banded from the three estuaries.

More than 12,707 survey records - some dating back to 1989, as well as 1,663 nest (addling) records, and 4,746 records of re-sighted marked Canada Geese over the last seven years (2008 - 2014) were used to examine the structure, abundance, and distribution of our regional Canada Goose population.

Canada Geese on the Englishman River estuary were marked with USFWS metal leg bands and M-series, black-on-white plastic collars.

Release of geese rounded up at the Craig Creek estuary in 2012. We ran out of bands before we ran out of birds to band.

All birds were marked under appropriate CWS scientific capture and band permits.

It is noteworthy that unusual preening behavior was observed among some collared birds. This issue merits further investigation.

Englishman River estuary round-up. Canada Geese were herded into a trap, banded, and collared during the moulting period in July.

Limitations

Marked Canada Geese were sexed or aged only when it was easy to do so (e.g., goose and gander could be differentiated at the nest, as only the goose incubated the eggs). Without this information, certain types of analyses were impossible.

Some birds banded at the LQRE and ERE removed their collars. Collars were glued to prevent loss, for geese banded at the CCE.

Once flocks had been collared, leg-banded geese may have been under-represented in surveys generally, as surveyors were often positioned at distances where collars could be read with a spotting scope.

Because all marked birds were captured during the nesting and moulting seasons, the sample is heavily biased to specific migrant types, notably birds that are locally resident during the spring and summer, and moult migrants. (See Chapter 6.4 for a description of migrant types.)

Compared to coloured leg bands, collars were much easier to read in tall vegetation, on the water, and at a distance.
Photo by Guy Monty

6.2 Goose Surveys

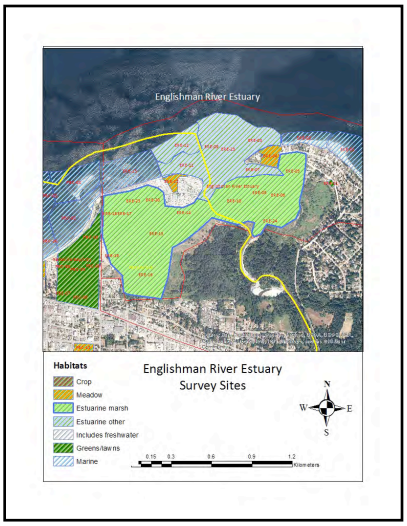
6.21 Survey Areas and Sites

CWS/MoE established routes and survey areas in the late 1980s, and in subsequent years, areas were added or merged. By the mid-2000s, the region was divided into 17 survey areas (Figures 6-1 and 6-2, Table 6-1). A group of volunteer surveyors were responsible for surveying one or more of these 17 survey areas.

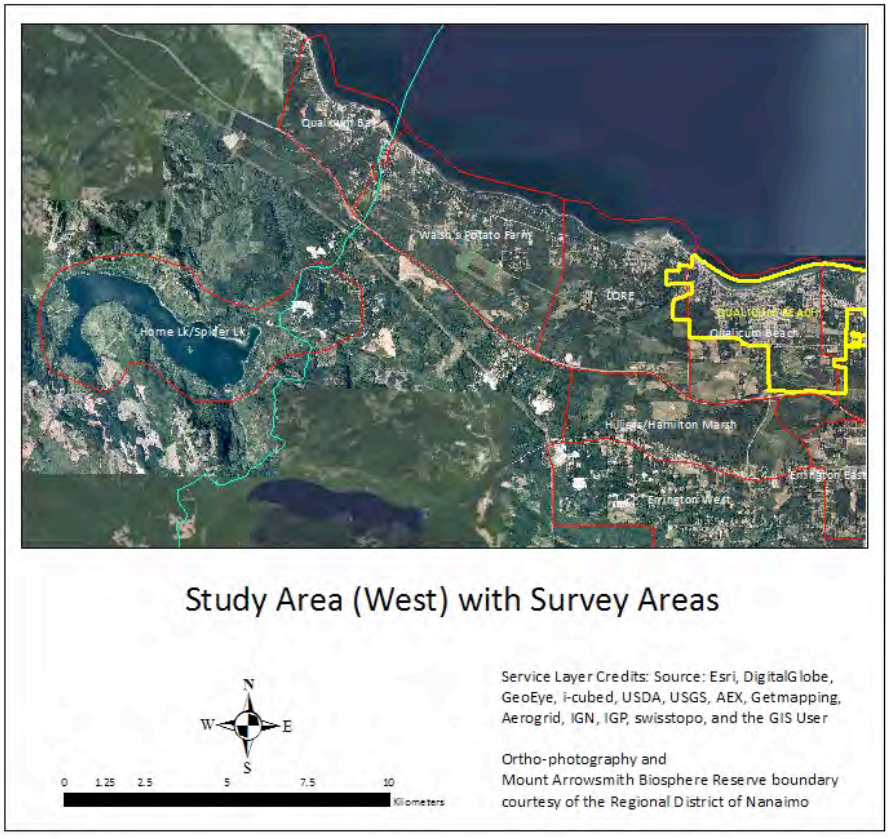
Most areas included habitats that geese would be unlikely to use, such as forests. It is unclear whether Canada Goose populations were growing and expanding into new areas, whether the survey effort was increasing, or both.

The Guardians used the 17 areas for later surveys (and many of the same volunteers), but also mapped 342 specific survey sites within the larger areas.

