THE INTRODUCTION OF POTENTIALLY INVASIVE ALIEN PLANT SPECIES FOR HORTICULTURAL PURPOSES IN NORTH AMERICA: ASSESSING STAKEHOLDER PERSPECTIVES AND PREFERENCES

by

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ABSTRACT

Invasive alien plant species are known to cause significant economic and ecological losses. Nonetheless, potentially invasive plant species are often deliberately introduced and sold for ornamental horticulture. Although links between the nursery trade and the invasive alien plant problem are recognized, existing policies largely ignore the problem's horticultural dimension. Therefore, novel policies are needed to reduce invasion risks stemming from deliberate introductions. However, many stakeholders are affected by the problem, including those benefiting from horticultural sales and those negatively affected by invasions, and their policy preferences are not clearly documented. I describe current regulations, present viable alternatives and, through the analysis of survey data, explore stakeholder preferences for a variety of policy options. While policies rooted in white listing are most popular, policy preference varies both between and within role-based stakeholder groups. Although most respondents preferred a mandatory approach, a small subset of the sample favoured voluntary measures.

Keywords: Invasive alien plant species; ornamental horticulture; policies; black listing; screening; economic instruments; stakeholder preferences; North America

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LIST OF ACRONYMS AND ABBREVIATIONS

APHIS: Animal and Plant Health Inspection Service
CFIA: Canadian Food Inspection Agency
NAPRA: Not Authorized for Import Pending Risk Analysis
NRC: National Research Council
PD: Problem Definition
SC: Strategy Consideration
TPPWG: Terrestrial Plants and Plant Pests Working Group
USDA: United States Department of Agriculture

CHAPTER 1: INTRODUCTION

Invasive plant species are defined as those species that encroach into both undisturbed and human-modified vegetation, where they subsequently dominate and/or disrupt the existing plant community (Reichard and White, 2001). The majority of such species are exotic species, often referred to as alien or nonindigenous species. Therefore, these species originate in other areas and are introduced, either intentionally or unintentionally, to new and suitable ecosystems where they flourish by successfully competing with native flora, those plant species occurring naturally in a region (Haber, 2002). The encroachment of non-native invasive plant species can cause substantial damages, both ecological and economic.

From an ecological standpoint, alien species are described as the second largest source of biodiversity loss in the United States (Wilcove *et al.*, 1998). Studies indicate that there are 2,000-3,000 naturalized non-indigenous plant species in the United States, while in Canada approximately a quarter of the estimated 5,800 plant species are alien (Haber, 2002; Kartesz, 1994). However, only a small percentage of the non-indigenous plant species in both countries are considered invasive (Haber, 2002; Marinelli, 1996). Nonetheless, alien plants are contributing to the decline of approximately twenty percent of the endangered and threatened plants in Canada (Haber, 2002).

In economic terms, the damages caused by invasive plant species and the subsequent control costs have been estimated at $35 billion USD per year in the United States (Pimentel *et al.*, 2005). In Canada, approximately $7.5 billion CAD per year is dedicated to invasive plant research and control efforts in the forestry and agriculture sectors (RNT Consulting, 2002). However, such monetary evaluations do not always consider the ecological impacts of invasive alien species, and are therefore thought to underestimate the costs associated with such species (Pimentel *et al*., 2005; Perrings *et al*., 2002).

Moreover, invasive plants are difficult and expensive to control once established and, as such, most invasions are irreversible (Ewel *et al*., 1999; Horan *et al*., 2002). Consequently, damages associated with invasive alien plant species typically continue for extended periods of time beyond the initial introduction event. From a spatial perspective, the impacts of one invasion event are rarely limited to the site of initial establishment. Many invasive plants have vast distributions, radiating out from the areas where the species was first established and often expanding across political boundaries (Mullin *et al., 20*00).

The horticulture industry has been identified as a key pathway for the introduction and dispersal of invasive alien species (Haber, 2002; Reichard and White, 2001). Governments in both Canada and the United States are aware of the damages caused by invasive plants, recognize that the horticulture industry is a pathway, and are seeking solutions (TPPWG, 2004; National Invasive Species Council, 2001). However, clear policies targeting the horticulture industry for its role in the introduction and dispersal of invasive alien plants in North America have yet to be effectively implemented.

1.1 Problem Statement

Current North American policy aimed at addressing the horticultural dimension of the invasive plant problem is plagued by fundamental deficiencies, and is thus largely ineffective.

1.1.1 Horticulture as a Pathway for Invasive Plant Species

Horticultural pathways for potentially invasive plant species include the introduction of exotic plant species (or their propagative parts, such as seeds) for botanical gardens and arboreta collections, sale by nurseries and garden centres, and horticultural society exchanges (Reichard and White, 2001). The horticulture industry itself consists of plant growers, distributors, and sellers as well as landscape designers and installers.

The industry in the United States is described as a "diverse multibillion dollar industry with importers running the gamut from small, family operations specializing in a few species to large corporations importing hundreds of taxonomically diverse species" (Mack et al., 2000, 703). In 2005, domestic floriculture production totalled US$ 5.36 billion, wholesale, for growers reporting $10,000 or more in sales (National Agricultural Statistics Service, 2006). Total gross sales from nursery crop production in 17 American states were US$ 3.97 billion in 2003 (National Agricultural Statistics Service, 2004). In the United States, floriculture and nursery crop production is characterized as one of the fastest growing agricultural sectors in the last decade (Economic Research Service, 2006). Canadian ornamental flower and plant sales, including retail, wholesale, and export sales, totalled CDN$1.4 billion in 2005. Total sales of nursery stock in Canada, including retail sales and sales to landscapers and garden centres, approached CDN$6 million in 2005. Landscapers accounted for 25% of sales reported by nursery product growers. Purchases by garden centres accounted for 22% of Canadian nursery stock sales (Statistics Canada, 2006).

The horticulture industry is responsible for introducing and dispersing plant species known to be invasive as well as other exotic species that have the potential to become invasive. Horticulturists often prefer introduced ornamentals to native plants because they are aesthetically pleasing and generally easier to grow (Myers and Bazely, 2003; Reichard, 2004). Indeed, the majority of the annuals, perennials, and woody species sold for gardening are exotic (Armitage, 2004; Harrington *et al.*, 2003). Very few of the non-native species sold by the horticulture industry have been identified as invasive (Harrington *et al.*, 2003), yet many of these have the potential to invade. Specifically, the biological traits that facilitate cultivation of intentionally introduced plant species are congruent with those that increase the likelihood that they may become invasive (Harrington *et al.*, 2003; Mack, 2005). As such, horticultural fashion and the growth of the horticultural market have been identified as important components of the contemporary human-mediated dispersal of invasive plants (Hulme, 2003).

Consequently, large economic incentives exist to introduce and disperse novel species that may subsequently become invasive (Mack and Lonsdale, 2001; Mack, 2005). Even though only a small percentage of the ornamental plants introduced for horticulture subsequently cause economic and ecological damage (Reichard and White, 2001; Harrington *et al.*, 2003), the elevated rate of introduction associated with horticulture has resulted in ornamental species comprising the vast majority of invasive plants in many countries (Baskin, 2002). In North America, approximately half of the 300 species of established invasive plants were introduced for ornamental horticulture (Marinelli, 1996). Despite the scientific evidence suggesting that the horticulture industry is a major pathway for the introduction of invasive alien plant species, plant importers often deny the negative consequences of their actions (Mack *et al.*, 2000).

Therefore, many potentially invasive plant species are deliberately introduced for economic benefit such that a species can be simultaneously classified as destructive by one segment of society and desirable by another (Reichard, 2005, Lodge and Shrader-Frechette, 2003). The importation and subsequent sale of exotic plants by the horticulture industry is the most obvious example of the benefits derived from harmful, or potentially harmful, exotic plant species (Barbier and Knowler, 2006). Indeed, "one person's ornament is another person's invader" (Shogren and Tschirhart, 2005, 269).

1.1.2 The Existing Policy Framework

Although the introduction of invasive and potentially invasive alien plants produces benefits in addition to costs (Lodge *et al.*, 2006; Mack, 2005), current North American policies frame the issue solely in terms of costs. Furthermore, current policies fail to consider the invasion risks associated with the introduction of new exotic ornamental plant species. As a result, some horticulturalists refuse to cease importing new exotics since they have yet to be characterized as invasive (Armitage, 2004). Despite recent developments indicating that horticultural professionals are increasingly accepting their role in causing plant invasions (Baskin, 2002), empirical evidence suggests that some horticulturalists ignore laws aimed at halting the sale and transport of known invasive plant species in the United States (Maki and Galatowitsch, 2004).

The approach typically adopted for addressing the alien invasive plant problem involves listing known invasive species, usually on noxious weed lists, and subsequently prohibiting their import, transport, and growth. Newly introduced plant species are deemed innocent until proven guilty, at which point they are listed and their import and sale is banned (Simberloff, 2005). Thus, such policies emphasize the need to regulate the movement of plant species only once they have been listed as noxious.

This approach, known as black listing, has been widely criticized. Specifically, such regulations are deemed ineffective due to fundamental design flaws. Because most invasions are irreversible, focusing exclusively on species known to be harmful is injudicious (Lodge and Shrader-Frechette, 2003). Thus, policies that rely on reactive adaptation strategies, such as black listing, do not effectively address the invasive plant problem.

In addition, existing American laws rooted in black listing are often ignored, suggesting low industry support (Maki and Galatowitsch, 2004). Indeed, banning the sale of certain exotic plant species, as is the intent of such regulations, could significantly reduce horticulture industry revenues. As such, a disincentive is associated with adhering to black list regulation, thus fostering low industry compliance.

Furthermore, these 'command and control' policies have been deemed economically inefficient due to their failure to consider benefits derived from the import and sale of exotic species or to internalize invasion costs (Knowler and Barbier, 2005; Perrings *et al.*, 2002; Jenkins, 2001; Doelle, 2003; Perrings *et al., 2*005; Shine *et al.*, 2000).

1.1.2.1 Black listing in Canada

Most Canadian regulations governing invasive plant species rely on a black listing approach. The application of current legislation in the context of invasive alien plant species is compromised due to limited scope, namely a focus on agricultural concerns (White *et al.*, 1993), and reactive measures (Sierra Legal Defense Fund, 2004). Furthermore, legislation to directly regulate the deliberate introduction of exotic plant species for horticultural sale in Canada has not been enacted.

The lack of specific invasive alien plant species polices in Canada is reflected in the scope of federal legislation. A review of current legislation finds that the Canadian federal government has failed to put forth a comprehensive legislative response to tackle the issue (Sierra Legal Defence Fund, 2004). For example, the species listed as noxious within the *Weed Seeds Order, 1986* (S.O.R./86-836) of the *Seeds Act* (R.S.C. 1985, c. S-8) are limited to those known to cause harm within the agriculture sector. Similarly, the regulations stemming from the *Plant Protection Act* prevent the import, export, and proliferation of pests injurious to plants, but no invasive exotic plant species have been listed as pests despite their propensity to invade and cause harm to other plants. Thus, existing federal laws aimed at regulating weed seeds, plant pests, and noxious weeds in Canada do not explicitly target invasive plant species. In fact, very few known invasive alien plant species are regulated in Canada. As such, the Canadian horticulture industry is able to sell and import live exotic plants despite the actual or potential damages associated with them.

Canadian government agency publications indicate that the federal government is aware of the invasive plant issue and has identified the horticulture industry as an important pathway (TPPWG, 2004; White *et al.*, 1993). In 2004, the Terrestrial Plants and Plant Pest Working Group (TPPWG), co-chaired by the Canadian Food Inspection Agency (CFIA) and the Ontario Ministry of Agriculture, issued a preliminary strategy, namely phase 1 of the *Proposed Action Plan for Invasive Alien Terrestrial Plants and Plant Pests*. Federal, provincial and territorial Ministers of forests, fisheries and aquaculture, and wildlife approved the plan, which includes the development of pathway analysis and the enhancement of risk assessments as decision support tools in invasive species prevention. However, the plan does not specify the degree to which the horticulture pathway will be prioritized. The Plant Health Division of the CFIA provides leadership in the implementation of the plan. In 2005, a *Proposed Implementation Plan* was drafted with timelines for each area of delivery (TPPWG, 2005). However, it is unclear when the various components of the plan will be fully implemented, due to the open-ended nature of many of the timelines.

1.1.2.2 Black listing in the United States

Similarly, legal frameworks for dealing with invasive plant species in the United States are, in practice, black lists. Under the Plant Protection Act (7 U.S.C. 7701-7772 *et seq.* Public Law 106-224, June 2000), the importation, exportation, and interstate movement of listed noxious weeds is restricted or prohibited. The noxious weed list contains 96 plant species. Thus, at least two-thirds of the approximately 300 alien plant invaders established in the continental United States are not listed as noxious weeds (Marinelli, 1996).

In order to add or remove species from the list of regulated noxious weeds, the Animal and Plant Health Inspection Service (APHIS) must conduct a pest risk analysis. However, these risk assessments are based solely on expert opinions formulated using subjective, qualitative methods, rather than on structured protocols that ensure expert opinion corresponds to the credible application of the scientific method (Lodge *et al.*, 2006; Maguire, 2004; NRC, 2002). Moreover, the screening process conducted by APHIS is only applied to a very small percentage of species being imported. Notably, many of the species found on the federal noxious weed list had established populations in the United States before they were prohibited from being imported (Lodge *et al.*, 2006). Thus, introductions of new plant species for horticultural purposes are not routinely assessed and statutes tend to regulate the movement of species that have already invaded.

Furthermore, the existing USDA regulation regarding importing plants for planting and propagation, referred to as Quarantine 37 (7 CFR 319.37), is antiquated and fails to effectively protect the US environment and economy against the introduction of harmful plant species. Quarantine 37 was established in 1919, when the volume and diversity of plants being imported was limited. Also, the protection of biodiversity and natural landscapes was not the main purpose of the regulation. Thus the regulation is not well suited to addressing the ecological risks associated with the large quantities and types of plants being imported today. As such, Quarantine 37 is currently being reviewed and revised in order to increase its relevance. APHIS is investigating ways to address the risks, including the risk of invasion, associated with introducing alien plants. Specifically, the creation of a new category of 'plants for planting' consisting of those species not authorized for import pending risk analysis (NAPRA) has been suggested (APHIS, 2005). However, the exact risk analysis protocol to be adopted has yet to be specified.

Other federal laws in the United States that could potentially be applied to addressing the invasive plant issue include the Federal Seed Act of 1939 (7 USC 1551-1611), the National Environmental Policy Act of 1970 (42 USC 4321) and the Endangered Species Act of 1973 (16 USC 1531 *et seq*.). However, none of these laws can be applied to comprehensively address the issue of deliberate introductions of potentially invasive plant species by the horticulture industry.

Clearly, North American policy aimed at addressing the invasive plant problem is plagued by fundamental deficiencies. The main limitation of the existing regulatory framework is the focus on reactive measures that overlook the risks associated with the intentional introduction of plant species for horticulture.

1.1.3 Stakeholders

Many stakeholder groups are confronted by the problem of plant invasions stemming from horticultural trade. People with stakes in the issue include those that are negatively affected by invasive ornamentals (e.g., agriculturists, park managers, and naturalists), those who derive benefits from their introduction (e.g., professional horticulturists and gardeners), as well as those who devise and evaluate strategies to address the invasive plant issue (e.g., botanists, academic experts, government researchers, land managers, government decision makers).

The successful implementation of policies is often dependent, in part, on their acceptability to a wide range of stakeholders (Altman and Petkus, 1994). Thus, an understanding of stakeholders' perceptions of the problem, as well as their preferences for strategies to address it, ought to inform the policy development and implementation process.

1.2 Research Objectives

Due to the limitations of the current policy framework, more effective policies must be developed to address the horticultural dimension of the invasive plant problem. A primary goal of this research is thus to identify and characterize policies that could be implemented to tackle the issue of potentially invasive plants being introduced for ornamental horticulture.

Due to the likelihood for divergent views of the problem and how it ought to be addressed, I investigate stakeholder perceptions of the invasive alien plant problem and possible solutions. I also intend to explain and predict how stakeholder views and perceptions influence preferences for different policies.

In sum, this research has three main objectives:

1. To identify and characterize plausible alternative policy options to address the introduction and sale of invasive plants by the North American horticulture industry.

2. To assess stakeholder perspectives of the problem and preferences for the defined policy options.
3. To determine how stakeholder perceptions, attitudes, and characteristics shape preferences for different policies.

Furthermore, a less central goal of my research is to determine if policy preferences vary significantly across jurisdictions. The cross-border nature of the invasive plant problem implies that a coordinated approach to address the issue across political boundaries is required. As such, I will compare Canadian and American stakeholders to determine whether preferences within the two countries are divergent or if they align to facilitate the development of a coordinated North American approach.

1.3 Organization of Report

In Chapter 2, I provide a review of existing literature related to the horticultural dimension of the invasive plant problem. Chapter 3 contains an overview of my approach to the research and describes the survey methodology I used to collect data and the methods applied to subsequently analyze it. Then, in Chapter 4, I present the preliminary results of the research, focusing primarily on the socio-demographic characteristics of stakeholders surveyed. The next chapter consists of the results of more detailed analyses where stakeholder groups are characterized and contrasted. In Chapter 6, the final results chapter, I show how stakeholders can be grouped according to shared attitudes and perceptions. I also indicate that policy preferences within a sample can be accurately predicted based on the percentage of respondents belonging to each of these groups. Finally, I discuss the implications and limitations of my research in Chapter 7 and highlight the main conclusions stemming from the research in Chapter 8.

CHAPTER 2: LITERATURE REVIEW

As previously mentioned, government agencies in Canada and the United States are formulating new invasive alien plant strategies that place more of an emphasis on screening protocols. Although the benefits of a preventative approach have been documented, the feasibility of applying screening procedures in the context of the invasive plant problem is debated. Here, I review literature where the viability of screening procedures is assessed as a tool for reducing the risks stemming from intentional ornamental plant introductions.

2.1 Feasibility of Screening Procedures

Prevention has been described as the "most effective, economical, and ecologically sound approach to managing many invasive species" (Windle and Chavarria, 2005, 107). A preventative policy approach consists of the use of risk assessment frameworks to determine the capacity of a plant species to cause harm when introduced to a region beyond its original range. Using both the probability of invasion and the magnitude of the impacts anticipated in the event of an invasion, the expected damages, or risk, associated with the introduction of the species can be calculated (Hughes and Madden, 2003). Thus, expected losses, stemming from the introduction of a potentially invasive plant, can be compared to expected benefits, such as horticulture sector profits, to determine if importing a specific species is likely to cause more harm than good.

Theoretically, the probability of invasion could be obtained by assessing the biological attributes of each plant species considered for introduction (Goodwin *et al.*, 1999; Finnoff and Tschirhart, 2005). In practice, the probability of invasion can be predicted with high rates of accuracy for plants belonging to some groups using post hoc tests that compare the predicted invasive potential of previously released plant species, based on biological traits, to their actual behaviour (Reichard and Hamilton, 1997). These high accuracy rates, such that a large proportion of known invasive plant species are correctly identified as invaders, have been used to promote the feasibility of screening procedures.

Nonetheless, some suggest that the high accuracy rates of screening systems developed using retrospective tests of plants with known invasive tendencies may not be maintained when applied to the import of new species. Also, the value placed on risk assessments with high accuracy rates has been questioned because, due to the low base-rate of invasions, high levels of accuracy can be achieved only in conjunction with high error rates, so many species will be misclassified as invasive (Smith *et al.*, 1999). The high numbers of false positives (Type I error) results in low levels of reliability such that many harmless alien species are denied entry. The potential for such errors may underlie the failure of most countries to implement risk analysis procedures for the introduction of exotic species (Keller *et al.*, 2007).

Furthermore, substantial difficulties exist with respect to acquiring information pertaining to environmental and economic impacts (i.e., costs) needed to conduct the assessment (Hughes and Madden, 2003; Parker *et al.*, 1999). Indeed, the prediction of long-term impacts is impossible (Henderson *et al.*, 2006). Furthermore, the inability to make generalizations about the patterns and processes that govern plant invasions impedes the completion of credible risk assessments. Risk assessments do not account for time lags, evolution, and other biological phenomena and, as such, risks are underestimated (Simberloff *et al.*, 2005). Addressing the invasive species problem within the context of a conventional risk-management framework thus proves complicated, such that decisions must be issued despite incomplete information (Horan *et al.*, 2002).

As a result, the ability to predict invasiveness remains highly uncertain and imprecise (Mack *et al.*, 2000; D'Antonio *et al.*, 2004). The most reliable predictor of a plant's ability to become invasive in the United States is information regarding the invasiveness of the species in other geographical areas

(NRC, 2002). In short, although "a conceptual basis exists for understanding invasions that could be developed into predictive principles", scientific principles or dependable procedures for identifying the invasive potential of plants are lacking (NRC, 2002, 142). Even so, policies rooted in screening procedures appear to be emerging as the favored approach. Indeed, recent research involving the application of a straightforward bioeconomic model reveals that a risk assessment strategy produces positive net economic benefits over a range of plausible assumptions, including various accuracy rates (Keller *et al.*, 2007). Nonetheless, further research with respect to quantifying the risks associated with purposeful introductions of invasive plant species would be valuable (Ewel *et al.*, 1999; Andersen *et al.*, 2004).

