A Clear Threat to Conservation: Using Public Policy to Reduce Bird Collisions with Windows in Homes

by

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B.A. (Hons., Public Administration), University of Saskatchewan, 2010

Research Project Submitted In Partial Fulfillment of the
Requirements for the Degree of
Master of Public Policy

In the
School of Public Policy
Faculty of Arts & Sciences

SIMON FRASER UNIVERSITY

Spring 2013

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Abstract

Over the past 40 years in North America, more than 40 species of migratory birds have seen population declines in excess of 50%. A significant source of migratory bird mortality is collisions with the windows of single and semi-detached homes, which result in an estimated 15.8 million to 30.5 million deaths annually in Canada. The federal government, who has jurisdiction over migratory birds and a legislative obligation to protect them, has not publicly outlined a strategy to address this source of mortality. By conducting a willingness to pay survey, this research seeks to understand how Canadians value reducing bird-window collisions with their homes. Using this data, in combination with elite interviews and a literature review, alternative policies are assessed. It is recommended that the federal government undertake a public information campaign, seek partnerships with municipalities, and assist in the development of bird-friendly design criteria for willing home certification programs.

Keywords: Bird-window collisions; incidental take; willingness to pay; total economic value; defensive expenditures; Migratory Birds Convention Act, 1994

For my parents who taught me to question the world around me with compassion

Acknowledgements

I would first like to thank, in the same breath, my capstone supervisor Dr. Nancy Olewiler and my coop supervisor at the Canadian Wildlife Service, Krista De Groot. Nancy possesses a combination of approachability and intellect that are both rare and inspiring. Thank you, Nancy, for your calming influence and your willingness to laugh with me through my mistakes. Nancy drew me to this program and I feel very lucky to have written my capstone under her invaluable guidance. Thank you, Krista, for creating this project and giving me the opportunity to see it through to the end. It has been a wonderful and challenging experience; one that has reaffirmed my belief in a talented, passionate, and dedicated public service.

I would also like to thank my classmates who shared this experience with me and remained supportive as we tried to balance our work ethic against our sanity. It was a pleasure to work alongside so many talented people. I have made friendships that I hope will last a lifetime. Thanks also, to all of my professors in the program for sharing their own expertise and anecdotes from storied and inspiring careers.

Lastly, thank you to my two interviewees, who provided valuable information for my capstone. Thanks also to the organizations that assisted in the dissemination of my survey, which included the American Bird Conservancy, Nature Canada, Bird Protection Quebec, Centre de Conservation de la Faune Ailee, Wildlife Rescue Association of BC, Newfoundland and Labrador Environment Network, and the Yukon Bird Club. The survey would not have received such a high number of responses without their help and I hope that they find this study insightful and useful in the future.

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List of Acronyms

EC	Environment Canada
CWS	Canadian Wildlife Service
MBCA	Migratory Birds Convention Act
MBR	Migratory Birds Regulations
NAFTA	North American Free Trade Agreement
CEC	Commission for Environmental Cooperation
RMF	Risk Management Framework
BMPs	Beneficial Management Practices
BCRs	Bird Conservation Regions
FLAP	Fatal Light Awareness Program
EPA	Environmental Protection Act
OSPCAA	Ontario Society for the Prevention of Cruelty to Animals Act
YCC	Young Corporate Centre
SARA	Species at Risk Act
LEED	Leadership in Energy and Environmental Design
USGBC	United States Green Building Council
TEV	Total Economic Value
WTP	Willingness to Pay
MWTP	Marginal Willingness to Pay
AWTP	Average Willingness to Pay
FCM	Federation of Canadian Municipalities
CCBFC	Canadian Commission on Building and Fire Codes
NRCC	National Research Council of Canada
PTPACC	Provincial Territorial Policy Advisory Committee on Codes
PIC	Public Information Campaign
CGBC	Canadian Green Building Council

Executive Summary

Since scientists began systematically studying bird populations 30 years ago, significant declines in many species have been witnessed. Migratory birds are particularly hard hit; 44% of migratory species are currently experiencing population decline. Significant sources of bird mortality include habitat degradation and loss, domestic and feral cat predation, collisions with vehicles, and a range of land-use practices in forestry, agriculture, mining, and oil and gas extraction. Reducing each source of mortality will require a distinct approach. Another significant, but less well known source of mortality is collisions with the windows of homes and buildings. While addressing other sources is complicated by issues of public contentiousness, legislative barriers, and lack of viable solutions, collisions with windows can be addressed in the relative short term with the right policies.

The protection of migratory birds falls under the jurisdiction of the federal government. Environment Canada is the ministry responsible for overseeing the relevant legislation and the Canadian Wildlife Service undertakes much of the monitoring and enforcement work. Collisions with the windows of homes and buildings has been discussed in the context of incidental take - the inadvertent harming, killing, disturbance or destruction of migratory birds, nests, and eggs. Incidental take is prohibited under legislation. However, Environment Canada has not publicly identified a strategy to address bird collisions with windows. Collisions with homes are estimated to cause between 15.8 million and 30.5 million deaths annually, or 90% of bird-window collisions in Canada (Machtans et. al., 2012). This research assesses a number of potential policy responses to reduce bird-window collision mortality, focussing on collisions with homes, defined as single detached homes, row or town houses, duplexes, and mobile homes

The impetus for policy action is driven by the presence of market failure, which is indicated by significant declines in bird populations. Birds and the ecological goods and services that they provide, which have economic value, are a public good and are un-priced in the market place. As a result, the actions of firms or individuals that lead to bird mortality produce external costs; costs borne by society at large rather than the individuals or firms undertaking the activity. In order to assess what types of policies

might be effective in reducing bird mortality, and the extent to which government resources should be invested, it is important to determine how society values birds and the ecological goods and services they provide.

This study uses a willingness to pay survey (WTP) approach to determine how Canadians value reducing bird-window collisions. Because there are products currently available that can be used to reduce bird-window collisions, this study was able to use the willingness to make defensive expenditures as a proxy for valuing reducing collisions. This data is first compared to the costs of reducing bird-window mortality, and then is used to assess how Canadians might respond to various policy approaches. In addition, an extensive literature review and interviews with two government officials were used to inform the analysis of the policy approaches. Each policy option was assessed against a number of criteria including effectiveness – a function of the expected reduction in collision mortality with homes and the ability of the policy to generate broad-scale public awareness about the issue – government cost, political feasibility, and public acceptability.

Policy Option 1: Conduct a Federally Led Public Information Campaign

- Change household behaviour without altering incentives or authority structures
- Raise awareness about bird-window collisions as a threat to conservation
- Reduce search costs by providing clear and accurate information about how to reduce the risks of bird-window collisions with homes
- Use interactive tools to increase participation and assist with program evaluation

Policy Option 2: Create a Point-of-Sale Rebate Program for Bird-Friendly Products

- An immediate partial repayment for the purchase of a program certified bird-friendly product
- Reduces the relative price of targetted goods in order to stimulate additional consumption
- Potential to administer rebate alongside the *Energy Star Program*

Policy Option 3: Facilitate the Development of Bird-Friendly Design Criteria for Home Certification Programs

- Building certification programs have shown significant successes in improving environmentally conscious design, and government has played a vital role in promoting these initiatives
- The trend towards a more holistic concept of sustainable design indicates that, if provided with the necessary information, home certification programs would likely be willing to include bird-friendly criteria
- Crucial opportunity to generate awareness within the home building sector and perhaps spur on innovative design practices

Policy Option 4: Design Standard: Amend the National Model Construction Code to Reflect the Provisions of the Migratory Birds Convention Act and the Migratory Birds Regulations

- Design standards fall into the command and control category of policy tools, and specify particular technologies or strategies to mitigate negative impacts on an ecological good or service
- Construction codes fall under provincial jurisdiction, but the model code is set nationally, and adapted and adopted by each province/territory
- Would apply to all new homes, as well as retrofits where building codes apply

After analyzing each policy option across the chosen criteria, this paper recommends that Environment Canada pursue a combination of policies 1 and 3 – a federally led public information campaign and assisting in the development of bird-friendly design criteria for willing home certification programs. These measures are considered short term and low cost necessities that lay the foundations for other policy options moving forward. In the long-run, the literature is clear that setting the right incentives is important for changing household behaviour as it relates to the environment.

1. Introduction

"The State of Canada's Birds, 2012" report indicates that 44% of migratory bird species occurring in Canada have experienced population declines over the past 40 years (NABCIC, 2012). Steep declines are not confined to rare species. In North America, more than 40 species of common birds have declined by over 50% in the same time period (NABCIC, 2012). Thus, while many species of migratory birds still appear to be abundant, the sharp downward trends in population are a troubling sign. Further, due to a lack of long-term monitoring data on many tropical-forest, boreal-forest, and arctic tundra birds, these figures likely underestimate the extent of migratory bird population decline (Arizmendi et al., 2010).

Conservation efforts aimed at particular species of migratory birds have shown that with targeted action, specific species can recover from population decline. Ducks, geese, and other waterfowl have benefited from international efforts by governments and conservation organizations, such as the North American Waterfowl Plan, to protect and restore crucial waterfowl habitat (NABCIC, 2012). This is a conservation success story. However, for many migratory bird species, particularly land-birds, direct and indirect anthropogenic threats continue to jeopardize long-term survival. "The State of Canada's Birds, 2012" report makes this very clear.

Not surprisingly, the greatest threat to migratory bird populations is habitat degradation and loss throughout the lifecycle of migrant birds in Canada, the United States, Mexico, and Central and South America (NABCIC, 2012). The realities of an annual life-cycle that occurs across a broad range of geographic areas and political jurisdictions make international cooperation necessary and complicate attempts to develop effective conservation initiatives that can be implemented at the appropriate spatial scale.

Other indirect threats to birds include climate change, invasive species, and a range of land-use practices including agriculture, livestock grazing, mining, energy

development, and logging. Direct threats include domestic cat predation, pesticides, and collisions with vehicles, wind turbines, and communications towers. Research is also uncovering how climate change is affecting migratory birds. For example, due to the uneven spatial effects of climate change, evidence suggests that migratory birds are experiencing timing mismatches between peak resource availability and their arrival on breeding grounds (*the phrenology mismatch hypothesis)* (Jones and Creswell, 2010). The difficulties of adapting to environmental change may be more pronounced for migratory species. It is clear that migratory bird population declines are likely the result of cumulative pressures across their entire range.

A lesser known, but significant source of bird mortality is collisions with residential and commercial buildings. Daytime collisions with the windows of homes and buildings are the result of a bird's inability to detect clear glass and plastic, or to distinguish between a reflection of habitat and real habitat. Dr. Daniel Klem Jr., a renowned expert on bird collisions with buildings, says that:

> "The fundamental problem for avian conservationists is that birds behave as if clear and reflective panes are invisible to them, and they kill or injure themselves attempting to reach habitat or the illusion of habitat seen through or reflected in windows (Klem, 2010: 244)."

As a result, birds often collide with clear and reflective surfaces at full speed. From a perch just greater than a meter away, a bird can gain enough velocity to create a fatal collision (Klem, 2010). Although some birds fly away after a window collision, they may succumb to their injuries afterwards. It is estimated that half of all bird collisions with windows are fatal, often due to internal bleeding or severe head trauma (Klem, 2010).

1.1. Scale of Migratory Bird Mortality Associated with Building Collisions

A lack of data collected using randomized sampling designs over large spatial-scales and across a gradient of urban to rural environments has complicated attempts to

quantify this type of bird mortality. National mortality estimates are typically derived using local data sets, small-scale studies, or data collected for the purpose of direct bird conservation rather than a hypothesis driven scientific study (Loss et. al., 2012). These data were not intended to be used for large-scale extrapolation (Loss et. al., 2012). Although estimates of bird mortality associated with building collisions have been rigorously derived, the limitations of the source data remain. As a result, the precise number of bird deaths resulting from collisions with buildings is not known. Estimates place the worldwide tally well into the billions (Sheppard, 2011). In 2012, an analysis led by Environment Canada (EC) estimated that there are between 16.1 million and 42.2 million bird mortalities resulting from collisions with buildings each year in Canada (Machtans et al., 2012). Table 1.1 shows some of the most significant sources avian mortality in Canada.[1]

Table 1.1: Estimates Significant Sources of Bird Mortality in Canada

Source	Year of Estimate	Minimum	Maximum
Domestic and Feral Cats	Blancher, 2012	50,000,000	400,000,000
Roads/Vehicles	Bishop and Brogan, 2012	2,550,000	61,020,000
Residential/Commercial Building Glass	Machtans et. al. 2012	16,100,000	42,200,000
Agricultural Mowing and Pesticides	Machtans and Elliot, 2011	4,500,000	7,900,000
Forestry	Machtans and Elliot, 2011	560,000	1,000,000
Oil and Gas Sector	Van Wilgenburg et. al. 2011	20,000	530,000

* Estimates taken from presentations to Canadian Wildlife Service (personal communication).

[1] Comparing mortality estimates is more complex than simply looking at aggregate numbers. Incidental take in the forestry sector affects eggs and chicks whereas collisions with buildings affect juveniles and adults (CWS Interview Participant #1). Moreover, the lifecycle characteristics of the species involved is important. Sea birds live longer and have fewer chicks while land birds typically have shorter life cycles and breed annually.

1.2. Contribution of Building Types to Collision Mortality

1.2.1. Collisions with Homes

According to the EC analysis, the vast majority of these fatal collisions occur with houses, defined as single detached homes, row or town houses, duplexes, and mobile homes (Machtans et al., 2012). While a single commercial building can cause a high number of bird fatalities each year, the sheer volume of the residential building stock accounts for the high proportion of bird collision mortality relative to other buildings types. In Canada, these residential structures are estimated to cause between 15.8 million and 30.5 million bird deaths each year or, 90% of the total annual mortality (Machtans et al., 2012). Rural homes account for a disproportionately large share of bird collision mortality. Rural homes comprise 23% of the housing stock, but contribute 41% of the estimated bird mortality accruing to residential structures (Machtans et al., 2012).

1.2.2. Collisions with Commercial, Institutional, and High Rise Buildings

Commercial and institutional buildings less than 12 stories high were estimated to cause 0.3 million to 11.4 million bird deaths annually, or just under 10% of the total (Machtans et al., 2012). There was great variation among this subset, with 82% of mortality attributed to one third of these buildings (Machtans et al., 2012). Typically, this category would include university campuses, schools, and libraries among others. Finally, it was estimated that tall buildings in urban cores resulted in 36,000 to 390,000 deadly collisions each year, or less than 1% of the total (Machtans et al., 2012). Again, this is due to the small number of tall buildings in urban cores relative to other building types. Some of the most lethal singular structures in Canada fall into this category. For example, a not-for-profit group called the Fatal Light Awareness Program, which collects data on bird collisions in Toronto, has documented individual commercial towers in Toronto's downtown that have killed over 5,000 birds in a ten-year span from 2000-2010 (FLAP, 2010).

1.3. Impact of Collision Related Mortality on Migratory Bird Populations

The question of whether or not collisions with homes and buildings are contributing to a decline in migratory bird populations is hotly debated. As previously discussed, current estimates are not based on studies that systematically assess collision mortality. In a controversial study, Arnold and Zink concluded that collisions with buildings have no impact on the long-term viability of migratory bird populations (Arnold and Zink, 2011). Their analysis has been heavily criticized by a number of organizations and individuals (Loss et. al., 2012, Klem et. al., 2012). Perhaps equally as controversial, Daniel Klem Jr. has argued that collisions with buildings are the second greatest threat to migratory bird conservation, next only to habitat destruction (Klem, 2010). The vast majority of studies show that bird-window collisions may be a serious conservation issue, but a lack of strong empirical research has prevented any definitive conclusions from being made (Bayne et. al, 2012). While it is a good thing to consider population-level effects, it is important to note that this holds the collision mortality issue to a higher standard of proof than is accepted for other conservation threats.

While there is certainly room for improving estimates of bird mortality arising from various sources (*see:* Loss et. al., 2012), collecting the data required to isolate the impact of any single factor on population trends of a group highly mobile organisms - with variable life characteristics and ranges that span multiple continents - is a tall order. This level of proof has been incredibly difficult to obtain for any conservation threat facing migratory birds, including habitat loss. This is not an uncommon problem in conservation biology generally. Estimated building collision mortality represents less than 0.5% of the breeding bird population each year (Machtans, et. al. 2012). This may not sound significant, but this is occurring each year and presents a real conservation threat. Further, glass is an indiscriminate killer, posing the same risk to strong healthy breeding birds as the old and weak (Klem, 2010). This unnatural selection has the potential to affect population dynamics more dramatically by killing experienced migratory flyers and successful breeders – a concept known as biological significance. Growing evidence supports the claim that collisions with homes and buildings are *among* the most significant sources of direct human caused avian mortality (Klem 2006, 2009, 2010; Erickson et. al. 2001; Manville 2005, 2008). Moreover, trends in architecture and

landscape design - specifically the increasing use of glass and inclusion of green spaces on and around buildings - will exacerbate this problem into the future.

While collisions with buildings do not constitute the greatest source of bird mortality (see table 1.1), it may be the most effective and feasible source of mortality to address. Controlling feral cat populations, which number from 1.4 million to 4.2 million in Canada (Blancher, 2012), would require implementing expensive trap neuter release programs[2] or less costly euthanasia programs. Trap neuter release programs are expensive, costing $50 to $70 per neuter/spay plus the costs of trapping, caring for, and releasing the animals (Wildlife Society, 2011). Moreover, evidence to date suggests that these programs do not reduce feral cat populations (Dauphine and Cooper, NO DATE). Less costly euthanasia programs face significant public opposition and would not currently be achievable politically. Very little work has been done on mitigating bird-collisions with vehicles, and no feasible and effective solutions currently exist (Jacobson, 2005). As will be discussed, reducing bird mortality resulting from industry activities, including forestry, agriculture, and the oil and gas sector, would likely require legislative change, and is beyond the scope of this study. Reducing bird mortality resulting from collisions with buildings addresses a significant source of mortality, which may be cost effective and for which solutions are already available.

1.4. The Policy Problem

Migratory birds fall exclusively under federal jurisdiction and Environment Canada is the department responsible for managing these legislative obligations. Specifically, the Canadian Wildlife Service (CWS) is the directorate within EC that oversees conservation efforts. The federal authority is derived from the *Migratory Birds Convention Act, 1994* (MBCA, 1994). Bird collisions with buildings are categorized by EC as *incidental take*: "the killing or harming of migratory birds, and/or the disturbance or destruction of their nests or eggs, resulting from human activities that do not aim to

[2] Despite a strong advocacy base for trap-neuter-release programs, there is little evidence to support the effectiveness of such an approach (Dauphine and Cooper, 2009). The cost of spaying and neutering ranges from $50 - $70 per cat, which does not include the costs of trapping and releasing the cats (The Wildlife Society).

affect migratory birds, nests or eggs" (EC, 2012, IT). Incidental take is prohibited under the *Migratory Birds Regulations (C.R.C. c. 1035),* which are given legal standing by the MBCA, 1994.

From a legislative perspective, EC must strategically manage the cumulative pressures facing migratory bird populations, focussing its efforts on factors that are significant and on which it can exert influence (CWS Interview Participant #1). While addressing indirect threats like habitat degradation and loss is a very difficult task, reducing collisions with buildings is achievable in the relative short term; there are solutions currently available. Because direct threats contribute to mortality that can be linked to a particular activity or structure, targeted action has the potential to significantly reduce bird mortality resulting from building collisions (Loss et. al. 2012). Moreover, there is already a wealth of information available to reduce bird-window collisions - both with new construction and the existing stock of homes and buildings. The lack of precision in estimating collision mortality should not preclude EC from policy action (CWS Interview Participant #1).

Declining migratory bird populations can also be framed as a market failure.[3] Birds are an integral part of our ecosystem. They provide a number of ecosystem goods and services including pest insect regulation, pollination, seed dispersal, nutrient cycling, among others. These goods and services are not priced explicitly in the economy. Relative to the social optimum, this leads to an under-provision of investment in activities that contribute to the health of bird populations, and an excess of activities that exacerbate or cause population decline. Activities that result in significant bird mortality produce negative externalities: a cost to society that is not borne by the firms and individuals undertaking those activities. Like carbon emissions, migratory bird mortality has a variety of sources, some more significant than others. Unlike carbon emissions, different sources of bird mortality require *very* different policy solutions (ex: pricing carbon affects all emitters). Correcting the market failure associated with declining migratory bird populations demands different types of intervention for different sources of mortality.

[3] See section 4 for further discussion.

A summary of the policy problem is:

- Birds and the ecological goods and services they provide are un-priced. Declining populations constitutes market failure, resulting in less than socially optimal numbers of birds.

- Declines in populations of migratory birds are the result of cumulative pressures, and EC must strategically manage those pressures.

- Under existing legislation, EC has an obligation to protect migratory birds from incidental take. Incidental take is defined as the inadvertent harming, killing, disturbance, or destruction of migratory birds, nests, or eggs.

- Collisions with homes and buildings are a significant source of anthropogenic avian mortality, and one for which solutions currently exist.

- Trends in architecture and landscape design suggest that bird collisions with homes and building will continue to increase into the future.

Environment Canada has already been working to assist the commercial building sector in reducing bird-window collisions, which is discussed in the next section. Single detached homes, row and town houses, duplexes, and mobile homes (*from here on referred to as homes*) are estimated to cause the vast majority of bird-window collision mortalities, and this study focuses on policies to reduce collisions with this segment of the building stock. Throughout the study, a distinction will be made between addressing the existing stock of homes and addressing the potential stock of new homes. From a policy perspective, reducing collision related mortality in the residential sector is perhaps a more challenging undertaking. Although this form of incidental take is technically illegal, it is not reasonable or feasible to hold every homeowner liable. A more creative and carefully thought out approach is necessary. The next section examines the evolution of the current regulatory environment, discusses recent developments on the topic, and presents a framework for policy makers to think about bird-window collisions with homes.

2. Background: Jurisdiction, Regulatory Context, and Recent Developments

2.1. Jurisdiction and Governing Legislation

2.1.1. The Migratory Birds Convention Act (S.C. 1994, c. 22)

In Canada, the federal government has the authority to create laws and regulations that pertain to migratory birds. By the turn of the 20th century in North America, unsustainable hunting practices and damage to ecosystems were threatening a number of species of migratory birds, with some driven to extinction. It was recognized that the protection of migratory birds would require a collaborative, cross-border effort (OAGC, 2011). In 1916, the United States and Great Britain, on Canada's behalf, signed an agreement called the Migratory Birds Convention, which led to the creation of the *Migratory Birds Convention Act (MBCA), 1917* (MBCA and Regulations, 2012). The *MBCA*, *1917* enabled the federal government to pass and enforce regulations to protect those species that it covers. These have come to be known as the *Migratory Birds Regulations (C.R.C. c. 1035).* Amendments to the *MBCA* in 1994 and 2005 included provisions to establish migratory bird sanctuaries and expanded enforcement powers over birds oiled at sea in Canada's exclusive economic zone. In addition, the 2005 amendments brought clarity to the intent of the act, which was to protect migratory bird populations as a whole, rather than the individual birds, nests, and eggs (CWS Interview Participant #2).[4]

[4] CWS practices reflected this idea already, but the act was amended for clarity.