Each site that encompassed known or potential goose habitat was designated one of seven habitat types: crop, meadow, estuarine marsh, estuarine other, includes freshwater, greens/ lawns, or marine (See Appendix A). Site mapping occurred over time, as geese were discovered on new sites and survey routes expanded. Some sites were lost to development. There are also potential goose habitats that were not mapped, because they were difficult to access or simply because geese were never observed there.



See Appendix A for maps of survey sites.



Limitations

Progressively expanding survey areas made it difficult to discern changes in population size from changes in survey area and effort. We addressed the issue of survey effort by limiting specific components of our analysis to areas where geese had been observed, by eliminating peripheral areas that were added to later surveys, or by using densities, rather than total numbers.

Figure 6-1. Study area (west) with survey areas and sites. The MABR boundary is turquoise, the area polygons are red, and the boundaries of the municipalities are yellow.

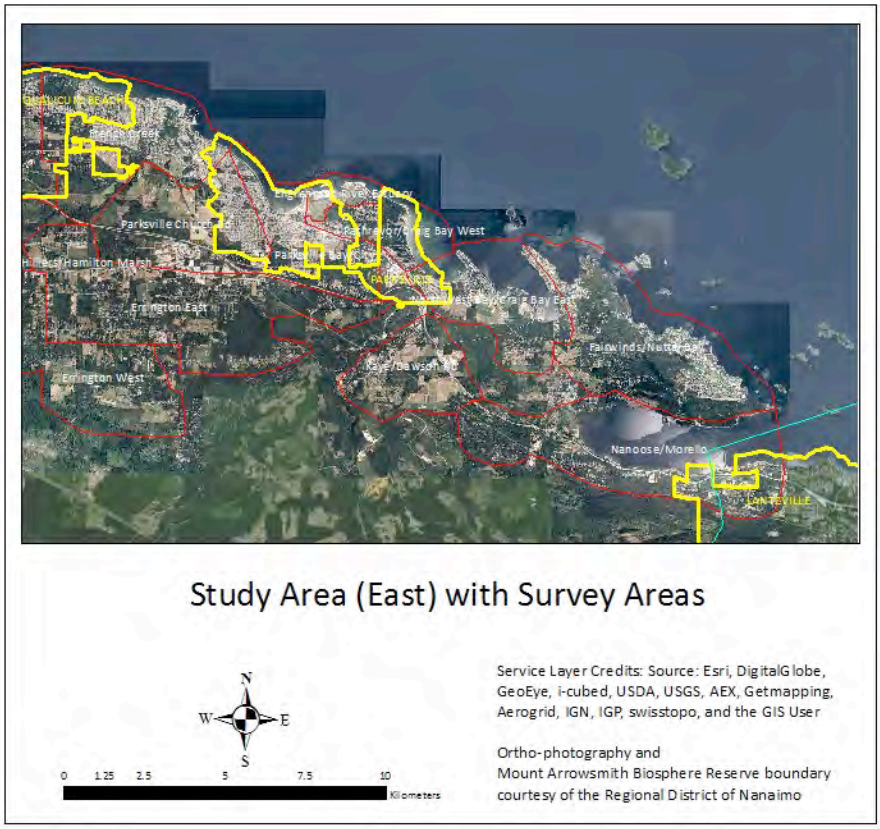


Figure 6-2. Study area (east) with survey areas and sites. The MABR boundary is turquoise, the area polygons are red, and the boundaries of the municipalities are yellow.

6.22 Survey Types

We conducted several types of regular surveys, including winter/autumn counts, moult counts, routine population counts, addling counts, and waterfront counts. A 'dawn to dusk survey' was carried out to augment the data from regular counts. Each of these are described below. Survey dates are shown in a series of calendars in Appendix B.

6.23 Winter/Autumn Counts

Autumn surveys conducted from 1989 through 1993 by CWS and MoE (Dawe & Morrison 1989, 1991; Dawe, Martin & Morrison 1994; Dawe, Monty & Clermont 2006) provided a baseline for our surveys. Limited visibility (fog) in November 2005 caused surveyors to repeat the count in January 2006, whereupon they discovered greater numbers of birds were present in winter. The Guardians then replicated this survey in January 2012, 2013 and 2014, as an assessment of peak overwintering birds.

6.24 Moult Counts

Summer moult counts were conducted in 2007, and 2011 through 2014. Surveys focused on the Parksville-Qualicum Beach Wildlife Management Area and larger freshwater bodies.

Limitations

Because the November and January counts were conducted in different seasons, they were not directly comparable.

The 2012 to 2014 winter counts were only partly useful for gathering mark-re-sight data. Some forms stated, "the purpose of this survey is to do a count so don't worry too much about getting band/collar numbers. If you can simply mark whether bands/collars were present, it will give us information as to where banded CAGO have been seen so that we can go back at a later date to get the numbers".