2.2 Novel Policies

A few possible policy options for addressing the horticultural dimension of the invasive plant problem have been formulated: white listing, industry self-regulation, and the application of economic instruments. Each of these policies can be rooted in screening procedures and applied as a preventative measure. An overview of the three novel approaches, as described in recent publications, is provided below.

2.2.1 White Listing

The most commonly promoted application of screening procedures with respect to preventing invasions by purposefully introduced species involves excluding all species unless the risk of invasion is acceptably small (Lodge *et al.*, 2006; Keller *et al.*, 2007; Biber, 1999). A 'clean' or 'white' list would denote species known to be noninvasive, and thus permitted, while all other species would be subject to a risk assessment or screening process by the relevant government agencies prior to introduction (Klein, 2004; Doelle, 2003; Shine *et al., 20*00). Non-native plant species shown to have a sufficiently low invasion risk would be added to the white list while the government would prohibit all species characterized by a high risk of invasion. White listing is a preventative, rather than reactive, approach. It involves the creation of approved lists such that the introduction of listed species is permitted while all other species are assumed to be risky and are banned (Andow, 2005). Hence, the introduction and sale of a plant species is allowed or prohibited based on the estimated capacity of the species to cause harm.

By revealing the most harmful species, risk assessments can be used to better allocate the scarce resources dedicated to regulating invasive species. Unlike current policies, where species are presumed innocent and a burden is placed on stakeholders attempting to halt the introduction of a species, screening mechanisms shift the burden of proof onto those seeking to introduce non-native species[1] (Simberloff, 2005; Biber, 1999). As a result, many more species would be prohibited (Biber, 1999). Nonetheless, assessments should be conducted by an independent agency of scientific experts that are equipped to analyze risks objectively using a rigorous and standardized procedure (Biber, 1999; NRC, 2002).

2.2.2 Industry Self-Regulation: Codes of Conduct

Horticulturalists are promoting self-regulation as a suitable approach for addressing issues surrounding invasive ornamental plants (Mezitt, 2005). Voluntary approaches are commonly managed by national industry associations and involve the persuasion of industry association members, including retailers, growers, and landscapers, to remove specific high-risk plant species from their inventories (Moss and Walmsley, 2005; Harrington *et al.*, 2003). Voluntary codes of conduct in the United States have been designed for the self-governance and self-regulation of the horticulture industry in order to limit the use and dispersal of invasive plants (Baskin, 2002; Reichard, 2004). Similar self-regulation schemes

[1] Shifting the burden of proof in this way is consistent with the notion of a safe minimum standard (SMS). In the context of species conservation, proponents of adopting an SMS approach argue that, until it is proven otherwise, conservation of a species ought to be recognized as optimal (Tisdell 1990; Berrens 2001).

have also been applied in Australia and New Zealand (Moss and Walmsley, 2005).

Most codes of conduct recognize the importance of identifying new species likely to invade and the determination of which species currently sold should be removed from inventories and gardens (Reichard, 2005). Although most voluntary schemes have focused on eliminating the sale and planting of known invasive plant species, screening procedures could also be used in industry self-regulation schemes. However, instead of government agencies implementing and enforcing the screening process using mandatory regulations, the regulation of potentially invasive plants would be administered by the industry itself.

Voluntary measures for addressing the introduction of potentially invasive plants are appealing to both government and industry. Governments often support self-regulation initiatives in order to avoid implementing potentially controversial and unpopular policies (Moss and Walmsley, 2005). From an industry standpoint, self-regulation is an attractive proactive policy approach that precludes "pre-emptive government intrusion" (Mezitt, 2005,109) by ensuring direct horticulture industry participation (Harrington *et al., 20*03). Thus, in addition to confirming that the industry is willing to accept some responsibility with respect to the invasive alien plant issue, such initiatives demonstrate a "strong preference for voluntary initiatives over legislation that would restrict plant introduction, propagation, use, and sale" (Baskin, 2002, 467).

However, voluntary efforts are not guaranteed to produce satisfactory results. Although the rejection of voluntary codes by irresponsible horticulturists is a primary concern (Reichard, 2005), the potential for horticulture industry self-regulation to fail is predominantly rooted in the characteristics of the industry itself. For example, the limited coverage of national industry associations is such that many firms are not at all compelled to adhere to codes developed by industry representatives (Moss and Walmsley, 2005). For instance, the 2,200 members of the American Nursery and Landscape Association (ANLA) represent less than 15% of the total number of floriculture growers and nursery operations in the United States. Importantly, big-box stores and supermarkets that sell garden plants are typically not members of industry associations.

Limited membership in industry associations also suggests that member firms are more likely to disregard industry association policies. Specifically, some member firms may choose not to comply with the voluntary regulations in order to remain competitive with firms outside the sphere of influence of industry associations. Therefore, the shortcomings of self-regulation are not always a simple issue of negligent horticulturalists refusing to participate. The lack of incentives associated with participating in self-regulation strategies and the presence of undeniable economic disincentives are key issues (Canton, 2005). There are also instances where industry association members will choose to ignore codes of conduct in order to generate increased profits through the sale of restricted species. Codes of conduct may thus provide a perverse incentive, motivating some member firms to sell restricted invasive plants in order to capture a market niche (Moss and Walmsley, 2005; Canton, 2005).

Recent empirical studies highlight the failure of voluntary measures in Australia, New Zealand, and the United States to significantly curb the horticultural trade of invasive plants, due to the issues outlined above (Moss and Walmsley, 2005; Canton, 2005). However, voluntary campaigns have successfully generated public awareness of the issue and increased knowledge of the invasive plant problem among horticultural professionals (Moss and Walmsley, 2005; Harrington *et al.*, 2003). As such, the development of more restrictive regulatory frameworks that apply to the entire industry in conjunction with voluntary initiatives, focused on education and accreditation, has been recommended (Moss and Walmsley, 2005; Reichard, 2005; Windle and Chavarria, 2005).

2.2.3 Economic Instruments

Economic instruments involve the application of a monetary charge, such as a tax or an environmental fee, in order to induce a change in behaviour. Taxes of this nature are typically levied on firms, such as polluting industries, whose activities result in costs to third parties. Costs of this kind are referred to as negative externalities. Taxes can therefore be applied to internalize the externality by charging the polluter for the external costs associated with emitting pollution, thereby creating the appropriate incentive for attaining the socially optimal level of pollution.

In the context of the invasive alien plant problem, the dispersal of invasive species often is referred to as biological pollution (Elliott, 2003), with nurseries and other exotic plant importers and growers considered polluters. Because the costs stemming from the deliberate introduction of exotic species are frequently borne by parties who are not necessarily responsible for causing the problem, such as farmers and naturalists, these costs are characterized as negative externalities (Barbier and Knowler, 2006; Perrings et al., 2005; Jenkins, 2001).

Economic instruments, such as taxes, import duties, tradable permits, environmental bonds, or environmental fees applied to the sale or import of all alien plant species thus have emerged as potential policy options to address horticultural trade as a pathway for plant invasions. Recent research suggests that economic instruments could be adopted to internalize the negative externalities associated with nurseries selling exotic plant species (Knowler and Barbier, 2005). Additionally, charges can act as a disincentive for those activities that increase invasion risks and can generate funds for invasive species control programs (Biber, 1999; Jenkins, 2001; Doelle, 2003).

One theoretical policy option that follows from the characterization of invasive plants as biological pollution involves the application of a variable tax to the sale of all newly imported non-native plant species. The tax rate is dependent on the likelihood of invasion of a species and its potential damages, such that species found to have higher expected damages are associated with a higher tax rate than those plants with a lower expected damages (Knowler and Barbier, 2005). Consequently, through the impact of a variable tax on selling price, purchasers of potentially harmful plant species are provided incentives to change their behaviour and the likelihood of invasion associated with their activities is reduced (Touza *et al.* in press). Furthermore, because it relies on screening procedures to determine the invasive potential of non-native ornamental plants, a variable tax policy can be categorized as a preventative strategy for dealing with the risks associated with the horticultural pathway. As such, variable tax policies are not designed to generate revenues for controlling established invasive plants, although the funds collected through a variable tax could potentially be used to fund control efforts. A fixed environmental fee, where a fixed monetary charge is imposed on the sale of all non-native plant species, is a policy option more likely to be implemented with the goal of collecting funds earmarked for control efforts.

The idea of applying economic instruments, such as taxes, to the problem of biological pollution stems from their effectiveness in addressing standard pollution problems (Shine *et al.*, 2000). Indeed, taxes are promoted as a policy tool because "an efficient tax rate forces polluters to fully internalize the costs of their activities" (Biber, 1999, 441). Furthermore, many features of invasion events are comparable to those of standard pollution problems, including ozone layer depletion (Biber, 1999) and oil spills (Jenkins, 2002). The traits shared by biological pollution and standard pollution include general and diffuse damages arising from the cumulative effect of a multitude of small, disperse, actions that are associated with some degree of risk.

However, despite the similarities between biological and standard pollution problems, significant differences exist. Novelty and irreversibility are characteristics of biological pollution that differ from many standard types of pollution (Horan *et al.*, 2002). Unlike typical pollution problems, in which the level of pollution can be measured, there are no measures of how invasive species compromise biological integrity (Miller and Gunderson, 2004). Moreover, invasions occur almost unnoticed and, hence, establishing obvious responsibility is rarely possible (McNeely, 2001). In addition, "unlike chemicals, biological entities reproduce and spread autonomously, often over great distances, and can even evolve to adapt to changing conditions" (Simberloff, 2005, 216). Invasions are ongoing and not site-limited (Shine *et al.*, 2000). Therefore, notable differences exist between externalities as traditionally understood in economics and biological invasions (Perring *et al.*, 2000). Consequently, the economic instruments typically used to address conventional pollution problems may not be as effective in internalizing the externalities associated with biological pollution.

Finally, although determining the optimal level of the tax is shown to be dependent on the profitability of the exotic plant species and the level of risk associated with its introduction (Knowler and Barbier, 2005), the effective use of taxes is compromised by difficulties surrounding setting the optimal, or efficient, taxation level (Biber, 1999). Indeed, the optimal level at which to set a tax in the context of invasive plants is sensitive to many unknown or uncertain parameter values (Knowler and Barbier, 2005). The lack of necessary data combined with the "stochastic and ex ante nature of the invasion problem" results in the need to adopt many "heroic assumptions" when designing taxes in this context (Knowler and Barbier, 2005, 13). As such, the application of the polluter pays principle to biological pollution is controversial and complex.

2.3 Knowledge Gap

The merits and limitations of the policy options outlined above have been discussed at length within the literature. Clearly, existing policies are failing to adequately address the horticultural dimension of the invasive plant issue and screening-based policies are emerging as potential alternatives.

Although several competing policy alternatives rooted in screening have been formulated, stakeholder preferences for novel policies relative to one another, as well as to the status quo, have not been established. A recent survey of horticulture industry professionals in one U.S. state, namely Minnesota, revealed that preferences for government regulation and industry self-regulation were equal (Peters *et al.*, 2006). However, only members of the horticulture industry were surveyed and descriptions of the policies were not provided to survey respondents.

The latest research into the preferences of nursery and landscape professionals with respect to strategies to limit the sale and use of invasive plants failed to include screening procedures as an option provided to respondents (Gagliardi and Brand, 2007). While the study revealed that professional horticulturists in Connecticut preferred approaches involving the sale of sterilized invasive plant varieties or the marketing of non-invasive alternatives, the authors ignored the problem of newly introduced plants escaping the garden prior to being deemed invasive. In addition, links between respondent perceptions and their preferences for the solutions described were not established. Interestingly, the study also indicated that statewide bans and taxation strategies were the least preferred approaches and that self-regulation was preferred to mandated bans.

Furthermore, the effect of stakeholder group membership and stakeholder attitudes on preference for competing policies has not been quantified or assessed. Given the potential for divergent stakes with respect to the issue as well as heterogeneous views of what the problem is and which considerations should be prioritized when formulating a strategy to tackle invasive ornamental plants, information to clarify the links between policy preferences and stakeholder perspectives could serve to facilitate the policy development and implementation process.

The dearth of information pertaining to stakeholder preferences for a variety of plausible policy options to reduce the invasion risk associated with horticultural activities serves as the catalyst for this research. As discussed in detail in the subsequent sections, I have analyzed the data obtained using a detailed stakeholder survey with the aim of revealing and explaining stakeholder preferences for a range of alternative policy options.

CHAPTER 3: APPROACH & METHODS

This chapter describes the methodology I used to collect and analyze the data in order to achieve the stated research objectives. First, the general approach that I utilized is outlined. Then, I explain how policies and stakeholder groups were identified. Finally, I provide a detailed description of the survey methodology and the data analysis techniques used.

3.1 General Approach

As described in detail below, the information collected during literature review was used to describe and define policy options and stakeholder groups. Then, a web-based survey was distributed to potential members of defined stakeholder groups residing in Canada and the United States. The resulting data were analyzed using basic statistical analyses, principal components analyses, as well as a multinomial logit model. These analyses provided the results used to draw conclusions about stakeholder preferences for the policy options and make recommendations regarding the development and implementation of policies to address the problem of potentially invasive plants being introduced for horticultural purposes.

3.2 Identifying and Describing Policies and Stakeholders

3.2.1 Policies

Plausible policy options were obtained by reviewing the existing policy framework for dealing with invasive ornamentals in North America (see section 1.1.2) and the literature describing new approaches for preventing the introduction of exotic horticultural plant species (see section 2.2). Similar policies were grouped together and classified based on defining attributes.

For inclusion in the stakeholder survey, the policy options were simplified and described using two main elements: the process used to regulate the import and sale of invasive plants and the implementation and enforcement strategy applied. The first element was distilled into two considerations, namely how plant species are determined to be invasive and how the import and sale of invasive species is restricted. Approaches were then specified for each consideration (Table 3.1). Table 3.2 depicts how policy options were presented to respondents in the survey. All possible permutations associated with the approaches listed yields twelve unique options. However, to maintain the relevance of the study and to avoid burdening respondents with ranking a large number of options, only the five most plausible options were included. Definitions of the terms in bold were also provided to respondents (Table 3.3).

Table 3.1: Approaches used to describe policy options

Elements	Considerations	Approach
Process used to regulate the import and sale of invasive plants	How plant species are determined to be invasive	Black list Screen
	How the import and sale of invasive plants is regulated	Ban Variable tax Fixed environmental fee
Implementation and enforcement strategy	How the regulation is implemented and enforced	Mandatory Voluntary

Table 3.2: Presentation of policy options to survey respondents

	Policy options				
	Option 1	Option 2	Option 3	Option 4	Option 5
Import & sale	**Black list** and **ban** all species listed	**Screen** and **ban** species with a high likelihood of invasion	**Screen** and **ban** species with a high likelihood of invasion	**Screen** and **variable tax**	**Fixed environmental fee**
Implement & enforce	**Mandatory**	**Mandatory**	**Voluntary**	**Mandatory**	**Mandatory**

Table 3.3: **Definitions of terms used to describe policy options**

IMPORT AND SALE	
Black List:	Creating lists of non-native plant species known to be invasive in a given region. Only species that have already invaded in a region will be listed.
Screen:	Assessing the likelihood that newly imported non-native plant species will become invasive. Only species that have a high likelihood of invasion will be considered invasive. [2]
Ban:	Completely prohibiting the import and sale of all plant species that are considered invasive.
Variable Tax:	Imposing a variable monetary charge on the sale of newly imported non-native plant species. The tax rate is dependent on the likelihood of invasion of a species (i.e., the sale of species that are more likely to invade is associated with a greater charge).
Fixed Environmental Fee:	Imposing a fixed monetary charge on the sale of all non-native plant species.
IMPLEMENT AND ENFORCE	
Mandatory:	Imposed and enforced by the government.
Voluntary Self-regulation:	Imposed and enforced by the horticulture industry (e.g., voluntary codes of conduct).

3.2.2 Stakeholders

In conducting the literature review I obtained an understanding of the problem of potentially invasive plants being introduced for horticultural purposes that allowed me to define groups of individuals that are confronted, directly or indirectly, by the problem. Thus, those blamed for causing the problem, those most affected by the problem, those seeking to solve the problem, and/or those potentially affected by policies devised to tackle the

[2] The simplified version of white listing provide here, where the probability of invasion is used as a proxy for risk, might be more feasible given that techniques for estimating the probability of invasion appear more refined than methods aimed at quantifying the impacts stemming from invasions. Due to the complexity inherent to assessing the impacts of a species once established (Hughes and Madden 2003; Parker *et al.* 1999; Henderson *et al.* 2006), the simplification involves ignoring the costs component of risk analysis and focusing solely on the probability of invasion (e.g., see Jefferson *et al.* 2004). Instead, a precautionary approach is adopted such that plant species with high probabilities of invasion are banned in the absence of information pertaining to the magnitude of the resulting impacts. Although the risk associated with species having a low probability of invasion in concert with immense potential negative impacts once established is thus discounted, focusing on the probability of invasion appears to improve the practicality and feasibility of screening at present.

problem were all defined as stakeholders and classified into discrete stakeholder groups.

As such, individuals from the following groups were surveyed: *professional horticulturalists* (nursery and garden centre owners, managers, and staff, professional landscapers, professional gardeners, and horticulture industry representatives), *hobby gardeners*, *agriculturalists* (farmers and ranchers, agriculture industry representatives, agricultural weed management specialists, extension agents, and fieldmen), *park managers and staff*, *experts* (government researchers, academic researchers, botanists, and botanical garden curators and technicians), and *naturalists and conservationists*.

3.3 Web-Based Survey Methodology

3.3.1 Design

The online survey was designed in accordance with the Tailored Design Method developed by Dillman (2007), with particular design elements incorporated to tailor the survey to the survey situation, namely the use of a web-based format.

The first page of the survey briefly stated the objective of the survey and provided respondents with basic instructions (Figure 3.1). Prior to logging on and accessing the survey questions, respondents were provided with information detailing the purpose of the study and the scope of the survey. A link to definitions of key terms used throughout the survey was provided along with links to contact information and a privacy policy. Pop-up windows opened when respondents clicked on these links (Figure 3.2). The privacy policy outlined the voluntary nature of the study and assured respondent confidentiality and anonymity. Contact information consisted of an email address where participants could direct questions, comments, or concerns.

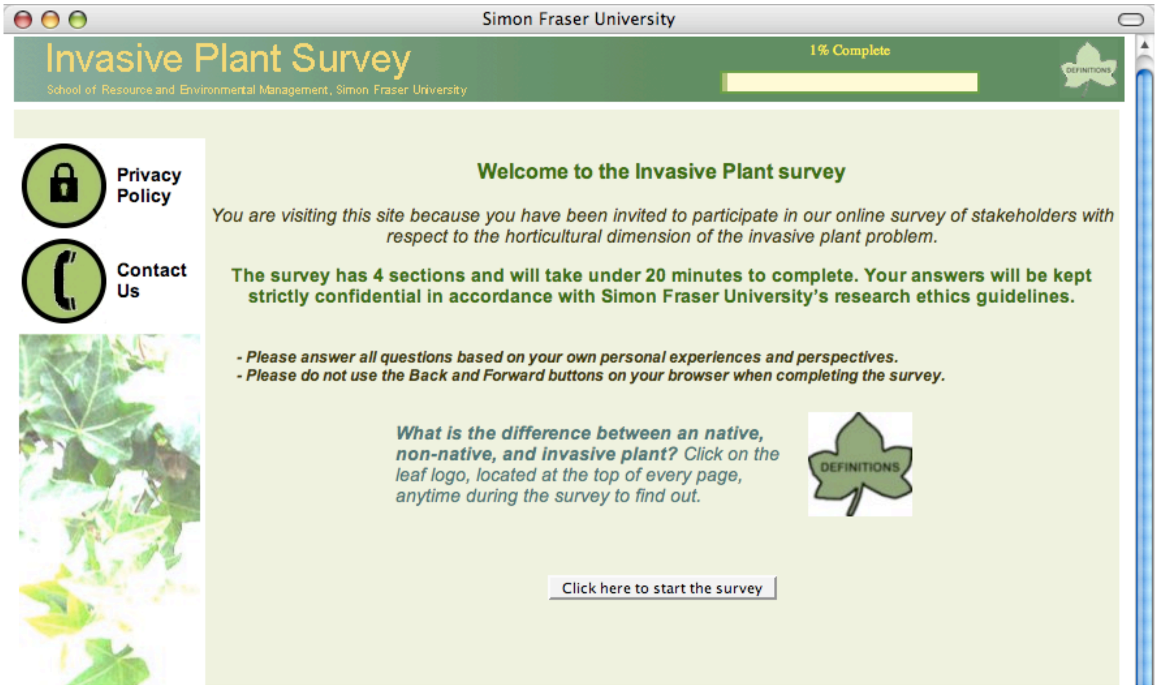

Figure 3.1: Introductory page of online survey

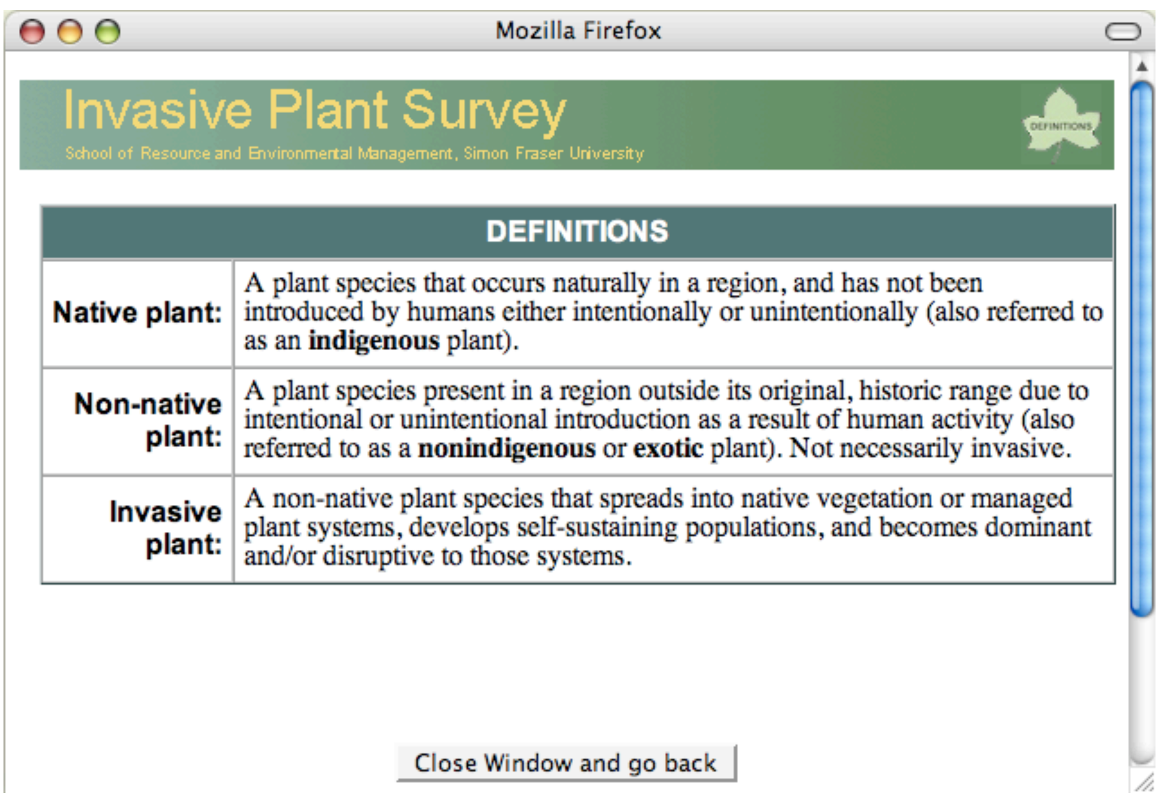

Figure 3.2: Pop-up window containing definitions

To begin the survey, participants clicked on a clearly labelled button situated at the bottom of the page. Similar buttons were used throughout the survey to proceed from one survey page to the next and to close pop-up windows. A status bar and a link to the definitions of key terms were placed in the survey header, which appeared on every page of the survey. Colours and fonts were applied consistently throughout the survey (e.g. Figure 3.3).