2.1.2. The Migratory Birds Regulations (C.R.C. c. 1035)

The *Migratory Birds Regulations (C.R.C. c. 1035)* are derived from, and given legal standing by, the *MBCA, 1994.* The regulations specify the conditions under which a permit to destroy migratory birds can be issued. For example, Environment Canada may issue hunting permits, permits for scientific research, and permits to destroy migratory birds that are causing property damage or are a danger to human safety (*MBR, C.R.C. c. 1035).* The legal basis for incidental take is found in the *Migratory Birds Regulations,* section 6 (a), which states that "no person shall disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird" (*MBR, C.R.C. c. 1035*). This section is applicable if an individual has not received a permit for one of the aforementioned reasons.

In addition, the *MBCA, 1994* states under section 13 (1.8) that, "A person or vessel that establishes that they exercised due diligence to prevent the commission of an offense under this Act, other than an offense under paragraph 5.2(a), (c) or (d) or section 5.3, shall not be found guilty of this offense" (*MBCA, 1994*). In effect, so long as an individual or firm can establish that they took reasonable care to prevent incidental take, that person or firm will not be punished under the act. The standard of care is open to interpretation and has led to a number of legal proceedings. A brief look at EC's approach to managing incidental take currently and in the past will help to frame policy considerations for collisions with homes.

2.2. Past Developments in Managing Incidental Take

2.2.1. MBCA, 1994 and the North American Free Trade Agreement

Managing incidental take has long been part of the work done by CWS (CWS Interview Participant #2). However, legal action against the forestry sector in the United States - under the provisions of NAFTA, and in relation the MBCA – drew stronger attention to the issue of incidental take in Canada's own forestry industry (CWS Interview Participant #2). In 2002, Sierra Legal (now Eco Justice) submitted a complaint to the Commission for Environmental Cooperation (CEC) claiming that Canada was failing to satisfy its obligations to protect migratory birds under the *MBCA, 1994* with

specific reference to Ontario's logging industry. The CEC was established under the provisions of the North American Agreement on Environmental Cooperation (NAAEC), a side accord of the North American Free Trade Agreement (NAFTA), and monitors the enforcement of environmental law by member countries. The CEC's goal is to ensure that no NAFTA member country receives a competitive advantage over others members by neglecting to enforce its own environmental law. The CEC has no authority to make rulings, but rather, conducts and publishes investigations into allegations of non-enforcement by member countries in an effort to hold members accountable to the citizens of North America as a whole (OAGC, 2011). The 2006 factual record issued by the CEC found Ontario clear cutting operations had destroyed nests in the order of tens of thousands each year (OAGC, 2011).

When Sierra Legal brought the allegations forward in 2002, EC came under pressure to develop a formal framework to manage incidental take. In May of 2005, the *MBCA, 1994* was officially amended to give EC the authority to create a regulatory regime to capture incidental take (OAGC, 2011). The new section, 12(h.1), stated that, "the regulations should ensure that any such actions would be permitted only where they are consistent with the purposes of the act" (*MBCA, 1994*). Essentially, the new regime would break the legislated prohibition of incidental take. The idea was to create a system that would allow incidental take under an enforceable and conditional framework, with the overall goal of advancing migratory bird conservation efforts and fulfilling EC's obligations under the *MBCA, 1994.*

2.2.2. The Incidental Take Task Force

Shortly after the amendments were passed, an Incidental Take Task Force was established to gather information and to examine regulatory proposals to address incidental take (CWS Interview Participant #2). The task force is a coordination committee made up of government employees across Canada; it is not mandated by legislation and is considered an informal body rather than a clear-cut government organism (CWS Interview Participant #2). The task force decided to pursue a permitting approach, where proponents would be issued incidental take permits under specified conditions of risk mitigation. A risk management framework (RMF) was developed by Environment Canada to assess project applications for risk of incidental take. Where the

magnitude of risk was low, a permit would be issued with attached mitigation requirements for the proponent. As the risks of significant incidental take increased, the assessment of the application would include a panel review process. The highest risk applications would not be issued permits. The greatest advantage of a permitting system, from the proponent's perspective, was that it gave legal certainty. A permit issued meant that, so long as the conditions attached were appropriately met, a proponent was safe from legal action by the federal government or third parties. Because the prohibition of incidental take was so difficult to monitor and enforce, permitting would also allow EC to apply a more holistic approach to managing incidental take in certain sectors.

As EC prepared for discussions and input from stakeholders, there was concern that the permitting system would overwhelm the scientific and administrative capacity of the small wildlife division (CWS). The agricultural sector posited that an onerous permit system might actually discourage conservation, causing a "shoot, shovel, and shut up" reaction (CSWG, 2010). When the RMF was taken to stakeholders for comment in February of 2010, stakeholders had difficulty envisioning where they might fit on the spectrum of the RMF. There was a lack of clarity around how the permitting system would interact with provincial jurisdiction over land-use planning (CSWG, 2010). This uncertainty worried some stakeholders. In October of 2010, after a flurry of lobbying activity, the Deputy Minister decided to stop any further development of the permitting system for incidental take. Since the development of the permitting approach was stopped, the incidental take task force has been much less active (CWS Interview Participant #2). However, one interviewee expressed a favourable view of its creation, and noted that the task force can serve an important policy coordination role moving forward, including for building collision mortality (CWS Interview Participant #2).

2.3. Environment Canada's Current Approach to Incidental Take

Compliance Promotion and Beneficial Management Practices

The development of a permitting approach to incidental take was discontinued in favour of a new model based on compliance promotion (OAGC, 2011). Under this

model, EC plays a facilitative role in the design of avoidance strategies. Rather than develop guidelines for industry, EC supports the industry led creation of *Beneficial Management Practices* (BMPs) by providing scientific expertise and interpretation of its own objectives and conservation actions (ex: recovery strategies for species at risk) (OAGC, 2011). EC may also evaluate the effectiveness of a BMP in reducing incidental take or in meeting EC's conservation objectives (OAGC, 2011).

EC does not have the authority to recommend specific BMPs for a specific circumstance, but rather, provides general guidance on mitigating the risks of incidental take (OAGC, 2011). Proponents may voluntarily adopt any combination of BMPs that they feel fulfills their obligations under the *MBCA, 1994.* As section 13 (1.8) of the *MBCA, 1994* stipulates, it is up to the proponent to ensure due diligence (*MBCA, 1994)*. Therefore, in the event of prosecution, the risk of falling short of obligations under the *MBCA, 1994,* falls squarely on the proponent's shoulders. EC avoids the possibility of an *officially induced error*; an illegality occurring as a result of erroneous legal advice received from an appropriate official – essentially, EC avoids being found in violation of their own legislation.

2.4. Recent Attention on Bird-Window Collisions in Canada

2.4.1. Toronto's Fatal Light Awareness Program

In Canada, a Toronto based group called the Fatal Light Awareness Program (FLAP) has been working since 1993 to protect migratory birds from collisions with commercial buildings. Originally, founder Michael Mesure intended to draw attention to the hazards of light pollution for birds that migrate during the night. However, he and his team of volunteers soon realized that daytime collisions were potentially a much greater source of migratory bird mortality. FLAP and its volunteers monitor buildings in Toronto suspected of having high collision rates, and has become one of the richest sources of collision data in North America. Similar organizations have since sprouted in Montreal, New York, and Chicago, among other cities (FLAP, 2012). The efforts of FLAP have brought the issue of bird collisions to the forefront in the City of Toronto and beyond.

In April of 2005, the City of Toronto adopted Motion J(17), on the *Prevention of Needless Deaths of Thousands of Migratory Birds in the City of Toronto* (City of Toronto 2007). Certainly attributable in part to the work done by FLAP, the motion sought to look at ways to reduce bird-window collisions with buildings in Toronto. The passing of this motion led the City of Toronto to publish its *Bird Friendly Development Guidelines* in March of 2007*,* a resource tool-kit for incorporating bird-friendly design into new and existing buildings. Initially, the guidelines were voluntary, but beginning January 31, 2010, some of these guidelines were made mandatory as part of the city's wider sustainability strategy, *Toronto's Green Development Standard* (Sheppard, 2011). All new low-rise non-residential, and mid to high rise residential, industrial, commercial, and institutional buildings are now required to treat or mute the reflection of the first 10 – 12 metres of the building above grade (City of Toronto, 2010).

2.4.2. Legal Action Against Building Owners in Toronto

In 2011, hearings began in an unprecedented legal case against a building owner in Toronto. Ecojustice, a not-for-profit organization that advocates for stronger environmental laws, teamed up with Ontario Nature, a not-for-profit conservation organization, and launched a lawsuit against Menkes Development Ltd. for its role in collision related bird mortalities (Kohl, 2010). It was alleged that one of Menkes' buildings, Consilium Place, was in violation of section 14 of the *Ontario's Environmental Protection Act, 1990* (EPA), prohibiting the discharge of a harmful contaminant into the environment (EPA, 1990). The contaminant was alleged to be the reflection of sky and habitat emanating from the windows of Consilium Place, and the adverse environmental impact is the death of migratory birds. Menkes Development Ltd. is also being charged under the *Ontario Society for the Prevention of Cruelty to Animals Act* (OSPCAA), *1990,* for causing birds to die in distress. This case has been completed, and no charges will be laid against Menkes Development Ltd.

In April of 2012, Ecojustice and Ontario Nature brought a second set of charges against Cadillac Fairview Corp., owner of the Yonge Corporate Centre (YCC). In addition to similar charges under the EPA and the OSPCAA, Cadillac Fairview was charged under the *Species at Risk Act (SARA),* after 10 individuals of two species listed as threatened under the act were documented to have been killed at YCC (Tapper,

2012). A recent court decision determined that no charges will be laid (*Podolsky ["Ecojustice"] v. Cadillac Fairview Corp. et. al.*, 2013). However, with respect to charges under SARA, the judge's decision set an important precedence for commercial building owners moving forward.

Under SARA, which protects applicable species even if death was accidental or inadvertent, the judge ruled that *actus reus* was satisfied. [5] However, SARA, like the MBCA, has a *due diligence* provision expressing that persons who contravene the act will not be held liable if satisfactory due diligence was performed. [6] The standard for assessing due diligence is based on the actions of a *reasonable person in like circumstances* (*Podolsky v. Cadillac Fairview Corp. et. al.*, 2013). A number of factors are considered in this assessment, depending on the nature of the case. The ruling emphasized costs incurred by YCC, the steps taken by management to address the collisions, and the practicality and timing of available solutions. Put simply, the judge determined that YCC had taken reasonable steps to avoid killing species protected under SARA. What is interesting is that *actus reus* under the provisions of SARA was established. Commercial building owners are no doubt aware of this decision's implications. This will be discussed further in section 2.6.

2.5. Environment Canada's Work with the Commercial Building Sector

Collisions with the commercial building sector are currently being dealt with in the context of EC's compliance promotion approach for incidental take. Due to legal action against building owners in Toronto – though charges were not under the MBCA - two national building associations that are representing commercial building owners have reached out to EC for technical assistance. EC is not able to recommend specific avoidance measures because it cannot provide legal certainty against prosecution from third parties. This is an excellent example of EC avoiding the potential of committing an

[5] Establishing actus reus indicates that the act was indeed contravened.

[6] For a more in depth discussion of actus reus and due dilligence view the official ruling at *http://www.ecojustice.ca/media-centre/media-release-files/cf-migratory-birds-ii-court-ruling/view*

officially induced error. Rather, EC provides technical advice and general guidance, leaving stakeholders to make their own decisions about what specific strategies to employ to avoid or minimize incidental take. Stakeholders are responsible for determining appropriate due diligence in reducing the risk of incidental take in order to avoid prosecution. While the issue of collisions with buildings has no doubt been elevated into the consciousness of Canadians, and indeed citizens around the world, outrage has arguably been unfairly targeted towards commercial building owners alone. This is not to say that these building owners are not deserving of scrutiny. Government agencies should consider addressing sites where there are high annual mortality rates (Klem, 2006). However, as already discussed, homes account for the vast majority of collision related bird mortality.

2.6. A Framework for Thinking about Incidental Take and Collisions with Homes

Applying the concept of incidental take to collisions with buildings and homes is not as straightforward as in other industries. One interview participant explained that they saw collisions with buildings in a different context than other forms of incidental take (CWS Interview Participant #2). Incidental take occurs as a result of carrying out an *activity* (ex: logging a section of forest), and in the case of bird-window collisions, this activity is much more difficult to define (CWS Interview Participant #2). On the spectrum of directed action causing incidental take, bird-window collisions are on the border of accident (CWS Interview Participant #2). There is also great variability in terms of how much home and building owners can "control" their actions (CWS Interview Participant #2). Bird-window collisions have been discussed as a kind of outlier with respect to incidental take, where legal liability is a much less clear notion (CWS Interview Participant #2). Moreover, it would be virtually impossible for EC to prosecute individual

homeowners; this would not be an efficient use of resources as detection and legal costs would be very high relative to the expected number of birds saved. [7]

This section has outlined the legislative context that policy makers have been working within to address bird-window collisions with the commercial sector and incidental take more generally. The prohibition of incidental take and the resulting legal implications, has proven challenging for policy makers. Most notably, prohibition suffers from an inability to effectively monitor and enforce, and this is especially true with respect to collisions with homes. Viewing collision mortality with homes through the prohibitive lens of incidental take, as defined in legislation, is not a very useful approach. While policy makers must remain cognisant of the current regulatory environment, it is important to think beyond prohibition. One interview participant noted that a lot can be done with other policy tools (CWS Interview Participant #2) and those other tools are what this paper explores. Currently, EC has not publicly outlined a strategy for addressing bird-window collisions with private homes.

[7] Prosecution often results from investigating third party complaints, for which EC has a legislative obligation. If the MBCA is contravened, EC may be forced to take action. Therefore, prosecution is not always initiated by EC. However, it is difficult to imagine an individual going out of their way to collect the evidence required to launch a complaint against a homeowner.

3. Other Jurisdictions' Approaches to Bird-Window Collisions

This section examines how other jurisdictions have dealt with the issue of bird collisions with buildings. Examples from the United States are relevant here because the *Migratory Birds Convention* has led to a very similar legislative landscape for both Canada and the United States. Generally, efforts to reduce bird collisions with buildings have evolved from civil society advocacy, towards various levels of government intervening with both voluntary guidelines and legislative requirements. What is important to note is that action taken by all jurisdictions has focussed on the commercial building sector rather than homes.

3.1.1. Municipal Strategies for Dealing with Building Collisions

Voluntary Guidelines

The cities of Chicago, New York, St. Paul, Markham and Calgary have all instituted voluntary bird-friendly design guidelines for building owners. The City of Vancouver is currently in the design phase of its own bird-friendly guidelines. In various formats, these voluntary guidelines discuss the causes of collisions, investigate available solutions - both pre construction and retrofit - and present collision reduction strategies. Typically, the guidelines also provide case studies and checklists so that building owners can assess the "threat level" of their buildings. For the most part, existing guidelines have targeted commercial building owners, although many of the same principals apply to homes. Unlike some cost saving investments in sustainability (ex: energy efficiency), there are no private pecuniary benefits generated from making a building bird-friendly. If the failure to prevent or reduce the risk of bird mortality has no negative consequences[8],

[8] The recent court ruling discussed in section 2.4.2 has implications here. Negative consequences does not refer only to direct financial penalties, such as regulatory fines. In some cases, green practices have led to a competitive advantage for companies.

there are no incentives for building owners to spend to reduce bird-window collisions. Thus, some municipalities have gone a step further.

Municipally Mandated Requirements

Two North American cities have recently developed mandatory bird-friendly guidelines. As previously discussed, Toronto's Green Development Standard now requires all *new* low-rise non-residential, and mid to high rise residential, industrial, commercial, and institutional buildings to treat or mute the reflection of the first 10 – 12 metres of the building above grade (City of Toronto, 2010). In addition, for those buildings not covered under the mandatory guidelines, the City of Toronto offers an acknowledgement program for buildings that meet standards equivalent to those found in the mandatory Green Development Standard. A building can market itself as bird-friendly and receives an original print of a local artist (SFPD, 2011).

The City of San Francisco has also instated bird-friendly building requirements. The San Francisco Planning Department's *Standards for Bird Safe Buildings,* divides the threat posed to birds into location-related risks and building feature related risks (SFPD, 2011). A building falls under the purview of location related threat factors if it is within 300 feet of an *Urban Bird Refuge.*[9] A building is subject to feature related hazard[10] requirements when it is newly constructed or when additions are made to the building (only the addition requires treatment) (SFPD, 2011). The City of San Francisco's guidelines are the most targeted, specific, and comprehensive, explaining when requirements will be enforced, what constitutes satisfaction of those requirements, and includes a detailed description of exceptions (ex: historic buildings) (SFPD, 2011).

[9] Urban Bird Refuges are defined as open spaces at least 2 acres in size that include forest, meadow, grassland, water features, wetlands, open water, vegetated landscaping, and green rooftops (City of San Francisco Planning Department, 2011).

[10] Feature related hazards include standing clear glass walls, skywalls, greenhouses on rooftops, and balconies with unbroken glass segments 24 square feet or larger (City of San Francisco Planning Department, 2011).

3.1.2. State and Federal Action

The State of Minnesota has passed into law a bill that requires all state owned and state leased buildings to turn out their lights in the evenings during migration seasons (Sheppard, 2011). For non-state owned buildings, the legislation is not mandatory. While this does not address daytime collisions, it is an example of a state led approach to reduce bird collisions with buildings. The State of New York has legislation, which is currently pending approval, that would require the use of bird-friendly building materials and design features in new buildings (Sheppard, 2011). The specifics of this legislation are unknown. In 2011, Illinois congressmen Mike Quigley introduced the *Federal Bird Safe Buildings Act*. If approved, this act would require all federally constructed or acquired buildings to incorporate bird-friendly features to prevent collisions with clear and reflective glass (Sheppard, 2011). Under the legislation, similar action would be required on existing federally owned buildings *where practicable* (Sheppard, 2011).

3.1.3. NGO and Private Sector Initiatives to Reduce Bird-Window Collisions

The *American Bird Conservancy* and the *Audubon Society* have programs dedicated to educating the public about bird collisions. These major national organizations provide resources for the public, building owners, and city planners about how to reduce the impact of clear and reflective glass on birds. A number of other smaller organizations, including the aforementioned FLAP, are dedicated specifically to the issue of bird-building collisions. Some of these organizations are also conducting research to better understand collisions, and are working with scientists and manufacturers to develop technical solutions (ABC, 2012).

In October of 2011, the LEED green building rating program adopted a pilot bird-friendly building credit. Developed in cooperation with the American Bird Conservancy, the Bird-Safe Glass Foundation, and the US Green Building Council (USGBC), the LEED credit is currently being piloted to assess its effectiveness (ABC, 2012). If effective, it may become a permanent fixture in the LEED rating system. The credit provides a framework for assessing the threat level of a given building, based on the

building materials used, façade area, and lighting techniques (LEED, 2011). In order to qualify for the credit, buildings must be below a specified "threat level" (LEED, 2011).[11] Proponents must also specify a plan for monitoring the building for collisions and have a contingency plan in place for problematic areas (LEED, 2011).

3.2. Conclusion

Bird-friendly guidelines introduced by cities, states, and conservation organizations, whether mandatory or not, are excellent resources for city planners and architects designing bird-friendly buildings and can help to educate the public. However, these guidelines have been created at different times, in different places, and with different information, which can lead to confusion and contradiction (Sheppard, 2011). Most importantly, regulatory efforts by various levels of government have targeted commercial, multiunit residential, and government buildings rather than the types of homes this study concerns. Now that the legislative landscape has been set out, and efforts by other jurisdictions examined, it is important to discuss some of the risk factors that lead to collisions, and some of the available solutions. This discussion, while not meant to be definitive or viewed as an authoritative voice on reducing bird-window collisions, will provide perspective for the development and analysis of policy options.

[11] For a description of how the threat level is calculated, see *http://www.usgbc.org/ShowFile.aspx?DocumentID=10402.* For a listing of the threat factor posed by various materials, see *https://www.usgbc.org/ShowFile.aspx?DocumentID=10397*.

4. Collisions with Homes: Risk Factors and Solutions

Wherever birds and glass coexist, bird-window collisions will occur; there is no time of year when birds are immune from window collisions (Klem, 2006). The single greatest predictor of collision rates is the density of birds in the presence of glass (Klem, 2006). Thus, generally speaking, anything that increases the abundance of birds in the presence of glass increases the risk of collisions. This section is intended to provide a brief overview of collision risk factors and risk mitigation strategies to give context to the reader, and should not be viewed as a definitive or authoritative discussion. A number of bird-friendly building guidelines, produced by organizations with a deeper knowledge of the subject, are available online.[12]

4.1. Collision Risk Factors

4.1.1. Geographic Related Risk Factors

Beginning at a macro scale, there are particular geographical features that may increase the abundance of birds in an area, and thus, the risk of collisions. Generally, settled areas located along migratory pathways are at higher risk because the abundance of birds can increase significantly during the spring and fall migration seasons. Specifically, geographic features that cause large numbers of birds to gather in one area during migration, sometimes called migratory stopover sites, are more vulnerable to bird-window collisions (Sheppard, 2011). The Great Lakes are an excellent example of this phenomenon. Birds on migration will gather to rest before

[12] For a comprehensive discussion of collisions risk factors and solutions, see the American Bird Conservancy's Bird Friendly Building Guide. Also, see the ABC's annotated bibliography of empirical studies on bird-window collisions at: http://collisions.abcbirds.org/pdf/Window_Collision_BibliographyOctober2012.pdf

and/or after flying over the Great Lakes. This contributes to higher collision rates in the cities of Toronto and Chicago. Large open green spaces within settled areas, such as park space or green buffer zones between a river and the urban environment, are also thought to increase the risk of collisions for adjacent homes/buildings (SFPD, 2011).