Table 6-1. Survey areas

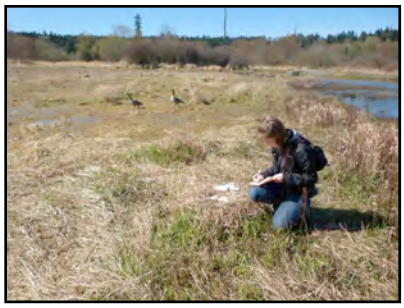
Area ID	Size (ha)	Area Description
EE	179.1	Errington East
ERE	311.3	Englishman River Estuary
EW	177.6	Errington West
FC	182.7	French Creek
FNB	172.1	Fairwinds/Nuttal Bay
HHM	150.2	Hilliers/Hamilton Marsh
HSL	17.5	Horne Lake/Spider Lake
KDR	119.0	Kaye Road/Dawson Road
LQRE	186.1	Little Qualicum River Estuary
NBCB	319.5	Northwest Bay/Craig Bay East
NM	329.8	Nanoose/Morello
PBC	154.2	Parkville Bay/City
PCR	132.8	Parksville Church Road
QBA	98.7	Qualicum Bay
QBE	271.1	Qualicum Beach
RCB	221.6	Rathtrevor/Craig Bay West
WPF	155.0	Walsh's Potato Farm
All Areas	3,178.3	Study Area

Surveyor Aaron Ritchie conducting routine population counts in Errington, June 2014

6.25 Routine Population Counts

Population surveys were conducted from June 2011 through June 2014. Our most frequent surveys, they were performed monthly from January through March, and twice each month from May through December, whenever staffing or volunteer support was available. April surveys were abandoned in favour of addling efforts. Winter and moult counts replaced the January and first July surveys, respectively (Morrison 2013; Guardians of Mid-Island Estuaries Society 2014). The population surveys typically occupied a smaller area than the area surveyed during the winter count; for example, Horne and Spider Lakes were not included in regular population surveys but were included in winter counts.

Two routes, one for Parksville-Nanoose Bay, and the other for Errington-Coombs-Qualicum Beach, were driven by one or two surveyors as quickly as possible while counting Canada Geese and reading bands. Two surveyors often surveyed the entire area in one day. A single surveyor might require up to three days (Morrison 2013; Guardians of Mid-Island Estuaries Society 2014; A. Ritchie, pers. comm., 2014).



Addling crew leader Danielle Morrison beside a goose nest at the Little Qualicum River estuary

6.26 Addling Counts

The addling counts were not true surveys, as personnel only counted nesting pairs and the occasional marked bird on the nesting grounds. Non-breeding, unmarked birds on the periphery were generally ignored. See Chapters 12.11 and 12.2 for more information on the egg addling program.

6.27 Waterfront Counts

Waterfront surveys were conducted during the moult along the shoreline, first in 2012 to find out how Canada Geese were moving leading up to the July 2012 roundup, and shortly thereafter to locate the newly marked geese (Morrison 2013). In 2013, waterfront surveys were done to look for geese returning for the moult. Waterfront counts were not comparable from year to year, or to other types of surveys. They were most useful for re-sighting marked birds (D. Morrison, pers. comm., 2014).

6.28 Dawn to Dusk Survey

Because our surveys were conducted in the daytime using repetitive routes, and estuaries were known to be important loafing/resting and roosting sites, we conducted a survey every two hours from 1 p.m. to dusk on November 13, 2014, and from dawn to 1 p.m. November 14, on the Craig Creek estuarine marsh and outer estuary to determine whether the timing of surveys had a profound impact on our knowledge of their movement and use of the estuaries in particular (see Chapter 8.61, Seasonal Distribution, Autumn Migration - A Cold Day in November). The survey was initiated during the hunting season, and over a cold snap, which augmented our understanding of these factors on Canada Goose movement.

Limitations

Our surveys did not measure the sensitivity of birds to egg addling crews or surveyors, although there was some evidence during banding at the nest and addling that, in general, LQRE geese were more skittish than those at the ERE. They were easily flushed off their nests and quick to leave the area if one ventured too close. These propensities likely affected nest detectability, although many repeated visits to the estuaries for egg addling may have minimized any significant differences.

Notably, in an experiment designed to measure flushing and return time related to human disturbance, Miller, Abraham, and Nol (2013) found the frequency of visits did not affect either flushing distance or return time.

Limitations related to seasonal detection and survey effort are described in Appendix C.

6.3 Subpopulations

The marking of Canada Geese at three separate estuarine sites affords a window into potential management strategies that would not be present had the study used a single capture site. We can better examine the characteristics and mixing of the three groups to determine if we have a single population where individuals freely mix, two or more spatially disjunct metapopulations which interact through immigration/emigration, or two or more loosely defined subpopulations.

If the marked birds freely mix, and use habitats in similar ways at similar times, then management techniques that successfully control some birds may be useful for the others. If the regional population is largely segregated, a one-size-fits-all approach could fail. Management activities would need to be employed at finer scales to be tenable (cf. Huang 2010).

On separating re-sights of the marked Canada Geese into groups based on where they were banded (i.e., CCE, ERE, LQRE groups), there appear to be three mostly distinct, but sometimes overlapping subpopulations (Figure 6-3). Assuming the marked birds are representative of the regional population, the LQRE, ERE, and CCE subpopulations merit different management approaches.