Radio buttons were used for most questions such that respondents could only choose one of the response categories provided. A 'check all that apply' format was adopted for one question and drop-down menus were used to select area of residence. Additionally, the only open-ended question consisted of a text box provided for respondents to enter the town/city of residence. All the other survey questions were close-ended.

Where applicable, neutral or 'no opinion' categories were provided for opinion questions and 'none of the above' or 'other' options were provided for questions with unordered response categories. Many of the opinion questions contained scalar response categories, such as 3- or 5- point Likert scales (Figure 3.3).

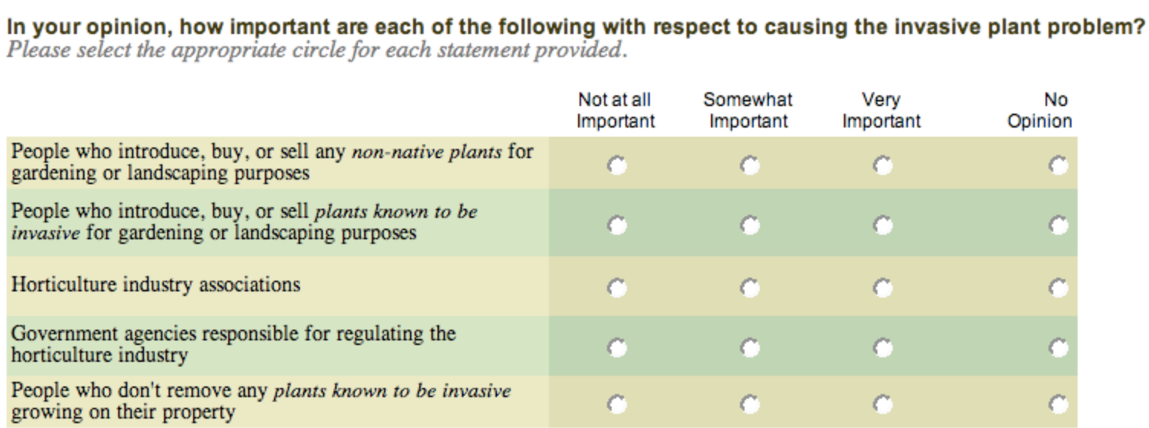

Figure 3.3: Question demonstrating the use of a 3-point Likert scale, the inclusion of a 'no opinion' option, and the use of font and colour to enhance clarity

On the final page of the survey, respondents were provided a text box in which they could enter any comments regarding the survey or the invasive plant issue.

The survey consisted of four sections: an introductory section containing background questions, a policy section where respondents were asked to rank five policy options, an attitude section aimed at highlighting stakeholder perceptions of the invasive plant problem, and a socio-demographic section where respondents were asked to provide information such as age, gender, income, and place of residence (Appendix A).

In the first section, survey respondents were required to select the capacity in which they were confronted by the invasive plant problem from a list of specified groups, thus identifying the stakeholder group to which they belonged. Then, members of each stakeholder group were presented specific questions to clarify their stakes with respect to the issue. After those questions were completed, all survey respondents were presented the same set of questions (Appendix A, sections 1.8 to 4).

The survey was programmed using logic to guide respondents through the survey automatically such that, where applicable, respondents were directed to the appropriate page based on their response to a specific question. Respondents were not forced to answer most of the questions; however they were unable to skip questions that determined which set of questions would be viewed next.

3.3.2 Sampling Plan

A link to the online survey was sent to individuals belonging to the stakeholder groups identified in section 3.2.2. Individuals residing in specific Canadian provinces and American states were recruited as study participants (Figure 3.4).

In Canada, respondents were recruited from British Columbia (BC), Saskatchewan (SK), Ontario (ON), and New Brunswick (NB). In addition, stakeholders residing in Alberta were recruited in order to conduct a pilot test of the survey (see 3.3.3). In the United States, stakeholders residing in the states of California (CA), Montana (MT), Ohio (OH), Connecticut (CT), and Florida (FL) were recruited. These nine jurisdictions were selected to ensure that the survey respondents were distributed across the North American continent from a wide range of ecological regions[3]. As such, the sample included stakeholders from different geographical and ecological regions.

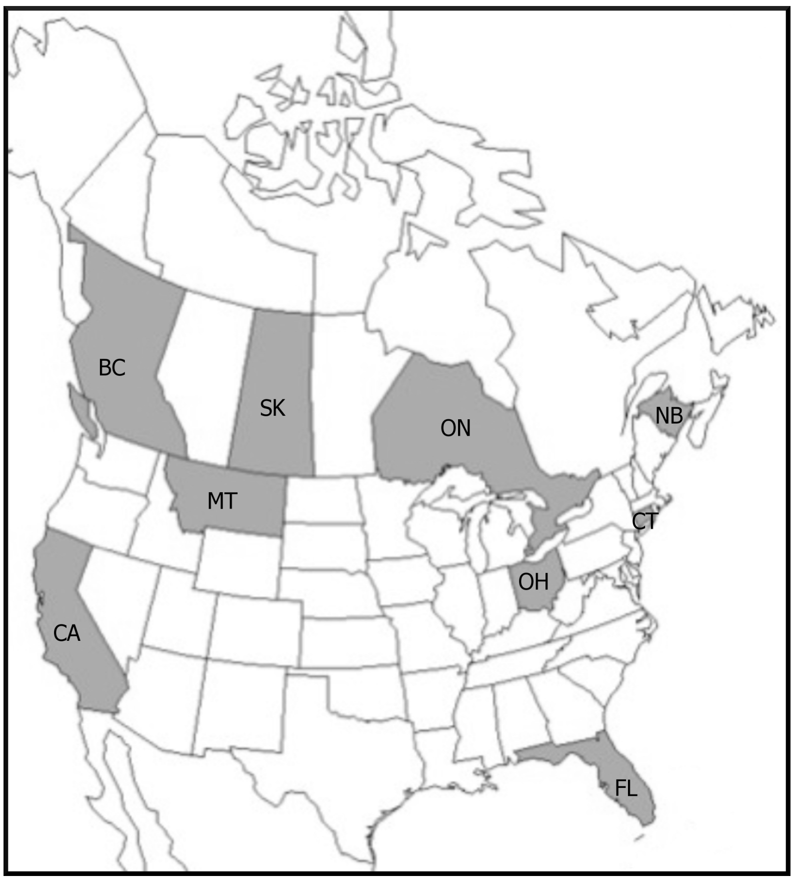

Figure 3.4: Sample jurisdictions in Canada and the United States

[3] Due to the vastness of both the Great Plains ecoregion (which stretches from Montana to Texas) and the Eastern Temperate Forest ecoregion (extending south of Ohio into eastern Texas and east of Ohio to the Atlantic coast), respondents from the central U.S. states were not included in the sample. As such, respondents from the largest number of ecoregions were represented while sampling within jurisdictions along both sides of the U.S.-Canada border and maintaining the feasibility of the study by minimizing the number of sample jurisdictions .

The scope of the sampling was advantageous in that it allowed for the collection of data from key regions, both politically and ecologically, across the North American continent. By restricting the sample to four provinces and five states, I was also able to maintain the practicability of the study given the time needed to collect stakeholder contact information, as described below. However, a lack of data for a significant portion of the continent results from the uneven nature of the sample coverage, especially in the United States.

All study participants were contacted via email. The names and contact information, particularly email addresses, of individuals belonging to the identified stakeholder groups within the nine jurisdictions were collected via Internet searches using the Google™ search engine. Search terms used included names of states and provinces and key words related to invasive plants and to the various stakeholder groups. For example, email addresses were obtained from the following sources: academic and government websites, staff lists and board of director pages from the websites of industry and non-governmental organizations, and commercial websites. As such, all email addresses were obtained from publicly accessible sources.

Table 3.4: Number of emails sent to North American stakeholders

Jurisdiction		Number of Emails Sent	
Canada	British Columbia (BC)	698	1952
	Saskatchewan (SK)	339	
	Ontario (ON)	736	
	New Brunswick (NB)	179	
United States	California (CA)	1720	5044
	Montana (MT)	576	
	Florida (FL)	972	
	Connecticut (CT)	640	
	Ohio (OH)	1136	
Total		**6996**	

The number of individuals contacted varied between jurisdictional areas due to discrepancies in population size and prevalence of the stakeholder groups being explicitly targeted. Therefore, the sampling plan was not intended to produce a representative sample of the North American population. To account for the possibility of low response rates and undeliverable emails (i.e., erroneous or outdated email addresses), the number of initial emails sent to potential respondents in each jurisdiction was high (Table 3.4). Furthermore, those contacted were able to invite others to participate in the study, thus potentially increasing the total number of respondents.

Data were collected and stored on a secure server. Duplicate responses were avoided by providing recruited participants with a username and password such that they could log on to and complete the survey only once. Individuals that obtained the survey indirectly were not provided with a unique username and password, but the IP addresses of all respondents were recorded in order to detect and eliminate duplicate responses.

3.3.3 Survey Testing and Launch

A preliminary test of the online survey was conducted on September 7, 2006, prior to the official launch. Students from Simon Fraser University's School of Resource and Environmental Management, friends, and family were asked to pretest the survey. Testers were encouraged to provide written feedback relating to all facets of the survey, including design, content, and clarity. The time taken to complete the survey and any technical issues were also recorded. In total, twenty-four people tested the survey and provided feedback.

After modifying the survey based on the initial pretest, the survey was administered to stakeholders residing within a jurisdiction that was not included in the official sample, namely Alberta. A link to the online survey was sent via email to 466 stakeholders residing in Alberta on September 11, 2006. Pilot study participants were asked to complete the survey and provide feedback in comment boxes provided on each page of the survey. Responses were also inspected for patterns that may suggest biases, misunderstood instructions, or poorly constructed response scales. A reminder email was sent to pilot study participants six days after the initial mailing. Three days later, final reminder emails were sent to those who had not started the survey and to those who had started, but not finished, the survey. Thank you emails were sent to those who had completed the survey (see Appendix B). In total, 123 Albertans, 31% of those invited, participated in the pilot study.

Once the pretesting was completed and any necessary revisions were made, the finalized survey (Appendix A) was sent to the actual sample. An email containing an invitation to participate in the study and a link to the survey was distributed to potential respondents. Initial emails were sent to all jurisdictions, except Ohio, on October 23, 2006. The emails to stakeholders in Ohio were sent one week later. Thank you/reminder emails were sent eight days after the initial emails. Approximately ten days later, final reminders were emailed to those that had yet to complete the survey. Final thank you emails were sent to all participants on November 27, 2006 (Appendix C).

3.4 Data Analysis

Data collected through the online survey were analyzed using a variety of statistical methods. The composition and characteristics of the entire sample were investigated using basic descriptive analyses. Then more detailed analyses, including one-way analysis of variance (ANOVA) tests, principal components and cluster analyses, and multinomial logit modelling, were conducted.[4]

3.4.1 Initial Statistical Analyses

To identify significant differences between groups for responses to questions with nominal response categories, the Pearson's chi-squared test was

[4] Respondents that did not identify themselves as a member of one of the six main stakeholder groups were excluded from the sample for the more detailed analyses.

employed using SPSS. For responses to questions with ordinal response categories, such as Likert scales, means for the different groups were calculated and compared. By comparing means using the one-way ANOVA procedure in SPSS, differences between groups were highlighted with respect to: awareness and perceptions of the problem, outlooks regarding the importance of various considerations when solving the problem, and preferences for the policy options.

The adherence of the data to the assumptions associated with the one-way ANOVA, namely that the dependent variable is normally distributed and has the same variance in each category of the independent variable, was tested prior to conducting the analyses. SPSS was used to calculate the Levene test statistic for homogeneity of variance.

The one-way ANOVA is robust and departures from normality are not a concern unless sample sizes are very small or the data are highly nonnormal (Elliott and Woodward 2007). The validity of the analysis is only slightly affected by even considerable departures from normality (Zar, 1999). Indeed, according to the central limit theorem, "sample means are approximately normal for sufficiently large sample sizes", where sample sizes exceeding forty are considered sufficiently large (Elliot and Woodward, 2007, 26). Thus, because sample sizes in this research are greater than forty, the survey data can be analysed using parametric tests, such as the one-way ANOVA procedure.

Although heterogeneous variances are problematic if the sizes of the samples being compared are unequal, resulting in the possibility that the probability of a Type I error will deviate from α, the assumed level of statistical significance, ANOVA is robust for moderate deviations from equal variances. However, acceptable differences in variances decrease as differences in sample sizes increase.

Where variances were unequal, a Tamhane post hoc multiple comparisons test, which is appropriate when variances and sample sizes are unequal (Tamhane, 1979), was used to substantiate the differences revealed by the ANOVA. Where variances were equal, post hoc Hochberg GT2 multiple comparisons tests were conducted. The GT2 approach is conservative and can be used when sample sizes are unequal (Stoline, 1981, Toothaker, 1991). Finally, most multiple comparison procedures are robust to departures from normality (Toothaker, 1991).

3.4.2 Principal Components Analysis and Multinomial Logit Modelling

Principal components analyses (PCA) were also conducted, using the Factor Analysis tool in SPSS with a Varimax rotation, to derive orthogonal components based on two sets of attitudinal variables. Specifically, the group of seven variables relating to perceptions of the problem and the set of seven variables representing respondents' views regarding considerations associated with selecting a strategy were summarized using PCA. Each principal component is a construct representing the relationships between variables belonging to a set (Kline, 1994). Component loadings as well as component scores for each respondent were calculated. Component loadings were used to determine the correlation between each variable and the principal component, while component scores were used to segment the sample into homogeneous clusters, as described below.

Using cluster analysis, respondents were grouped on the basis of similarity with respect to principal component scores yielded by the PCA. The Hierarchical Cluster tool in SPSS was applied to group respondents using Ward's method. The resulting agglomeration schedule was used to determine the optimal number of clusters. As such, homogeneous segments of respondents were identified based on component scores associated with each of the original sets of variables. In other words, clusters formed from the seven variables associated with perceptions of the problem were created independently from clusters derived from the seven strategy consideration variables.

Clusters were then characterized by taking the mean of the principal component scores within each cluster for each of the principal components to determine which principal component, if any, dominated each cluster. The composition of each cluster was also assessed from a socio-demographic standpoint.

Finally, the segmentation of the sample into clusters was used to estimate a multinomial logit model[5] using the LIMDEP software package. Cluster membership was treated as the input variable, and the resulting model was used to predict which policy option would be most preferred by respondents based on sample characteristics, such as cluster membership.

Multinomial logit models are most commonly used for nominal outcomes and can be specified such that only characteristic effects, such as group membership or demographic traits, are considered. These models are applicable to data that are individual specific. A multinomial logit model is thus applicable to the current research context, where respondent characteristics will be used to predict the probability of policy preference.

Multinomial logit models are based on the framework of utility maximization with respect to the choice of a preferred alternative or, in this case, policy option, from a menu of inherently unordered alternatives. Assuming that utility is a linear function of determining variables, the utility that the *i*th person ($i = 1, \ldots, N$) derives from selecting the *j*th alternative ($j = 1, \ldots, M$) when presented *M* alternatives to choose from can be calculated as

$$U_{ij} = \sum_{r=1}^{R} \beta_{jr} X_{ir} + \varepsilon_{ij} = Z_{ij} + \varepsilon_{ij} \qquad (3.1)$$

where the values of the *R* variables representing the characteristics of the *i*th person are X_{ir}, $r = 1,\ldots,R$ and β_{jr} is the coefficient associated with the *r*th characteristic for the *j*th alternative. Thus, an increase in X_{ir} will result in an increase in utility for person *i* from choice *j* if β_{jr} is positive and will cause a

[5] The multinomial logit modelling is not a central component of the current research. The model is applied as an initial attempt to link respondent perceptions to policy preferences. Refer to Borooah (2002) for a complete discussion of the multinomial logit model.

decrease in utility if β_{jr} is negative. The error term (ε_{ij}) accounts for the inexactness of the relationship between utility and the determining variables.

Within this framework, a respondent will choose policy option $j = m$ only if it provides the highest level of utility when compared to the other policy options in the choice set.

If the policy option selected first by person i is represented by a random variable, Y_i, having a value ($j = 1, \ldots, M$), the normalized logit model, assuming that the error terms ε_{ij} ($j = 1, \ldots, M$) are independently and identically distributed with a Weibull distribution, is:

$$\Pr(Y_i = 1) = \frac{1}{1 + \sum_{j=2}^{M} \exp(Z_{ij})} \tag{3.2.1}$$

$$\Pr(Y_i = m) = \frac{\exp(Z_{im})}{1 + \sum_{j=2}^{M} \exp(Z_{ij})} \quad m = 2, \ldots, M \tag{3.2.2}$$

The multinomial logit model can be used to predict probabilities by computing the mean of Z_{ij} across all respondents for each policy option $j = 1, \ldots, M$ as

$$\begin{aligned} \bar{Z}_j &= \sum_{i=1}^{N} Z_{ij} / N = \sum_{i=1}^{N} \left(\sum_{r=1}^{R} \beta_{jr} X_{ir} \right) \Big/ N \\ &= \sum_{r=1}^{R} \beta_{jr} \left(\sum_{i=1}^{N} X_{ir} / N \right) = \sum_{r=1}^{R} \beta_{jr} \bar{X}_r \end{aligned} \tag{3.3}$$

such that the predicted probabilities can be calculated as

$$\hat{p}_1 = \frac{1}{1 + \sum_{j=2}^{M} \exp(\bar{Z}_j)} \tag{3.4.1}$$

$$\hat{p}_m = \frac{\exp(\bar{Z}_j)}{1 + \sum_{j=2}^{M} \exp(\bar{Z}_j)} \quad m = 2, \ldots, M \tag{3.4.2}$$

and, consequently, the *m* logit has the form:

$$\log\left(\frac{\Pr(Y = m)}{\Pr(Y = 1)}\right) = \sum_{r=1}^{R} \beta_{mr} \bar{X}_r = \bar{Z}_j, \ (m = 2, \ldots, M). \tag{3.5}$$

Equation 3.5 represents the log risk ratio. Therefore, the sign of β_{mr} is indicative of the direction of change in the risk-ratio induced by small changes in $\bar{X}_r$. Specifically, the probability of $j = m$, relative to $j = 1$, increases if β_{mr} is positive and decreases if β_{mr} is negative.

The LIMDEP software package was used compute the means for specified sample characteristics ($\bar{X}_r$), namely cluster membership, as well as the associated coefficients (β_{mr}). These coefficients represent the additional contribution of cluster membership to the relative probability of each of the novel policy options (m = 2, 3, 4, 5) being selected first, as compared to the status quo policy option.