4.1.2. Landscape Related Collision Risk Factors

Landscape collision risk factors refer to the particular landscaped features around the structure. According to a 2009 study of urban buildings in Manhattan, landscape related risk factors have a larger effect on the number of collisions than the actual features of a building itself (Klem et. al.).[13] Of relevance to homes, the greater the height of ground cover surrounding the home (bushes and other vegetation) the greater the collision rate will be on average (Klem et. al., 2009). Another study found that as the amount of vegetation reflected in windows, or visible through windows, increased, the likelihood of a bird-window collision also increased (Gelb and Delecretaz, 2006). Generally speaking, more vegetation will attract more birds to the vicinity of a home, resulting in an increased risk of collisions (Sheppard, 2011).

In a recent study, Bayne et. al. found that rural homes were more susceptible to bird-window collision on the order of magnitude of 2-3 times (Bayne et. al., 2012). The study also found that the age of a neighbourhood influenced the number of collisions occurring at a particular residence (Bayne et. al., 2012). These findings likely reflect the abundance of mature vegetation in rural settings and older neighbourhoods, which increase bird densities. In a non-linear model, neighbourhood age was significant until 20-40 years, at which point the number of collisions plateaued (Bayne et. al., 2012).

4.1.3. Building Design Feature Related Collision Risk Factors

Building design related risk factors refer to elements of a building's construction that lead to an increase in bird-window collisions. As the proportion of a building's facade that is glass increases, in comparison to other materials, so too does the

[13] Assuming the building has design features which can cause collisions. If the building has no glass or reflective/clear properties, the landscape risk factors may be irrelevant.

likelihood of bird-window collisions (Klem et. al., 2009). It is also widely accepted that the more reflective the glass used in a building, the more dangerous it becomes to birds (Sheppard, 2011). Mirrored glass reflects vegetation, sky, and other habitat features and birds mistake this reflection for reality. In addition, transparent glass can become reflective at certain times of day, appear as an unobstructed flyway, or appear as a dark void that can be flown through (Sheppard, 2011).

4.1.4. Time of Year Related and Other Collision Risk Factors

There is much debate about the effect of seasons on bird-window collisions. Early work determined that birds were most susceptible to collisions during the winter months (Klem, 2004, 2006). In a study of commercial and institutional buildings, Hager et. al. found that the majority of collisions occurred during the spring and fall migratory periods, but not at all buildings (2008). The study by Bayne et. al., based on self-reported memory of collisions, determined that the majority of collisions occur during the summer months (2012). Anecdotally, it is widely cited that the number of bird-window collisions increases during migration. As birds migrate through any one particular area, the density of birds rises. Birds also become more restless and competitive during migration, which results in more aggressive behaviour, and could increase the number of collisions with windows (Hager et. al., 2008). The presence of bird feeders and other bird attractants (ex: bird baths) also significantly increases the rate of collisions at a particular site (Bayne et. al., 2012). Predators or other birds can startle birds at feeders causing them to take off in a panic flight and increasing the potential for bird-window collisions. Table 4.1 summarizes bird-window collision risk factors:

Table 4.1: Summary of Collision Risk Factors with Homes

Category	Risk Factor	Description of Risk
Geographic Risk Factors	Proximity to bird habitat	The closer a home is to large open vegetated areas, the more likely a collision is to occur at that home (ex: city park space).
	Proximity to migratory stopover sties	Certain geographical features along migratory routes, such as large bodies of water, cause birds to "stopover" during migration, greatly increasing the density of birds in the area. This leads to an increase in bird-window collisions.
Landscape Risk	Presence of	The more vegetation that is reflected in windows, or is

Category	Risk Factor	Description of Risk
Factors	vegetation reflected in or visible through windows	visible through clear windows, the higher the likelihood of a bird window collision.
	Height of vegetative ground cover	Decreasing the height of ground cover vegetation results in a decreased risk of bird-window collisions.
Building Design Feature Factors	Percentage cover of facade by windows	The greater the proportion of windows to other materials on a building's facade, the greater the risk of a bird-window collision.
	Reflexivity of windows	The more reflective the windows are on a building's facade, the more likely a bird-window collision is to occur.
	Presence of bird feeders and other bird attractants	Feeders attract birds to a yard, increasing the density of birds in an area. "Panic" flights away from the feeder increase the risk of bird-window collisions.
Seasonal Risk Factors	Winter + Bird Feeders	The effect of bird feeders increasing bird-window collisions is thought to be greater in the winter months as food is scarce and more birds are attracted.
	Migratory Periods	During migration periods in the fall and spring, the density of birds in a given location can increase significantly. When combined with physiological changes in birds during migration (restless and aggressive), the risk of a bird-window collision is thought to increase.

4.2. Reducing Bird-Window Collision Risk Factors

4.2.1. Bird-friendly Building Design: New Home Construction

Incorporating bird-friendly features into the initial design of a home can reduce collision risks with no additional monetary costs (Sheppard, 2011). Reducing the amount of exposed glass is an integral first step. Of course, this has an implicit cost for an individual who prefers an abundance of glass. This can be achieved either by limiting the amount of glass used in the design of the home, or by using facades, grilles, shutters, and exterior shades (Sheppard, 2011). Setting the windows back in the structure can also reduce the amount of exposed glass (Sheppard, 2011). In addition, angling the glass towards the ground by twenty degrees or more has been shown to be a very effective deterrent to collisions on ground story windows (Klem et. al., 2004). The ground is then reflected from the window surface, a barrier recognized by birds. Where

exposed glass is used, ceramic frit patterns or etching can be applied to the *exterior* of the window to signal a barrier for birds (Sheppard, 2011). Frosted and stained glass can also be effective for reducing bird-window collisions (Sheppard, 2011). There is also evidence that the use of alternating patterns of ultra violet light reflecting and absorbing material in or on windows can be a very effective bird-collision deterrent (Klem, 2006). The additional benefit here is that this material is barely visible to the human eye. All patterns, whether ceramic frits, frosting, etching, or otherwise should not be spaced more than 2 inches horizontally or 4 inches vertically.[14]

4.2.2. Bird-friendly Building Retrofits: Existing Housing Stock

The window treatments discussed in the last paragraph can be used as a retrofit solution for existing homes. Netting and screens can also be placed several inches in front of the window to "catch" the bird before it collides with the window and are very cost effective (Sheppard, 2011). There are also a number of window films that can be applied to existing windows. They come in various designs, some less obstructive to the view than others. One type of film, for example, is the same film used to advertise on city buses. It appears opaque from the outside looking in, but permits a view, though obstructed, from the inside looking out. Window decals can also be used, but in contrast to manufacturer's recommendations, must be applied according to the 2 by 4 rule (Sheppard, 2011). Keeping blinds down and slightly open can also disturb the window's reflective properties at certain times of the day (Sheppard, 2011). There are many other creative ways to signal a barrier to birds including, but not limited to, white washing windows or decorating the exterior of the window (using the 2 x 4 rule).

4.2.3. Addressing Geographic, Landscape, and Other Risk Factors

Reducing the amount of vegetation reflected in or visible through windows can reduce the risk of bird-window collisions. For example, removing or trimming vegetation near reflective windows, or moving plants inside the home away from windows can

[14] Research has shown that birds will not typically fly through horizontal spaces smaller than 2 inches, and vertical spaces smaller than 4 inches. This is often called “the 2 by 4 rule” and is considered the most effective method of signaling a barrier to birds.

reduce the risk of collisions. Reducing the height of ground cover can also reduce the risk of collisions, though this may not a practical solution for homes. Counter-intuitively, relocating bird feeders and other attractants (ex: bird bath) within one metre (3 feet) of a window can reduce the number of collisions (Klem, 2006). This proximity to the window does not allow birds to gain enough speed in their flight away from the feeder to cause a fatal collision. Many macro scale geographic related risk factors cannot be controlled. The City of Toronto is not going anywhere anytime soon, for example. Homes in older neighbourhoods or near to open green spaces face a similar problem. These are cases where altering the appearance of windows, or incorporating bird-friendly building design into new construction, are more important as mitigation measures.

4.3. Implications of Collisions Risk Factors and Solutions for Public Policy

The nature of bird-window collisions, as a function of risk factors and available solutions, has consequences for the consideration of policy responses. First, conducting risk assessment at a micro level is not feasible. While the CWS can use its expertise in migration patterns to determine macro scale risk assessment, micro scale risk factors create a high degree of collision variation within a given area. Second, there are many strategies and numerous products already available, both for application to new and existing homes, which can reduce bird-window collisions. While new homes can be designed to be inherently bird-friendly, there remains no product available that is considered a "silver bullet" in terms of bird-window reducing collisions. Products typically affect the appearance of the window, which has been identified time and time again as a significant barrier to widespread adoption. However, this remains an active area of research and has recently yielded some potentially promising new solutions.[15] The next section discusses the value of birds, and why it is socially desirable to reduce this source of mortality. As will be demonstrated, the collision reduction products

[15] See http://controlium.com/ for a description of the Spectral Impulse Anti-Collider. Also, see Daniel Klem Jr.'s research into ultra-violet light reflecting and absorbing films that create little or no disturbance to the aesthetics of the window (Klem, 2009).

discussed in this section provide an opportunity to assess how citizens value reducing bird-window collisions.

5. Market Failure and the Value of Birds: A Societal Perspective

From an economic perspective, birds display public good characteristics. A public good exhibits two fundamental qualities. First, they are non-rival; consumption of the good by one individual does not affect the ability of any other individual to consume it. Second, public goods are non-excludable; if available, no individual can be excluded from consuming the good. In this case, to *consume* has an array of meanings including viewing birds, enjoying the sounds of birds, and reaping the benefits of any ecological goods and services that birds provide. Public goods are particularly vulnerable to negative externalities, which occur when the external costs of actions are not fully accounted for in private decisions. As a result, the costs are born by society at large and this is termed market failure. Market failure is one rationale for government intervention.

To illustrate these concepts, when consumers purchase windows they are only incurring the private costs of that window.[16] Unless well informed about the consequences of bird-window collisions, the consumer does not consider the cost of bird mortality that may result.[17] This is an external cost. The social cost, therefore, is the simple addition of the private costs and the external costs. From a societal perspective, goods that produce negative externalities, in this case traditional windows, are underpriced and overproduced. This represents an inefficient allocation of resources because if the consumer were forced to pay the full social cost for each window purchased, the demand for traditional windows would likely decrease resulting in a gain in net benefit for society. In order to achieve efficient outcomes, decision-makers require

[16] This is an oversimplification for illustrative purposes. As discussed, many other factors contribute to bird-window collisions.

[17] This also ignores the *free-rider* problem. If an individual knows others are making efforts to reduce collisions, they may choose not to take action and still reap the benefits of improved environmental quality.

information about the potential benefits and costs of policy. The framework provided by the concept of total economic value is a good starting point.

5.1. The Total Economic Value of Birds

The calculation of total economic value (TEV) is an attempt to account for the full value of benefits derived from an environmental good *by society* (Pearce et. al., 2006). TEV measures the external costs/benefits that are lost or gained when some activity impacts an ecological good or service. In the case of bird-window collision mortality attributable to homes, the application of TEV can assess the social costs associated with the loss of these birds. Typically, TEV is divided into use values and non-use values (Pearce et. al., 2006). Use value refers to the utility derived from consuming the good in question and is further typified into *direct use values* and *indirect use values.*[18] Non-use (or passive use) values refer to the willingness to pay (WTP) to preserve an ecological good even if there is no actual or planned use for that good (Pearce et. al., 2006). Non-use values are separated into existence values, the WTP to preserve a good simply for its existence, and bequest values, the WTP to preserve the existence of an ecological good specifically for future generations.

5.1.1. Direct Use Values: The Bird Watching Industry

One example of a direct use value for migratory birds[19] is the value of the bird watching industry. According to a 2006 study of wildlife viewing in Canada, over 1.8 million Canadians had participated in bird watching activities during an overnight trip away from home within the past two years (Lang Research, 2006). A 1996 survey evaluating the importance of nature to Canadians, found that there were over $1.3 billion in expenditures on *wildlife viewing* trips away from home (some portion of which was for bird-watching), both as a primary and secondary activity (Environment Canada, 1996).

[18] For a comprehensive typology of TEV, see Peace et. al. 2006. While these typologies provide a useful tool for thinking about the economic value of environmental goods, they are not rigid, and their usefulness in application varies across different goods.

[19] Although hunting birds for sport and/or food is a more obvious example, the species of birds typically involved in collisions are not the same species that are hunted.

In addition, Canadians spent over $320 million on *wildlife viewing* around the home in 1996 (Environment Canada, 1996). A 1989 study at Point Pelee National Park in Ontario estimated that expenditures by bird watchers that year were $5.4 million, with a willingness to pay (net economic value) of $6.3 million (Hvengaard et. al., 1989). A 2012 U.S. Fish and Wildlife Service survey found that Americans spent over $4 million on bird feed alone, just under $1 million on bird feeders, bird baths, and nest boxes (U.S. Fish and Wildlife Service, 2012). While these numbers are dated and many do not disaggregate expenditures on bird watching specifically, they do provide some indication of the value of bird watching in Canada.

5.1.2. Indirect Use Values: Ecological Goods and Services Provided By Birds

Birds provide a number of ecological goods and services, free of charge.[20] These include, but are not limited to, pest insect regulation, pollination, seed dispersal, and nutrient cycling. No market exists for these goods and services, but various methodologies have been developed to infer these kinds of value. For example, assessing expenditures on replacement goods and services is called the *cost of treatment methodology*. In the agricultural sector, the cost of treatment for the loss of natural pest insect regulation provided by birds could be measured by the increased expenditures on pesticides. Sometimes, a replacement good or service cannot be developed or implemented feasibly, which can lead to decreased productivity. For example, nearly 33% of all bird species disperse seeds, a relationship which contributes to the health and biodiversity of almost all ecosystems (Wenny et. al., 2011). This dispersal mechanism has direct value to humans through its contribution to timbre production, medicines, and other foods (Wenny et. al., 2011). Assessing the costs of lost productivity (ex: timber production) resulting from diminishing ecological goods and services is called the *lost productivity methodology,* and is again an indication of the value of that good or service.

[20] For a more thorough discussion of the ecological goods and services provided by birds, see Wenny et. al. 2011.

5.1.3. Problems with the Valuation of Direct and Indirect Uses Derived from Birds

The kinds of services provided by birds are difficult to measure. Provisioning services, where a good is provided for human consumption (ex: timbre from a forest), are typically easier to measure because these goods have observable markets (ex: the market price for a type of timbre). In contrast, regulatory services contribute to production in complex and overlapping ways (Wenny et. al., 2011). The dose response functions required to measure lost productivity caused by diminishing regulatory services are difficult to establish (Wenny et. al., 2011). Further, the effects of diminishing regulatory services are often long-term in nature, making the relationship between input and output difficult to identify. Much work remains to be done between both ecologists and economists in order to quantify the ecological goods and services provided by birds (Wenny et. al., 2011). In addition, it would be very difficult to isolate the impact of collision-related mortality on these services. This paper recognizes that the ecological goods and services provided by birds have substantial value, and that bird-window collisions are a threat to this value, but does not seek to quantify this component of TEV.

5.1.4. Defensive Expenditures: The Value of Reducing Bird-Window Collisions with Homes

Defensive expenditures, or averting behaviours, refer to the willingness to pay to avoid unwanted risk. The majority of literature has investigated defensive expenditures related to improving health outcomes in relation to avoidance of environmental risks (Konishi and Adachi, 2011, Abdalla et. al., 1992, Abrahams et. al., 2000). These methods can also be used to elicit the value of improved environmental quality that cannot be directly linked to human health risks (Jakus, 1994). Bird-collisions with windows are an excellent example. One could examine household expenditures on collision mitigation products and use this as a proxy for the societal benefits associated with reducing bird-window collisions. However, in the presence of a lack of information about the scale and impacts of bird-window collisions, using *existing* defensive expenditures can significantly understate the willingness to pay (Konishi and Adachi, 2011). Given these circumstances, the application of the contingent valuation method is a fitting approach for eliciting the willingness to pay (defensive expenditures) to reduce

bird-window collisions. This data can be used to help design an effective policy response. In the next section, the methodology discusses the application of contingent valuation.

6. Methodology

6.1. Literature Review

A literature review informed the introduction and background for this capstone. Academic papers, NGO publications, and information from government websites, private sector organizations, and legal documents were all consulted in this study. In working for the Canadian Wildlife Service this past summer, I was also able to communicate with a number of individuals in the department about various issues related to incidental take generally, and bird collisions more specifically. CWS employees provided general guidance in terms of source material, as well as valuable background information about the legislative arena and the Government of Canada's current approach to incidental take. The literature was also used to inform the survey and interview instruments, as well as provide insight into the selection of policy options.

6.2. Online Survey

A major component of the project was a willingness to pay (WTP) survey, which targeted, but was not restricted to, homeowners. The survey design was informed by an extensive literature review of bird-window collisions, including contributing factors, available solutions, costs and effectiveness of these solutions, and prevalence of collisions with residential buildings. In addition, academics were consulted on the WTP question to ensure its legitimacy. The survey asked questions related to preferences for bird-friendly retrofit products, acceptability of various policy options, and collision rates at their homes, among others. Demographic questions were used to test for sample representativeness.

The central purpose of the survey was to measure the compensating variation- the maximum WTP that leaves the individual no better or worse off- for windows that are

designed to reduce bird collisions. Although difficult to pinpoint, these defensive expenditures are likely related to concern for the environment or birds generally, avoiding the unpleasant feeling of witnessing a collision, and perhaps avoiding the inconvenience of disposing of a bird carcass/cleaning the window. Respondents were given a hypothetical choice to pay an additional $45 or $90 for specific levels of bird protection in windows. These prices are comparable to the price of bird-friendly windows currently available on the market.[21] Information about energy efficient windows was included in the WTP question to reduce the spotlight effect[22], and to present a more realistic purchase decision. The data collected allowed a calculation of the average WTP for some level of bird-friendly features in a window. In addition, analyzing the trade-off between energy efficiency and bird protection elicited a weighted average WTP for specific levels of bird protection in windows. This measure is an indication of how respondent's valued the effectiveness of bird-collision reduction products.

It is important to note that the WTP question attempted to avoid a significant problem with most collision reduction products. That is, most products affect the aesthetics and clarity of view out of the window. The WTP question elicits an estimate of willingness to make defensive expenditures, absent of this significant barrier. The goal of the survey was to use these defensive expenditures as a proxy for how the public valued avoiding bird collisions with windows in their homes. This information helped to inform the analysis of policy options, particularly estimates of how homeowners might respond to proposed policy alternatives.

The survey was constructed using Simon Fraser University's Web Survey Tool. A link to the online survey was distributed by representatives of the Canadian Wildlife Service, myself, and my thesis supervisor, Dr. Nancy Olewiler, who were then encouraged to distribute it to their own networks, creating a snowballing effect. In

[21] One company manufactures windows that have an ultraviolet light reflecting material inserted between the panes of glass, which can be effective in reducing bird-window collisions. The ultraviolet light reflecting material is largely undetectable by the human eye.

[22] The *spotlight effect* refers to a situation where the survey respondent becomes focused on a specific aspect of a problem as a result of the information they are provided. In a WTP survey, the spotlight effect can induce the respondent to ignore/forget trade-offs that they would make in the real world. In this case, the survey introduced energy efficiency into the window purchase decision, a trade-off that many consumers consider when buying windows.

addition, a number of organizations agreed to host a link to the survey on their respective websites/newsletters or assisted in dissemination through their own networks.[23] Although this project is mainly concerned with the attitudes and values of Canadians concerning bird-window collisions, and a Canadian approach to dealing with this problem, respondents of the survey were not required to be Canadian citizens. A number of American citizens completed the survey due to the web dissemination. This information was used to draw comparisons between Canadians and citizens of the United Sates.

6.3. Semi-Structured Elite Interviews

Semi-structured elite interviews with two government officials were conducted in order to fill in the gaps of the literature review and to gain a more comprehensive understanding of the issue from a legislative perspective. These officials were known to have direct knowledge about incidental take and relevant government policies. The interviews provided valuable context to the analysis, especially in setting the boundaries of feasibility for the development and consideration of policy alternatives.

6.4. Limitations

A major limitation in this study was the inability to secure a representative sample. The distribution strategy focused disproportionately on contacting environmental organizations that would be willing to post a link to the survey on their respective websites. Therefore, the sample did not capture a true cross-section of the Canadian population. Readers are encouraged to see all footnotes in the data analysis section, as well as view appendix D, which presents an in depth discussion of the survey results. By asking a series of demographic questions the analysis can be disaggregated to examine the implications of the non-representative sample. Although attempts are

[23] Organizations that agreed to host the survey: The American Bird Conservancy, Nature Canada, Bird Protection Quebec, Centre de Conservation de la Faune Ailee, Wildlife Rescue Association of BC, Newfoundland and Labrador Environment Network, and the Yukon Bird Club.

made to adjust for the effects of non-representativeness, the data reported in this study should be used with caution.

SFUs survey tool did not have a random generation feature to randomly order the answers within a question. This could have led to some embedding effects, where the ordering of the responses biases the answer. In the same vein, the WTP question responses could not be randomized. The most logical way to organize the WTP options was from least expensive to most expensive. This could have given rise to an anchoring effect. Anchoring occurs when the price of the initial response choice causes the respondent to set an expectation of what an appropriate price to pay should be. With the resources available for this project, an online survey was considered the best alternative to conduct a WTP survey.

7. Data Analysis: Summary of Survey Results

From October 15th, 2012 until December 1st, 2012, the survey received a total of 966 respondents, including 883 responses to the English language version, and 83 responses to the French language version. After cleaning the data and removing invalid responses, including those who did not answer the willingness to pay question, or only partially completed the survey, the sample totalled 958 observations. There was no way to ascertain how many other respondents came to the survey, but did not fill it out. This could have occurred if potential respondents found the survey difficult, too time consuming, or were not sufficiently interested. This section presents an overview of the results of the survey.[24]

7.1. Survey Demographics and Respondent Characteristics: An Overview of Sample Bias

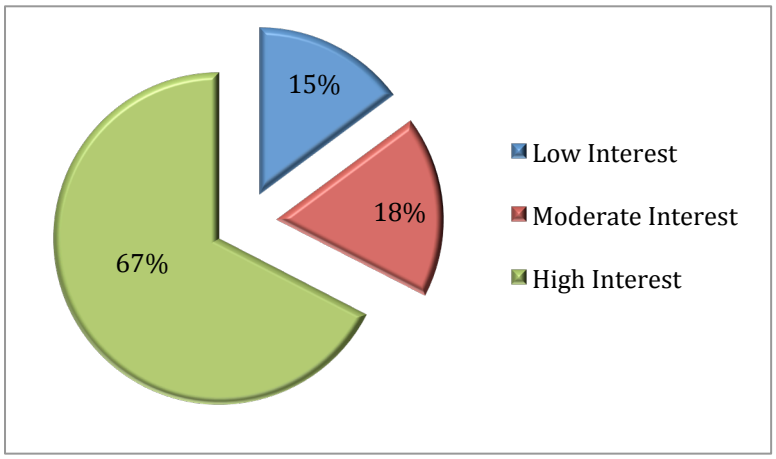
Appendix B shows the aggregate distributions of respondent demographics. Overall the sample was slightly older and much more educated in comparison to Canadians more generally. There was also a significant gender bias present in the survey sample as 63.5% of respondents were female, compared to 36.5% male respondents. The median reported household income approximates the median for Canadians as whole. However, a large number of respondents reported household incomes in excess of $100,000, indicating that the sample mean household income is likely higher than the Canadian average. Respondents from British Columbia, Ontario, and Quebec were overrepresented, totalling 590 of the 774 Canadian respondents.