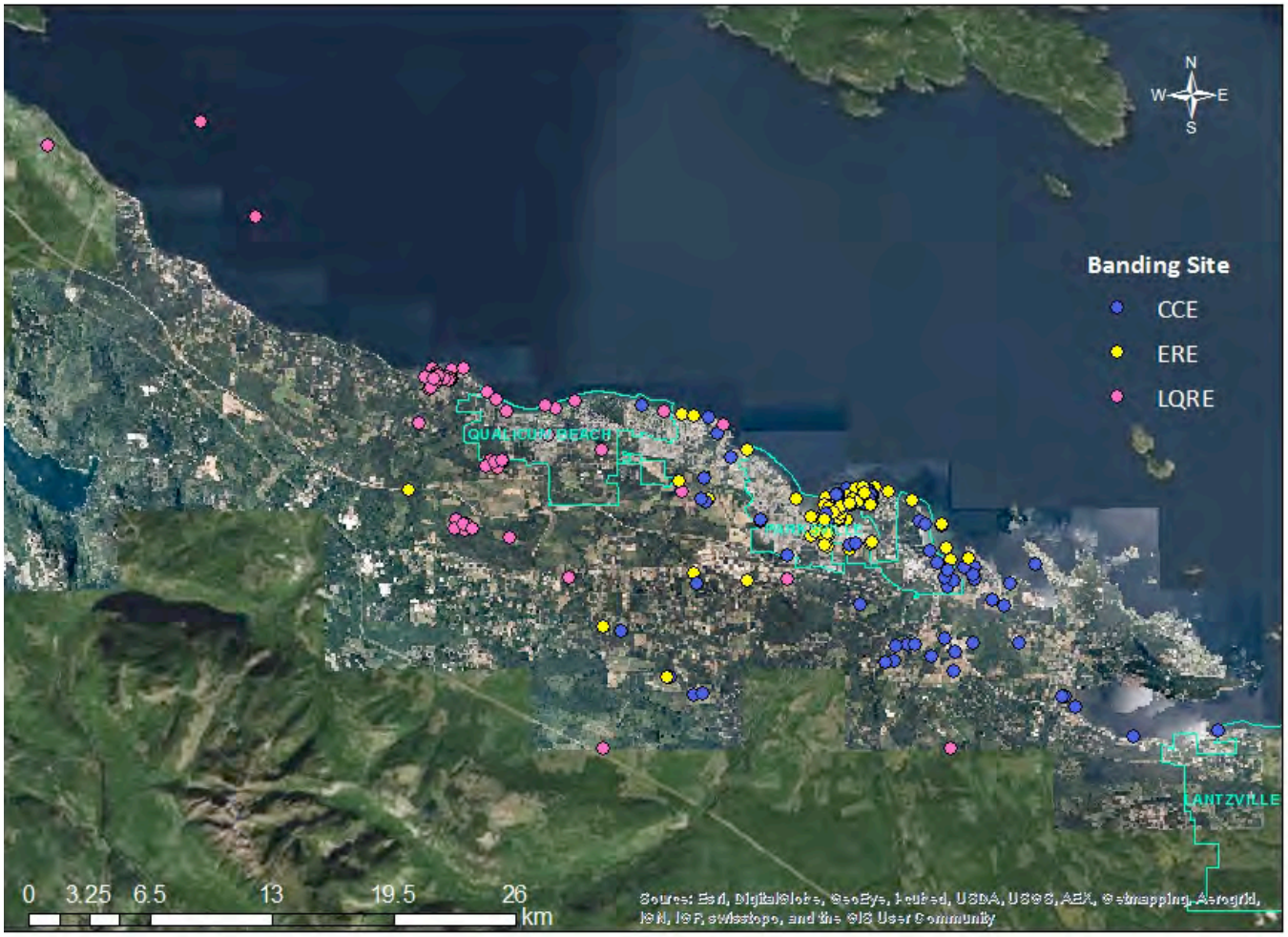


Figure 6-3. Re-sights of marked Canada Geese banded at the Craig Creek estuary (CCE), Englishman River estuary (ERE), and Little Qualicum River estuary (LQRE), 2008-2014.

6.4 Migrant Types

6.41 What is a "resident" Canada Goose?

There is a vast body of literature identifying and attempting to manage the 'too many geese' problem. A Google search on "Canada Goose" and "problem" on November 24, 2014 yielded 7,870,000 hits. "Canada Goose" and "resident" landed 413,000 results, only ~5% of the broader search, yet the perception of many is that resident geese cause most of the problems (e.g., Vancouver Sun 2008; Eckberg 2010). Are they, as some have proposed, birds that have lost their ability to migrate? Or as others have suggested, are they individuals that don't need to go anywhere else because they have everything they need right here? (cf. CWS 2011).

The rootedness of non-migratory Canada Geese is likely a function of a strong fidelity to nesting areas, which is well documented in the literature (e.g., Balkcom 2010). Howard Breen (1990) suggested the earliest residents were injured females unable to return to their traditional nesting sites. When their progeny reached breeding age, they returned to their birthplaces to nest. With the return of subsequent generations, local numbers increased from year to year. In our area, the earliest residents were more likely to be transplants from other regions, or the progeny of transplanted birds held in captivity, than injured birds. Yet the end result was the same. Breeding birds returning to the nesting areas to breed year after year, and their returning young, could generate exponential growth in local breeding populations if they were not constrained by natural limitations, such as the availability and quality of habitats, as well as human controls (e.g., egg addling).

The notion that geese stay home because their current landscape provides them with everything they need is more complex. Simply put, if local resources met the needs of all geese in the area, none would migrate.

Importantly, fourteen migrant types have been identified in this region, and all of these birds have been sufficiently 'resident' to enable capture and marking during the nesting and moulting periods.

The capture of birds on the nest and during the moult was expected to restrict the study to a mostly resident population. Birds that do not nest or moult in the estuarine capture areas may use the region but were mostly absent from our mark/re-sight data. In other words, migrants were under-represented and our understanding of them is restricted to those captured and marked. Northern-breeding migrants were probably unrepresented.