Equation 3.5 was applied to calculate the average log risk ratio, $\bar{Z}_j$, and the predicted probabilities of each policy option being preferred most were obtained using equations 3.4.1 and 3.4.2. The effects of changes in $\bar{X}_r$ on the predicted probabilities of each policy option being selected first were then modelled. I was thus able to ascertain how change in cluster membership affects preferences for the policy options.

CHAPTER 4:
RESULTS – INITIAL ANALYSES

In this section, I outline the preliminary results obtained from the stakeholder survey. First, I provide the survey response rate. Then, I describe the sample as a whole based on demographic information, reported levels of familiarity with invasive alien plants amongst respondents, and extent to which respondents claim to have been affected by invasive alien plants.

4.1 Survey Response Rates

In total, 1801 completed surveys were collected, of which 1300 originated from the recruited sample (Table 4.1). Individuals who received the survey from a member of the recruited sample completed the remaining 501 surveys. The survey response rate for the recruited sample, once undeliverable email addresses were removed, was calculated to be 22%. However, the Canadian response rate was slightly higher than the response rate in the United States.

Only completed or nearly completed surveys were retained for analysis; survey records having a high proportion of unanswered questions were discarded while those with many missing data points were excluded from many analyses. In addition, survey responses were removed from the dataset when respondents did not identify themselves as affected by the invasive plant problem in any capacity. Once these cases were removed, the data set contained 1740 observations.

Table 4.1: Survey Response Rates

Jurisdiction		No. of Valid Email Addresses	No. of Completed Surveys	Response Rate	
Canada	BC	598	187	31%	24%
	SK	283	58	20%	
	ON	643	177	28%	
	NB	163	25	15%	
United States	CA	1485	313	21%	20%
	MT	434	90	21%	
	FL	863	208	24%	
	CT	541	108	20%	
	OH	981	134	14%	
Total		**5991**	**1300**	**22%**	

4.2 Descriptive Analysis

The characteristics of the entire sample (n = 1740) are presented here. Specifically, I outline the socio-demographic composition of the sample as well as the extent to which respondents were aware of, and affected by, the invasive plant problem.

4.2.1 Demographics

Slightly more than half, 51%, of the respondents were female. The average age of respondents was between 41 and 50 years. Sixty-one percent of respondents were between 41 and 60 years old. Moreover, female respondents tended to be older than male respondents (Figure 4.1).

The majority of those that provided their employment status (70%) were employed full time (Figure 4.2). The sample consists primarily of well-educated individuals, with 40% having completed university and 31% having obtained a post-graduate degree (Figure 4.3). Less than 1% of respondents had not completed high school.

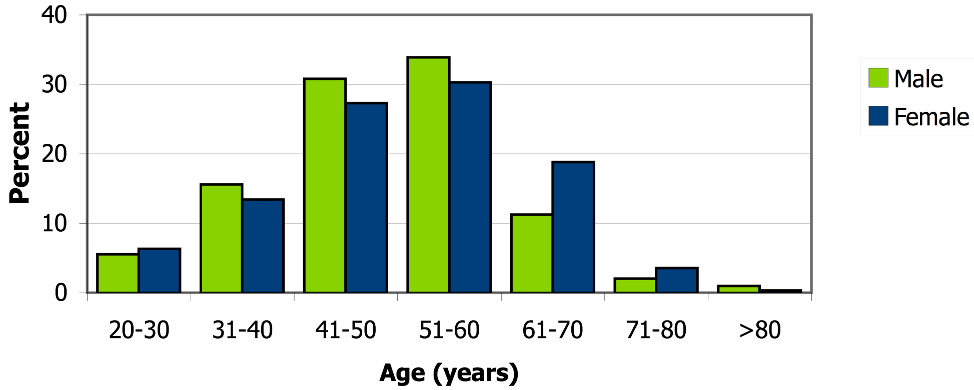

Figure 4.1: Age distribution among male and female respondents (n=1707)

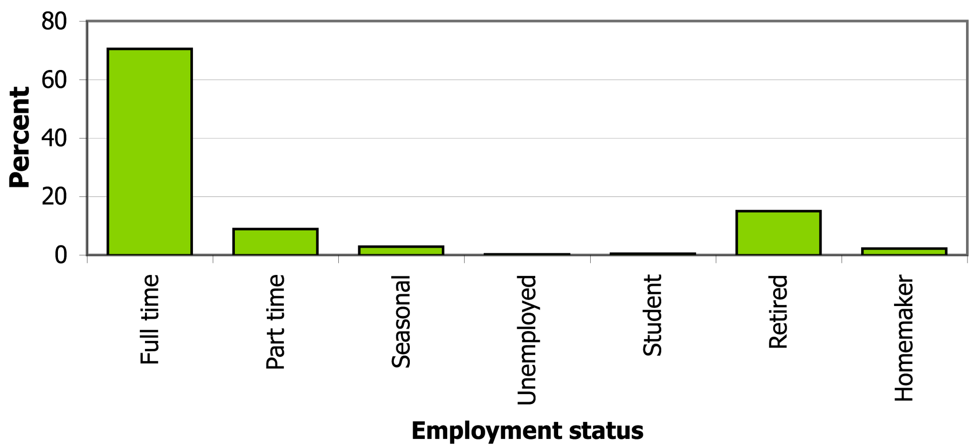

Figure 4.2: Employment status of respondents (n=1705)

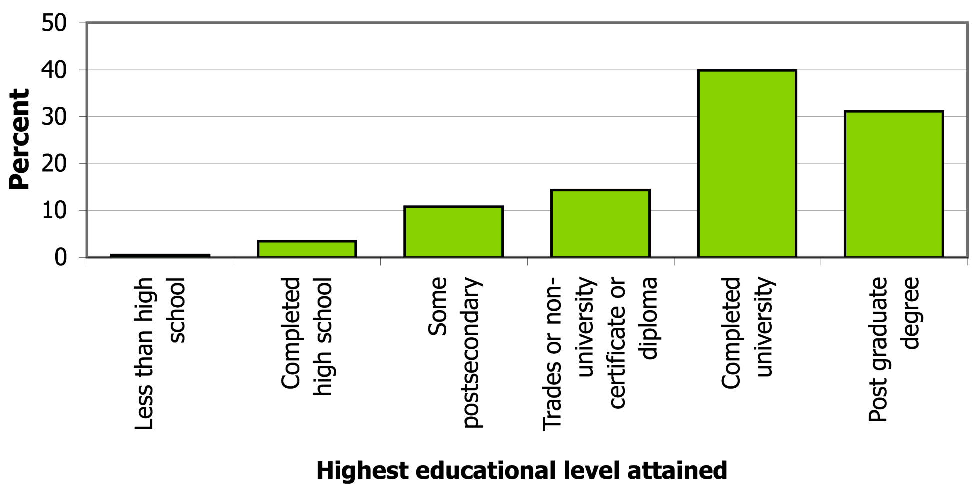

Figure 4.3: Respondent education level (n=1722)

When asked to provide annual household income level in the currency of their country of residence, the greatest proportion of respondents (28%) reported an annual household pre-tax income of between $50,000 and $74,000 (Figure 4.4). Fifty-nine percent of respondents lived in the United States while 41% of respondents were residents of Canada. The vast majority (98%) of respondents lived in one of the nine key sample jurisdictions. Figure 4.5 illustrates the percentage of respondents residing in each of the nine jurisdictions.

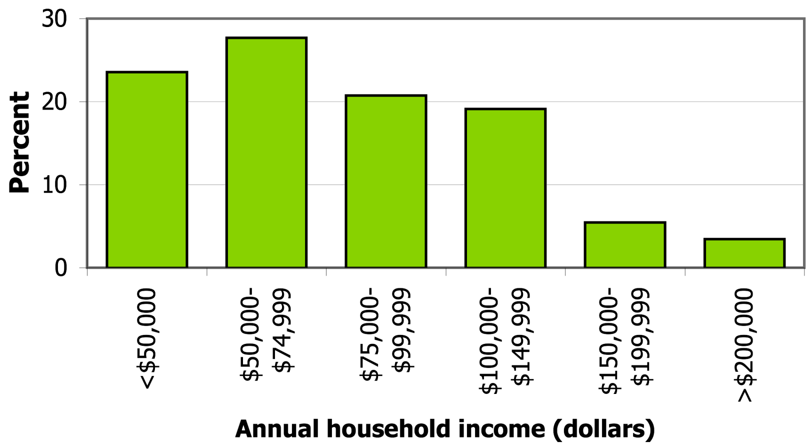

Figure 4.4: Annual household income, before taxes (n=1583)

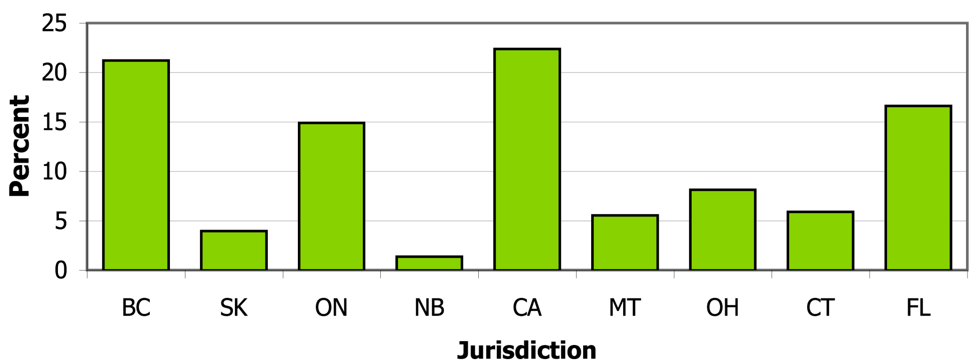

Figure 4.5: State or province of residence (n=1697)

The socio-demographic traits of the sample differed from those of the general population of Canada and the United States. When compared to census data from both countries, the sample was slightly older, more educated, and characterized by higher annual household incomes (Table 4.2).

Table 4.2: Comparison of sample traits to characteristics of the general public

DEMOGRAPHIC VARIABLE	SAMPLE	CANADA[1]	UNITED STATES[2]
Mean Age	41-50 years	40-49 years*	40-49 years♦
Modal Age	51-60 years	40-49 years*	40-49 years♦
Completed university	40%	13%†	20%¥
Obtained Postgraduate degree	31%	5%†	10%¥
Modal Annual household income	$50,000-74,999	<$50,000▲	<50,000§
Annual household income between $50,000-$74,999	28%	17%▲	18%§

[1] Statistics Canada
* 2006 data (last updated 2006)
† 2001 data (last updated 2004)
▲ 2005 data (last updated 2007

[2] U.S. Census Bureau
♦ 2000 data (last updated 2004)
¥ 2001 data (last updated 2006)
§ 2006 data (last updated 2007)

4.2.2 Knowledge, Experience, Attitudes, and Perceptions

As illustrated in Figure 4.6 and Figure 4.7, respondents considered themselves more familiar with the invasive plants present in their area of residence than with existing government regulations and laws dealing with the invasive plant problem.

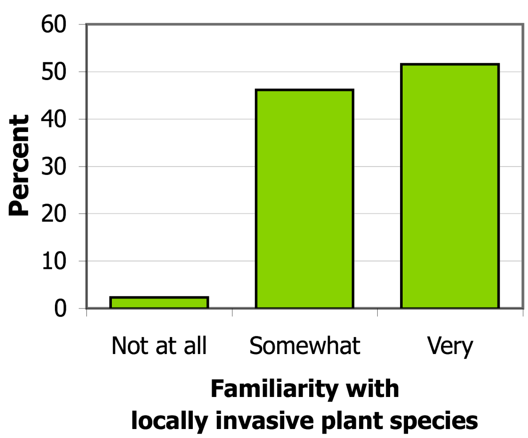

Figure 4.6: Familiarity with local invasive plant species (n=1723)

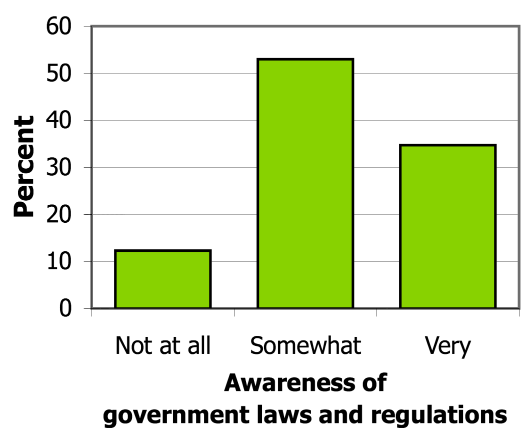

Figure 4.7: Awareness of laws and regulations (n=1736)

Furthermore, most respondents indicated that they were very much affected by the invasive plant problem in at least one respect while very few felt they were not at all affected by the problem in any way. Interestingly, the proportion of respondents that did not experience reduced enjoyment of their property due to the occurrence of invasive plants was much lower than the percentage that devoted time to removing or controlling invasive plants on their property (Figure 4.8). In contrast, although 78% of stakeholders surveyed experienced some degree of reduced enjoyment of natural areas due to the occurrence of invasive plant species, only 59% allocated time to the control of such species in natural areas (Figure 4.8). Most respondents did not experience any economic losses due to plant invasions (Figure 4.9). Nonetheless, the majority of those surveyed indicated that they had changed their behaviour to some extent in an attempt to prevent future invasions. Two-thirds of respondents stated that they were affected to some level by invasive plants in another, undefined, way (Figure 4.9).

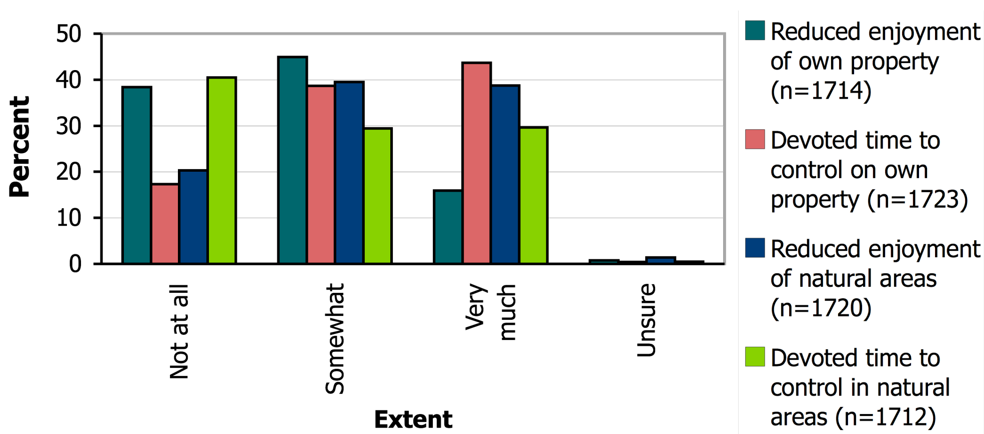

Figure 4.8: Extent to which respondents were affected by the problem on their property and in natural areas

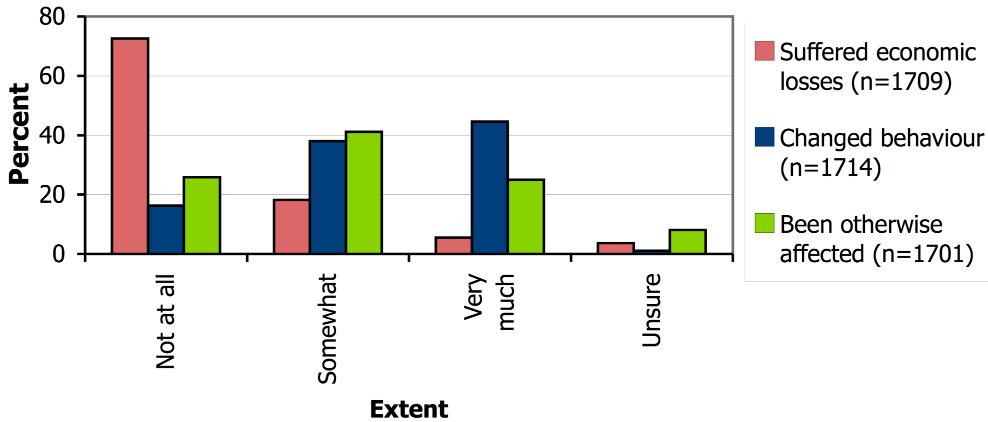

Figure 4.9: Extent to which respondents were affected by the invasive plant problem more generally

4.2.3 Stakeholder Group Membership

Twenty-four percent of respondents reported belonging to the professional horticulturists stakeholder group (n = 420), making this the largest group followed by hobby gardeners (19%, n = 337.) Sixteen percent characterized themselves as members of the agriculturalist group (n = 281), while the expert and naturalist groups represented 17% (n = 295) and 13% (n = 222) of respondents, respectively. Only 8% of respondents belonged to the group consisting of national, state, provincial, or municipal park employees (n = 137). Three percent were confronted by the problem, but not in any of the aforementioned capacities and were assigned to the 'other' group (n= 48) (Figure 4.10).

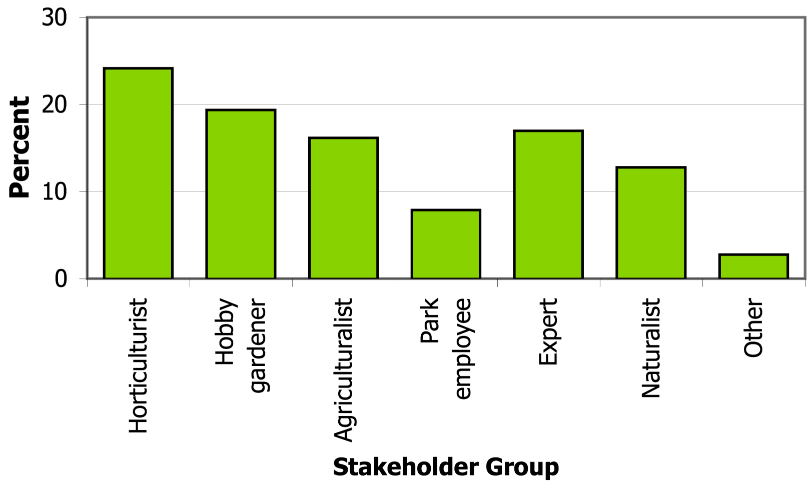

Figure 4.10: Stakeholder groups (n=1740)

4.2.4 Summary

In general, survey respondents were well educated, full-time employees belonging to a wide variety of stakeholder groups from across North America. Furthermore, the vast majority of respondents indicated that they were affected by the invasive plant problem to some extent. Respondents considered themselves to be more aware of locally invasive plant species, as compared to the government regulations and laws adopted to address the issue of plant invasions.

CHAPTER 5:
RESULTS – ANALYSIS OF STAKEHOLDER GROUPS

Here, I present the key differences between the six stakeholder groups. Differences were revealed using Chi-square, one-way ANOVA, and multiple comparisons analyses. Specifically, I highlight the significant differences with respect to demographic composition, attitudes, and policy preferences.

5.1.1 Composition

Despite the almost equal proportion of male and female respondents within the entire sample, there was a significant difference in gender distributions between stakeholder groups (χ^2 (5, N = 1671) = 200.8, $p < 0.001$). The hobby gardener and naturalist groups contained more female respondents, while the other groups comprised a greater proportion of male respondents (Figure 5.1).

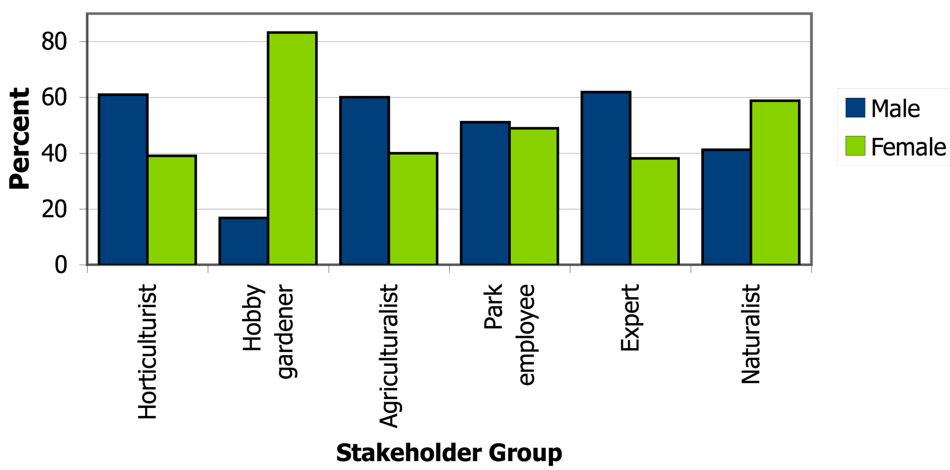

Figure 5.1: Gender composition of the six key stakeholder groups (n=1671)

Moreover, there was a significant difference between the groups with respect to age (χ^2 (30, N = 1666) = 353.6, $p < 0.001$). The hobby gardener group was the only group with an average respondent age between 51 and 60 years. All other groups were characterized by an average respondent age in the 31 to 50 year range.

The expert group was the most educated, as the majority (53%) of respondents from this group held a post-graduate degree (Figure 5.2). In contrast, over 40% of members of both the professional horticulturist and the hobby gardener groups did not hold a university degree. Indeed, educational level attained differed significantly between the six stakeholder groups (χ^2 (10, N = 1674) = 230.6, $p < 0.001$).