The sample was heavily skewed towards respondents who reported having a high level of interest in birds. Figure 7.1 shows the results of survey question 4, which

[24] Only the general observations related to demographics, respondent characteristics, and other questions are presented here. For a more detailed discussion and analysis, see appendix D.

explored respondents' interest in birds.[25] Survey respondents also reported spending a great deal more than the average Canadian on bird related activities. Moreover, based on respondents' penchant to donate to organizations with conservation mandates, the survey sample is over representative of respondents interested in conservation more generally. I have taken these biases into account in my analysis. The sample can be segmented to analyze how various demographics and characteristics affected responses to central questions in the survey.

Figure 7.1: Respondent Level of Interest in Birds



7.2. Average Willingness to Pay to Avoid Bird-Window Collisions

First, it is important here to note a limitation on the WTP question. As designed, the question gives respondents the choice to pay $45 or $90 for a specific level of bird protection.[26] Respondents who reported not being WTP $45 did not necessarily have a WTP of $0; they just were not willing to pay $45. Similarly, respondents with a WTP of $90 may have been WTP *more* than $90 for the bird-friendly window features. The

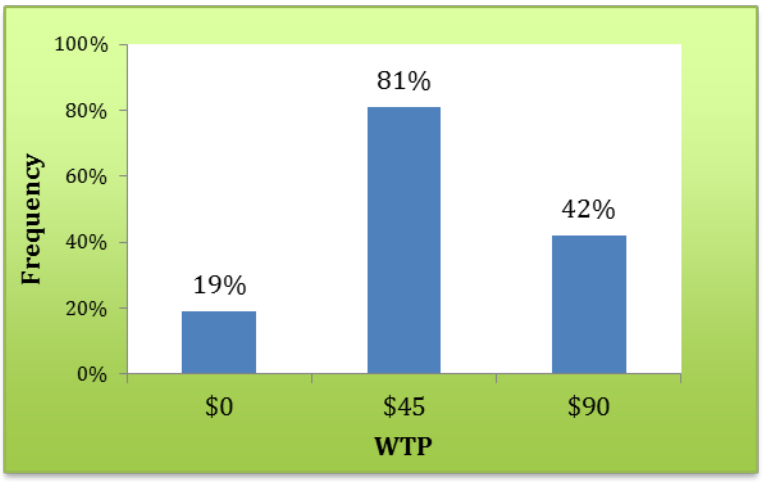
[25] *Low Interest* = I am not that interested in birds *or* I enjoy hearing birds when I am outdoors *or* I casually observe birds as different times, but never go out of my way to do so. *Moderate Interest* = I occasionally make time to observe birds, *High Interest* = I regularly make time to observe birds *or* I take special trips away from home to go bird watching.

[26] As discussed, these prices approximate real windows with bird-friendly features currently on the market.

aggregate calculations of WTP from the survey data, *all else equal*, are likely to understate the WTP of this particular sample, but not necessarily the population as a whole.

Figure 7.2 shows the aggregate frequencies of survey respondents' AWTP. By aggregate, I infer that those who are WTP $90 are also WTP $45, so I have aggregated these two categories in figure 7.2. Individually, 42.2% (n=404) of respondents reported a WTP of at least $90 for bird-friendly windows. Those WTP at most $45 were 39.1% (n=375), and 18.7% (n=179) of respondents reported not being willing to pay $45 for bird-friendly windows, but might have been WTP an amount less than $45.. The sample-mean WTP for some level of bird collision reduction properties in a 15 square foot window falls between $53 and $58.[27] If only single and semi-detached homeowners are included in the sample, the focus of this study, the AWTP ranges from $56 to $61, which is not statistically different from the aggregate sample.

Figure 7.2: Frequencies of Responses for the WTP for Bird-friendly Features



Characteristics with Significant Effects on AWTP

Age, income, reported donations to conservation organizations, level of interest in birds, and reported annual home window collisions all appear to significantly and

[27] See appendix D, table C-3, for a summary of AWTP across respondent characteristics. All statistics reported at the 95% level of significance.

positively impact respondent WTP.[28] Middle age respondents (40-69) were WTP more to reduce bird-window collisions than younger (19-39) and older (>70) respondents. Likely related to age, in terms of lifetime earnings trajectories, higher incomes resulted in a higher AWTP. In addition, as the number of reported collisions increased, the respondent's AWTP also increased. However, appendix D shows that those who reported a higher level of interest in birds were also more likely to report a higher number of collisions, likely because they are more aware of the issue or were answering strategically. This correlation likely overstates the effect of increasing collisions reported on the AWTP.

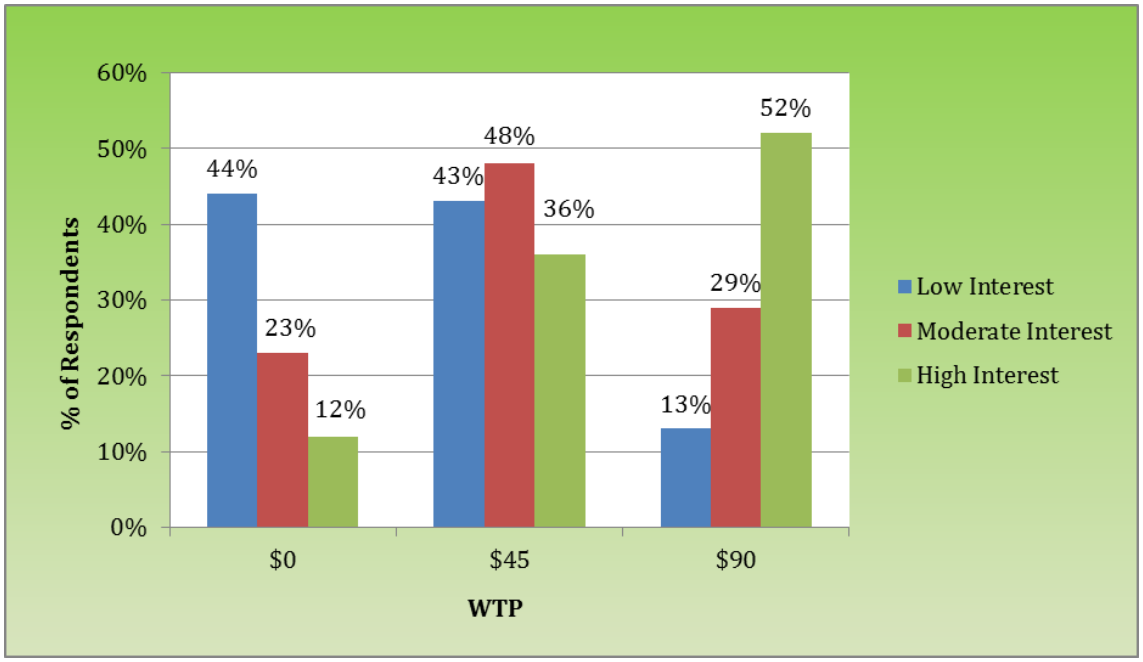
Of these characteristics, the most conservative estimate of AWTP can be gleaned from the level of interest in birds.[29] Those who reported a low, moderate, and high interest in birds had an AWTP of $26-$36, $43-$53, and $61-$65 respectively. Figure 7.3 shows this relationship in graphical form. The WTP to prevent collisions appears to be heavily influenced by interests and attitudes towards birds, which economic theory would indicate is not surprising. More interestingly, even among Canadians without a special interest in birds or who are particularly conservation minded, a sizeable benefit exists.[30] Using respondents with a low interest in birds to approximate the average Canadian, the AWTP for a 15 square foot window is $31 per household.

[28] Regression analysis was not used and so these statistics do not account for the interactive effects occurring between respondent characteristics.

[29] See Appendix C for a summary of demographics of respondents with a low level of interest in birds.

[30] Respondents with a low interest in birds stated average donations to conservation organizations between $39 and $105, which is in line with the average Canadian's donation to environmental organizations of between $97 and $114.

Figure 7.3: Interest in Birds and Respondent WTP



7.3. Collision Data for Single and Semi-Detached Homes

Using the lower bound and upper bound for each response option range, the mean value for collisions per household per year in the survey sample was between 3.1 and 5.4.[31] If only collisions at single and semi-detached homes are included, estimated number of annual collisions reported falls between 3.1 and 6.1. Past studies have identified bird feeders as a major risk factor for bird-window collisions. Considering that 60% of single and semi-detached dwellings in the sample reported having bird feeders, this aggregate collision rate over-estimates the true mean collision rate.

Figure 7.5 shows the difference between reported collision rates of homes with and without feeders. The mean collision rate for homes with feeders falls between 4.3 and 7.2 and the mean collision rate for homes without feeders falls between 2.1 and 4.0.

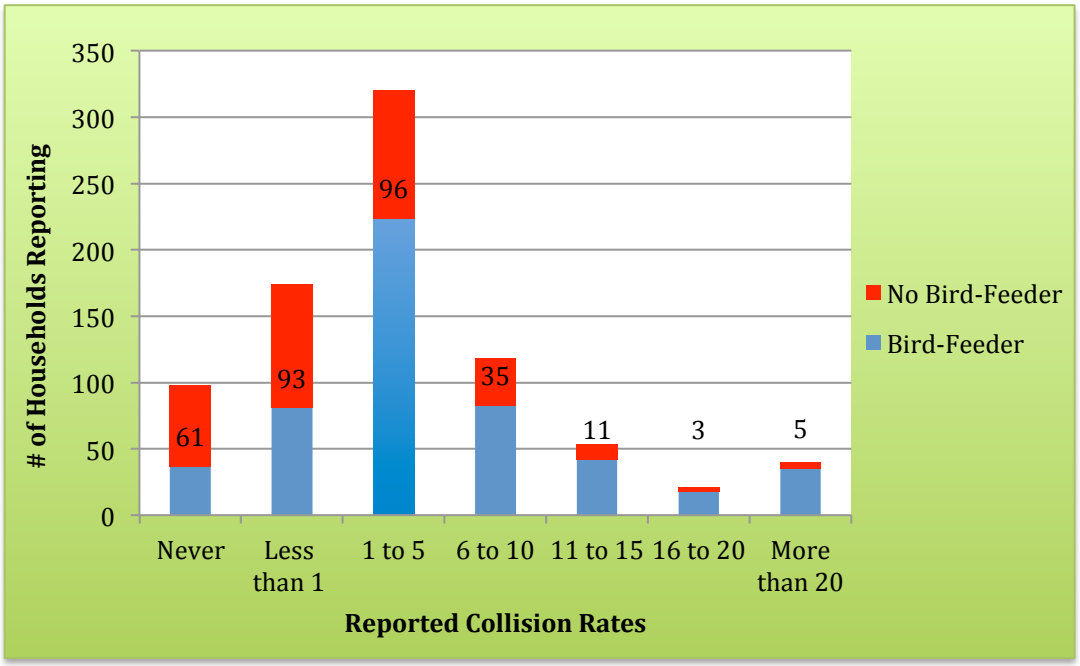
[31] For both the upper and lower bound estimates, *less than 1 per year* was considered to be 0.5 and the open ended category *more than 20*, was considered to be 21. This estimate is therefore likely to be conservative and caution should be used when using this data. This method will be used to calculate all mean ranges for collisions.

In their 2012 study, Machtans et. al. estimate that between 15 and 25% of Canadian homes have bird feeders. Using a simple weighted adjustment based on 15% and 25% of homes having bird feeders, the mean range collision rate for this sample is approximately 2.4 to 4.5 and 2.6 to 4.8 respectively.[32] If Klem's estimate that half of all bird-window collisions result in a fatality is accepted, the mean mortality rate per household in this sample ranges from 1.2 to 2.4 birds per year. Because an adjustment for searcher error was not made, which EC's study estimates to be between 2.3 and 5 per home, this estimated mortality rate per home is conservative (Machtans et. al., 2012).[33] Overall, these results are comparable with other studies (see appendix D).

[32] 0.15 x (4.3 - 7.2) + 0.85 x (2.1 – 4.0) = 2.4 – 4.5

[33] Searcher error refers to bird carcasses not found/seen by respondents due to missed observations and or the scavenging effect - bird carcasses are scavenged by other animals eliminating evidence of a collision.

Figure 7.4: Number of Collisions per Year, Households with and Without Bird Feeders



7.4. Birds: Components of Value for Respondents

Understanding why people value birds can be an important consideration for policy makers. Table 7.3 shows the aggregate results for survey question 5.[34] The lowest importance was placed on the cultural value. Even so, 74% of respondents reported the cultural value of birds being either important or very important. The use value, existence value, and value of ecological goods and services provision all had above 90% of respondents indicate that they were important or very important. [35] The provision of ecological goods and services was hailed the most important, according to the sample, with 97% of respondents indicating it was important or very important. Among those who reported a low interest in birds, the existence value and the value of

[34] Question 5 was designed to explore respondent attitudes about the *existence value, the use value, the provision of ecological goods and services by birds, the cultural value, and the scientific value (ecological knowledge gained as a result of the study of birds)* of birds.

[35] It is possible that this question was subject to the *warm glow effect*, where respondents would feel guilt for expressing their true attitudes, and hence reported a strong positive response.

ecological goods and services are cited as important or very important by 86% and 94% of respondents respectively (see appendix D). The value of ecological goods and services showed the least variation in terms of importance among respondents with differing interests in birds. The concept of ecological goods and services provision is one that is likely to resonate well with Canadians, followed by the more abstract concept of the existence value.

Table 7.1: Components of Value for Birds, Aggregate Sample

Value Category	Percentage of Respondents				
	Very Important	Important	Neither Important nor Unimportant	Unimportant	Very Unimportant
Existence Value	82.4%	13.9%	2.4%	0.3%	1.0%
Use Value	69.7%	22.8%	5.5%	0.7%	1.4%
Ecological Goods and Services	87.2%	10.2%	1.4%	0.2%	0.9%
Cultural Value	41.8%	31.8%	15.0%	2.8%	2.3%
Scientific Value	70.7%	23.7%	3.7%	0.9%	0.9%

7.5. Support for Policy Approaches

In total, 61% of respondents indicated that they agreed or strongly agreed with a policy of providing monetary incentives to homeowners, while 25% indicated neutrality and 15% indicated that they disagreed or strongly disagreed. Among those with a low interest in birds, 45% reported agreeing or strongly agreeing with providing monetary incentives to homeowners to reduce bird-window collisions, while 29% reported disagreeing or strongly disagreeing with the approach. Of particular interest here is that only 11% of respondents with a low interest in birds indicated that they strongly agreed with the policy. Respondents were also asked how they felt about a program that would seek to educate homeowners about bird-window collisions, and how to prevent them. In aggregate, 78% of respondents indicated agreeing or strongly agreeing with an education campaign, while 14% reported neutrality and 8% reported disagreeing or strongly disagreeing. Among those with a low level of interest in birds, 52% indicated

the agreed or strongly agreed with a policy of educating homeowners about bird-window collisions. Just over 25% of these respondents reported being neutral to an information campaign, while 21% of respondents with a low level of interest in birds reported disagreeing or strongly disagreeing with the policy approach. The survey results show that Canadians are more receptive to policies of education about bird-window collisions, than they are to a policy that would provide incentives for homeowners to take measures to reduce bird collisions.

7.6. Respondent's Current use of Mitigation Strategies

In aggregate, there was a general willingness by homeowners to adopt simple collisions reduction measures, including relocating bird feeders, using decorations or decals, and altering landscaping. These simple methods were also most popular among respondents with a low interest in birds. While evidence supports the effectiveness of each of these simple methods, it is highly contingent upon how they are applied, and it is not clear how many respondents used them correctly. Respondents were less willing to use the more substantial and costly solutions, including window films and bird-friendly glass, even among those with a high interest in birds. To speculate, this is likely a function of lack of awareness/access to products, cost, practicality of use, and aesthetic appeal. This data shows that homeowners are willing to employ simple methods to reduce bird-window collisions. This represents great potential, generally, for educating the public about bird-window collisions and, specifically, how to effectively use various mitigation strategies.

Table 7.2: Homeowner's Reported Use of Collision Mitigation Strategies, Aggregate and by Level of Interest in Birds

	Method of Collisions Deterrence								
	Modify Trees/Shrubs	Relocate Feeders/Baths	Decorations	Decals	Window Films	Bird-Friendly Glass	Other	None	Total
Aggregate Sample	131 (19.8%)	278 (41.9%)	206 (31.1%)	224 (33.8%)	64 (9.7%)	8 (1.2%)	82 (12.4%)	174 (26.2%)	663
High Interest	117 (23.4%)	245 (49%)	182 (36.4%)	200 (40%)	60 (12%)	7 (1.4%)	72 (14.4%)	88 (17.6%)	500

	Method of Collisions Deterrence								
Moderate Interest	11 (10.9%)	21 (20.8%)	17 (16.8%)	16 (15.8%)	3 (3%)	1 (1%)	6 (5.9%)	50 (49.5%)	101
Low interest	3 (4.8%)	12 (19.4%)	7 (11.3%)	8 (12.9%)	1 (1.6%)	0 (0%)	4 (6.5%)	36 (58.1%)	62

7.7. Respondent's Reported Willingness to Adopt Collision Reduction Retrofit Products

The final survey question inquired about homeowners' willingness to adopt various retrofit collision reduction products. These products are applied to existing windows and all affect the appearance and transparency of the window to some degree. By comparing these answers to the WTP question, some observations can be made about the impact of aesthetics on citizens' willingness to adopt collision mitigation measures. The data show that, in aggregate, respondents reported being less willing to adopt the retrofit solutions that affect the aesthetics of the window. Those reporting a moderate interest in birds, however, were about equally as likely to accept these less optimal retrofit solutions. The numbers presented here appear quite optimistic. This is likely a function of the survey tool's inability to incorporate photographs into the question. Rather, the products and their effect on the appearance of windows had to be described in text, which may have prevented proper visualization by respondents. This may have led to an overstatement of their true willingness to adopt these retrofit products.

Table 7.3: Homeowner's Reported Willingness to Adopt Bird-Collision Reduction Retrofit Solutions

	None	Window Screens	1-Way Property Film	Window Tape	Fritted Pattern Window Film	Total
Low Interest	29 (58%)	9 (18%)	10 (20%)	2 (4%)	0	50
Moderate Interest	19 (22%)	37 (42%)	21 (24%)	10 (11%)	1 (1%)	88
High Interest	70 (22%)	96 (30%)	141 (43%)	14 (4%)	4 (1%)	325

8. Policy Options to Reduce Collision Mortality with the Windows of Homes

8.1. Policy Goals: Reducing Bird Mortality and Increasing Public Awareness

In thinking about alternative policy responses, it is important to think about the goals that policy is trying to achieve. Beginning at the highest level, the overarching societal objective that motivates this policy problem is sustainability. Sustainability refers generally to keeping natures balance. Flowing from the sustainability objective, the fundamental goal for policies addressing bird-window collisions is to reduce bird mortality. Considering that this issue is only beginning to gain attention, even within the conservation community, it might be prudent to view mortality reduction as a long term goal.

In the short term, a second policy goal is to increase public awareness about bird-window collisions as a conservation issue. The current level of public knowledge about bird-window collisions is very low, especially with respect to homes (CWS Interview Participant #1 and #2). This lack of awareness amongst the general public about the scale and potential impact of bird-window collisions should be considered a serious barrier to achieving reductions in this source of mortality. For one, it limits voluntary action. This also has implications for the policy process, especially from a political perspective. If citizens do not perceive the issue as a problem, policies that expend government resources are likely to be viewed as a waste of taxpayer dollars. An informed public will be receptive of other government policies to address collision mortality (UN, 2005). While all policy naturally has an informational component, the goal here is broad scale public awareness. Policies that seek to raise awareness can also reduce the search costs associated with finding appropriate collision mitigation strategies. Existing information is dense, conflicting, and often inaccurate (CWS Interview Participant #1). High search costs have been identified as a barrier to the

adoption of environmental products and technologies (UN, 2005). The following sections address the selection and description of policy alternatives to achieve these goals.

8.2. Comparing the Costs and Benefits of Reducing Bird-Window Collisions with Homes

If the estimated average WTP among Canadian households is $31, as indicated by the survey results, the size of the benefit is quite large. With an estimated 10 million homes of the type studied in this paper, the benefit to Canadians of reducing bird-window collisions is estimated at $310 million for investing in windows or other activities that reduce the probability of bird strikes. In order to motivate the need for policy with respect to bird-window collisions with homes, it is important to compare these benefits to the costs of reducing collisions. This is difficult because there are many solutions that come at different costs and have different effects on the clarity of the window. Each choice will be guided by the preferences of individual households, which are difficult to measure. If the average WTP is thought of as a proxy, more generally, for reducing collisions, it can be assumed that most people would adopt some or all of the "non-window" retrofit solutions if provided with the necessary information, including relocating bird-feeders and removing vegetation visible through windows.

Households that have a high interest in birds, or in conservation more generally, would be most likely to purchase a bird-friendly window, or one of the window retrofit products currently available. Based on the price of currently available products, the cost to retrofit a 15 square foot window- which is comparable to the WTP survey question- for all households would range from $100 million to $900 million. The "bird-lovers" and those more interested in conservation would be much more likely to purchase the retrofit solutions, or the bird-friendly windows because they indicated they are WTP the actual extra cost for a 15 square foot window ($90) of having a high level of protection for birds. When extrapolating to the entire population of households, these people likely represent a relatively small fraction of the total. Other households may require some type of pricing incentive to be induced into purchasing the window retrofit solutions or bird-friendly windows. However, there are also creative and very low cost things that can be

done to the window to reduce collisions, which some non-birder households may also be willing to apply. Thus, while the benefits do not justify the costs of all households applying the most costly solutions, they do justify some form of intervention to reduce bird strikes. This is the key driver for policy.