Terms such as, "resident" or "nonmigratory", have multiple meanings, largely depending on the scale at which they are applied. In the U.S., resident geese are typically defined as 'non-migratory geese that nest and reside predominantly within the conterminous United States' (cf. USDA 1999). In other words, geese that rarely cross the Canadian border are U.S. residents. The Subcommittee on Pacific Population of Western Canada Geese (2000) described the Pacific populations of Western Canada Geese *(B.c. moffitti)* as "relatively nonmigratory, with many segments wintering on or in close proximity to breeding areas" (p. 1). Geese nesting or moulting in southern Canada are often called 'temperate-breeding geese' (cf. Fraser & Fraser 2010).

For the purpose of this regional strategy, 'local residents' refer to birds that are locally present in all periods, or seasons, of the Canada Goose annual life cycle (i.e., spring migration, nesting, moulting, fall migration, overwintering). In the following typology, local residents and migrants are further differentiated.

6.42 Assigned Migrant Types

Migrant types, shown in the box below, were delineated and assigned to each marked Canada Goose, based on their encounter history (i.e., site, date, and frequency of re-sights).

Of all 296 marked birds, more than a third (36.5%) were present in our area for 6 months or more (Figure 6-4). A few others (2.4%) were present only during the moult and winter.

Another 4.4% were characterized as moult migrants, birds that come back to the area to moult, and may be present before and after for a short time (see 8.4, Moulting).

More than 15% had dispersed, emigrated, or otherwise disappeared within two years of banding.

Less than 1% were identified as juveniles that had dispersed and returned to breed; however, most banded birds were not aged, so this number may be low.

Also, 13.5% were some form of migrant - they were present in the area only sporadically, or had been documented elsewhere on Vancouver Island, the Gulf Islands, in mainland B.C., Alberta, Washington, Oregon or California.

Nearly a third (27%) could not be assigned a migrant type based on existing information.

Four birds deemed to be migrants nested in our area, including one Vancouver Island migrant (observed in Bowser in September). This appears to contradict the notions that only local residents nest locally, that our local area boundary encompasses an entire population, or both.

Estuary-based subpopulations were characterized by unique blends of migrant types (Figure 6-5). For example, there were fewer local residents and more emigrants among the LQRE-marked birds when compared to the ERE and CCE-marked birds

Local resident 065T preening at the Craig Creek estuary

A TYPOLOGY OF MIGRANT TYPES

Local Resident (LR): Locally present in all periods or *seasons* of the Canada Geese annual life cycle (spring migration, nesting, moult, fall migration, overwintering), consecutive or not. Generally more than 20 resights over several years.

Local Resident Plus (LR+): Locally present in at least 6 calendar months. Not seen for at least one season over multiple years.

Moult and Winter Resident (MWR): Present during the moult and in winter, over the bird's entire encounter history.

Moult Migrant (MM): Present during at least 2 consecutive moult periods. Not seen during nesting and winter.

Migrant (M**):** Present sporadically, over at least a 2 year encounter history. May have been observed just outside the study area.

Dispersed Juvenile (DJ): Juvenile dispersed (or dead). Confirmed 'hatch-year' (HY) when banded. Locally present until at least the end of the first calendar year, but less than 2 years, then absent.

Emigrant (E): Emigrated (or dead). Age likely 'after-hatch-year' (AHY) or unknown (U) when banded. Locally present until at least the end of the first calendar year, but less than 2 years, then absent.

Returned Juvenile (RJ): HY bird that has returned to nesting/moult area after a period of absence

Vancouver Island Migrant/Moult Migrant (VIM/VIMM): Resighted on Vancouver Island outside of the local study area

B.C. Migrant (BCM): Resighted on the Gulf Islands or mainland B.C.

Alberta Migrant (ABM): Resighted in Alberta.

U.S. Migrant /Moult Migrant (USM/USMM): Resighted in the U.S.A.

Not Enough Information (NEI): Not enough information to assign a migrant type, or not seen or died in the first calendar year.

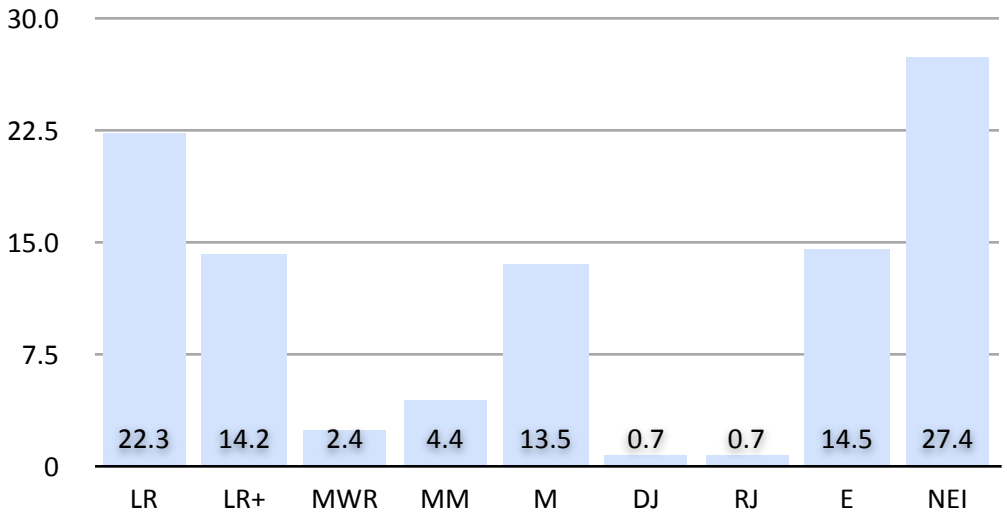


Figure 6-4. Migrant types of Canada Geese banded in the study area (%) (n=296). (See box for descriptions.)