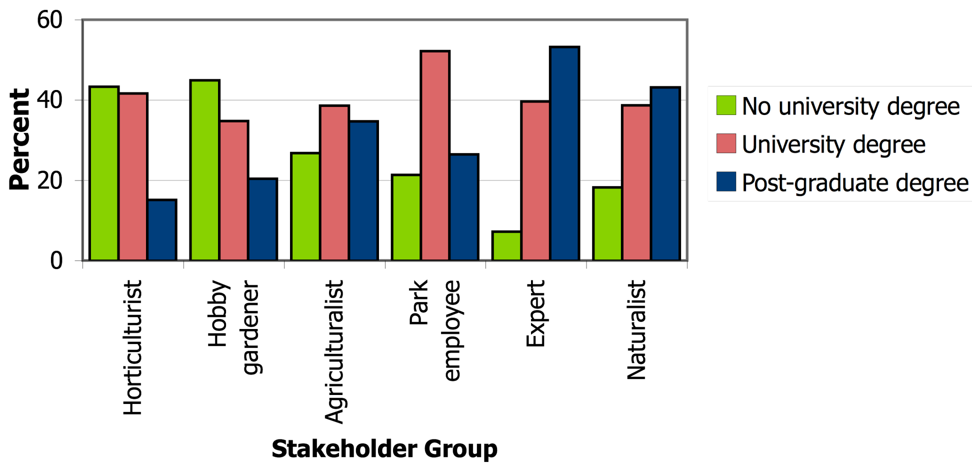

Figure 5.2: Percentage of respondents within each group obtaining one or more university degrees (n=1674)

In addition, country of residence varied greatly and significantly across the different stakeholder groups (χ^2 (5, N = 1692) = 166.0, $p < 0.001$) (Figure 5.3). The vast majority (70%) of respondents that were most affected by the problem as hobby gardeners were Canadian. All the other stakeholder groups had more American respondents, as would be expected due to the larger number of Americans in the sample.

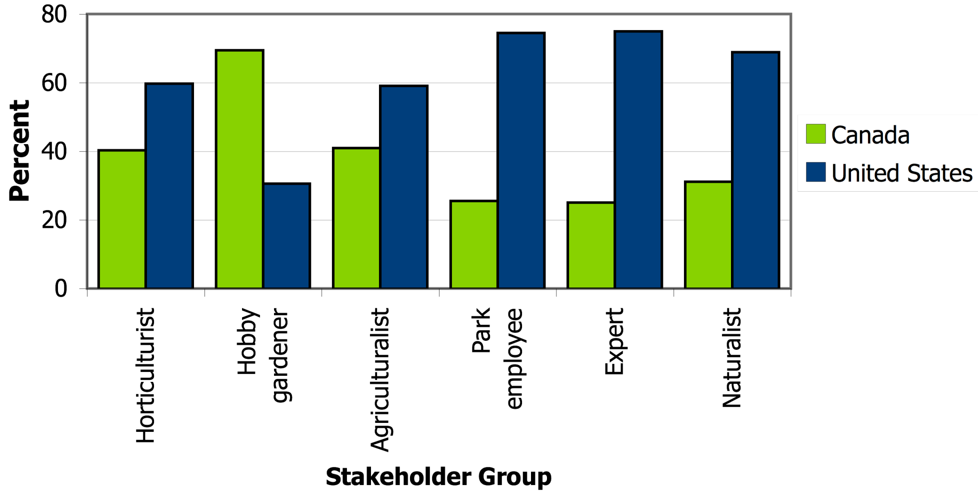

Figure 5.3: Composition of each stakeholder group with respect to country of residence (n=1692)

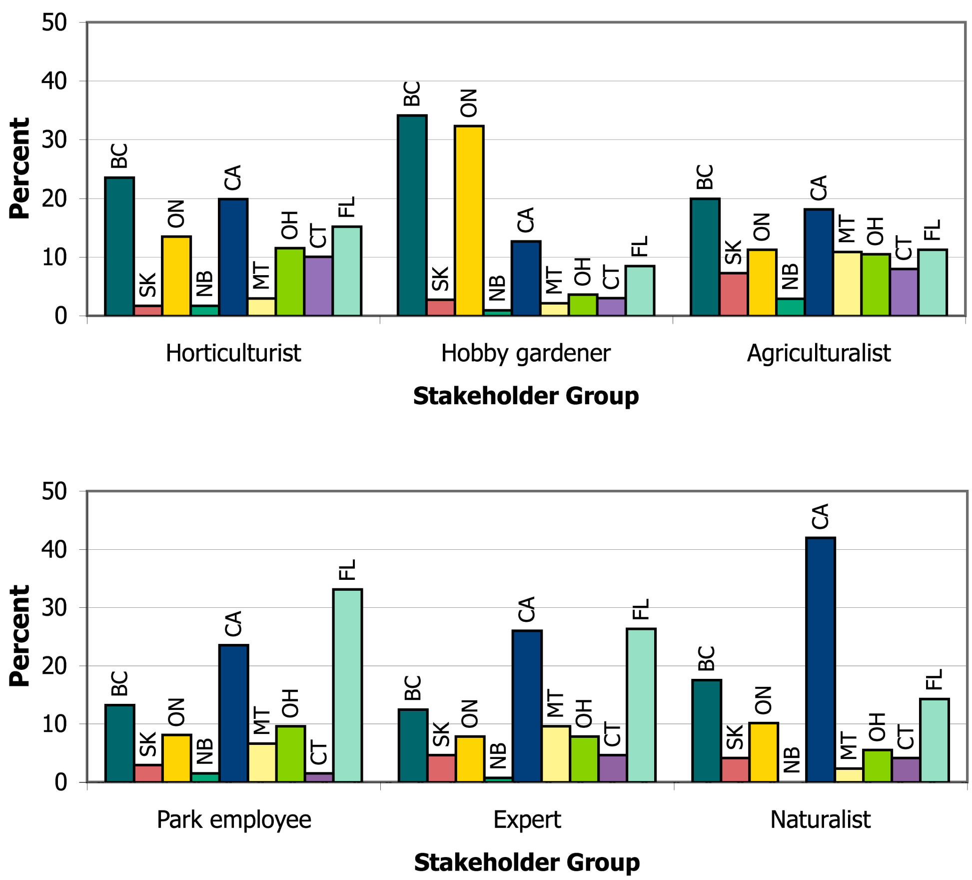

Figure 5.4: Composition of the six stakeholder groups in terms of province or state of residence (n = 1649)

Finally, as would be expected, most stakeholder groups consisted mainly of respondents residing in the provinces and states where the bulk of responses were gathered, namely British Columbia, Ontario, California, and Florida. Nonetheless, the composition of the six stakeholder groups differed significantly from each other with respect to state or province of residence (χ^2 (40, N = 1649) = 350.6, $p < 0.001$), as shown in Figure 5.4.

5.1.2 Perceptions of the Invasive Plant Problem

A one-way ANOVA also indicated significant differences between the six stakeholder groups with respect to the importance of various features of the invasive plant problem. Specifically, statistically significant differences between groups were found regarding the importance of: damage to managed areas ($F(5,1656) = 5.18$, $p < 0.001$), damage to natural areas ($F(5,1669) = 17.59$, $p < 0.001$), irreversible damage ($F(5,1626) = 10.01$, $p < 0.001$), transborder dispersal ($F(5,1661) = 11.12$, $p < 0.001$), not punishing those responsible for causing the problem ($F(5,1620) = 2.13$, $p < 0.1$), and allowing the continuation of activities known to cause the problem ($F(5,1646) = 10.29$, $p < 0.001$). No significant differences between groups were found with respect to the significance of the problem ultimately affecting individuals not responsible for causing it. The results of post-hoc multiple comparisons tests, isolating differences between specific groups, are provided below. See Appendix D for homogeneity of variance test results.

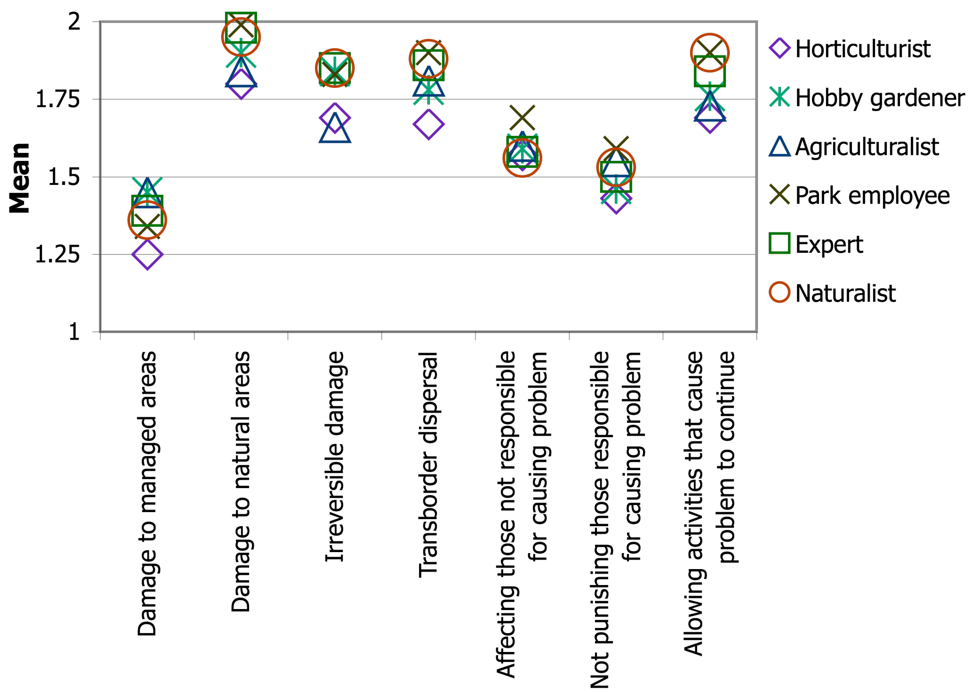

Figure 5.5: Mean significance of facets of the invasive plant problem, on a scale of 0 (not at all significant) to 2 (very significant)

The post-hoc multiple comparisons Tamhane test indicated that, on average, the horticulturalist and agriculturalist groups differed significantly from the other groups, especially the park employee, expert, and naturalist groups ($p < 0.05$). In general, the mean importance assigned to various facets of the problem was lower among the horticulturalist and agriculturalist groups (Figure 5.5).

The exceptions to this trend were found with respect to damage to managed areas, where this aspect of the problem was deemed to be less important by horticulturists as compared to members of the hobby gardener, agriculturist, and expert groups ($p < 0.05$). Interestingly, the perceived importance of damage to managed areas did not differ significantly, on average, between horticulturalists, park employees, and naturalists. Nonetheless, all groups perceived this facet of the problem to be the least significant (Figure 5.5).

Furthermore, the views held by hobby gardeners aligned with those of the experts, park employees, and naturalists with respect to the importance of certain components of the problem. For instance, on average, hobby gardeners, experts, park employees, and naturalists considered the irreversible nature of the invasive plant problem to be significantly more important than did members of the horticulturist ($p < 0.05$) and agriculturalist ($p < 0.01$) groups (Figure 5.5).

No significant differences were found between the stakeholder groups with respect to the mean importance of not punishing those responsible for causing the problem (Figure 5.5).

5.1.3 Considerations when Choosing a Strategy

The one-way ANOVA also highlighted differences between groups with respect to the mean importance of various considerations when selecting a strategy to address the invasive plant problem (see Appendix D for homogeneity of variance test results and Appendix E for means and standard deviations). Significant differences were found for mean importance of the cost of the strategy ($F(5,1651) = 3.21$, $p < 0.01$), who pays for the strategy ($F(5,1646) = 6.81$, $p < 0.001$), the ability to ensure compliance with the strategy ($F(5,1643) = 2.31$, $p < 0.05$), the ability of the strategy to prevent invasions in natural areas ($F(5,1653) = 12.51$, $p < 0.001$) and managed areas ($F(5,1651) = 14.15$, $p < 0.001$), and the ability of the strategy to control invasions in natural ($F(5,1651) = 5.33$, $p < 0.001$) and managed areas ($F(5,1641) = 15.27$, $p < 0.001$). The specific differences between the six groups for each of these considerations are described below.

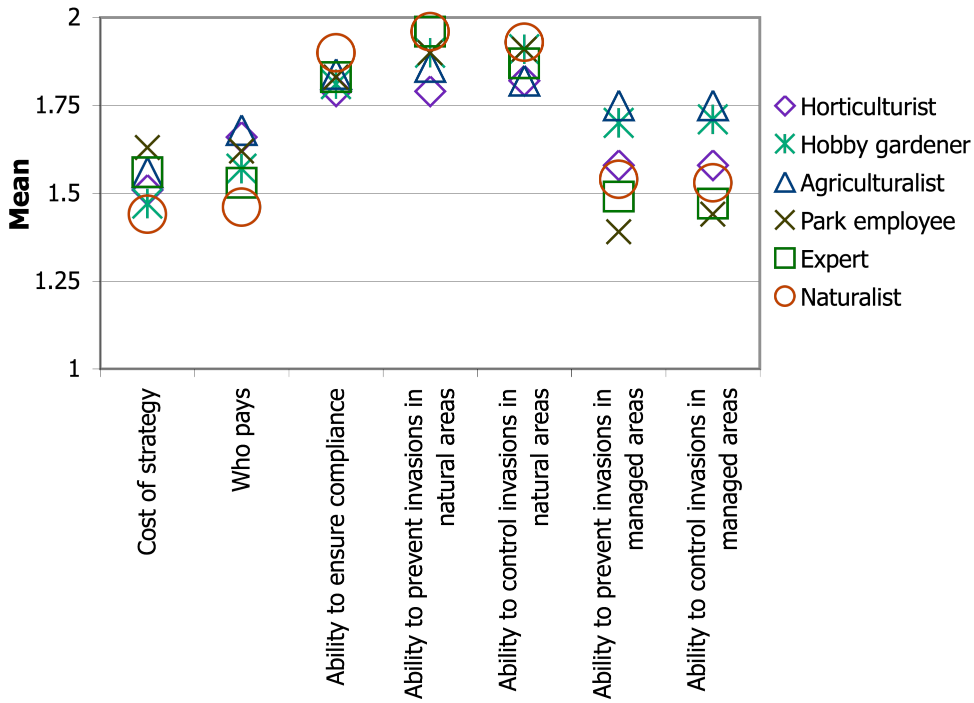

Figure 5.6: Mean importance of various considerations when choosing a strategy, on a scale of 0 (not at all important) to 2 (very important)

The trends observed when assessing differences with respect to the importance of facets of the problem did not necessarily hold when comparing groups according to the importance assigned to considerations when choosing a strategy. For instance, the Tamhane test revealed that members of the park employee and naturalists groups diverged with respect to the importance of the cost of a strategy ($p < 0.05$). Moreover, mean importance of who pays for a strategy was significantly lower for the naturalist group as compared to the park employee ($p < 0.1$) groups (Figure 5.6).

Although all groups deemed the ability to ensure compliance with a strategy to be very important, on average, members of the naturalist group perceived this consideration to be significantly more important than did members of both the professional horticulturist ($p < 0.01$) and hobby gardener ($p < 0.1$) groups. Interestingly, no other significant differences were found with respect to this consideration (Figure 5.6).

As expected, professional horticulturists and agriculturalists, on average, tended to assign lower levels of importance to the ability of a strategy to prevent and control invasions in natural areas. For instance, the horticulturist and agriculturalist groups both had significantly lower means than the expert and naturalist groups with respect to importance of potential invasion prevention in natural landscapes ($p \leq 0.001$) (Figure 5.6). Interestingly, fewer significant differences between groups were observed when considering the importance of a strategy's ability to control invasions in natural areas in comparison to the ability of a strategy to prevent invasions in natural areas (Figure 5.6).

Also as expected, gardeners and agriculturalists, on average, both perceived a strategy's ability to prevent and control invasions in managed areas to be significantly more important than did any of the other groups ($p < 0.05$) (Figure 5.6).

5.1.4 Policy Preferences

A one-way ANOVA also revealed significant differences between the six stakeholder groups with respect to mean ranking of four of the five policy options (see Appendix E for means and standard deviations). Differences in the mean ranking were observed for Option A – black listing ($F(5,1686) = 6.94$, $p < 0.001$), Option B – mandatory white listing ($F(5, 1686) = 6.59$, $p < 0.001$), Option C – voluntary white listing ($F(5, 1686) = 26.00$, $p < 0.001$), and Option E – environmental fee ($F(5, 1686) = 2.54$, $p < 0.05$).

Although all groups assigned Option A, black listing, a mean rank of between 2 and 3, a post-hoc Tamhane multiple comparisons test indicated that, on average, experts and naturalists ranked Option A significantly higher (i.e., closer to 1), and thus preferred it to a greater extent, than did professional horticulturists ($p < 0.001$) (Figure 5.7).

With respect to mean rank of the mandatory white listing policy, Option B, significant differences were found, using a post-hoc Hochberg GT2 test, when comparing the expert group to the horticulturist ($p < 0.001$), hobby gardener ($p <$

0.01), and agriculturalist ($p < 0.01$) groups. On average, members of the expert group preferred this policy option significantly more. Also, the mean rank of Option B was significantly higher within the naturalist group as compared to the horticulturalist ($p < 0.01$) and the hobby gardener ($p < 0.05$) groups. Thus, significant differences in preferences for Option B were found between the groups despite the observation that all groups, on average, assigned Option B a rank of between 1 and 2 (Figure 5.7).

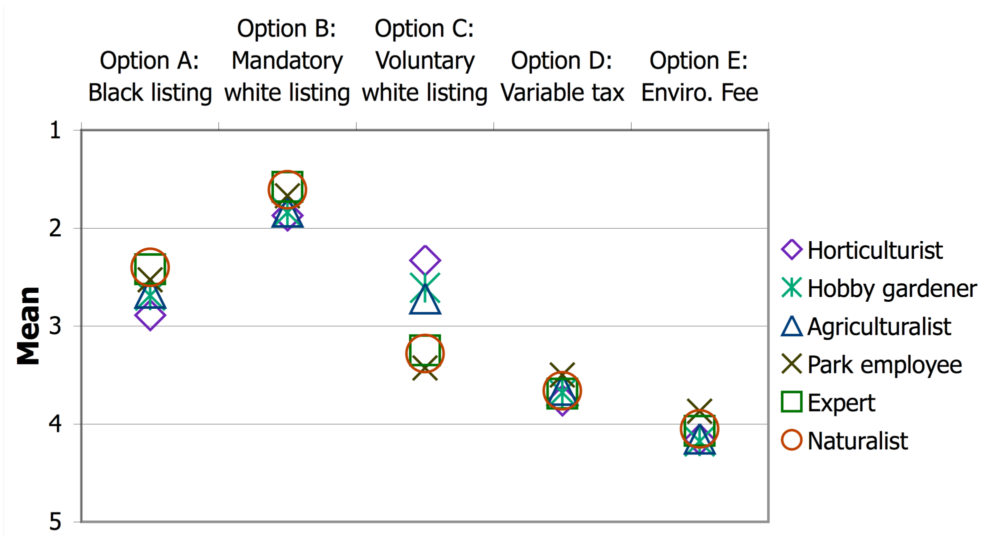

Figure 5.7: Mean rank of the five policy options on a scale of 1 (most preferred) to 5 (least preferred)

Figure 5.7 illustrates that there was more variability between stakeholder groups with respect to the mean rank of Option C, voluntary white listing. A post hoc Hochberg GT2 test revealed that members of the horticulturist group, on average, ranked this policy significantly higher than the agriculturist group ($p < 0.01$) as well as the park employee, expert, and naturalist groups ($p < 0.001$). Indeed, the horticulturist was the only group that preferred the voluntary option most (Figure 5.8). No significant differences were found at the 0.05 level when comparing the hobby gardener group to the horticulturist and agriculturalist groups with respect to the mean rank of Option C. Notably, preference for the voluntary option was significantly lower, on average, among the park employee, expert, and naturalist groups as compared to the other three groups ($p < 0.001$).

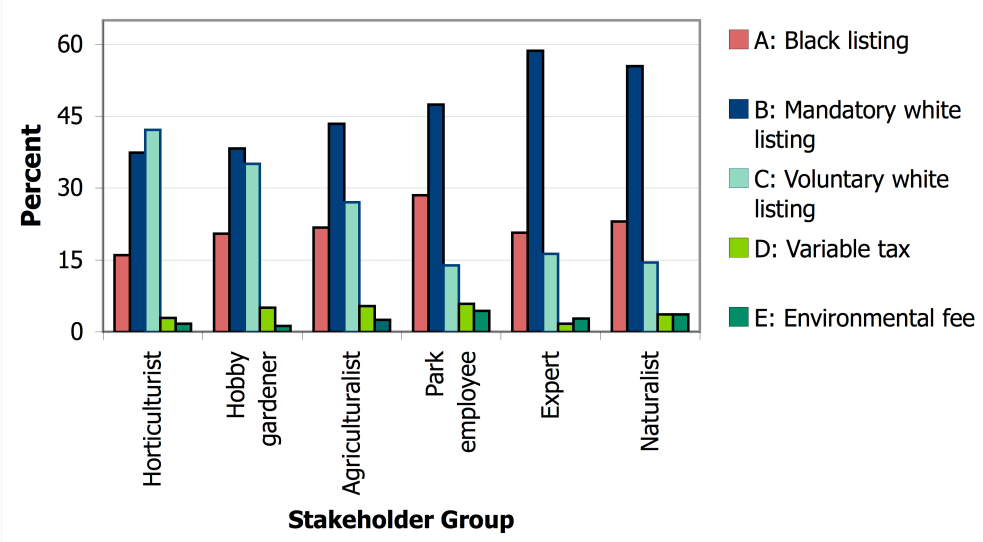

Figure 5.8: Percentage of each stakeholder group choosing each policy option first

No significant differences were revealed between the groups with respect to mean rank of the variable tax option, Option D. However, a difference was found regarding mean rank of Option E, fixed environmental fee. The Hochberg GT2 test revealed that, on average, the park employee group preferred this option significantly more than average members of the horticulturist and hobby gardener groups ($p < 0.05$).