8.3. Market Failure: Framing the Selection of Policy Options

The choice of policy options to explore is contingent on the nature of the policy problem. Environment Canada has a legislative obligation to protect migratory birds, but other than the prescriptions of the legislation itself[36], this does not tell us much about what type of government intervention is warranted. If viewed as a market failure, as discussed in section 5, there are a number of potential policy options that might be worth exploring. Some important considerations, gleaned from the literature, interviews, and the survey provide context for the selection of policy options:

- The level of awareness about bird-window collisions as a conservation issue is very low (CWS Interview Participants #1 and #2).
- Canadians reported being WTP a premium for bird friendly windows, averaging $31 per household for a 15 square foot window.
- WTP to reduce bird-window collisions appears largely driven by interest in birds and perhaps conservation more generally.
- There is a wide range of collision-reduction products with varying effects on a window's appearance and varying costs. Generally, people do not want the appearance of their windows altered. There are many other simple and costless ways to reduce collisions (ex: moving bird feeders).
- Existing regulations, namely the prohibition of incidental take, are ineffective due to the inability to monitor or enforce. The issue is conducive to challenges with monitoring and enforcement more generally. Environment Canada is unable to assess risk on a case by case basis.

8.3.1. Closing the Information Gap

Market failure could be viewed as an information gap between homeowners' perceptions of the impacts of bird-window collisions and the reality that collisions have

[36] As discussed in section 2.6, the regulated prohibition of incidental take is not an effective approach to reducing collisions with homes.

been identified as a conservation threat. The fundamental purpose of providing information is to achieve policy goals without altering incentives or authority structures. Informational policies would seek to inform homeowners, architects, and homebuilders about the potential impacts of bird-window collisions, and how those impacts can be reduced. Consumption of green products is contingent upon ecological consciousness (Brecard, 2012) and functioning markets require, in part, that consumers are aware of the costs and benefits of the products they purchase. According to the survey results, the vast majority of homeowners know that collisions occur. However, there remains a lack of understanding about the scale and implications of this source of mortality (CWS Interview Participant #1 and #2). In addition, the provision of information can stimulate demand for bird-friendly products, incentivizing the development of new and innovative products. Provision of information may have value in addressing bird-window collisions.

8.3.2. Using Market Based Policy Tools

Market-based instruments can also correct market failure by sending appropriate price signals to consumers with respect to environmental damages (Pearce et. al., 2006). Taxation, for example, could be used to incorporate the external costs of collisions into the price of traditional windows. Assuming the marginal benefit is indicated by the WTP results from the survey, and an efficient tax (MC=MB) could be set, taxation remains problematic for a number of reasons (Pearce et. al., 2006). First, the impact of collisions may be negligible in some areas and at many homes, making a broadly applied tax inefficient. Not all windows are susceptible to collisions. It may be only one or two windows in a given home that cause concern from a collision perspective. The tax cannot be tied specifically to potentially high-risk windows and so there is no way to ensure that a tax would have the intended effect.[37]

Moreover, taxation is most effective in changing consumption when there are available substitutes. Facing a window tax, prospective homeowners could choose to reduce the amount of glass used in construction or purchase windows that would not be

[37] With carbon emissions, a carbon tax can be applied to all sources, which cumulatively cause environmental damage. As an analogy, if it were the case that some carbon emissions contributed to climate change, and others did not, but we were unable to assess this risk and differentiate between the two, a carbon tax applied uniformly may be inefficient.

subject to the tax, such as frosted or fritted glass. This substitution may not be ideal or practical in most cases, as the view out of the window would be affected. In addition, these "specialty" glasses are more costly, which offsets the income effect brought on by a tax. Considering the prevalence of windows in homes and the lack of available substitutes, the demand for traditional windows in home construction is likely to be price inelastic. Taxing traditional windows is not likely to have much effect on consumption.

Another market-based instrument is the subsidy, which in this case would be used reduce the price of a targeted good to stimulate consumption. Subsidies take various forms - tax credits, point of sale rebates, and low interest loans to name a few (Pearce et. al., 2006) - and serve to induce those who would otherwise not purchase a bird-friendly window product to do so. There are a number of concerns with subsidies. The free rider problem, for example, occurs when people who would have purchased the product in the absence of the subsidy still make the claim. Moreover, theory says that if the rebate were provided as a direct cash transfer, rather than tied to the consumption of a particular good, individuals could achieve the same level of utility (well-being) at a lower cost. Finally, evidence from other forms of subsidies to purchase socially desirable home improvements (ex: subsidies to purchase energy efficient appliances) often find a small take-up rate, especially if they are not large enough to offset the price differentials between the more socially desirable good and the good contributing to the negative externality.

Despite these inefficiencies, subsidies may be justified if the societal gains are sufficiently large. A subsidy may fit well as a tool for the problem of bird-window collisions, particularly for retrofits because there are existing products available in the market. The survey results show a WTP by Canadians, which could be augmented by subsidy to stimulate additional take-up of bird-friendly products. A subsidy would also allow homeowners to purchase products for windows that they know are susceptible to collisions, which make it more targeted than a tax.

8.3.3. Using Regulations

The final group of policies used to address market failure are regulatory measures. Bird-window collisions, as viewed under current legislation, constitute

incidental take, which is prohibited. Monitoring and enforcement of this regulation (ex: penalizing those who do not comply) is not feasible in the case of bird-window collisions with homes. Permitting, as discussed in section 2.6, and performance regulations, which entail a limit on the number of bird-window collision mortalities allowed at a home in a given time period, are two other examples that suffer from an inability to enforce or monitor. One might also look at regulating glass manufacturers themselves, requiring some portion of glass production to be bird-friendly. However, without the requisite demand from consumers, such a regulation would likely pose high costs on industry and without consumer take-up, would not significantly reduce window collision mortality. One regulatory approach that may have promise is the use of design standards, which could be applied through the provincial building codes. Design standards specify the use of specific collision mitigation strategies and products for new home construction and retrofits that are subject to building codes. While monitoring the results might still be challenging, enforcement can be undertaken within the existing building code inspection apparatus.

Using the previous discussions, a set of policy options with the potential to reduce bird-window collision mortality with homes were developed. Since no level of government has a publicly known strategy in place specifically targeting collisions with homes, as defined in this study, the status quo is not considered. Presented in order of appearance, the policy options are: *conducting a federally led public information campaign, using a point of sale rebate to stimulate consumption of bird-friendly construction and home retrofit products, regulating bird-friendly home construction by implementing changes to the National Model Construction Code, and encouraging and assisting in the creation of bird-friendly criteria for existing home certification programs.*

8.4. Option 1: Conduct a Federally Led Public Information Campaign (PIC)

Currently, available information about bird-window collisions is confined to the websites and efforts of conservation organizations and special interest groups, which only reaches a small percentage of the population. In order to increase broad scale awareness among the general public, the federal government could conduct a nationally

led public information campaign about bird-window collisions. The protection of migratory birds falls under the jurisdiction of the federal government, which also contains the relevant expertise required to carry out an effective PIC. A national campaign can also deliver a consistent message to all Canadians. Both interview participants had a favourable view of the role of information provision as part of the solution (CWS Interview Participants #1 and #2). This initiative would put Environment Canada's compliance promotion policy on incidental take into action with respect to bird-window collision mortality.

Aside from creating awareness, a PIC can reduce search costs by providing accurate and easily accessible information on collision mitigation strategies. For those who already have tried to reduce collisions, accurate information can lead to more effective applications of solutions. In addition, it is very difficult for EC to conduct risk assessment at a micro level (CWS Interview Participant #2). While the risk factors are *relatively* well understood, targeting homes where collision risks may be elevated is a difficult undertaking for EC. Educating the public about bird-window collisions and the related risk factors allows homeowners to conduct their own risk assessment. It is unlikely that a PIC would have much traction with homeowners who do not experience bird-window collisions, which is perfectly consistent with strategically managing this source of bird mortality (CWS Interview Participant #1). A more in depth discussion of the PIC is presented in the analysis and recommendation sections.

8.5. Option 2: Create a Point of Sale Rebate Program for Bird-Friendly Products

A point of sale rebate is a market-based instrument that attempts to incentivize a desired behaviour by reducing the relative price of a good(s). The rebate would take the form of an immediate partial repayment of the cost of bird-friendly products. This subsidy has the effect of increasing demand for abatement products at the margin. The rebate would be available to all consumers and applied to products that have been deemed eligible under the program.[38] This would require establishing guiding principles

[38] The rebate would cover X% of the product cost up to a maximum of $Y.

for the selection of eligible products. Eligibility can be reviewed in light of new technologies, product availability, and performance issues with already certified products.

There are some key advantages of this type of subsidy over others, for instance, one that is delivered through the tax system. With a tax credit, consumers must wait until the following tax year to receive their rebate, which acts as a disincentive to use the program, especially for lower income households. In addition, the program can be administered through similar programs that already exist - the Energy Star program for example. A challenge is the availability of products. In order to qualify for the rebate, products must have a Canadian distributer. There are a few products with Canadian distributers, but many are currently only available for purchase online through the United States or otherwise.

One challenge with a point of sale rebate, and indeed subsidies more generally, is the free rider problem. It is likely that some households, for example those with a high level of interest in birds, would be willing to pay the full amount to purchase the bird-friendly product as was indicated by my survey. It is likely that they would also take advantage of the rebate program if offered. This inefficiency could be quite problematic if only those who would otherwise have purchased the product participate.

8.6. Option 3: Facilitate the Development of a Bird-Friendly Component within Residential Sector Home Certification Programs

Building certification programs have shown significant successes in improving environmentally conscious design, and government has played a vital role in developing, promoting, and funding these initiatives. Certification programs targeted towards single and semi-detached homes present an opportunity to implement bird-friendly home design. While the focus has typically been on energy efficiency and reducing water use, extending certification criteria to encompass the broader impacts of the built environment on wildlife is consistent with the philosophy of many such programs. This notion is reiterated by LEED executives in the US with respect to the pilot bird-friendly credit

(ABC, 2011). One interview participant pointed out that building a bird-friendly component into existing certification programs is an avenue worth exploring (CWS Interview Participant #1). The trend towards a more holistic concept of sustainable design indicates that, if provided with the necessary information, home certification programs would likely be willing to include bird-friendly criteria.

Aside from achieving immediate reductions in bird-window collision mortality on selected homes, certification programs offer a crucial opportunity to generate awareness within the home building sector – a valuable distinction of this policy option. Moreover, homes that meet certification standards of some programs are showcased at high-profile media events, which can help to increase general awareness of bird-window collisions among the public and politicians. There is already a wealth of information available on bird-friendly building design. For example, the commercial sector LEED bird-safe pilot credit can be used as a template for developing the home building bird-friendly certification criteria. This approach has the potential to impact both new home construction and retrofitters looking to certify their homes.

There are a number of voluntary home certification programs currently operating in Canada. Some are very high profile, with only a select number of homes qualifying each year, while others are broader in scope. A few examples are listed below[39]:

- *LEED Canada for Homes:* Administered by the Canada Green Building Council, LEED Canada for homes is part of the well-known LEED accreditation system. With the assistance of designated LEED Canada Homes Providers, homeowners (or prospective homeowners) build or retrofit to LEED standards based on specified design criteria.
- *Built Green Program:* A third party rating system for energy efficiency and environmentally sensitive home design. The program has partnered with the CMHC to offer a 10% CMHC mortgage loan insurance refund as well as an extended amortization period on the home. Available in British Columbia, Alberta, and Ontario.
- *Passive House Initiative:* Led by the Canadian Passive House Institute, this program is a stringent international standard, which seeks to create homes

[39] This list features certification programs aimed at single and semi-detached homes. For a full list of environmental certification programs currently operating in Canada, see http://www.cmhc-schl.gc.ca/en/hoficlincl/cmhcin/cmhcin_009.cfm.

that can *truly be called sustainable.* The initiative has spawned over 40,000 passive homes worldwide.

8.7. Option 4: Design Standards; Amending the National Model Construction Code to Reflect the Provisions of the Migratory Birds Convention Act

While building codes fall under the jurisdiction of the provinces, the National Model Construction Codes, including the National Building Code of Canada, are developed and maintained by the Canadian Commission on Building and Fire Codes (CCBFC), an independent body created by the National Research Council of Canada (NRCC) (NRCC, 2013). The CCBFC takes advice from the Provincial Territorial Policy Advisory Committee on Codes (PTPACC), made up of provincial and territorial representatives (NRCC, 2013). The National Building Code of Canada is used by each province to develop their respective building codes. The provinces make modifications based on regional realities (ex: climate) and priorities. The National Building Code of Canada could be used as an avenue to achieve bird-friendly homes by regulating new construction, which would also apply to home retrofits. Justification for this kind of requirement in the code is found in a statement of intent by the CCBFC, which indicates that the code should respect all aspects of a building's impact on the environment (NRCC, 2013).

Changing the National Building Code of Canada amounts to enacting a design standard. Design standards fall into the command and control category of policy tools, and specify particular technologies or strategies to mitigate negative impacts on an ecological good or service. Design standards are often criticized for their lack of flexibility with respect to achieving some desired effect (Pearce et. al., 2006). Individuals or firms are forced to use specific technologies or techniques to reduce their impact on the environment rather than find solutions that minimize their costs. This can result in inefficiencies; a possible disequilibrium between the marginal costs of abatement and the marginal benefits of abatement. However, in this case, the range of solutions is so varied that the building code regulations can provide considerable discretion to architects, home-builders, and prospective homeowners in their choice of methods to reduce bird-window collision mortality. Moreover, incorporating bird-friendly design

features into homes can result in minimal additional construction costs (Sheppard, 2011).[40]

[40] See section 4.2 for this discussion.

9. Criteria and Measures: The Framework For Analysis

Analysis of the policy options presented in the previous section will be framed in the multi-criteria approach. By choosing criteria and relevant measures, the policy options can be examined and ranked while exploring the trade-offs between alternatives. The four criteria used for analysis are: effectiveness, government cost, political feasibility, and public acceptability. These criteria are assessed using a mix of quantitative and qualitative data and given rankings on a 3-point scale- except in the case of the effectiveness criterion, which is out of 6. The rankings for each criterion under each policy option are summed to produce a score out of 15. This section provides definitions of the selected criteria and measures that will be used to analyze the policy options, which is summarized in table 9.1.

9.1. Effectiveness

The effectiveness criterion will measure the ability of each policy option to achieve the two policy goals identified in section 8: *creating public awareness of the bird-window collision issue* and *the expected reductions in bird-window collision mortality.* The collision reduction criterion will be scored out of 3 and the raising awareness criterion out of 3, representing a double weighting of the effectiveness criterion. This is done to reflect the relative importance of each of the policy goals in the analysis. The estimated reduction in mortality will be measured using a combination of survey data, literature, and interviews to assess the likelihood of take-up or compliance with collision reduction measures under each policy option. The raising awareness criterion will be

measured qualitatively based on a policy's ability to generate broad scale public awareness (1=low, 2=medium, 3=high).[41]

9.2. Government Cost

Under conditions of government cutbacks and fiscal restraint, achieving policy goals at minimal cost is an important consideration. The cost for each policy option will be measured by the additional expenditures by federal, provincial, and municipal governments over and above current spending levels, as well as a consideration of the opportunity costs associated with re-directing bureaucratic efforts. The scoring for this criterion will use an inverse scale out of 3. Thus, a high score will be given to policy options that require minimal additional or opportunity costs. A low score will be given to policy options that require significant opportunity costs or additional government expenditures. Cost will be measured using examples from the literature, key informant interviews, and considerations of the complexity of implementation.

9.3. Political Feasibility

Political feasibility is a measure of the likelihood that, under the existing legislative framework, the policy option would receive support from federal decision makers. As discussed in previous sections, federal policies around incidental take have, in the past, been heavily constrained by the existing legislative environment. Regardless of the other merits of a policy option, the degree to which that policy is in line with the federal government's current strategy around incidental take is an important consideration. Policies that are aligned with the compliance promotion approach (*see section 2.3*) will receive a high score while policies that deviate from that approach will receive a low score. The measures for political feasibility will be discerned from key informant interviews, as well as a considered analysis of an option's alignment with the compliance promotion approach.

[41] Raising awareness within the home building sector will also be considered.

9.4. Public Acceptability

The public acceptability criterion measures the estimated degree of public support for each of the policy options. Given the low profile of bird-window collisions as a conservation issue amongst average Canadians, public acceptability is an important consideration for the evaluation of policy options. A high score will be allotted to options that are likely to be widely accepted by the public, while a low score will be given to options that are likely to receive a high degree of public scrutiny. Public acceptability has important implications, not only about what kinds of policies are palatable, but also about how a policy or combination of policies might be rolled out over time. Public acceptability will be measured using a combination of literature and survey data, which asked about respondent perceptions of a series of general policy approaches.

Table 9.1: Criteria and Measures for the Assessment of Policy Options

Criterion	Definition	Data Type	Measurement Scale	Data Source
Effectiveness	Degree to which policy will increase broad scale public awareness	Qualitative	**Low (1)** – Policy is not an effective awareness tool **Medium (2)** – Policy is an effective tool for raising awareness among certain groups in society **High (3)** - Policy is an effective tool for raising broad-scale public awareness	• Survey Data • Key Informant Interviews • Literature review
	Degree to which policy is likely to reduce bird-window collision mortality	Qualitative/ Quantitative	**Low (1) –** Not likely to significantly reduce mortality **Medium (2) –** Likely to achieve reductions in mortality **High (3) –** Likely to achieve significant reductions in mortality	
Cost	The level of additional government expenditures and bureaucratic effort required due to implementation complexity (opportunity cost)	Qualitative/ Quantitative	**Low (3) -** The policy option can be implemented within existing administrative structures with minimal bureaucratic effort **Medium (2) -** The policy option will require some additional expenditures/bureaucratic effort in order to implement **High (1) -** The policy option will result in significant additional expenditures and bureaucratic effort	• Literature Review

Criterion	Definition	Data Type	Measurement Scale	Data Source
Political Feasibility	The degree to which the policy option is aligned with the federal government's current compliance promotion approach for incidental take	Qualitative	**Low (1) -** The policy option deviates significantly from the compliance promotion approach **Medium (2) -** The policy option incorporates elements of compliance promotion mixed with other policy instruments **High (3) -** The policy option is directly aligned with a compliance promotion style approach	• Key Informant Interviews • Literature review
Public Acceptability	The likely level of support for the policy option by the public. In part, a function of the pervasiveness in terms of freedom of choice	Quantitative/ Qualitative	**Low (1) -** The level of public support for the policy option is low, relatively speaking **Medium (2) -** The level of public support for the policy option is medium, relatively speaking **High (3) -** The level of public support for the policy option high, relatively speaking	• Survey Data • Literature

10. Analysis of Policy Options

10.1. A Federally Led PIC

10.1.1. Effectiveness

Raising Awareness of Bird-Window Collisions

The strength of PICs as a policy tool is found in their ability to influence societal norms, appeal to citizen morals, and increase public awareness, which are important drivers of environmentally conscious behaviours in the absence of economic incentives or legal obligation (Cialdini, 2003, OECD, 2008, Brecard, 2012). While the ultimate goal of the PIC is to change individual behaviour, this should be viewed as a long-term objective (UN, 2005). The shorter-term goals of the PIC are to raise awareness and change attitudes about the environmental impact: in this case, bird-window collisions (UN, 2005). Considering the significant information gap, a federally led PIC fits well as a tool for raising broad scale public awareness of bird-window collisions as a conservation issue. The federal government can provide a consistent message to all Canadians through various forms of media, including the Internet and perhaps through targeted advertising (ex: similar to energy star program information in department stores).

In addition, a PIC can help to reduce search costs for those who wish to take action. One interview participant explained that there is a wealth of information available about collision risk factors and solutions, but that it is often complex and not well known at the household level (CWS Interview Participant #1). A PIC can significantly reduce search costs by collating credible information about the risks and scientifically verified solutions into a single location(s) (website, pamphlet, etc.). Moreover, evidence suggests that information on reducing an environmental impact receives a higher level of trust when supported or provided by government, particularly as it relates to certifying products (OECD, 2008). Similar principals likely apply here.

Reducing Bird-Window Collisions

In their own right, the success of PICs in changing individual behaviours on environmental issues varies widely from campaign to campaign and issue to issue (Weiss and Tsschirhart, 1994, UN, 2005, OECD, 2008). PICs have shown a lot of empirical success in encouraging people to recycle by breaking the perception that it is difficult or inconvenient to do so, an issue with some parallels to reducing bird collisions[42] (OECD, 2008). However, generally speaking, research into PICs and their success in achieving desired behaviour changes suggests that PICs on their own are unlikely to be very effective in many circumstances (UN, 2005, OECD, 2008). Research indicates that information provision can be very effective in a complimentary role among a mix of policy tools in achieving policy goals (OECD, 2011). The program evaluation report for EC's one tonne challenge, for example, found that the PIC would have benefited from the use of other policy tools, including economic instruments (Environment Canada, 2006).

The survey data shows that Canadians, as a whole, have a significant WTP to reduce bird-window collisions with their homes (AWTP = $31). While WTP provides an indication of how people value reducing bird-window collisions with their homes, the decision to implement solutions is much more complex (ex: aesthetics, practicality, ease of access to products). Even so, among respondents with a low level of interest in birds, 42% indicated a willingness to adopt a "non-ideal" retrofit solution presented in question 20.[43] A large survey by the European Commission in 2008 found that while 75% of respondents reported being willing to pay more for environmentally friendly products, a follow-up survey found that only 17% of respondents had recently bought products with an environmental label (Brecard, 2012). To provide a speculative estimate, if a similar

[42] For example, there is a lack of pecuniary benefits. In addition, the idea of altering the appearance of a window is perceived as inconvenient/impractical.

[43] The WTP question avoided issues of aesthetics. Question 20 asked about respondents' willingness to adopt various retrofit films/decals, all of which affect the clarity of the window to some extent. Because respondents were unable to see photographs of the retrofit solutions presented in question 20, this may understate the effect of aesthetics on choice of solution. See appendix D, table C-4

ratio is used, it can be expected that 9.5% of households will take-up a bird-friendly product, assuming all households are reached by the PIC.[44]

If the complexity of the decision to use retrofit products were fully captured by the survey, take-up rates would likely be lower still. In light of literature on the effectiveness of PICs as the singular policy tool, this is a very optimistic estimation of the effect on consumption of bird-friendly products. Unfortunately, limitations prevent further refinement of estimates on take-up. Further, this estimate ignores the free-rider problem, which may occur in this case.[45] However, survey data suggests that there is a significant WTP and that people who are aware of the issue - respondents interested in birds - are willing to do simple costless things to mitigate the risk of collisions (see table 7.4). Informing the general public about the issue has the potential to induce some portion of homeowners to adopt these simple measures and/or to use them more effectively. As one interview participant put it, information about bird-window collisions should be fairly well received by the public and at minimum, induce some portion of the population – the proverbial low hanging fruits - to adopt mitigation strategies (CWS Interview Participant #2).