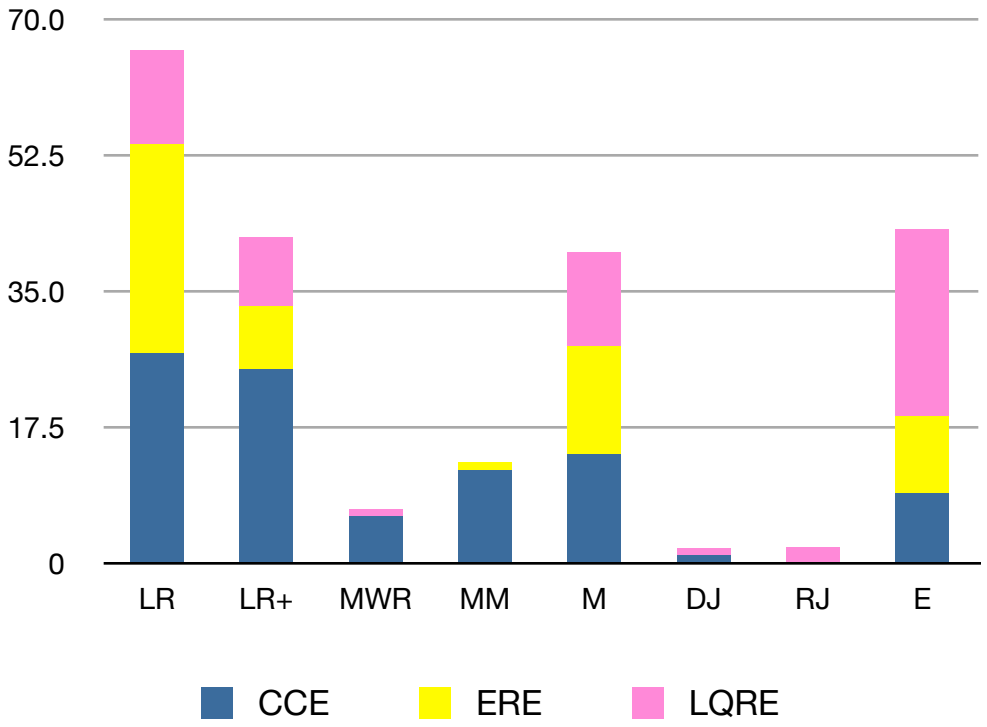


Figure 6-5. Migrant Types by Banding Location. Shown are the migrant types of Canada Geese banded at the Craig Creek estuary (CCE) (n=94), Englishman River estuary (ERE) (n=60) and Little Qualicum River estuary (LQRE) (n=62) (n assigned migrant types =216)

Craig Creek Estuary

Compared to the other estuaries/banding sites, Canada Geese banded at the CCE had the highest proportions of moult migrants (MM) and moult and winter residents (MWR) (Figure 6-6). The CCE also supported the highest percentage of LR+ birds, which were present for at least 6 months of the year, but absent for at least one season over multiple years.

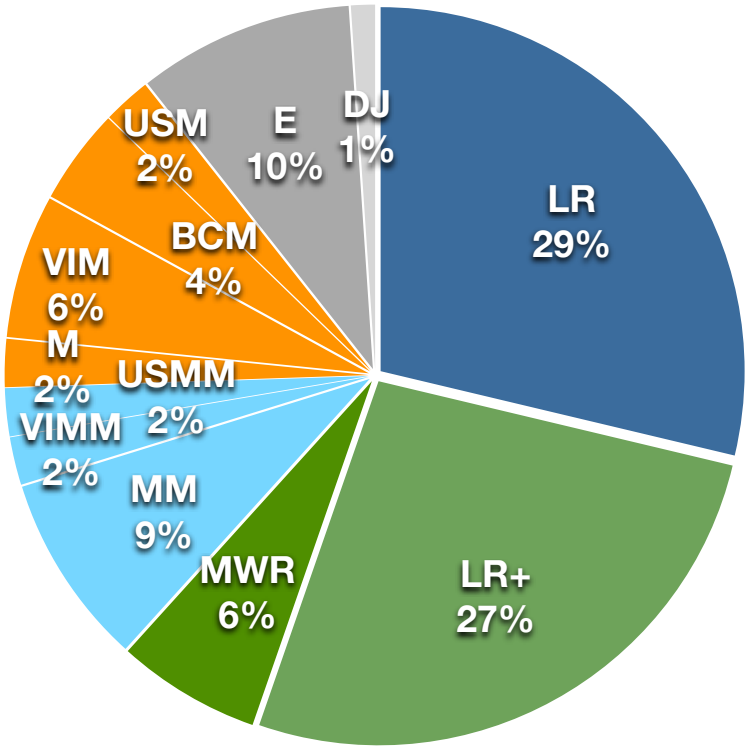


Figure 6-6. Migrant types of Canada Geese banded at the Craig Creek estuary (n=94). An additional 12 birds (11% of all Canada Geese captured at the CCE) were not assigned a migrant type.