5.1.5 Summary

In addition to being significantly different across socio-demographic characteristics, the six stakeholder groups differed significantly with respect to attitudes and perceptions. Not surprisingly, the stakeholder groups also differed significantly with respect to preferences for various policy options.

Generally, the professional horticulturist group perceived the particular aspects of the problem to be less significant than did the other groups. In contrast, when compared to the other groups, the expert, park employee, and naturalist groups assigned higher levels of significance to most facets of the problem. Nonetheless, all groups deemed all facets of the problem to be at least somewhat significant.

In terms of the average importance of various considerations when choosing a strategy, members of the hobby gardener and agriculturalist groups emphasized the importance of preventing and controlling invasions in managed areas to a greater extent than the other groups. The professional horticulturist and agriculturalist groups assigned a greater level of importance to the cost of the strategy than did the other groups. In general, as compared to the horticulturist and agriculturalist groups, experts, naturalists, and park employees ascribed higher levels of importance to addressing invasions in natural areas, which follows from expectations.

Differences between groups with respect to preferences for the policy options can be summarized by the observation that the order of the mean rankings of the five policies for four of the stakeholder groups, with horticulturists and hobby gardeners being the exceptions, was B > A > C > D > E. On average, members of the horticulturist and hobby gardener groups ranked the options as B > C > A > D > E, congruent with the elevated proportion (> 30%) of respondents from these two groups that selected Option C first.

CHAPTER 6:
RESULTS: ANALYSIS OF CLUSTER GROUPS

Principal components and cluster analyses were used to identify groups based on common perceptions and attitudes towards the invasive plant problem and the general characteristics of solutions adopted to tackle it. The clusters that resulted from these analyses are characterized and compared in this chapter.

In so doing, stakeholder perceptions are explored without drawing conclusions based on pre-defined, potentially homogenous, stakeholder groups. In addition, the analysis of policy preferences across the clusters helps solidify the links between attitudes and policy preferences. The results of the multinomial logit model, also presented in this chapter, illustrate how cluster membership can be used to predict preferences for the five policy options.

6.1 Cluster Identification

The principal components analyses, using an extraction method with Eigenvalues over 1, yielded two components based on the problem definition variables (Appendix A, Section 3, Q2-Q7) and three components based on the strategy consideration variables (Appendix A, Section 3, Q14-Q20). See Appendix F for the total variance explained by the principal component analyses.

The component loadings for the components based on problem definition (PD) variables (Table 6.1) indicate that the first component (PD component 1) was associated with higher perceived significance of not punishing those responsible for causing the problem, affecting those not responsible for causing the problem, inflicting damage to managed areas, and, to a lesser extent, allowing activities that cause problem to continue. The second component (PD component 2) was associated with significance of damage to natural areas, irreversible damage, and, to a lesser extent, transborder dispersal.

Table 6.1: PD component loadings

	Component	
	1	2
Significance of not punishing those responsible for causing problem	**.797**	.067
Significance of affecting those not responsible for causing problem	**.795**	.082
Significance of damage to managed areas	**.524**	.181
Significance of allowing activities that cause problem to continue	.517	.437
Significance of damage to natural areas	.082	**.822**
Significance of irreversible damage	.107	**.777**
Significance of transborder dispersal	.452	.533

Table 6.2: SC component loadings

	Component		
	1	2	3
Importance of ability of strategy to prevent invasions in managed areas	**.936**	.135	.053
Importance of ability of strategy to control invasions in managed areas	**.929**	.170	.062
Importance of ability of strategy to prevent invasions in natural areas	.133	**.835**	-.056
Importance of ability of strategy to control invasions in natural areas	.153	**.814**	-.073
Importance of ability to ensure compliance with strategy	.060	**.532**	.300
Importance of who pays for strategy	.069	.013	**.885**
Importance of cost of strategy	.032	.031	**.871**

Based on the component loadings for the components resulting from the solution consideration (SC) variables (Table 6.2), the first component (SC component 1) was associated with the importance of a strategy's ability to prevent and control invasions in managed areas. The second component (SC component 2) was associated with the importance of being able to ensure compliance with a strategy as well as a strategy's ability to prevent and control invasions in natural areas. The third and final component (SC component 3) was associated with the remaining variables, namely the importance of a strategy's cost and who pays for the strategy.

A hierarchical cluster analysis, using Ward's method, yielded four clusters based on the component scores derived from the principal components analysis of the problem definition variables. These clusters will be herein referred to as PD clusters (Figure 6.1). The same technique was also used to identify four clusters based on the component loadings obtained from the principal component analysis of the strategy consideration variables. These four clusters will be termed SC clusters (Figure 6.2). See Appendix G for a description of how the number of clusters was determined.

To understand the prevalence within the sample of different perceptions of the problem and of the strategies to address it, Table 6.3 describes the sample based on the percentage of respondents belonging to each combination of PD and SC clusters. The majority of respondents belonged to PD cluster 2 and SC clusters 2, 3, or, 4. The characteristics and composition of the PD and SC clusters will be discussed further in section 6.2.

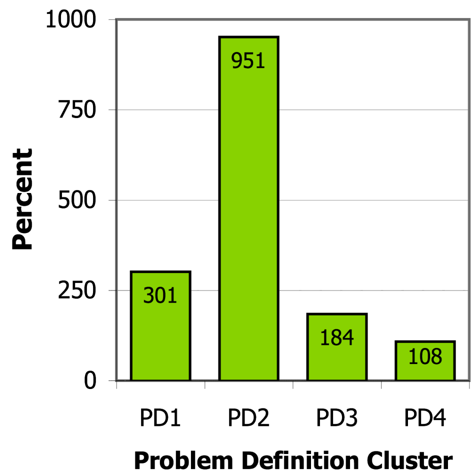

Figure 6.1: Size of the different PD clusters

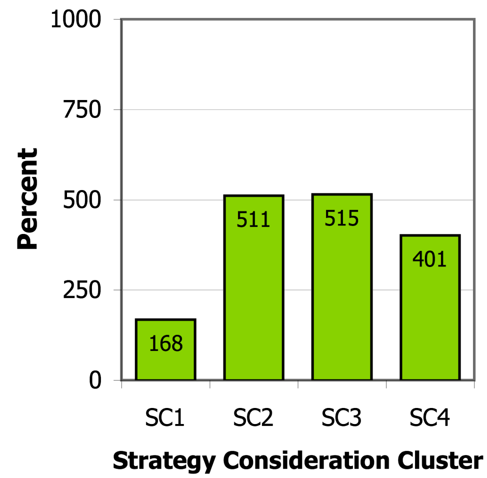

Figure 6.2: Size of the different SC clusters

Table 6.3: Crosstab of membership in PD and SC clusters

	SC 1	**SC 2**	**SC 3**	**SC 4**
PD 1	2.4%	9.1%	3.7%	4.3%
PD 2	3.0%	19.3%	22.8%	17.2%
PD 3	3.7%	2.9%	2.8%	2.1%
PD 4	1.1%	1.0%	2.6%	2.1%

6.2 Characterization of Clusters

In this section I present the characteristics of the clusters identified in the preceding section. Clusters were characterized using average principal component scores within each cluster and by examining the means of the attitudinal variables that were used to create the clusters.

6.2.1 PD Clusters: Perceptions of the Problem

The PD clusters were first described using the mean principal component scores for each PD component (Table 6.4). The mean scores provide information about the perceptions of the invasive plant problem held by members of each cluster.

Table 6.4: Average component score within each cluster for each PD component

Cluster	Mean Component Scores	
	PD Component 1	PD Component 2
PD1	-1.3187431	0.6950339
PD2	0.4741576	0.3215939
PD3	-0.8230066	-1.8394302
PD4	1.1353805	-1.2909423

PD cluster 1 had a higher and positive mean component score for component 2, as compared to component 1. Thus, PD cluster 1 represents a segment of the sample that emphasized the significance of damage to natural areas and irreversible damage. PD cluster 2 can be characterized as a group that perceived all aspects of the problem to be highly significant due to the positive values of the mean component scores for both components. In contrast, the negative means of the component scores for both components calculated for PD cluster 3 suggests that this group did not assign high relative levels of significance to any facet of the problem. Finally, members of PD cluster 4 had a much higher, positive mean for component scores for component 1 as compared to scores for component 2, thus suggesting that this group deemed not punishing those responsible for causing the problem, affecting those not responsible for causing problem, and damage to managed areas to be more significant than the other elements of the problem.

These results were corroborated by one-way ANOVA testing of all four PD clusters with respect to mean significance of the various facets of the problem, which revealed significant differences between the PD clusters ($p < 0.001$). The detailed results of the one-way ANOVA are found in Appendix H and the plot of the means is presented Figure 6.3.

Figure 6.3 illustrates that average members of PD cluster 1 did indeed confer high ratings to the significance of damage to natural areas and irreversible damage, while considering externalities and the failure to assign liability to be less significant. Furthermore, on average, members of PD cluster 2 considered most aspects of the problem to be highly significant while members of PD cluster 3 consisted of respondents who did not judge any particular facet of the problem to be especially significant. Finally, PD cluster 4 is comprised of individuals who, on average, stressed the importance of negative externalities and the failure to internalize them. Average members of PD cluster 4 also assigned high significance, as compared to cluster 1 and 3, to damage within managed areas and allowing the activities known to cause the problem to continue.

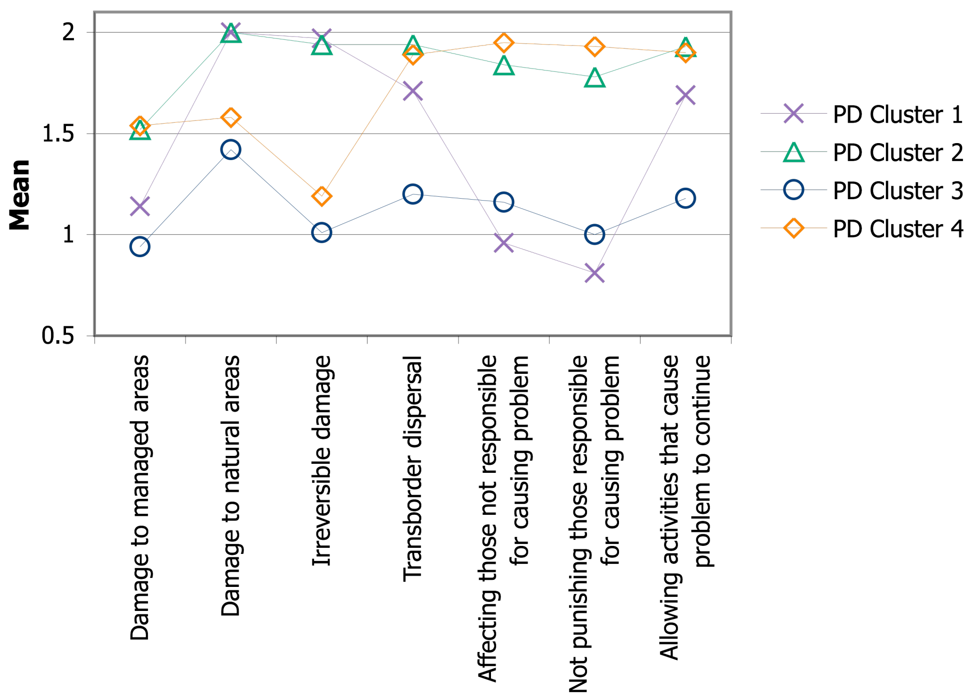

Figure 6.3: Mean significance of various aspects of the problem across Problem Definition clusters, on a scale of 0 (not at all) to 2 (very)

6.2.2 SC Clusters: Views Regarding Potential Strategies

The average principal component scores for the four SC clusters with respect to the three SC components are presented in Table 6.5. From these means, the characteristics of the SC clusters were defined in terms of perceptions of important considerations for selecting strategies for addressing the invasive plant problem.

Table 6.5: Average component score within each cluster for each SC component

Cluster	Mean Component Scores		
	SC Component 1	SC Component 2	SC Component 3
SC1	-0.2754691	-2.4644900	-0.0891395
SC2	-1.2050372	0.4488426	-0.1181779
SC3	0.6441710	0.1554146	0.8440373
SC4	0.8237563	0.2568379	-0.8890023

SC cluster 1 had negative mean principal component scores for all three components and was thus comprised of respondents who did not assign high levels of importance to any of the considerations with respect to selecting a strategy. However, because the mean associated with component 3 was the least negative, this cluster deemed a strategy's cost and who pays for the strategy to be of greatest importance. The mean principal component scores of SC cluster 2 were positive for SC component 2 and negative for the remaining components. Thus, SC cluster 2 can be characterized as a group that emphasized the importance of being able to ensure compliance with a strategy as well as a strategy's ability to prevent and control invasions in natural areas over all other considerations, especially the ability to control and prevent invasions in managed areas. While SC 3 was found to have positive mean component scores for all three components, indicating that this cluster represented those respondents that tended to deem all strategy considerations to be important, a higher level of importance was assigned by this cluster to the importance of a strategy's cost and who pays for the strategy. Finally, SC cluster 4 consisted of a segment of the sample that discounted the importance of a strategy's cost and who pays to implement the strategy, while emphasizing the importance of a strategy's ability to prevent and control invasions in managed areas.

The preceding characterization of the SC clusters is supported by significant differences ($p < 0.001$) between the SC clusters when comparing them based on mean importance assigned to strategy consideration variables. These differences were revealed through a one-way ANOVA, the results of which are summarized in Figure 6.4 (Appendix I).

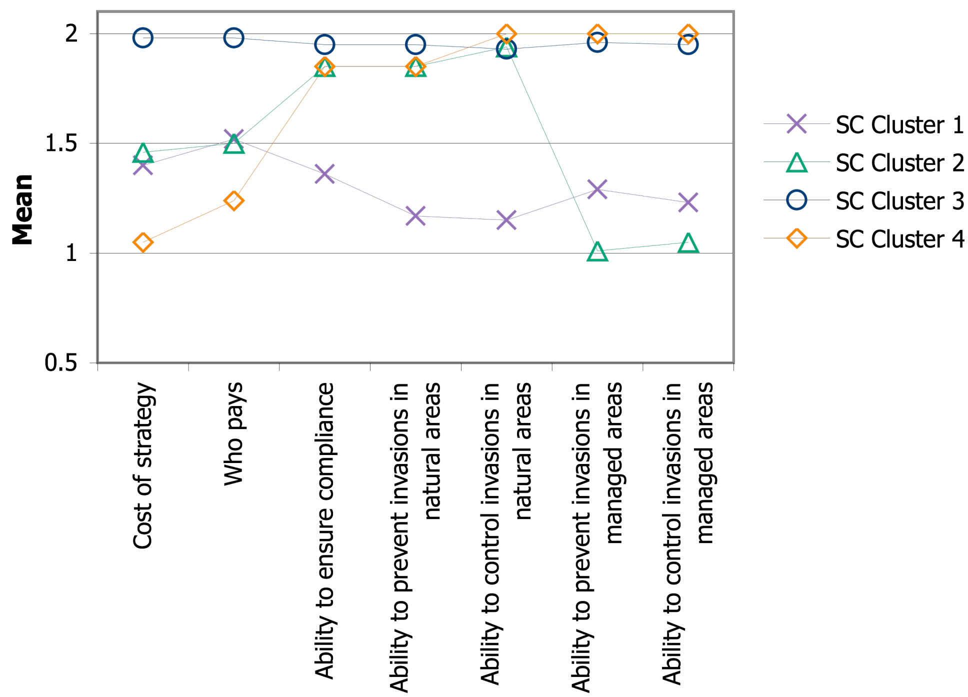

Figure 6.4: Mean importance of various considerations when choosing a strategy for each Strategy consideration cluster, on a scale of 0 (not at all) to 2 (very)

When comparing the four SC clusters based on mean component scores and significance ratings, the divergent perceptions held by each of the SC clusters regarding the importance of various strategies to address the invasive plant problem are apparent. Members of SC cluster 1, on average, stress the importance of cost considerations more than any other consideration. In contrast, while mean importance levels for cost considerations were similar when comparing members of SC cluster 2 to SC cluster 1, SC cluster 2 is characterized by higher means for importance of compliance assurance as well as for invasion prevention and control in natural areas. SC cluster 2 was also characterized by lower means for importance of preventing and managing invasions in human-modified areas. Finally, SC cluster 3 rated all considerations to be very important, on average, while SC cluster 4 was characterized by high mean importance for all considerations with the exception of cost considerations.

6.3 Differences Between Clusters

Here, I provide the results of analyses that revealed the differences between the four PD clusters and between the four SC clusters in terms of demographic composition and policy preferences.

6.3.1 Composition

Significant differences were found when comparing the composition of the problem definition clusters with respect to stakeholder group membership (χ^2 (15, N = 1544) = 93.8, $p < 0.001$), gender (χ^2 (3, N = 1530) = 52.5, $p < 0.001$), household income (χ^2 (15, N = 1416) = 32.9, $p < 0.01$), and jurisdiction of residence (χ^2 (24, N = 1503) = 63.3, $p < 0.001$).

An examination of the composition of the four PD clusters reveals that the composition cluster 3 differs most from the total sample as well as from the other clusters. For example, agriculturalists and horticulturists as well as male respondents are over-represented in PD cluster 3 (Figure 6.5, Figure 6.6). Moreover, PD cluster 3 has a relatively greater proportion of respondents with an annual household income surpassing $75,000 (Figure 6.7) and respondents residing in Ohio and Connecticut (Figure 6.8).

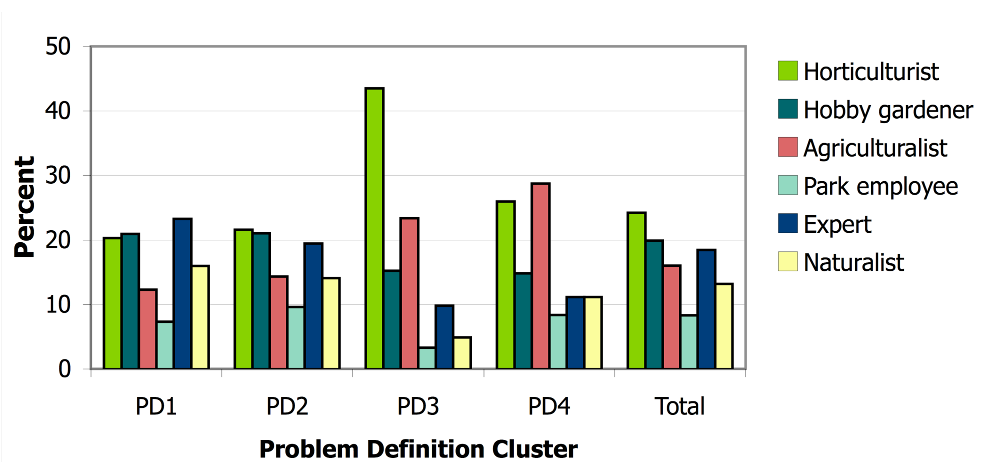

Figure 6.5: Stakeholder composition of the four problem definition clusters as compared to the composition of the total sample (n=1544)

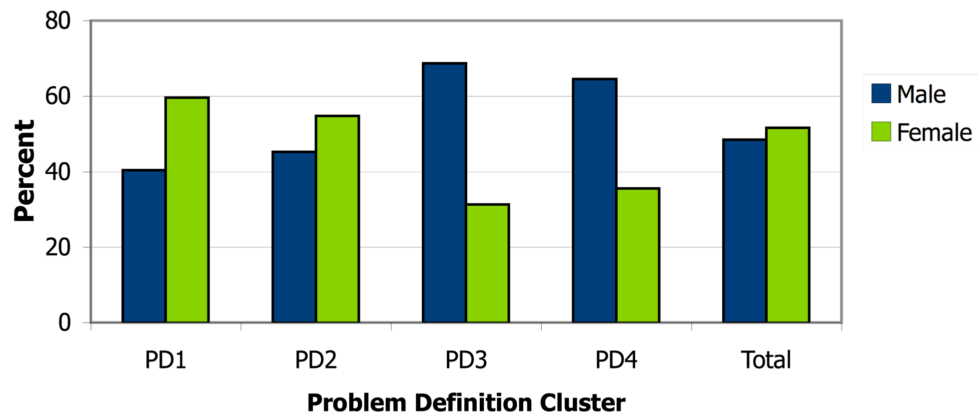

Figure 6.6: Proportion of each gender within each cluster and within the total sample (n=1530)