10.1.2. Government Cost

Implementation

The additional cost to the federal government of implementing a PIC would be quite low, relatively speaking. The incidental take task force has the mandate and necessary expertise to consider the technical aspects of the PIC. Government's task will be to effectively synthesize information and present it in an effective way to the public. A 2005 UN report suggests that taking advantage of partnerships with other organizations where it makes sense and is feasible to do so can keep costs down (UN, 2005). Environment Canada has a number of existing partnerships with NGOs who may be

[44] There are an estimated 10,127,135 homes in this category (Machtans, et. al., 2012). Using a 9.5% take up rate, the policy would affect approximately 1 million homes. While admittedly speculative and very optimistic, it provides a basis for making relative comparisons between policy options.

[45] If an individual knows others are trying to mitigate collisions, that individual can free-ride off the resulting improved environmental quality.

willing to lend their messaging and information dissemination expertise (CWS Interview Participant #1). The most significant cost - an opportunity cost - will be incurred up front during the planning stage.

Monitoring

It is difficult to monitor the success of a PIC; isolating the impacts of PICs can be a difficult task (Weiss and Tschirhart, 1994). However, lessons can be taken from previous PIC initiatives by Environment Canada. The One Tonne Challenge, which operated from 1999 until 2005 used interactive web-based tools to engage Canadians to reduce their emissions. Interactive web-based tools provide an opportunity to collect program evaluation data at low cost (UN, 2005). Interactive tools have the added benefit of engaging citizens into the process and can increase the effectiveness of the PIC (Weiss and Tschirhart, 1994, UN, 2005).

Total Cost Estimate

While it is difficult to estimate the total costs associated with a PIC, similar initiatives in Canada can provide at least a range of government costs. For example, the *Clean Air Day* initiative, run by EC from 1999 until 2005, which included the *One Tonne Challenge* cost the government roughly $140,000 annually (UN, 2005). The American Bird Conservancy, which runs a campaign aimed at educating the public about bird-window collisions, reported expenditures of $272,907 on education and outreach programs in its latest annual report (ABC, 2011).[46] In order to estimate the cost of this policy, a number of assumptions are made.[47] The initial planning phase, occurring in year one, is estimated to cost between $200,000 and $300,000 while ongoing costs range from $125,000 to $175,000 annually. EC may also want to consider additional survey work with more targeted questions and a representative sample, which would cost an additional $10,000 to $40,000 up front.

[46] This expenditure is for ALL education and outreach, of which collisions is only a part.

[47] Assume all senior staff and no external consultancy. Assume 3 person years required for planning the PIC (2 person years of research scientists and one person year of communications staff). Assume ongoing costs attributable to 1 full-time program administrator and a half person year of research scientist to update and refine messaging in light of new information or feedback etc. Salaries used reflect most recent Treasury Board rate of pay information: http://www.tbs-sct.gc.ca/hr-rh/lr_ca_rp-rt_cc_tr/index-eng.asp

10.1.3. Political Feasibility

A PIC falls perfectly within the bounds of compliance promotion, EC's current strategy to address incidental take. By providing a convenient place to access accurate information, EC allows homeowners to educate themselves about bird-window collisions without "prescribing" compliance measures. As one interview participant noted, education and outreach make a lot of sense within the compliance promotion approach (CWS Interview Participant #1). From a political/legislative standpoint, a PIC is a good policy fit.

10.1.4. Public Acceptability

The level of public support for a PIC can be gauged using survey data. Of those reporting a low level of interest in birds 52% agreed or strongly agreed with the PIC approach, while 21% reported disagreeing or strongly disagreeing with allocating resources to a PIC. A PIC is also a very non-invasive policy. It encourages individuals to change their behaviour by providing information, rather than forcing behaviour change (regulation) or using price signals that can result in additional costs to the individual (taxation) or significant investment of government resources (subsidy). For these reasons, and the data obtained from the survey, the level of public support for a PIC initiative is likely to be relatively high.

10.2. Create a Point of Sale Rebate for Bird-Friendly Products

10.2.1. Effectiveness

Raising Awareness

This policy would certainly require an educational component both to advertise the existence of the program, and to inform citizens about the need for such a program. It would have to be paired with an education component. In its own right, a program offering a rebate for purchasing bird-friendly products may not be a good mechanism for raising broad scale awareness about bird-window collisions. Ideally, the public would

already be informed. This will be discussed further in section 11. A rebate program can also significantly reduce search costs by providing the public with a list of qualifying products. Government sets the standard, and provides information about the effectiveness, aesthetics, and availability of products. Information about other collision mitigation measures, such as relocating bird feeders, can also be included on a program website.

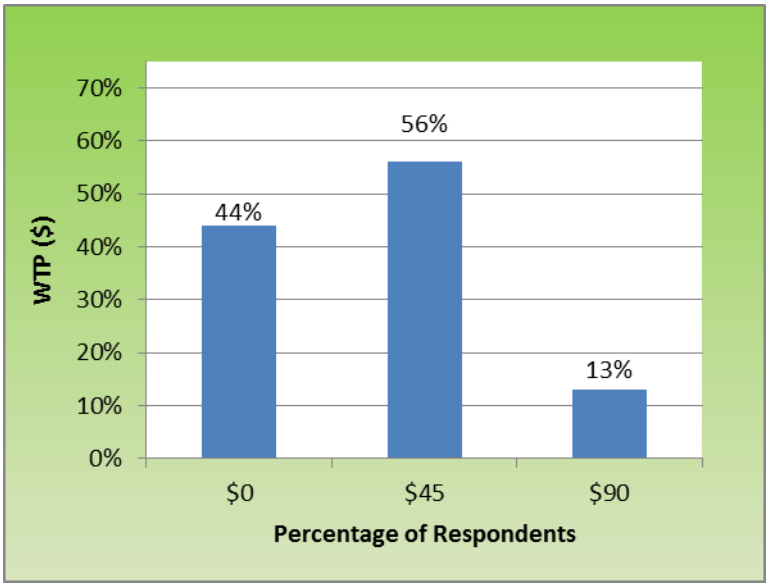
Reducing Bird-Window Collisions

The effectiveness of a rebate is a function of its ability to stimulate additional demand for the targeted good. Using the WTP data from the portion of the sample reporting a low interest in birds, it is possible to make some general observations about the potential effectiveness of a tax credit (see figure 10.1). First, the WTP to reduce bird-window collisions appears largely driven by attitudes and perceptions rather than cost considerations. Bird-friendly products appear to have a low price elasticity of demand. This suggests that a rebate would have to be quite large to stimulate significant additional demand, resulting in high costs. It is likely to be less cost-effective than other policies under consideration.

If the same assumptions used under the PIC guide the analysis for the rebate program – that is, all else equal - we can expect take-up rates to be higher because of increased consumption at the margins stimulated by the price signal. Again, due to the complexity of the decision to apply a retrofit product to a home (aesthetics, practicality, etc.), and the range of products available, it is difficult to determine the degree to which a rebate would stimulate additional demand. Another challenge is the lack of availability of products that could be eligible for the program. Many products marketed specifically as bird-friendly are not available through Canadian distributers, which is a qualifying feature of the rebate. However, there is evidence that, in light of legal decisions in Toronto's commercial building sector, companies are showing an increased interest in Canadian markets.[48]

[48] Via personal e-mail communications with Collidescape

Figure 10.1: Low Interest in Birds and WTP



10.2.2. Government Cost

Implementation

In order to offer a rebate, the federal government would have to create a list of products that are eligible for a claim, among other program criteria. Determining ideal values for the rebate will also be part of the planning process. The rebate could be administered through the Energy Star program, which would significantly reduce administrative burden. The rebate expenditures themselves are another consideration, and represent forgone government tax revenues, which could otherwise be invested in alternative initiatives.

Monitoring

Monitoring the effectiveness of a rebate program would require collecting data on take-up. Because venders submit sales data to reclaim their money, tracking take-up should be relatively simple. The data will indicate the number of products purchased, but also the types of products, which can provide general insight into the effectiveness in terms of reducing collision mortality. This data will be easy to access and measure against program targets. Therefore, the costs of monitoring take-up will be low.

Total Cost Estimate

Without being able to predict take-up of a point of sale rebate, it is difficult to estimate program costs. Assuming that the planning and administration costs are similar to that of a PIC, the additional expenditures on the rebate itself indicate that this policy will be more costly than a PIC.

10.2.3. Political Feasibility

Providing a rebate is somewhat out of step with EC's current compliance promotion approach. While it retains elements of compliance promotion - participation is voluntary - it requires some level of government prescription of solutions, something regulators have approached with caution in other sectors. A consideration from a political feasibility standpoint is whether or not it is acceptable to incentivise reducing collisions when they may technically prohibited by legislation. Further, as one interview participant noted, it is important not to focus only on collision reduction strategies that require expenditures, or even measures that target altering windows (CWS Interview Participant #2). Politically, providing a point of sale rebate to homeowners to reduce the risks of bird-window collisions may be a difficult sell, though it retains elements of the compliance promotion approach.

10.2.4. Public Acceptability

One of the survey questions asked respondents to indicate their level of agreement with providing monetary incentives to homeowners to undertake bird-friendly retrofits. When only those who reported a low interest in birds are included, 44% reported agreeing or strongly agreeing with the policy, while 30% reported disagreeing or strongly disagreeing with the approach. Even among those with a high interest in birds, 12% disagreed of disagreed strongly with such a policy, twice the level of disagreement as a policy of providing information to homeowners. The level of public support for an incentives approach is lower than for an information dissemination approach.

10.3. Facilitate the Development of a Bird-Friendly Design Component in Residential Certification Programs

10.3.1. Effectiveness

Raising Awareness

Adding bird-friendly design criteria to willing certification programs will not be an effective way to generate broad scale public awareness. However, it does provide a critical opportunity to engage the home building sector. Many homes certified under these programs are featured in events that draw industry representatives, homebuyers, and politicians. Raising the profile of bird-window collisions in the home building sector provides opportunities to educate builders, who in turn, can educate prospective homeowners. This option engages home-builders in a meaningful way, and can help transfer knowledge throughout the sector.[49] In addition, there is potential for home designers to come up with innovative ways to reduce bird-window collisions.

This option would certainly reduce search costs for those participating in the home certification program. Once an individual has decided on a certification program/level to pursue, the technical aspects are already defined and the search costs are eliminated. However, this policy is targeted to homebuyers, or in some cases renovators, who are seeking certification and would not reduce search costs for the general public.

Effectiveness

Adding a bird-friendly component to the current regime of sustainable home certification programs could serve to reduce bird-window collisions with a select number of new and retrofitted homes. To increase the effectiveness, the bird-friendly criteria must be made mandatory to receive accreditation- at minimum, made mandatory over-time. As one interview participant pointed out about the LEED Bird Safe Pilot Credit,

[49] Some rating programs, like the Built Green initiative, include a list of certified products to be used in construction. Others, like LEED for homes, rely on overall performance rather than prescribing certain products and providers. Instead, the LEED for homes program has certified LEED expertise providers who help builders ensure LEED standards are being met.

buildings in the commercial sector can still receive the highest rating without incorporating bird-friendly features (CWS Interview Participant #1). As an example of the reach of this policy, the LEED Canada for Homes initiative has registered roughly 1,800 homes since 2009, with 350 receiving certification to date (CGBC, 2012).

Ultimately, this policy targets only a small number of newly constructed or retrofitted homes. However, its strength goes beyond the application of bird-friendly design criteria to homes. It provides a crucial avenue to engage the home building sector and perhaps stimulate architectural/product innovation (ABC, 2011). While initial reductions in bird-window collision mortality might be minimal, there is potential for long-term benefits as awareness is generated within the home building sector. For example, in the United States, the Home Depot has partnered with the US Green Building Council to promote products in their store that can help to meet LEED standards. These kinds of partnerships offer great potential to increase access to products and bring bird-window collisions into the mainstream of sustainable home design.

10.3.2. Government Cost

Implementation

The costs of this initiative to government will be quite minimal. It would largely be led by the home certification industry itself, with consultation and technical support provided by EC. In the US, the US Green Building Council proved a willing partner in the development of the LEED Bird Safe Pilot Credit (ABC, 2011). The Canadian Green Building Council (CGBC) is a good potential partner, and one that can exert influence over the home accreditation sector in Canada through publications, national events, and conferences. The LEED Bird-Safe Pilot Credit can be used as a blue print for the design standard, although it will have to be adapted to be applied to single and semi-detached homes.

This work would likely be coordinated by the Incidental Take Task Force (ITTF), and carried out by CWS regional departments as required. There is potential that certifiers' demands and expectations will be different, requiring standard setting in concert with each rating program and increasing the demands on consultation and coordination efforts. Existing certification programs already feature partnerships to

federal government ministries including Natural Resources Canada, EC, and Industry Canada. These channels can potentially be used to ease the administrative burden. Ultimately, the cost of this policy is the opportunity cost of redirected bureaucratic effort.

Monitoring

Under this option, the monitoring costs for government would be quite low. Certification programs keep registries of certified homes, which would allow the federal government to track take-up of bird-friendly home design. Moreover, the LEED Bird Safe Pilot Credit for commercial buildings requires proponents to develop a bird collision-monitoring plan. A similar requirement, albeit less formal, should be recommended with bird-friendly home certification criteria. Encouraging self-reporting where feasible will help to assess the success of bird-friendly criteria in home certification programs.

Total Government Cost

Aside from providing advice and technical support, government's role in this initiative will be quite minimal. Assuming one full person year of a senior employee at CWS will be required to liaise with the CGBC, the cost to government is estimated to be between $90,000 and $120,000.

10.3.3. Political Feasibility

The Federal Government has been heavily involved in promoting green-building practices generally, as evidenced by their involvement in and provision of a number of green building initiatives. Specifically, engaging with the home building sector and encouraging certification programs to adopt bird-friendly criteria is fully in-line with EC's compliance promotion approach to incidental take. This option was viewed favourably by both government officials who participated in the interview process (CWS Interview Participants #1 and #2). It allows government to take advantage of existing programs as an avenue to achieve policy goals, while keeping its own direct involvement to a minimum.

Public Acceptability

Since certification programs are completely voluntary, it is likely that the public would view this as a favourable initiative. Moreover, the inclusion of bird-friendly criteria into homes would be largely industry led with a minimal role for government. The limited additional expenditures by government make this option more palatable to taxpayers.

10.4. Design Standards: Amending the National Model Construction Code to Reflect the Provisions of the MBCA

10.4.1. Effectiveness

Raising Awareness

Building code amendments themselves would do little to educate the public about bird-window collisions. Of course, the public must be informed about these changes and why they are being implemented, but as an education tool itself, building code amendments would not be effective. Under a policy of amending building codes to comply with MBCA, search costs for homeowners would be eliminated. The building code would specify which design features are in compliance, and prospective homeowners/retrofitters would be required incorporate them.

Reducing Bird-Window Collisions

Granted the specific requirements set out in the building code are effective at reducing bird-window collisions, amending the National Model Construction Code to reflect the provisions of the MBCA would significantly reduce bird-window collisions with new homes and some retrofitted homes. New single and semi-detached home starts in 2011 totalled 67,000, while preliminary data for 2012 shows a similar number (CMHC, 2012). This provides an indication of the number of homes impacted annually if such a regulation were to come into force. These regulations could be applied to homes that are retrofitted as well, but the majority of reduced bird-mortality will be realized by reducing the impact of the growing housing stock. This option eliminates the free-rider

problem with full integration of bird-friendly design into home construction practices, the most far reaching of the policy options in the long run.

10.4.2. Government Cost

Implementation

Creating a new regulation is a time-consuming process. A new regulation has to be well thought through and well supported to be successful (CWS Interview Participant #2). The creation of a new regulation requires extensive public consultation, a clear demonstration of the problem or risk and that this is a good use of limited resources, evidence that government intervention is warranted, and a benefit–cost analysis showing a clear benefit to Canadians. In addition, consultation and coordination would have to take place with provincial and federal advisor bodies, as well as with the home building sector. The extent of the effort required to consult, coordinate, study, and write the regulations would present a significant opportunity cost to government.

Monitoring

Regulation also requires explicit strategies for enforcement and monitoring. Enforcement can be carried out by the existing building code enforcement mechanisms. The additional effort required to enforce the bird-friendly standards may require additional resources, or risk an overall reduction in enforcement quality. Monitoring the effectiveness of the regulations to reduce bird-window collisions would be challenging. The public is unlikely to expend the effort to participate in a reporting, and government led monitoring of homes for collisions is not feasible. Monitoring would require a creative approach from government, with specific measures that capture the effectiveness of the regulation without broad scale systematic monitoring of homes.

Total Government Cost

This option is far and away the most costly option presented in this study. A regulation of this scale would require extensive research and consultation. The permitting approach discussed in section 2 was in development for 5 years before it was abandoned by EC. The opportunity cost associated with the required bureaucratic effort would be quite large.

10.4.3. Political Feasibility

This option strays furthest from EC`s compliance promotion approach. The supporting evidence required to justify a restrictive regulation of this reach - in terms of understanding collision risk factors for homes and how migratory bird populations might be affected - may not be strong enough (Pearce, 2006). Moreover, one interview participant noted that is important to think about this issue outside of the lens of prohibition (CWS Interview Participant # 2). The interviewee said that trying to tackle every home at once with the same approach may be an inefficient expenditure of effort and resources, and that this problem requires a more targeted and strategic approach (CWS Interview Participant # 2). There does not appear to be much support for this option politically, both as a function of existing policies for incidental take, and among government decision makers.

10.4.4. Public Acceptability

The survey did not ask respondents about their views on building code reform related to bird-friendly design. However, the pervasiveness of this policy option in relation to the low level of awareness about bird-window collisions would likely result in a high degree of public scrutiny.

10.5. Policy Matrix: Summary of Policy Analysis

The following matrix presents a summary of the analysis and policy options are scored based on specifications laid out in section 9. The total score for each policy is tallied in the cells at the bottom of the matrix. Each cell is also colour coded to present a visual representation of the trade-offs within and between policy options. Red indicates a low score, yellow a medium score, and green a high score. In the next section, the results are summarized and a series of recommendations are made.

Table 10.1: The Policy Matrix

		Public Information Campaign	Bird-Friendly Point of Purchase Rebate	Bird-friendly Home Certification	Building Code Amendments
Effectiveness	Reducing Collisions	1	2	1	3
	Raising Awareness	3	2	2	1
Government Cost		2	1	3	1
Political Feasibility		3	2	3	1
Public Acceptability		3	2	3	1
TOTAL		12/15	9/15	12/15	7/15

11. Recommendations, Next Steps, and Conclusion

11.1. Summary of Analysis and Recommendations

The analysis shows that, while there is no clear dominant policy, a federally led PIC along with the home certification program option ranked the highest overall, with a trade-off between them on cost and raising awareness. I recommend first initiating a PIC while simultaneously exploring the possibility of developing bird-friendly criteria into various home certification programs. Another option that was explored during my research was to explore the potential for a municipal role in this issue. Ultimately, due to lack of information, a comparable analysis could not be undertaken. However, since municipalities have already shown (ex: Toronto) that they can affect the commercial building sector, it may be worth examining the potential for a municipal role in reducing collisions with homes.[50] Looking at the matrix in section 10.5, it is the current political feasibility, degree of anticipated support from the public, and relatively low cost that makes these options particularly attractive. In this case, the attractiveness of the recommended actions trades off with effectiveness in terms of producing broad scale collision mortality reduction. However, when considered together, a PIC and bird-friendly home certification criteria have the potential to reduce collision mortality and raise awareness both amongst the public and within the home building sector.

The analysis presented here uses a short-term horizon to examine policies to reduce bird-window collision mortality, and the policy levers available to government appear quite limited from this perspective. The recommended actions should be viewed as laying the foundations for future policy work on this issue, a critical starting point. Changing household behaviour is a complex task. Education policies are typically seen as effective compliments to other policy tools that seek to affect the demand for environmental goods (OECD, 2011). Information about the environmental damage

[50] See appendix E for further discussion.

occurring, and the attributes of products that can mitigate those damages, allows consumers to make more informed choices (OECD, 2011).

In the long run, education policies will not be sufficient and setting the right incentives will be very important (OECD, 2011). Research supports the use of a mix of policy tools (OECD, 2011). Based on this analysis, a promising longer-term solution may be a point of sale rebate. Once the public is aware of the issue, there would likely be greater potential for significant take-up, which would justify such an investment. As the PIC unfolds, and perhaps as new bird-collision reduction technologies are developed, EC should continue to reassess the situation and consider other policy tools that could incentivize reducing bird-window collisions. In addition, integrating bird-friendly design criteria into home certification programs can act as a testing ground and incubator for new design features, products, and technologies, providing potential for wider application. If a more strategic long-term planning perspective is taken, the recommendations made here can be viewed as building the foundations for more substantive policies in the future.

11.2. Carrying out a Federally Led PIC: Next Steps

The literature emphasizes the importance of rigorous planning prior to embarking on a public information campaign (OECD, 2008). Information dissemination methods and the potential role of interactive tools must be carefully considered. EC should begin mobilizing its communications expertise and seeking out partners who might be willing to assist with the planning and development of a PIC. In addition, EC should begin to think about targeting. For example, identifying a stratified list of threats will enable EC to focus messaging on strategies that can produce significant reductions in collision mortality (CWS Interview Participant #1). How much emphasis should be put on window films and other products (CWS Interview Participant #2)? What are the trade-offs associated with focussing on simple, costless, less effective measures vs. more comprehensive, expensive, and effective solutions; where are the two synergistic? Where might the cumulative impacts of collisions be significant (CWS Interview Participant #2)? The data contained in this study provides a starting point for answering

some of these questions. Environment Canada should consider doing additional survey work to shape the public information campaign.

An OECD publication on communicating sustainability provides three broad objectives for PICs:

1. **Targeting works** - Target a specific audience with a refined message (UN, 2005). In this case, the central audience is single and semi-detached homeowners. CWS and the ITTF must work to craft a refined message.

2. **Be Inspiring** - People are concerned about the environment, but they find other issues more important (UN, 2005). One interview participant suggested tying this issue more broadly into the notion of living in harmony with nature (CWS Interview Participant #2).

3. **Make it personal and practical** - The message must be that individuals can easily do something about the problem. Providing a range of mitigation strategies, including the simple and costless, will help to make it practical.