Englishman River Estuary

Canada Geese banded at the ERE had the highest proportion of local residents (LR), and the highest percentage of U.S. migrants (USM) (Figure 6-7).

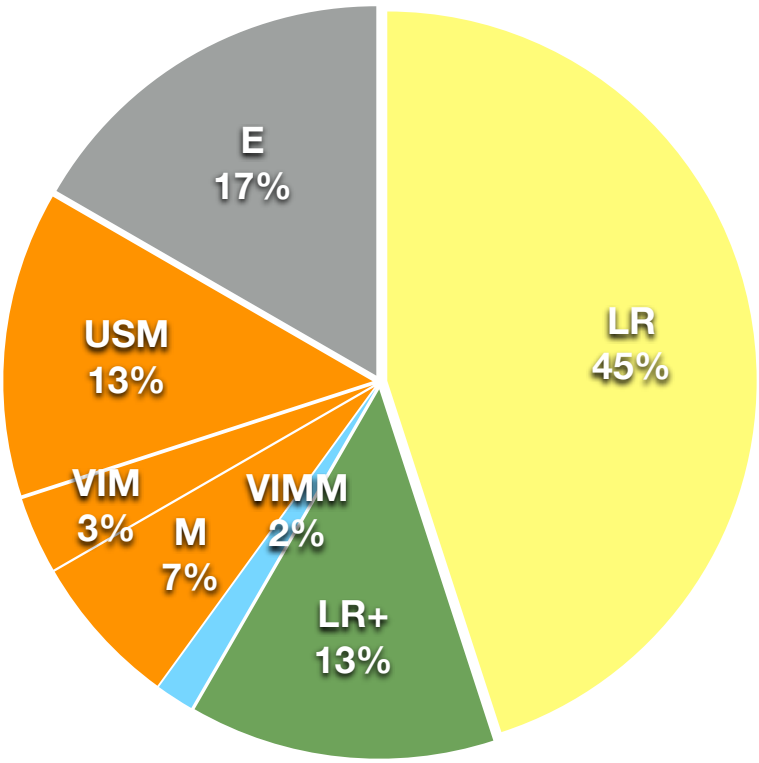


Figure 6-7. Migrant types of Canada Geese banded at the Englishman River estuary (n=60). An additional 33 birds (35% of all Canada Geese captured at the ERE) were not assigned a migrant type.

Little Qualicum Estuary

The LQRE supported the fewest number of local residents (LR), the highest proportion of emigrants (E), the only returned juveniles (RJ), and the highest percentage of Vancouver Island migrants (VIM), when compared to other banding locations (Figure 6-8). There were no moult migrants identified from the LQRE.

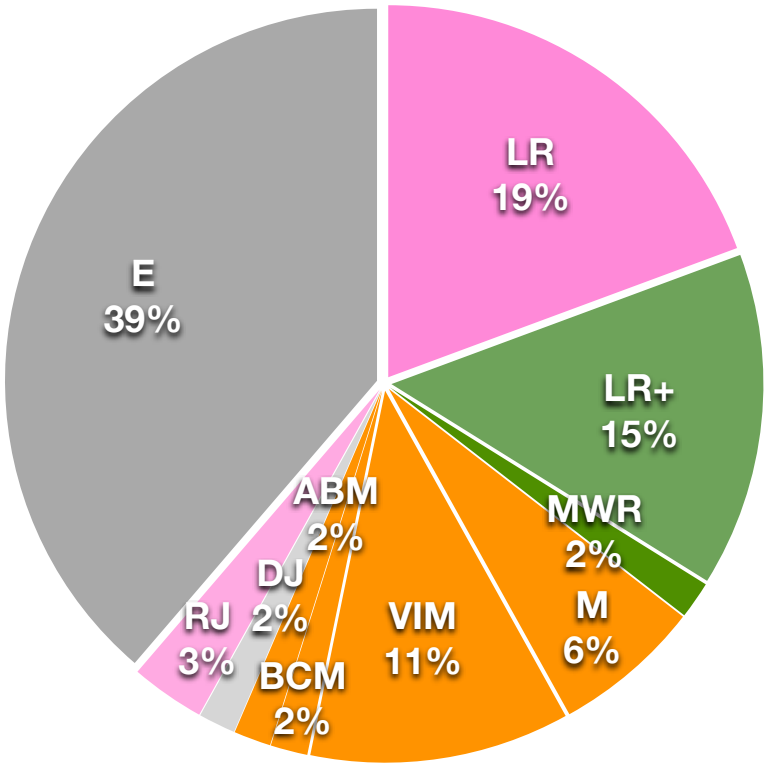
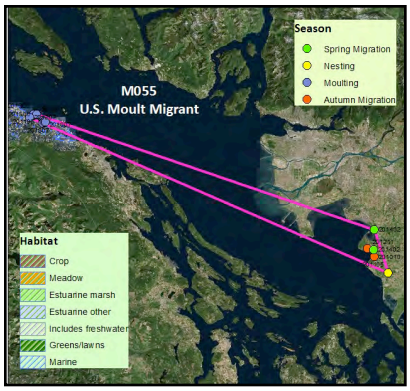


Figure 6-8. Migrant types of Canada Geese banded at the Little Qualicum River estuary (n=62). An additional 35 birds (36% of all Canada Geese captured at the LQRE) were not assigned a migrant type.