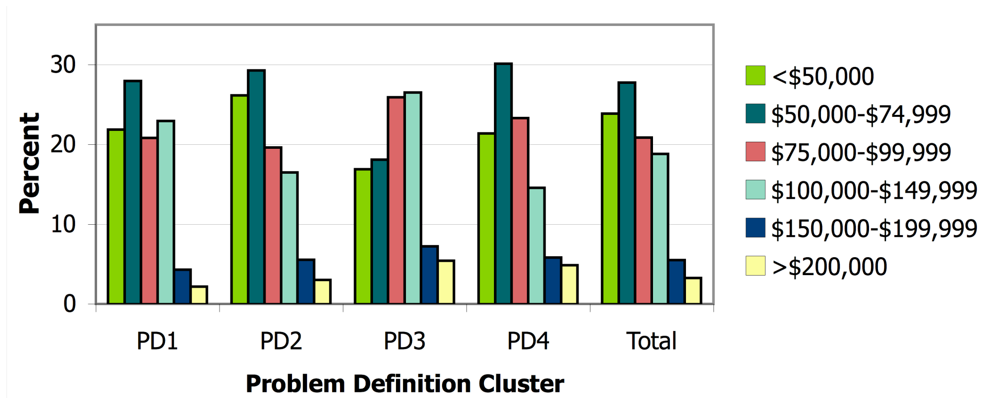

Figure 6.7: Percentage of respondents within each annual household income bracket belonging to each cluster and to the entire sample (n=1416)

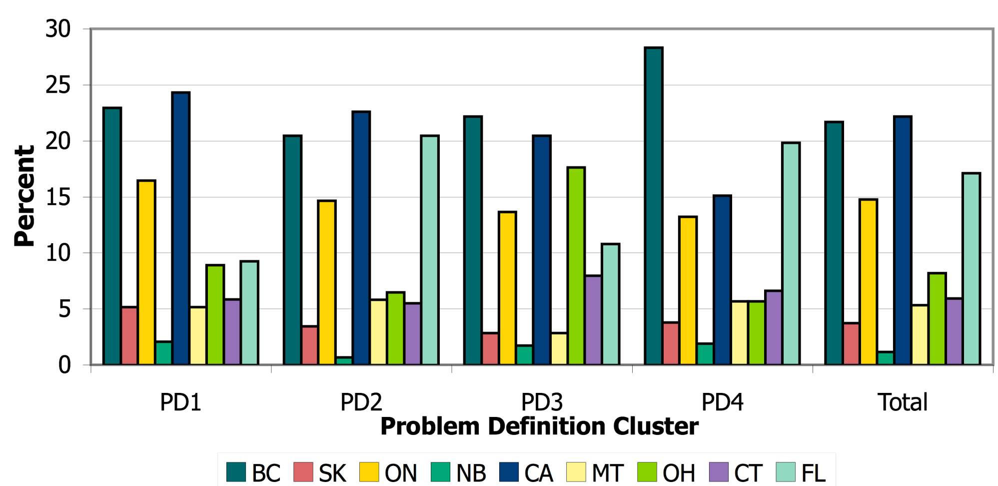

Figure 6.8: Composition of each cluster and the combined sample with respect to state or province of residence (n=1503)

Significant differences were also found when examining the composition of the solution consideration (SC) clusters with respect to stakeholder group membership (χ^2 (15, N = 1595) = 141.6, p < 0.001), gender (χ^2 (3, N = 1583) = 18.2, p < 0.001), highest educational attained (χ^2 (6, N = 1584) = 33.9, p < 0.001), and area of residence at both the state and provincial level (χ^2 (24, N = 1556) = 77.8, p < 0.001) as well as at the national level (χ^2 (3, N = 1595) = 27.2, p < 0.001).

When examining the differences with respect to the composition of SC clusters, the main differences are observed when comparing SC cluster 1 to the remaining clusters as well as to the total composition of the sample. For instance, SC cluster 1 is composed of a greater number of respondents belonging to the horticulturist and agriculturalist groups and fewer respondents from the expert and naturalist groups (Figure 6.9).

Furthermore, male respondents are overrepresented in SC cluster 1 (Figure 6.10). No significant differences were found between SC clusters based on income considerations, although educational background differed significantly between SC clusters: SC cluster 1 contained a relatively lower proportion of respondents having obtained a post-graduate degree. Finally, SC cluster 1 contained a higher percentage of respondents residing in Ohio and a lower percentage of respondents from Ontario and California (Figure 6.12).

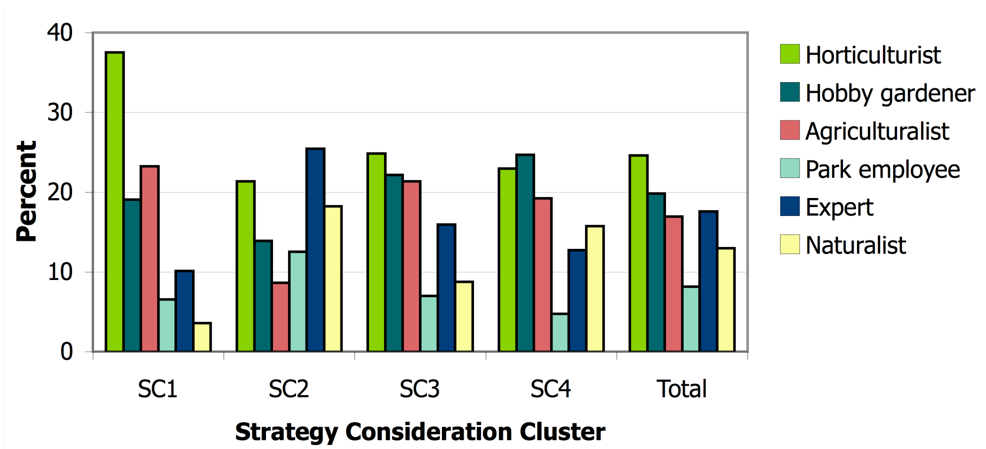

Figure 6.9: Composition of the SC clusters and the sample with respect to stakeholder group membership (n=1595)

Figure 6.10: Proportion of male and female respondents within each cluster and within the entire sample (n=1583)

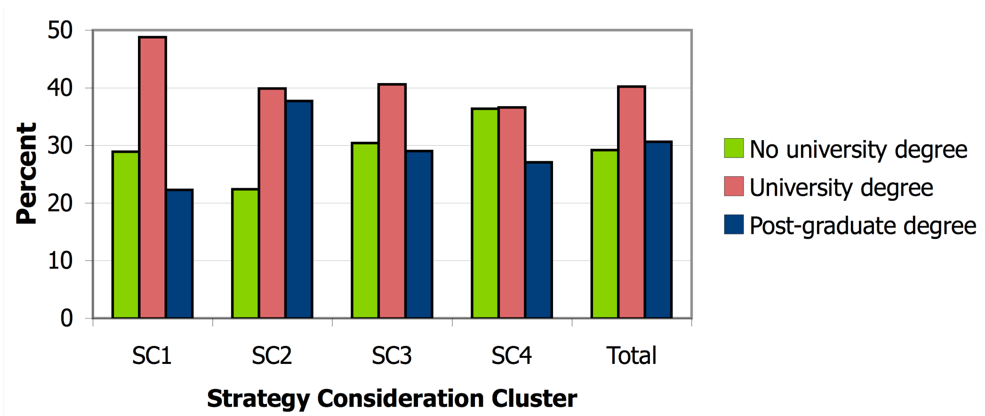

Figure 6.11: Differences in SC cluster composition with respect to educational level attained (n=1584)

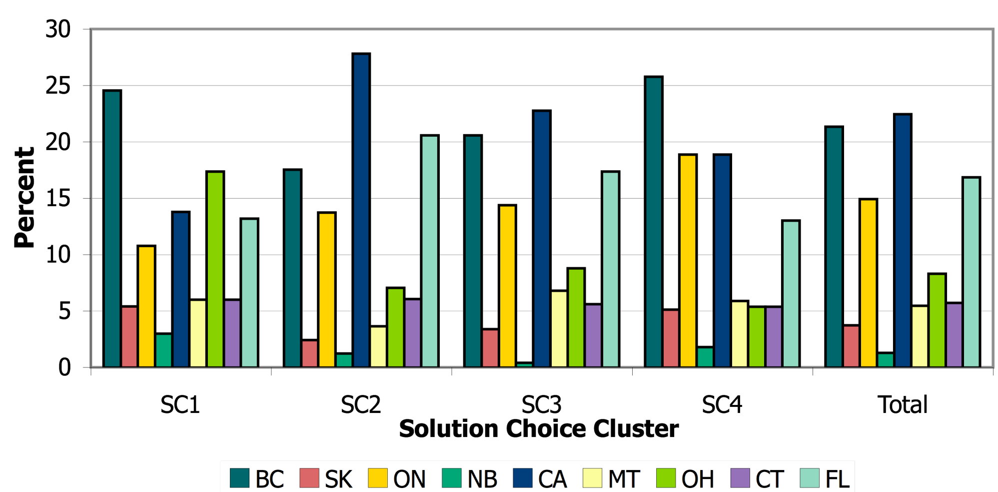

Figure 6.12: Percentage respondents from the each cluster residing in each of the nice key jurisdictions (n=1556)

6.3.2 Policy Preferences

A one-way ANOVA and subsequent multiple comparisons tests were performed. Significant differences in the mean rankings of the five policy options across PD and SC clusters were found.

With respect to mean ranking, there were significant differences between the four PD clusters with respect to mean rankings of Option A ($F(3,1540) = 22.19$, $p < 0.001$), Option B ($F(3,1540) = 15.43$, $p < 0.001$), and Option C ($F(3,1540) = 45.27$, $p < 0.001$). No significant differences in mean ranking of Options D and E were revealed across the PD clusters (see Appendix H for means and standard deviations).

A post hoc Tamhane test indicated that mean rank of policy Option A (black listing) differed significantly for all pairwise comparisons of the PD clusters ($p < 0.05$), except when comparing cluster 2 to cluster 4. The same results were observed when examining differences in mean rank of Option C (voluntary white listing). A post hoc Hochberg GT2 test revealed significant difference in the mean ranking of Option B between PD cluster 3 and clusters 1, 2, and 4 ($p < 0.01$) as well as when comparing cluster 1 to cluster 2 ($p < 0.05$). However, no significant differences were found when comparing PD cluster 4 to clusters 1 and 2. Thus, PD cluster 3 differs significantly from the other clusters with respect to mean rankings of the three policy options, A, B, and C.

Indeed, Figure 6.13 shows that PD cluster 3 was the only PD cluster where the mean rank of policy Option C exceeded the mean rank of all the other options, resulting in an average rank order of C > B > A > D > E. On average, members of PD clusters 2 and 4 ranked the options in the following order: B > A > C > D > E while the mean ranking of cluster 1 was B > C > A > D > E.

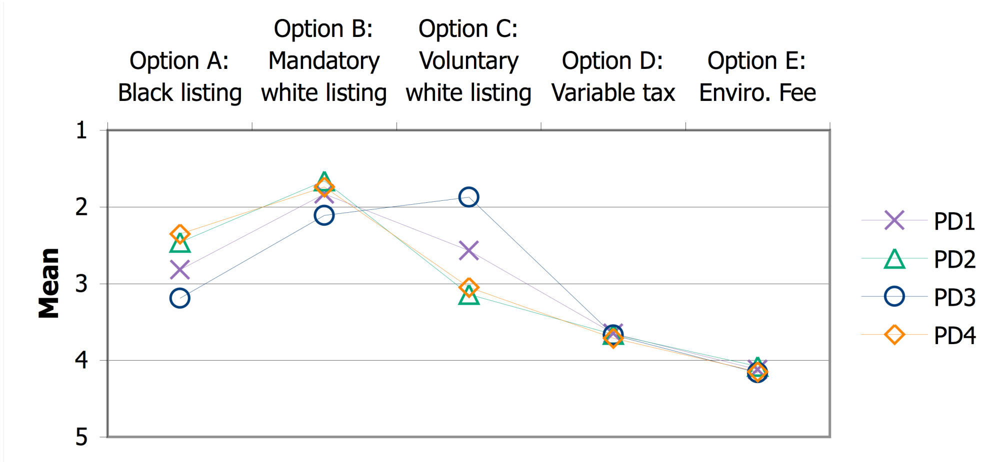

Figure 6.13: Mean ranking of the five policy options for each of the PD clusters, where 1 represents the most preferred option

A one-way ANOVA for the mean rank of each policy option for each SC cluster also revealed significant differences between clusters for Option A ($F(3,1591) = 8.43$, $p < 0.001$), Option B ($F(3,1591) = 13.61$, $p < 0.001$), Option C ($F(3,1591) = 14.59$, $p < 0.001$), and Option D ($F(3,1591) = 3.38$, $p < 0.018$) (Figure 6.14). Mean rank of Option E did not differ significantly between SD clusters. A Hochberg GT2 test revealed that mean rank of Option A differed significantly when comparing SC cluster 1 to the remaining three SC clusters ($p \leq 0.001$). However, no significant differences in mean rank of Option A were found when comparing cluster 2 to either cluster 3 or cluster 4 or when comparing clusters 3 and 4. The application of a post hoc Tamhane multiple comparisons test indicated that SC cluster 1 was significantly different from all the other SC clusters with respect to mean ranking of Options B and C. No other significant differences between clusters regarding the means of Options B and C were observed. Differences between SD clusters with respect to the mean rank of Option D were only slightly significant ($p < 0.1$) and were observed for all pairwise cluster comparisons.

The differences between SC cluster 1 and all the other SD clusters highlighted by the multiple comparisons tests are illustrated in Figure 6.14. With respect to the rank order, three of the four SC clusters provided a mean ranking of B > A > C > D > E, with SC cluster 1 being the exception. The rank order based on the mean rank assigned to the options by members of SC cluster 1 was B > C > A > D > E, where the mean rank of Option B only surpassed that of Option C by 0.04 (Figure 6.14).

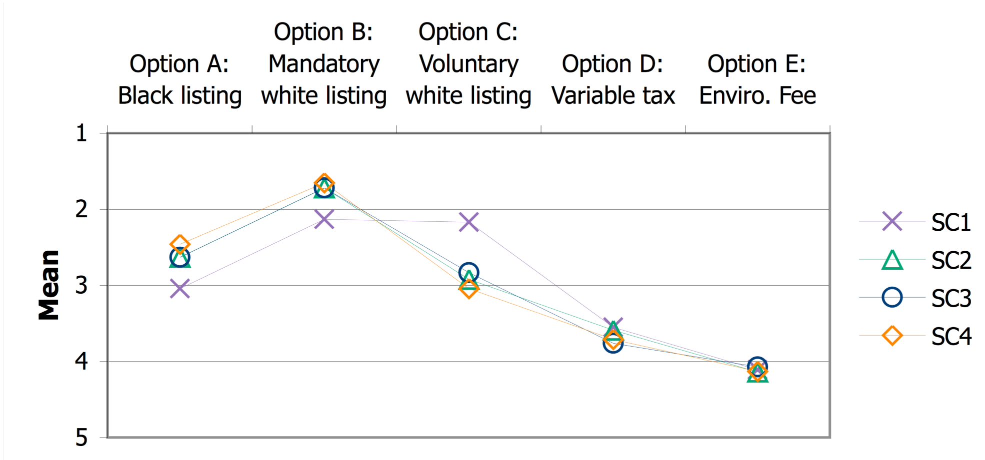

Figure 6.14: Mean rank assigned to the five policies options by each of the SC clusters, where 1 indicates the highest preference

Finally, when exploring the differences between the clusters with respect to most preferred (first choice) policy, significant differences were found between the PD clusters ((χ^2 (12, N = 1544) = 120.2, $p < 0.001$) as well as the SC clusters ((χ^2 (12, N = 1505) = 57.1, $p < 0.001$), as depicted in Figure 6.15 and Figure 6.16. The selection of most preferred policy options will be discussed in greater detail in the next section.

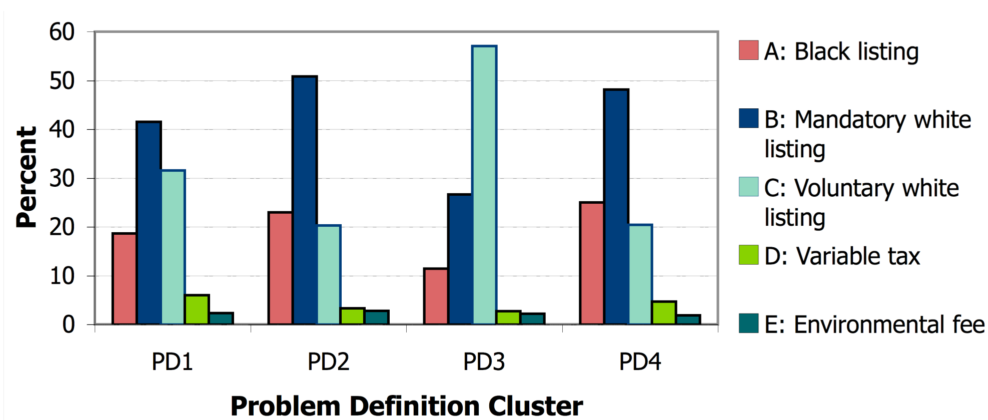

Figure 6.15: Percentage of members of each PD cluster that selected each of the five policy options first

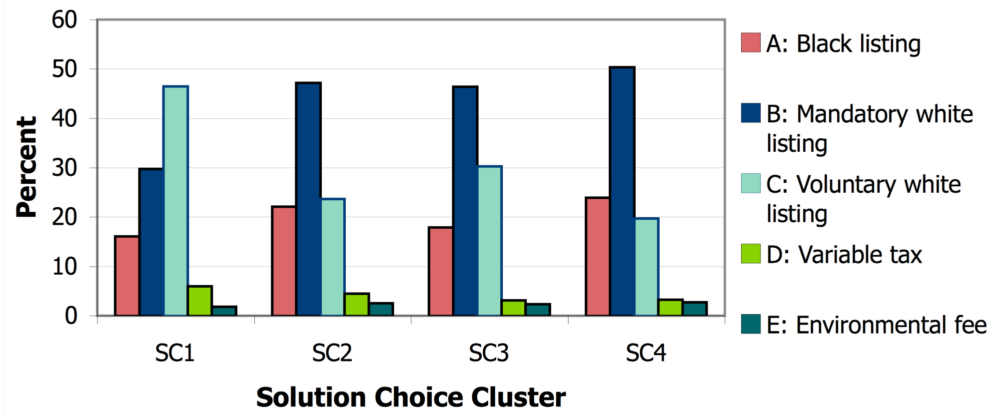

Figure 6.16: Proportion of respondents from SC cluster that preferred each of the five policy options most

Differences in policy preferences were observed when comparing Canadians and Americans belonging to the same cluster (Figure 6.17 and Figure 6.18). There were significant differences between the countries with respect to the mean rank of Option A within SC cluster 4 ($F(1,399) = 7.94$, $p < 0.01$). Significant differences between respondents from Canada and the United States with respect to the mean rank of Option C were observed within PD cluster 1 ($F(1,399) = 7.55$, $p < 0.01$), PD cluster 2 ($F(1,949) = 14.99$, $p < 0.001$), PD cluster 4 ($F(1,106) = 6.98$, $p < 0.01$), SC cluster 2 ($F(1,509) = 6.89$, $p < 0.01$), SC cluster 3 ($F(1,513) = 7.67$, $p < 0.01$), and SC cluster 4 ($F(1,399) = 9.45$, $p < 0.01$). Significant differences between countries regarding the mean ranking of Option D were found within PD cluster 3 ($F(1,182) = 7.78$, $p < 0.01$) while differences in the mean ranking of Option E by Canadians and Americans were found within PD cluster 2 (($F(1,949) = 5.47$, $p < 0.05$) (See Appendix J for means and standard deviations).

The most notable difference in policy preference between the two countries was the elevated preference for voluntary white listing (Option C) amongst Canadians. Indeed, on average, Canadians preferred Option C significantly more than American respondents within three-quarters of the clusters (Figure 6.17 and Figure 6.18).