11.3. Recommendation 2: Engage the Canada Green Building Council to Encourage and Help Facilitate the Development of Bird-friendly Criteria for Home Certification Programs

Next Steps

The Canadian Wildlife Service should begin thinking about how to engage the CGBC in order to encourage and help facilitate the development of bird-friendly criteria in home certification programs. The Incidental Take Task Force has the requisite expertise and mandate necessary to undertake this work, with CWS regional offices assisting as necessary. Again, the technical aspects of such requirements have to be developed, and the LEED Pilot Bird-Safe Credit provides an excellent starting point. Other organizations, such as the American Bird Conservancy, which helped to develop the LEED credit, may also be willing to lend their experience and support.

11.4. Conclusion

With many species of migratory birds in the midst of troubling population declines, reducing significant sources of bird mortality is a priority for Environment Canada. Applicable legislation that is not feasible to enforce is of little use in meeting broad conservation objectives. While it is easy for policy makers to assume government has a role to play in all of society's ills, it is important to find and rationalize the nexus for government action. One way to view this problem is in the context of market failure. The widespread and increasing use of clear and reflective glass as a building material poses a threat to birds that will only worsen as the stock of buildings continues to grow. This has implications for human wellbeing both as a function of the effect on ecological goods and services provided by birds as well as the various reasons people wish to avoid having their windows kill birds. The relationship between loss of human wellbeing and bird-window collisions is indicated by survey respondents' WTP for bird-friendly products, which is a significant value if extrapolated to all Canadian households.

There are a number of tools available to correct market failure, which must be carefully considered with respect to each unique problem. In this case, the provision of information is a very valuable starting point. Bird-window collisions have only recently gained traction within the conservation community as a potentially serious threat and are relatively unknown amongst the general public. Moreover, the home certification sector has proven innovative and influential in promoting sustainable design, and can provide valuable leadership on this issue. In the short term, the problem is less about sending the appropriate price signals, and more about educating the public. In the long term, research suggests incorporating complimentary policies that set the appropriate incentives (OECD, 2011). By promoting a different view of responsible development - one that goes beyond the efficient use of resources and includes considerations of the wider impacts on wildlife – EC can help to shape new societal norms. Shifting this paradigm through education can increase public and political acceptance of more substantial initiatives. While education will not solve the problem tomorrow, it is a most critical starting point.

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Appendices

Appendix A: Survey Instrument

English Version

Q1 . Of the following options, please select the one that best describes your current living space: (Radio Buttons)

Single detached home	680	
Semi-detached or town home.	72	
Low or mid-rise apartment/condominium (less than 12 stories)	97	
High-rise apartment/condominium (12 floors or more)	19	
Other	12	

Q2 . Do you own or rent your current living space? (Radio Buttons)

Own	705	
Rent	174	

Q3 . Imagine that you are contemplating replacing a window at your home that is 15 square feet (3 feet by 5 feet), the size of a typical bedroom window. The following replacement slider window options contain various combinations of energy efficiency and bird collision reduction technologies and come at different price levels. Using standard energy efficient windows throughout your home can reduce annual energy costs by 10%. Using high energy efficiency windows can reduce annual home energy costs by 20%. Bird friendly windows contain an Ultra Violet light reflecting material between the panes of glass which is visible to birds, but is invisible to the human eye. Bird friendly windows are available with medium bird protection, which will reduce bird collisions by 50%, and high bird protection, which will reduce bird collisions by 75%. Keeping in mind your current budget, which one of the following replacement windows, if any, would you choose to install? (Radio Buttons)

Window 1: Standard energy efficiency; No bird collision reductions; Cost: $230	31	
Window 2: High energy efficiency; No bird collision reductions; Cost: $275	88	
Window 3: Standard energy efficiency; Medium bird collision reductions; Cost: $275	102	
Window 4: Standard energy efficiency; High bird collision reductions; Cost: $320	52	
Window 5: High energy efficiency; Medium bird collision reductions; Cost: $320	239	
Window 6: High energy efficiency; High bird collision reductions; Cost: $365	315	

I would not choose to purchase any of these options.	49	

Q4 . Which of the following statements describe you? Check all that apply. (Checkboxes)

I am not that interested in birds.	42	
I enjoy hearing birds when I am outdoors.	636	
I sometimes choose to include plants/shrubs/trees in my yard because they are known to attract birds.	519	
I have and maintain a bird feeder.	491	
I casually observe birds at different times, but never go out of my way to do so.	141	
I occasionally make time to observe birds around my home or while in nature.	214	
I regularly make time to observe birds around my home or while in nature.	515	
I take special trips away from home to go bird watching.	381	
None of the above describe me.	0	

Q5 . Please indicate how important or unimportant each of the following statements is to you. (Rating Matrix)

	Very Important	Important	Neither Important or Unimportant	Unimportant	Very Unimportant
The satisfaction gained simply from knowing that birds exist now, and will continue to exist for future generations	718	125	20	3	9
Birds are a source of inspiration for art, music, literature, national symbols, and carry spiritual significance for a number of cultures	420	281	131	26	20
The satisfaction gained from observing and listening to birds	599	207	51	6	13
Birds regulate pest insect populations, pollinate plants and crops, contribute to biodiversity, and act as indicators of overall ecosystem health	765	91	9	2	9
The study of birds generates valuable scientific knowledge, which contributes to our overall understanding of ecosystems	618	209	31	9	9

Q6 . On average, approximately how much does your household spend on bird watching and bird feeding activities in one year? This includes the purchase of bird seed, bird feeders, birding books, plants known to attract birds, binoculars and other related

equipment, and the cost of trips to bird watching destinations. (Radio Buttons)		
$0	117	
$1-$50	154	
$51-$200	179	
$201-$500	202	
$501-$1000	100	
More than $1000	129	

Q7 . Based on the number of times you have witnessed or heard birds collide with your windows, and/or the number of times you have found dead birds below your windows outside, approximately how many birds collide with the windows at your current home each year? (Radio Buttons)		
I have never witnessed or heard a bird collide with my windows, nor have I ever found a dead bird below my windows outside.	158	
Less than 1 per year	196	
1 - 5 per year	312	
6 - 10 per year	112	
11 - 15 per year	47	
16 -20 per year	18	
More than 20 per year	37	

Q8 . Which of the following measures, if any, have you taken to reduce the number of bird collisions with the windows at your home? Select all that apply. (Checkboxes)		
Modified the trees, shrubs, or bushes around the window(s) to reduce the likelihood of a bird collision.	154	
Relocated the bird feeder(s)/bird bath(s) to reduce the likelihood of a bird collision.	321	
Applied decorations to the window(s).	249	
Applied decals to the window(s).	270	
Applied a window film or similar product specifically designed to make window(s) more visible to birds.	76	
Replaced the window(s) with “bird-friendly” glass.	8	
Other	98	
None of the above.	295	

Q9 . Birds also collide with windows at commercial buildings where people work. Based on the number of times you have witnessed or heard a bird collision, and/or the number of times you have found dead birds below outside windows at work, approximately how many birds collide with windows at your workplace each year? (Radio Buttons)		
Not applicable.	375	
I have never witnessed or heard a bird collide with my windows, nor	242	

have I ever found a dead bird below the windows outside my work place.		
Less than 1 per year	62	
1 – 5 per year	107	
6 - 10 per year	34	
11 - 15 per year	18	
16 -20 per year	5	
More than 20 per year	31	

Q10 . If bird collisions with windows are occurring at the workplace, who do you think should pay for measures to reduce those collisions? Please indicate your level of agreement or disagreement with the following statements: (Rating Matrix)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
No one should pay; reducing bird collisions at the work place is not worth spending money on	7	14	62	226	435
The owner of the building should pay for measures to reduce bird collisions with windows at the work place	320	348	110	15	11
Employers (building tenants) of work places experiencing bird collisions should pay for measures to reduce those collisions	54	212	283	150	41
Building owners and employers should share the costs of taking measures to reduce bird collisions with windows at the workplace	228	284	178	87	36

Q11 . Please indicate your level of agreement or disagreement with the following statements: (Rating Matrix)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Government should reallocate some tax revenues from other programs or services to provide incentives for commercial building owners to reduce the number of bird collisions with their buildings	279	324	143	84	28
Government should reallocate some tax revenues from other programs or services	208	317	211	91	27

to provide incentives for homeowners to reduce the number of bird collisions with their homes					
Government should reallocate some tax revenues from other programs or services to undertake an initiative to educate home and building owners about bird collisions and how to prevent them.	344	347	114	46	17

Q12 . In total, approximately how much does your household donate annually to organizations with environmental or conservation mandates? (Radio Buttons)

$0 per year	95	
$1-$25 per year	71	
$26-$50 per year	99	
$51-$100 per year	156	
$101-$250 per year	151	
$251-$500 per year	132	
$501-$1000 per year	88	
More than $1000 per year	81	

Q13 . Please identify your gender. (Radio Buttons)

Male	309	
Female	569	

Q14 . From the following drop down menu, please select the age category that you fall into. (Pull Down Choice)

19-29	120	
30-39	106	
40-49	141	
50-59	198	
60-69	220	
70-79	68	
80 and over	17	

Q15 . In which country do you currently reside? (Pull Down Choice)

Canada	692	
United States	176	
Other	5	

Q16 . In which province, territory, or state do you currently live? (Pull Down Choice)

Alberta	45	

British Columbia	376	
Manitoba	13	
New Brunswick	6	
Newfoundland and Labrador	3	
Northwest Territories	1	
Nova Scotia	32	
Nunavut	0	
Ontario	108	
Prince Edward Island	1	
Quebec	23	
Saskatchewan	57	
Yukon Territory	26	
Alabama	1	
Alaska	3	
Arizona	3	
Arkansas	2	
California	11	
Colorado	5	
Connecticut	2	
Delaware	1	
Florida	3	
Georgia	1	
Hawaii	0	
Idaho	1	
Illinois	7	
Indiana	5	
Iowa	1	
Kansas	1	
Kentucky	1	
Louisiana	1	
Maine	3	
Maryland	11	
Massachusetts	2	
Michigan	4	

Minnesota	5	
Mississippi	1	
Missouri	2	
Montana	2	
Nebraska	0	
Nevada	0	
New Hampshire	4	
New Jersey	4	
New Mexico	0	
New York	9	
North Carolina	11	
North Dakota	0	
Ohio	3	
Oklahoma	0	
Oregon	20	
Pennsylvania	9	
Rhode Island	1	
South Carolina	1	
South Dakota	1	
Tennessee	0	
Texas	2	
Utah	4	
Vermont	0	
Virginia	9	
Washington	8	
West Virginia	1	
Wisconsin	8	
Wyoming	1	
Not a citizen of Canada or the United States	4	

Q17 . Please indicate the first three letters/digits of your postal code or zip code. (Single Line Text)

Only the 5 most recent submissions are displayed. Click "More" to see all submissions.

996
m4g
L4H

V0H
341

More...

Q18 . What is the highest level of education you have completed? (Radio Buttons)

Did not complete high school.	7	
Completion of high school.	66	
Completion of a college diploma, technical program, or apprenticeship training.	141	
Completion of an undergraduate university degree program.	334	
Completion of a Master's or Doctoral degree program.	329	

Q19 . What is your annual household income before tax? (Radio Buttons)

Less than $25,000 per year	79	
$25,000 - $49,999 per year	158	
$50,000 - $74,999 per year	187	
$75,000 - $99,999 per year	159	
More than $100,000 per year	235	

Q20 . There are a number of products available that can be applied to existing windows to reduce bird collisions at your home. Imagine you have a 15 square foot window where the majority of bird collisions occur at your home. Keeping in mind your current budget, which of the following products, if any, would you presently be willing to purchase and apply to this window? (Radio Buttons)

Product 1 is an externally mounted window screen which is installed using window mounts or window suction cups. The bird screens affect the appearance of the window much like a typical insect screen. These screens can be taken down and put back up at any time. This product is expected to reduce fatal bird collisions by about 99%. Cost- $30.00.	294	
Product 2 is a series of small, white, 1 cm in diameter circular dots that are applied to the window evenly in rows and spaced 5 centimeters apart. The product is visible from the inside and the outside of the window. This product is expected to reduce bird collisions by about 75%. Cost- $90.00.	19	
Product 3 is a film that is applied to the entire window and is similar to what is used to advertise on the windows of public buses. The film has a one-way property, appearing solid when looking into the window from the outside, while small perforations maintain viewing when looking out of the window from the inside. The film is expected to reduce the number of bird collisions with windows by about 99%.. Cost- $60.00.	294	
Product 4 is a tape that is applied to the exterior of the window to alert birds to a barrier. It is visible from the inside and outside of the window. When applied in horizontal stripes spaced 5 cm apart, the tape is expected to reduce the number of collisions by about 75%. Cost- $10.00.	54	
I would not purchase any of these products.	209	

Appendix B: Summary of Aggregate Survey Demographics

Attribute	Category	Number	Percent
Age	19-29	121	12.8%
	30-39	110	11.6%
	40-49	149	15.7%
	50-59	236	24.9%
	60-69	242	25.5%
	70-79	72	7.6%
	80 and over	17	1.8%
Gender	Male	349	36.4%
	Female	607	63.4%
Income	Less than $25,000	80	9.0%
	$25,000-$49,999	180	20.3%
	$50,000-$74,999	206	23.2%
	$75,000-$99,999	174	19.6%
	$100,000 or More	247	27.8%
Education	Did not complete high school	7	0.7%
	Completion of high school	76	8.0%
	Diploma, apprenticeship, or technical program	173	18.1%
	Undergraduate Degree	363	38.0%
	Master's Degree or PHD	336	35.2%
Country	Canada	774	81.4%
	United States	172	18.1%
	Other	5	0.5%
Province/Territory	Alberta	45	5.4%
	British Columbia	377	45.4%
	Manitoba	13	1.6%
	New Brunswick	6	0.7%
	Newfoundland/Labrador	3	0.4%
	Northwest Territories	1	0.1%
	Nova Scotia	32	3.9%
	Nunavut	0	-
	Ontario	110	13.2%
	Prince Edward Island	1	0.1%
	Quebec	103	12.4%
	Saskatchewan	57	6.9%
	Yukon	26	3.1%

Appendix C: Demographics, Low Interest in Birds

Attribute	Category	Number	Percent
Age	19-29	60	42.9%
	30-39	26	18.6%
	40-49	18	12.9%
	50-59	19	13.6%
	60-69	14	10.0%
	70-79	2	2.1%
	80 and over	0	-
Gender	Male	57	40.1%
	Female	85	59.9%
Income	Less than $25,000	20	14.7%
	$25,000-$49,999	31	22.8%
	$50,000-$74,999	27	19.9%
	$75,000-$99,999	21	15.4%
	$100,000 or More	37	27.2%
Education	Did not complete high school	1	0.7%
	Completion of high school	13	9.2%
	Diploma, apprenticeship, or technical program	30	21.1%
	Undergraduate Degree	56	39.4%
	Master's Degree or PHD	42	29.6%
Country	Canada	129	90.8%
	United States	12	8.5%
	Other	1	0.7%
Province/Territory	Alberta	10	8.2%
	British Columbia	64	52.5%
	Manitoba	1	0.8%
	New Brunswick	1	0.8%
	Newfoundland/Labrador	0	-
	Northwest Territories	0	-
	Nova Scotia	4	3.3%
	Nunavut	0	-
	Ontario	11	9.0%
	Prince Edward Island	0	-
	Quebec	2	1.6%
	Saskatchewan	26	21.3%
	Yukon	3	2.5%

Appendix D: An In-Depth Discussion of the Survey Results

Demographics

The sample provided a wide distribution of ages, except for the group 80 and over which, among other reasons, may be due to the survey being conducted online. In comparison to the Canadian population as a whole, there was under-representation of those aged 19-39 (24.4% in the sample, compared to 35.5% for Canada's population) and an over representation of those aged 50-69 (50.4% in the sample, compared to 32.3% for Canada's population) (Statistics Canada, 2012). The median household income for the survey sample fell within the $50,000 to $74,999 income category, which is consistent with the Canadian household median income of $69,860 (constant 2010 dollars) (Statistics Canada, 2012). However, with a large number of respondents reporting annual household incomes above $100,000, the mean household income for the sample may be higher than the Canada average. Respondents tended to be highly educated, with 73% of the sample holding a university degree, including 35.1% holding a Master's degree of PHD. By comparison, in 2010, 20.9% of Canadians held university degrees with 6.5% holding a post-graduate education (Statistics Canada, 2012). The vast majority of respondents were residents of Canada (774), with an additional 172 respondents from the United States and 5 from "other" countries. Within Canada, British Columbia, Ontario, and Quebec had the largest sample sizes, followed by Saskatchewan, Alberta, Nova Scotia, and the Yukon. Aside from Nunavut, which had no sample representation, the remaining provinces and territories had a few respondents each.

Respondent Characteristics

According to a 2006 study of wildlife viewing, 7.5% of Canadians took overnight trips away from home where bird watching was the main reason for the trip (TAMS, 2006). In the survey sample, 44.5% of respondents reported taking *special trips away from home to go bird watching*. Survey respondents were not asked to differentiate between overnight trips and day trips, or whether or not bird watching was the main reason for the trip. While the two statistics cannot be directly compared, it is fair to assume that the sample over-represents Canadians with a distinct interest in bird related activities.

The median value for spending on bird activities amongst respondents fell between $201 and $500 (see table C-1). According to a 1996 Environment Canada study of participation in nature related activities (the last year the study was conducted), Canadians spent an average of $297 per year on wildlife viewing (Environment Canada, 1996). The EC study asked respondents about spending related to trips taken away from home and included all wildlife viewing (Environment Canada, 1996). Question 6 (see Appendix A.) of my survey did not differentiate between expenditures on bird-watching related activities around the house (ex: purchasing a bird feeder) and expenditures on bird-watching related trips away from home. Again, a direct comparison cannot be made. However, using the lower bound, mid-point, and upper bound for each response category in the survey, the average spending on birding activities alone was $267, $352, and $437 respectively. It is appropriate to make the assumption that survey sample respondents spent more on bird watching related activities than the Canadian public on average. The sample is over-representative of those with interest in, and a willingness to pay for, bird-watching activities.

Table D-1: Spending on Bird-Related Activities

Spending Category	Frequency	Percent
$0	117	12.2%
$1-$50	156	16.3%
$51-$200	200	20.9%
$201-$500	228	23.8%
$501-$1000	115	12.0%
More than $1000	142	14.8%

The survey sample indicates that 89% of respondents donate annually to environmental organizations. Using the upper and lower bound method to calculate a mean range for donations to conservation organizations, the average donation in the sample ranged from $185.53 to $320.46. According to Statistics Canada's 2007 survey of charitable donations, Canadians donated an average of $97 to $114 to conservation organizations annually (Canada Survey of Giving, Volunteering, and Participating, Statistics Canada, 2007). The survey sample was greatly overrepresented by respondents with an interest in conservation generally, as indicated by their reported annual donations to conservation organizations. Table C-2 provides a summary of respondent's reported donations to organizations with conservation mandates.

Table D-2: Respondent Annual Donations to Conservation Organizations

Donations to Conservation Organization	Frequency	Percent
$0	105	11.0%
$1-$25	89	9.4%
$26-$50	116	12.2%
$51-$100	174	18.3%
$101-$250	161	16.9%
$250-$500	134	14.1%
$501-$1000	91	9.6%
More than $1000	81	8.5%

Average Willingness to Pay

Respondents were asked to imagine a situation in which they had to replace a 15 square foot window in their home and were presented with 6 options, each with a different combination of energy efficiency and bird-friendly characteristics. Responses were analyzed to determine the trade-offs respondents would willingly make between these window attributes. By assessing the resources that individuals are willing to allocate to prevent bird-window collisions, the *benefit* of reducing bird-window collisions can be calculated. Table D-3 shows the AWTP across the aggregate sample and relevant sample characteristics. At the 95% level of confidence, significant differences in AWTP occur with respect to age, income, level of interest in birds, reported

donations to conservation organizations, and interestingly, reported annual collisions occurring at the respondent's home. Figures D-1 to D-4 graphically shows characteristics with a significant impact on respondent WTP. These figures show the percentage of respondents in each category that indicated a WTP of $0, $45, *or* $90.[51]

Table D-3: Average Willingness to Pay by Characteristic, with Statistical Tests

Attribute	Category	T-Statistic	Degrees of Freedom	Mean Value	95% Confidence Interval	
					Lower	Upper
Aggregate	-	51.35	957	$55.57	$53.45	$57.69
Age*	19-39	20.20	230	$39.55	**$35.69**	**$43.40**
	40-69	46.29	626	$60.86	**$58.28**	**$63.44**
	70 and Over	15.72	88	$57.64	$50.36	$64.93
Income*	≤ $49,999	23.09	259	$49.85	**$45.60**	**$54.10**
	$50,000-99,999	33.27	379	$56.25	$52.93	$59.57
	≥ $100,000	31.95	246	$63.22	**$59.32**	**$67.12**
Education	No Post Secondary	14.23	82	$52.05	$44.77	$59.32
	Post Secondary	38.11	535	$55.41	$52.55	$58.27
	Graduate Degree	31.27	335	$56.65	$53.09	$60.22
Country	Canadians	44.61	773	$54.48	$52.08	$56.87
	Americans	25.63	171	$60.44	$55.78	$65.09
Homeowners	All Homeowners	46.30	670	$58.88	$56.38	$61.38
	Canadian Homeowners	40.00	531	$58.36	$55.50	$61.23
	American Homeowners	23.26	130	$61.15	$55.94	$66.35
Level of Interest in Birds*	Low	11.83	141	$30.74	**$25.60**	**$35.88**
	Moderate	19.21	169	$47.91	**$42.99**	**$52.84**
	High	51.43	645	$63.04	**$60.63**	**$65.45**
Donations to Conservation*	$0 - $50	21.63	309	$40.94	**$37.21**	**$44.66**
	$51-$500	40.48	468	$58.53	**$55.69**	**$61.37**
	>$500	33.69	171	$73.78	**$69.46**	**$78.10**
Reported Collisions Per Year*	None or < 1	26.34	372	$44.88	**$41.53**	**$48.23**
	1–10	39.87	465	$60.26	**$57.29**	**$63.23**
	>10	26.88	117	$70.55	**$65.35**	**$75.75**

**Indicates a significant difference in the AWTP across the demographic/characteristic*

Willingness to Pay Figures, Across Significant Characteristics

[51] Those that are WTP $90 are certainly also WTP $45, but these figures do not make this aggregation.