6.43 Migrant Types and Home Ranges

Canada Geese that are local residents or migrate for only short distances are known to have compact home ranges (cf. Giles 2010). Home range sizes for local residents were as small as 130.1 ha and as large as 18,585 ha, with a mean of 1,796.8 ha (or ~18 km^2). ERE-banded birds had the smallest home ranges (130.1 to 2,814.6 ha, averaging 927.5 ha (or 9.3 km^2); for context, the City of Parksville is ~1243 ha in size. By comparison, Groepper et al. (2008) reported mean home range sizes of 25.3 km^2 for resident females near Lincoln, Nebraska.

Migrants and moult migrants were clearly distinguishable from other migrant types by an index derived from their home range parameters (Figure 6-9). Appendix D provides summaries of encounter histories and associated maps for each migrant type, for marked Canada Geese that exemplify typical home ranges and have been re-sighted more often than others. Table D-1 in the Appendix shows that most U.S. migrants and moult migrants were re-sighted during the spring and fall migrations.



M055 was a moult migrant banded at the ERE in July 2010. It was spotted in Washington during the spring migration, nesting, and autumn migration periods, and came back to the ERE and CCE to moult in 2011, 2012, and 2013.

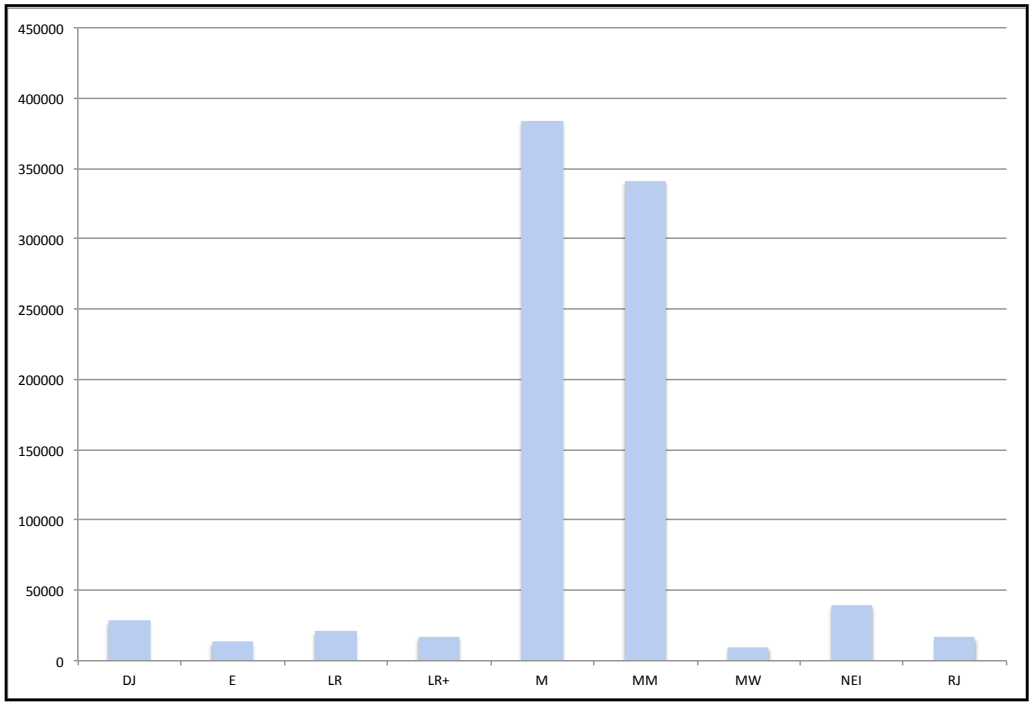


Figure 6-9. Mean Home Range Index. Minimum Convex Polygons (MCPs) were used to calculate the maximum distance between observations, the area of the home range, and its perimeter. These values were summed to create a home range index for each Canada Goose, and then averaged across migrant types. The "y" axis values are relative, not absolute.

6.44 Local Residents and Long-distance Migrants

Whereas geese that migrate long distances face a wide range of energetically demanding activities and threats (e.g., short growing seasons, long flights, cold weather, snow and ice-covered food and water resources, predators, cell phone towers and other structures to collide with, hunting seasons timed to their migration), local resident Canada Geese are more likely to spend their time loafing/resting, roosting, and grazing (USFWS 2002). Although local residents are more likely to be exposed to toxins and pets (USFWS 2002), their familiarity with the distribution of food resources, roost sites, cover, predators and hunters may offer significant reproductive and survival benefits (Hestbeck, Nichols, & Malecki 1999; USFWS 2002; Beaumont 2013).

With higher potential population growth rates, local residents, once a small fraction of total goose populations, may now rival or exceed migrant numbers in all flyways (USFWS 2002).

Notwithstanding, differentiating migratory Canada Geese from resident Canada Geese has been increasingly difficult for agencies to do. Migrants were once surveyed on wintering areas, as they were concentrated and easier to count. Once it was realized migrants and residents were mixing on the wintering grounds, migrants were counted on their breeding areas. However, the timing of counts was an issue. Nesting birds were difficult to spot, and moult migrants were on migrant breeding areas later in the season. Thus the reliability of surveys to detect long-distance migrant Canada Geese has continued to decrease as resident populations have increased (cf. USFWS 2002).