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.

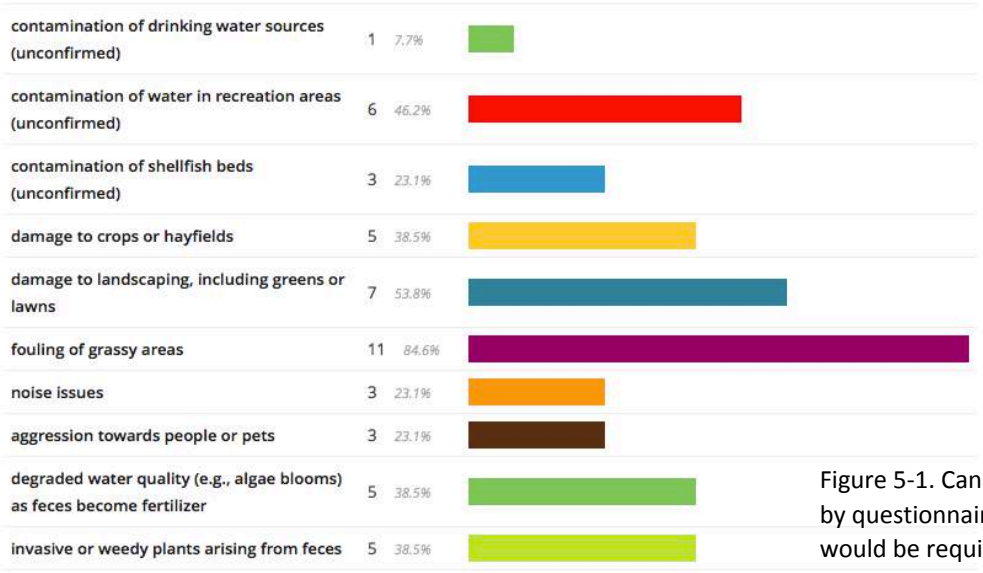

Figure 5-1. Canada Goose problems experienced by questionnaire respondents. Positive lab tests would be required to confirm contamination.

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

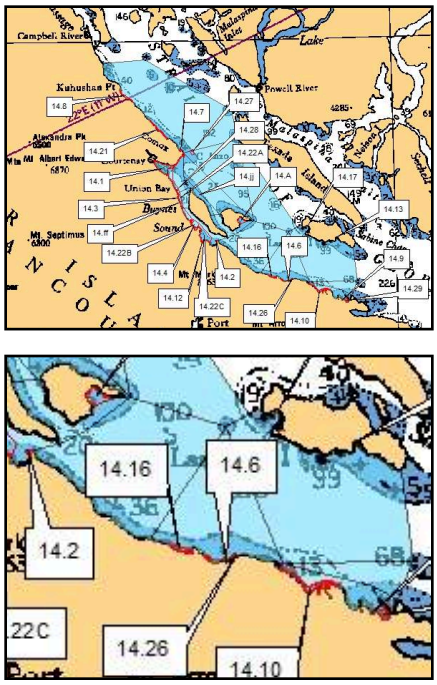

Figure 5-2. Sanitary shellfish closures. Regional context (upper) and specific beaches (lower) (Fisheries and Oceans Canada 2014)

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