Figure D-1: Respondent WTP vs. Reported Donations to Conservation Organizations

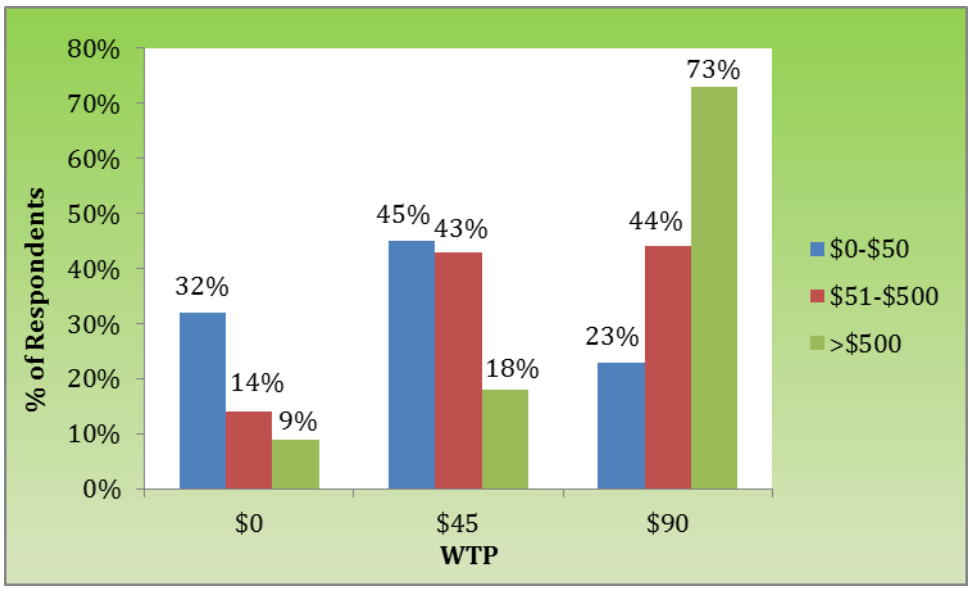


Figure D-2: Respondent WTP vs. Reported Annual Collisions at the Home

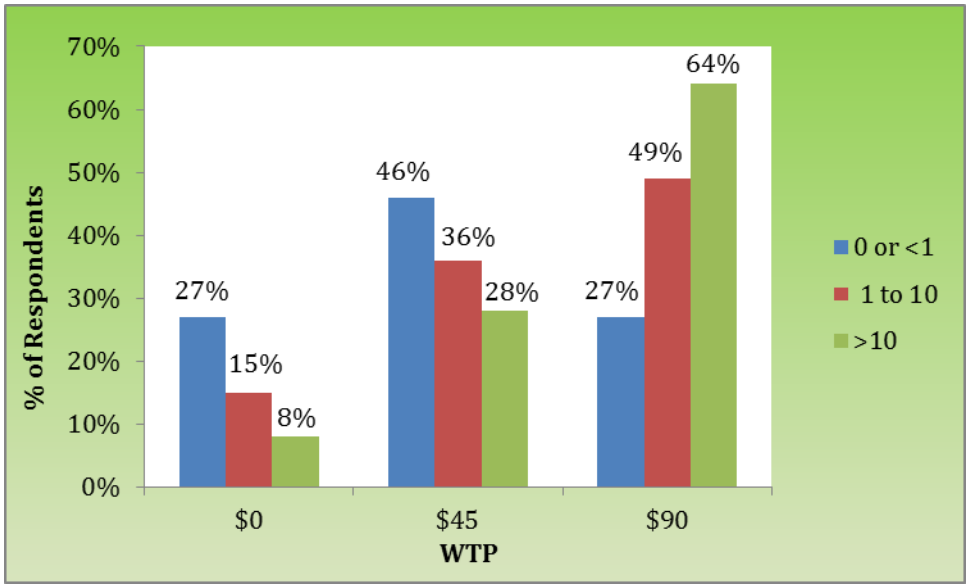


Figure D-3: Respondent WTP vs. Reported Income

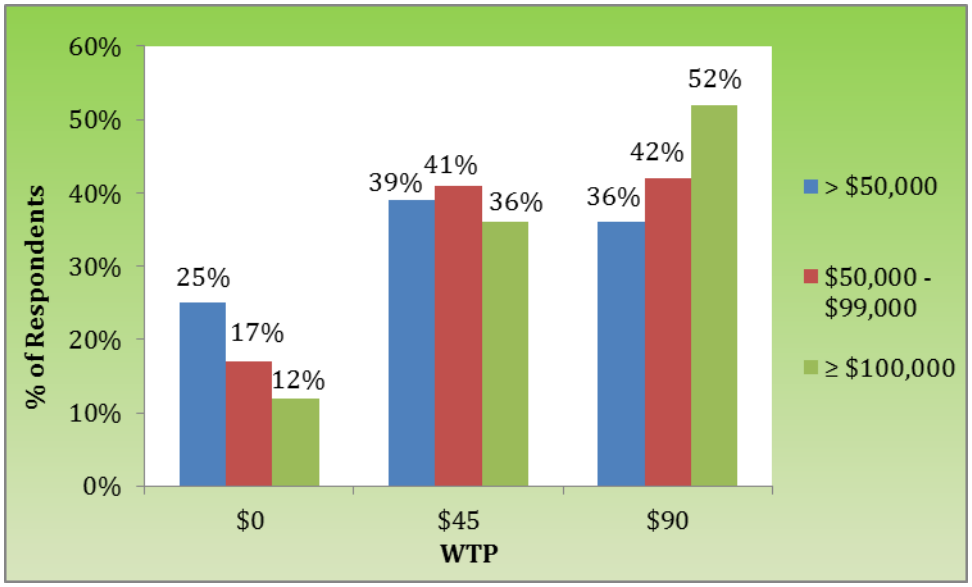
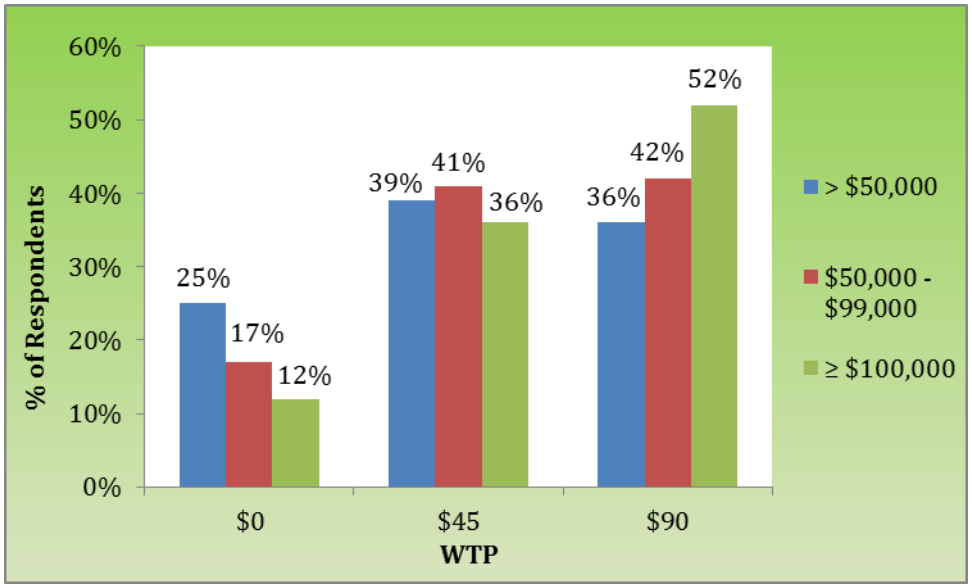


Figure D-4: Respondent WTP vs. Reported Age



An Alternative Measure of Average Willingness to Pay

The final survey question offers an additional measure of AWTP using existing retrofit products. Rather than replacing the entire window, these products can be applied on the exterior of the window to signal a barrier to birds. Table D-4 shows the response frequencies and AWTP across all levels of interest in birds. In comparison to the original WTP question, the data here indicate a

much smaller WTP. These products introduce aesthetic appeal, an important consideration and potentially significant barrier to the adoption of retrofit products. It must be noted that the survey tool was unable to incorporate pictures or visuals. Rather, the product was described in text, which respondents may have interpreted differently. The two products that received the most support were externally mounted bird screens and the 1-way window film. This question appeared at the end of the survey. At this point in the survey, respondents were aware of the bird friendly windows, so ordering and embedding effects cannot be ignored. Had this question appeared before question one, or in absence of question one, it is likely that there would be a higher WTP than is presented in table D-4.

Table D-4: Canadian Homeowners' Choice of Retrofit Product by Level of Interest in Birds

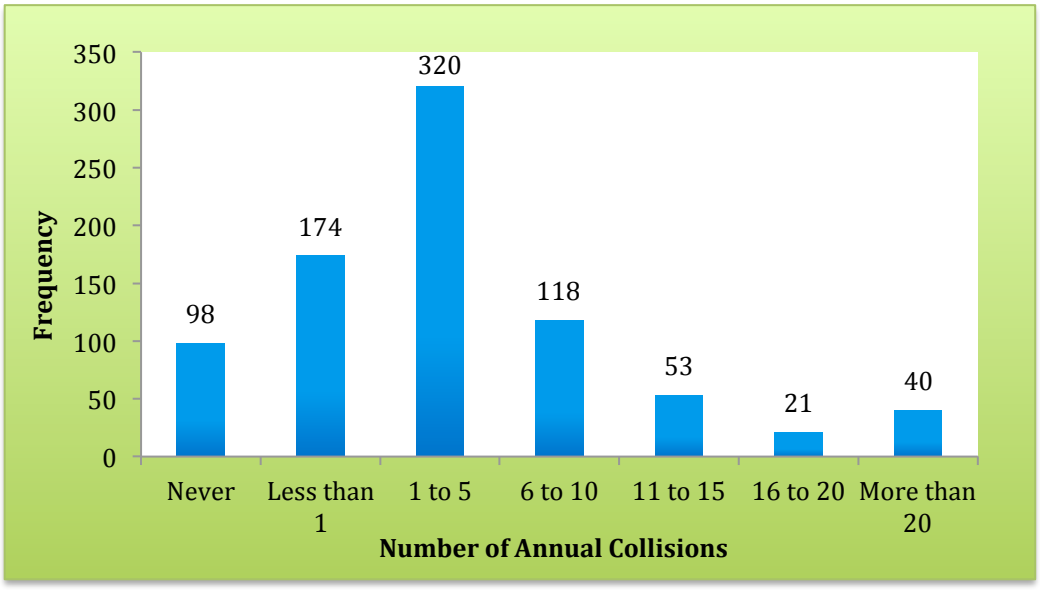
	None	Window Screens	1-Way Film	Window Tape	Fritted Film	Total	AWTP
Low Interest	29 (58%)	9 (18%)	10 (20%)	2 (4%)	0	50	$17.80
Moderate Interest	19 (22%)	37 (42%)	21 (24%)	10 (11%)	1 (1%)	88	$29.09
High Interest	70 (22%)	96 (30%)	141 (43%)	14 (4%)	4 (1%)	325	$36.43

Collisions

Figure C-1 shows the aggregate results for the number of collisions reported at single and semi-detached homes. Using two calculations, one using the lower bounds of the category range and one using the upper bound for the category range, the mean range for collisions per home is between 3.1 and 5.4. When only single and semi-detached homes are considered, the mean collision rate falls between 3.1 and 6.1. Using a weighted adjustment to account for the overrepresentation of homes with bird feeders in this sample, the mean collisions rate ranges from 2.4 to 4.5 (15% homes with feeders) and 2.6 to 4.8 (25% of homes with feeders). If Klem's estimate that half of all bird-window collisions result in a fatality is accepted, the mean mortality rate per household in this sample ranges from 1.2 to 2.4 birds per year. These results are comparable to other similar studies examining collisions rates at single and semi-detached homes. It is important to note that some studies report average annual bird mortality, which is different from the average annual collision rate. In a large survey conducted in Alberta, Bayne et. al. (2012) found that the mean annual collision rate per household was 1.7 ± 4.6 (s.d.). A survey of homeowners in Illinois found that, on average, 1.5 collisions occur annually as each home (Machtans et. al. 2012). Another study in Minnesota, which adjusted for search error[52], found an average mortality rate of 2.3 birds per home (Machtans et. al. 2012). A famous study by Dunn estimated mortality rates of 0.65 to 7.70 per household each *winter* (Machtans et. al. 2012). The study by Dunn has been scrutinized as being too high due to its focus on homes with bird feeders. A recent EC study used an estimate of 0.1 to 3.1 fatal collisions per home per year.

[52] Searcher error is the idea that people are not always home or do not always notice when a birds strikes their window. Further, scavengers often prey on dead or injured birds after a window collision, removing the evidence.

Figure D-5: Number of Collisions Reported at Single and Semi-Detached Homes



Examining how interest in birds affected the reported collision rate sheds some important light on the collisions results. Table C-4 shows these results. There are a few possibilities to explain the variance in reported collision rates. Considering that the WTP question was asked before respondents indicated the number of collisions annually occurring at their home, this could not be a result of order bias. Respondents with a high level of interest in birds may simply be more cognisant of the occurrence of collisions. Alternatively, there may be a slight strategic bias present in the results, whereby respondents with a keen interest in birds knowingly overstate the collision rate at their home in hopes of influencing future decisions on the matter.

Table D-5: Interest in Birds and Reported Collisions Rates

Reported Level of Interest in Birds	Lower Bound	Upper Bound
Low	1.2	2.0
Moderate	1.5	3.5
High	4.0	6.5

Components of Value

Table D-6: Components of Value for Birds Based on Level of Interest in Birds

Value Category	Interest in Birds	Percentage of Respondents				
		Very Important	Important	Neither Important nor Unimportant	Unimportant	Very Unimportant
Existence Value	Low	47.5% (n=66)	38.8% (n=54)	10.1% (n=14)	2.2% (n=3)	1.4% (n=2)
	Moderate	81.5% (n=137)	14.9% (n=25)	2.4% (n=4)	0% (n=0)	1.2% (n=2)
	High	90.2% (n=577)	8.3% (n=53)	0.8% (n=5)	0% (n=0)	0.8% (n=5)
Use Value	Low	20.3% (n=28)	46.4% (n=64)	26.8% (n=37)	3.6% (n=5)	2.9% (n=4)
	Moderate	51.8% (n=87)	41.7% (n=70)	4.2% (n=7)	0.6% (n=1)	1.8% (n=3)
	High	84.9% (n=546)	12.8% (n=82)	1.2% (n=8)	0.2% (n=1)	0.9% (n=6)
Ecological Goods and Services	Low	68.9% (n=95)	25.4% (n=35)	4.3% (n=6)	1.4% (n=2)	0% (0)
	Moderate	88.1% (n=148)	8.9% (n=15)	1.2% (n=2)	0% (n=0)	1.8% (n=3)
	High	91.0% (n=584)	7.3% (n=47)	0.8% (n=5)	0% (n=0)	0.9% (n=6)
Cultural Value	Low	25% (n=35)	37.1% (n=52)	24.3% (n=34)	10% (n=14)	2.9% (n=4)
	Moderate	41.2% (n=70)	38.2% (n=65)	15.3% (n=26)	1.8% (n=3)	3.5% (n=6)
	High	54.9% (n=353)	28.9% (n=186)	12.9% (n=83)	1.6% (n=10)	1.7% (n=11)
Scientific Value	Low	36.7% (n=51)	44.6% (n=62)	13.7% (n=19)	5% (n=7)	0% (n=0)
	Moderate	64.9% (n=109)	28.0% (n=47)	4.2% (n=7)	1.2% (n=2)	1.8% (n=3)
	High	79.6% (n=512)	18.0% (n=116)	1.4% (n=9)	0% (n=0)	0.0% (n=6)

Respondent Support for Policy Approaches

Table D-7: Level of Support for Policy Approaches, by Interest in Birds

Policy	Interest in Birds	Reported Level of Agreement with Policy					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Providing Incentives to Home Owners	Low	16 (13%)	21 (17%)	34 (27%)	40 (32%)	15 (12%)	126
	Moderate	1 (1%)	18 (12%)	44 (30%)	65 (44%)	19 (13%)	147
	High	9 (2%)	45 (10%)	107 (23%)	167 (35%)	147 (31%)	475
	Aggregate	26 (4%)	84 (11%)	185 (25%)	272 (36%)	181 (24%)	748
Provision of	Low	10 (8%)	17 (14%)	33 (26%)	45 (36%)	20 (16%)	125
	Moderate	0 (0%)	9 (6%)	25 (17%)	71 (48%)	44 (30%)	149

Policy	Interest in Birds	Reported Level of Agreement with Policy					
information to homeowners	High	8 (2%)	17 (4%)	47 (10%)	181 (37%)	234 (48%)	487
	Aggregate	18 (2%)	43 (6%)	105 (14%)	297 (39%)	298 (39%)	761
Providing Incentives to Commercial Building Owners	Low	15 (12%)	24 (19%)	29 (23%)	38 (30%)	20 (16%)	126
	Moderate	2 (1%)	16 (11%)	29 (20%)	72 (49%)	29 (20%)	148
	High	13 (3%)	41 (9%)	71 (15%)	163 (34%)	188 (40%)	476
	Aggregate	30 (4%)	81 (11%)	129 (17%)	273 (36%)	237 (32%)	750

Appendix E: The Potential for a Municipal Role

While municipalities are fairly limited in their ability to pay for incentive programs, there are a number of tools available to them to tackle environmental issues at the local level (CELA, 2010). As demonstrated in Toronto, municipalities can take action to reduce bird-collisions. Through the Federation of Canadian Municipalities (FCM), the federal government could partner with municipalities to explore and encourage the use of municipal tools to reduce bird-window collisions with homes. The following list of municipal tools, although not exhaustive, may be able to incorporate elements of bird-friendly building and landscape design for homes:

Community Plans - Municipal plans are documents that describe future land use planning in accordance with the objectives for future growth (CELA, 2010). Some community plans are designed around a specific issue, such as sustainability, which provides the platform for including bird-friendly development goals. For example, the City of Markham, Ontario recently adopted *Markham's Green Print Sustainability Plan,* which includes bird-friendly development guidelines.[53]

Site Plan Control - Site plan controls set requirements that must be met by developers before a development can take place (CELA, 2010). These requirements can include elements of sustainability. For example, the City of Toronto's *Green Development Standard* sets mandatory performance measures for new developments and retrofits, and includes bird-friendly building criteria in certain cases.

Zoning By-Laws - Zoning by-laws describe how land will be used in a municipality and specify requirements for building use and density, among other features. Zoning by-laws may not directly be used to reduce bird-window collisions, but are often necessary to implement other tools, such as site plan controls. This was the case with the City of Toronto's *Green Development Standard* when it became mandatory.

At minimum, it is apparent from real-world examples that municipalities have the ability to impart bird-friendly design on commercial and large-scale residential buildings. Therefore, regardless of whether any significant opportunities exist with respect to single and semi-detached homes, a federal-municipal partnership through the FCM is worth exploring. As demonstrated by the cities of Markham and Toronto, including bird-friendly guidelines into community planning documents was a crucial first step to initiating action. These "soft" policy measures can create awareness and influence the attitudes of citizens (OECD, 2008). Voluntary guidelines were cited as an essential first step to "acclimatize" developers to the Toronto bird-friendly guidelines before making them mandatory (CELA, 2010).

A Preliminary Policy Analysis

Effectiveness

Raising Awareness

[53] To see the full document, go to: http://www.markham.ca/wps/wcm/connect/0c98f70047b7a0ae8da6fd81675ea5bc/GreenPrint+FINAL+Plan_2011_lower+res.pdf?MOD=AJPERES&CACHEID=0c98f70047b7a0ae8da6fd81675ea5bc

Municipal plans that include bird-friendly development guidelines have been used to generate awareness about bird-window collisions, but mostly within the commercial building sector. While there are certainly exceptions, municipal officials are likely to be less familiar with the issue from a conservation perspective than federal officials who have the relevant expertise and intimate knowledge of conservation goals and practices. In this context, the federal government should assist municipalities in creating awareness of bird-window collisions as a conservation issue. This policy would only generate awareness to the extent that municipalities are willing to explore reducing bird-window collisions, likely concentrating in larger centres. Depending on the nature of action taken by municipalities, and the extent to which municipalities are willing to explore their role, search costs can be reduced for homeowners. For example, bird friendly guidelines in community plans can assist willing homeowners in finding effective collision reduction strategies. For some homeowners, search costs can be reduced.

Reducing Bird-Window Collisions

The municipal role in reducing bird-window collisions is best exemplified by the cities of Toronto and San Francisco. Using site plans, these municipalities have created mandatory requirements, in various forms, for new construction of commercial and multi-unit residential buildings. In the long run, this will certainly help to reduce bird-window collisions. This is a strategy worth exploring, *regardless* of whether municipalities can affect collisions at single and semi-detached homes.

Municipalities generally have limited ability to fund incentive programs, which means their role in reducing collision mortality with the existing stock of homes may be limited. In addition, municipal tools with regulatory power are difficult to tie to the development of single detached and semi-detached homes and neighbourhoods. Finding synergies with other municipal objectives, such as reducing sprawl, can increase resonance of the issue with municipal decision makers. The degree to which municipalities can reduce bird-collision mortality with single or semi-detached homes is unclear at this point.

At minimum, a uniform bird-friendly home design guideline could be developed nationally and offered for adoption into the planning documents of willing municipalities. Alternatively, the federal government could provide support on a case-by-case basis to municipalities looking at including bird-friendly information in community plans. Current work being undertaken in the City of Vancouver may shed light on the feasibility of these alternative approaches. Bringing together expertise on bird-friendly home design and expertise with the municipal tool kit could be a fruitful endeavour.

Government Cost

Engaging municipalities through the FCM will result in minimal additional federal government costs. Again, the initiative would not require additional expenditures above and beyond current levels, only a shift in bureaucratic effort. The Incidental Take Task Force could be given the responsibility to manage this partnership for the federal government, with CWS departments taking on responsibilities as needed. Municipalities would incur the majority of costs under this policy. Uniformity, such as creating a single national bird-friendly development guideline for municipalities, can reduce duplication of effort, and thus, costs.

Political Feasibility

Exploring the municipal role falls within the Federal Government's compliance promotion strategy. In this light, diverting action to the local level is also likely to be viewed favourably by federal decision makers. In developing community plans, the sharing of federal expertise would make this option more palatable to municipalities. In the case of more substantive undertakings that are outside of regular planning activities, municipalities may not be willing to bare the costs. The FCM would likely be a willing partner in an exploration of the municipal role in reducing bird-

window collisions, as evidenced by their willingness to assist with funding in Markham's Greenprint Sustainability Plan.

Public Acceptability

The non-invasive nature of a policy of partnering with municipalities is likely acceptable to the public. Ultimately, the level of public support will depend on the measures that municipalities take, if any, to reduce collisions with homes.