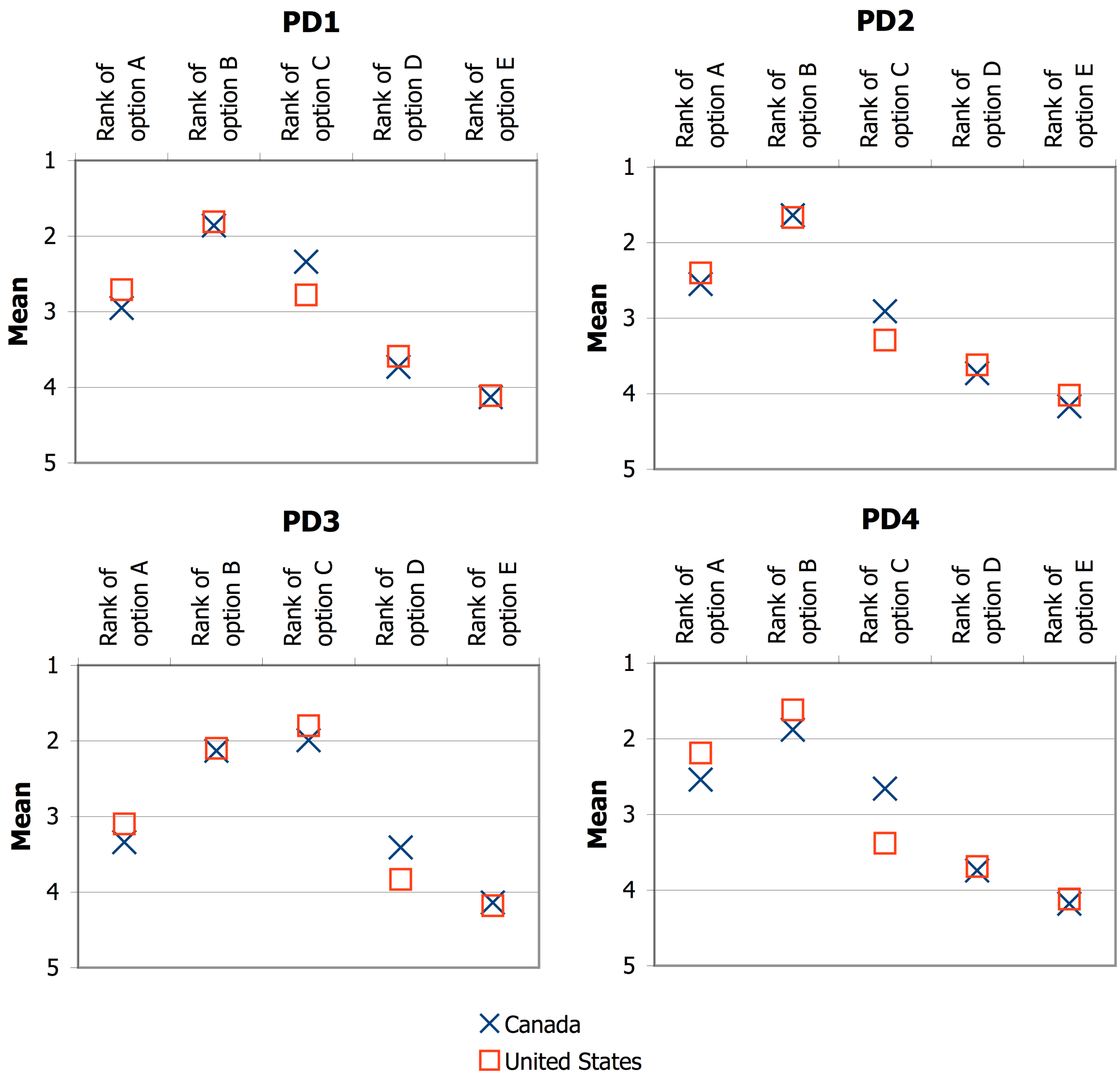

Figure 6.17: Mean ranking of the five policy options for Canadians and Americans belonging to each of the PD clusters, where 1 represents the most preferred option

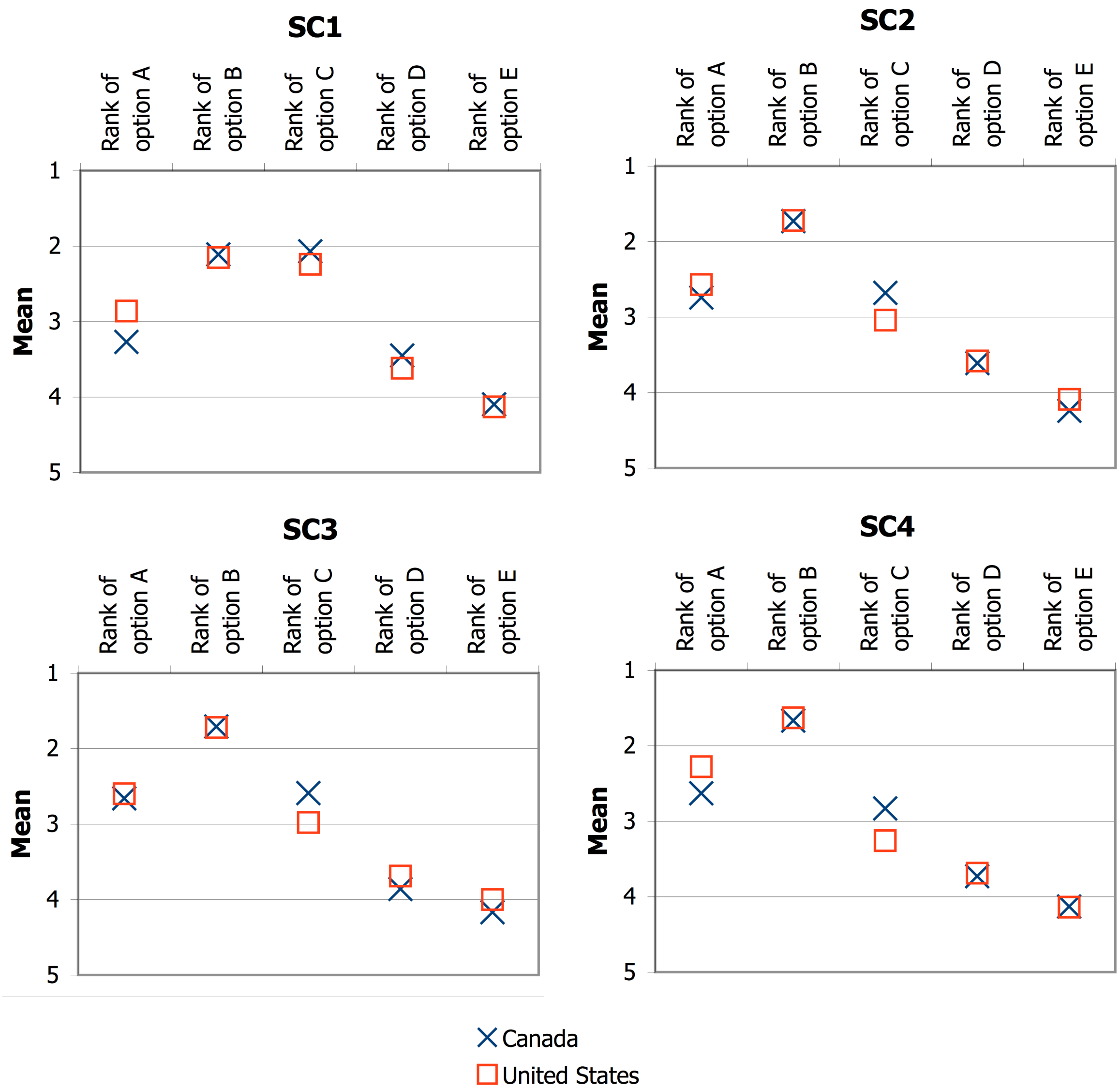

Figure 6.18: Mean ranking of the five policy options for Canadians and Americans belonging to each of the SC clusters, where 1 represents the most preferred option

6.4 Initial Results Using a Multinomial Logit Model

The effect of cluster membership on the selection of most preferred policy option was then determined using a multinomial logit model. The model was designed to compare preferences for the novel policies (B, C, D, and E) to stakeholder preference for the status quo, Option A. The data was coded such that the coefficients for PD clusters reflect differences relative to PD cluster 4 while those for SC clusters indicate departures from SC cluster 4. Thus, any significant differences measured represent differences in preferences for the policy options, relative to Option A, for each cluster as compared to the preferences of cluster 4 members.

The results of the multinomial logit model (Table 6.6) confirm the trends observed in Figure 6.15 and Figure 6.16, namely the insignificant effect of cluster membership on the relative preference of Option B (mandatory white listing) to Option A (black listing), and the significant and positive effect of membership in PD cluster 3 and SC cluster 1 on preference for Option C (voluntary white listing) over Option A. The significant positive coefficients associated with the constant for Option B also substantiate the finding that mandatory white listing is generally preferred to the status quo. Although Option C is favoured by members of certain cluster, the significant negative coefficients for Options C, D, and E confirm that voluntary white listing and economic instruments are, in general, not preferred to the status quo.

Furthermore, when using the information contained in Table 6.6 to calculate the predicted probabilities of each of the policy options being most preferred, predicted values for policy preferences were very close to the observed probabilities (Table 6.7). Therefore, information regarding PD and SC cluster membership may serve to accurately predict policy preferences. By systematically modifying the composition of the sample such that it is composed entirely of respondents belonging to each of the sixteen possible combinations of PD and SC cluster, changes in preferences for the policies with changes in cluster membership were ascertained (Figure 6.19).

Table 6.6: Output from the multinomial logit model

	Variable	Coefficient	Standard Deviation	b/St.Er.	*P*	Mean of X
POLICYB	Constant	0.656	0.267	2.456	**0.014***	
	PD1	0.171	0.300	0.569	0.570	0.193
	PD2	0.111	0.262	0.423	0.673	0.623
	PD3	0.151	0.363	0.417	0.676	0.116
	SC1	-0.164	0.285	-0.575	0.565	0.101
	SC2	-0.028	0.175	-0.163	0.871	0.323
	SC3	0.122	0.180	0.681	0.496	0.319
POLICYC	Constant	-0.598	0.328	-1.823	0.068**	
	PD1	0.832	0.350	2.376	**0.018***	0.193
	PD2	0.126	0.317	0.397	0.691	0.623
	PD3	1.695	0.387	4.385	**0.000***	0.116
	SC1	0.740	0.296	2.502	**0.012***	0.101
	SC2	0.085	0.213	0.400	0.689	0.323
	SC3	0.690	0.211	3.270	**0.001***	0.319
POLICYD	Constant	-2.288	0.615	-3.718	**0.000***	
	PD1	0.715	0.614	1.164	0.244	0.193
	PD2	-0.084	0.580	-0.145	0.884	0.623
	PD3	0.052	0.773	0.067	0.947	0.116
	SC1	0.954	0.538	1.772	0.076**	0.101
	SC2	0.562	0.409	1.375	0.169	0.323
	SC3	0.471	0.436	1.080	0.280	0.319
POLICYE	Constant	-2.543	0.780	-3.260	**0.001***	
	PD1	0.531	0.847	0.627	0.531	0.193
	PD2	0.426	0.768	0.554	0.579	0.623
	PD3	0.901	0.921	0.979	0.328	0.116
	SC1	-0.108	0.708	-0.152	0.879	0.101
	SC2	-0.040	0.437	-0.091	0.928	0.323
	SC3	0.108	0.444	0.242	0.808	0.319

***** Significance at the 5% level

** Significance at the 10% level

Table 6.7: Comparison of the actual frequency with which each policy was selected first with the frequency predicted based on the results of the multinomial logit model

	PREDICTED	ACTUAL
POLICYA	21%	21%
POLICYB	47%	46%
POLICYC	25%	26%
POLICYD	4%	4%
POLICYE	3%	3%

The output of the multinomial logit model (Table 6.6) aligns with the observations stemming from the preliminary exploration of differences in policy preferences between clusters (Figure 6.15 and Figure 6.16). The significant positive coefficients associated with the cluster membership variables indicates that preference for voluntary white listing (Option C), relative to the status quo (Option A), is significantly higher amongst members of PD clusters 1 and 3 as compared to members of PD cluster 4 ($p < 0.05$). Policy C is also preferred significantly more, relative to Option A, by SC clusters 1 and 3 members when compared to members of SC cluster 4 ($p < 0.05$). The output also reveals that, relative to the status quo, the variable tax option is preferred more by members of SC cluster 1 than by members of SC cluster 4 ($p < 0.1$).

Furthermore, the multinomial logit model output indicates that preferences for all the novel policy options are significantly different from preference for the status quo. Specifically, the significant positive coefficient associated with the constant for policy Option B denotes that mandatory white listing is generally preferred over the status quo ($p < 0.05$). The negative significant coefficients for the constants for the economic policies, Options D and E, suggests that these are less popular than the status quo ($p \leq 0.001$). Finally, the status quo is preferred to the voluntary white listing policy as suggested by the slightly significant negative constant for Option C ($p < 0.1$). The information displayed in Figure 6.15 and Figure 6.16 supports the results of the multinomial logit model described above.

By using the results of the multinomial logit modelling, predicted policy preferences were calculated for different scenarios. Each scenario represents a sample consisting entirely of individuals belonging to a specific PD and SC cluster combination. Thus, predicted policy preferences under sixteen scenarios, representing the sixteen possible PD and SC cluster combinations, were calculated (Figure 6.19).

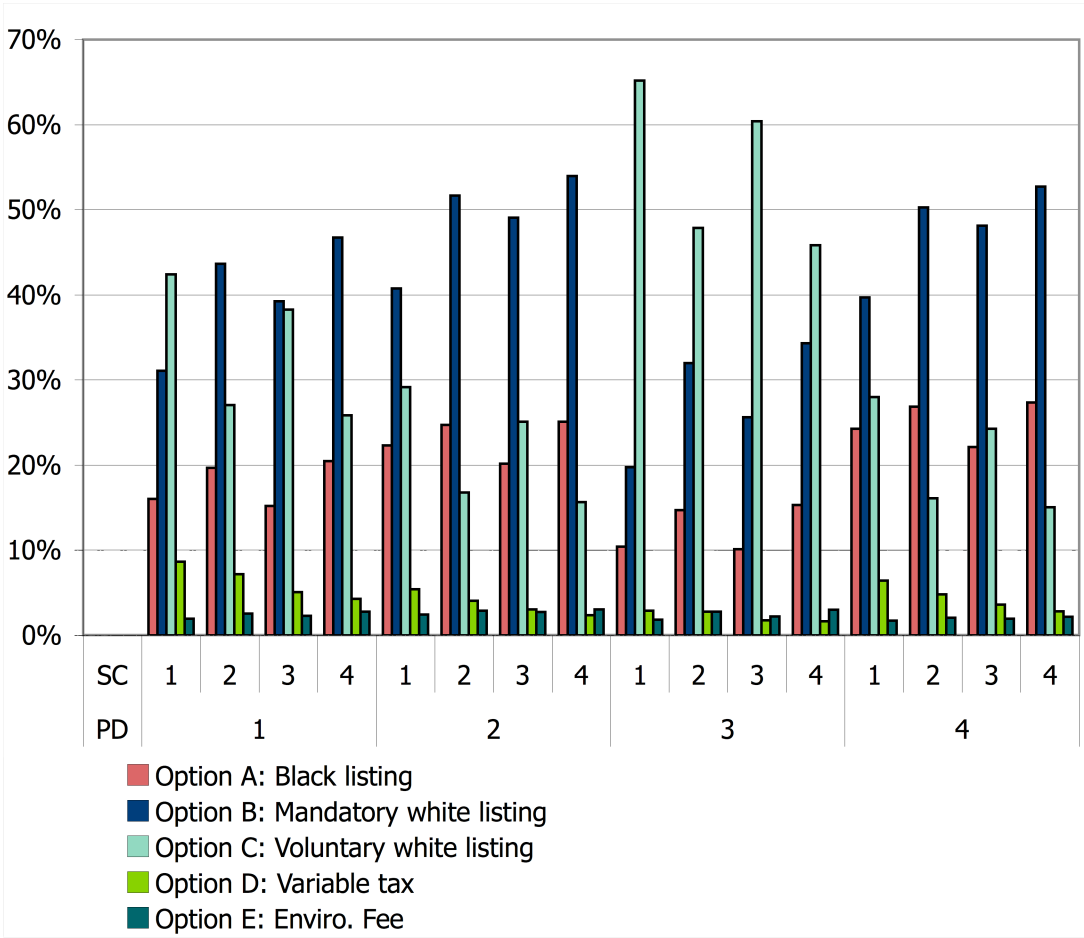

Figure 6.19: Predicted probability of each policy option being selected first by individuals belonging to each PD and SC cluster combination

These predictions indicate that Option A (black listing) would not be selected first by the majority of respondents, regardless of sample composition. However, as compared to the other scenarios, a sample comprised solely of individuals belonging simultaneously to PD cluster 4 and SC clusters 2 or 4 would have the highest preference for the status quo (Figure 6.19)

The predictions also suggest that members of both PD cluster 2 and SC cluster 4 would be most likely to select Option B (mandatory white listing) first. This option is the most popular in 11 of the 16 (or 69%) scenarios (Figure 6.19).

Respondents grouped within PD cluster 3 and SC cluster 1 are anticipated to opt for Option C first more than those belonging to any other pair of clusters.

The results also indicate that Option C is chosen by the majority of respondents under 5 of the 16 (31%) scenarios, namely all those where Option B is not the most popular. However, respondents belonging to any of these five cluster combinations represent only 14% of the original sample (Figure 6.19).

Interestingly, Options A, D and E are never predicted to be the most popular. The status quo, Option A, is always more popular than the economic instruments, Options D and E. Option D (variable tax) is more likely to be preferred to Option E (fixed environmental fee) in all but three of the scenarios (Figure 6.19).

6.5 Summary

Through principal components and cluster analyses, I was able to group respondents based on their perceptions with respect to the significance of various components of the invasive plant problem and the importance of various considerations when selecting a strategy to address the problem. Significant differences in opinion and composition were found between the resulting clusters. Notably, PD cluster 3 and SC cluster 1 differed the most relative to the remaining clusters.

Moreover, when comparing clusters in terms of preference for the policy options, significant differences were also isolated. Again, PD cluster 3 and SC cluster 1 were found to diverge from the other clusters due to an elevated preference for the voluntary white listing policy option.

Differences between Canadian and American respondents were observed within clusters. Specifically, in many cases respondents from Canada preferred the voluntary white listing policy to a greater extent than their American counterparts.

By using clusters membership as a respondent characteristic, a multinomial logit model was used to accurately predict policy preferences. The model suggests that the majority of respondents, regardless of cluster membership, would favour an option rooted in screening mechanisms. Moreover, mandatory white listing is preferred to voluntary white listing under most scenarios.

CHAPTER 7: DISCUSSION

The results presented in the preceding chapters provide important information regarding stakeholder perceptions of the invasive plant problem as well as their preferences for a variety of plausible policy solutions. Not only do the results indicate that perceptions and preferences vary between stakeholder groups, but also that they vary within stakeholder groups. Here, I discuss the significance of the difference between the stakeholder group and cluster analyses as well as the implications of my results with respect to policy development to address the risks associated with the introduction of plants for horticultural purposes. Finally, I discuss areas for future research, especially regarding opportunities to further develop the multinomial logit model.

7.1 Stakeholder Groups versus Clusters

The results provided in Chapter 5 show that significant differences between stakeholder groups exist when examining perceptions of the invasive plant problem and views of what a strategy devised to tackle the problem ought to achieve. Generally, the perceptions of those stakeholders actively engaged in the sale of potentially invasive plants, namely professional horticulturists, conflict with the views of those who are confronted by the problem or who are responsible for addressing it, namely experts, park employees, and naturalists. Moreover, the differences between the aforementioned groups are also observed when comparing mean rank assigned to some of the policy options. The most notable difference was the elevated preference for a policy centred on voluntary white listing among professional horticulturists.

Meanwhile, the results compiled in Chapter 6 indicate that significant differences between PD and SC clusters also exist and that, interestingly, each cluster is composed of individuals belonging to a range of stakeholder groups, although some clusters are dominated by one or two groups. As such it is important to discuss whether classifying respondents by stakeholder groups or by clusters is most appropriate.

When comparing the cluster means to stakeholder group means with respect to the significance of various aspects of the problem (Figure 6.3 to Figure 5.5), importance of considerations applied to choosing a strategy (Figure 6.4 to Figure 5.6), and preferences for policy options (Figure 5.7 to Figure 6.13 and Figure 6.14), the differences in means between the clusters are generally more pronounced than the differences observed across the stakeholder groups. This observation is substantiated by the larger values of the *F* statistic for the one-way ANOVA tests comparing clusters (Appendix I), relative to those obtained when comparing stakeholder groups. Moreover, the *F* statistics resulting from the one-way ANOVA procedures for mean rankings of the five policy options were greater when comparing clusters than when comparing stakeholder groups. The larger the *F* statistic, the greater the variation between groups as compared to the variation within groups. This result indicates that clusters represent more distinctive segments of the sample as compared to the stakeholder groups.

Furthermore, the results of the one-way ANOVA for the differences between groups (see Chapter 5) with respect to mean significance of different features of the problem, importance of considerations when choosing a strategy, and rank of the policy options indicates that the sum of squares within stakeholder groups is many times larger than the sum of squares between clusters for all dependent variables. Since the sum of squares is a measure of the degree of deviation of each observation from the mean, and thus a measure of dispersion, these results suggest high variability among the members of each stakeholder group.[6] In other words, members of a predefined group may not

[6] Indeed, preliminary analyses of the professional horticulturist group in isolation indicate that sub-groups within the stakeholder group (i.e., garden centre owners and employees versus landscapers) perceive the problem, as well as solutions to it, differently (Ransom-Hodges and Knowler, in press).

share attitudes and views regarding the invasive plant problem and, hence, any conclusions drawn from the results of the analysis of the stakeholder groups may conceal possible diversity within the groups. As such, basing conclusions on stakeholder group averages masks the high variability found *within* stakeholder groups. Thus, multiple comparisons across pre-defined stakeholder groups may not be the most appropriate approach for explaining preferences for policies employed to address potential invasions resulting from the importation of plants for ornamental horticulture.[7]

Therefore, important differences in views and preferences exist both *between* and *within* stakeholder groups. Due to lower levels of variation within the clusters, relative to the stakeholder groups, the results stemming from the cluster analyses make the link between attitudes and preferences more explicit. As such, cluster membership was used to predict policy preferences using the multinomial logit model. However, clusters are an artificial construct and may not be very applicable in a typical decision-making context. Indeed, targeting members of pre-defined groups for participation in stakeholder consultations is seemingly more feasible than gathering input from representatives of hypothetical cluster groups.

7.2 Predicting Policy Preference

Cluster membership was found to be an accurate predictor for policy preference, as indicated by the results of the multinomial logit modelling. Although policy options rooted in white listing were always most preferred, preference for voluntary versus mandatory policies varied depending on cluster membership. Indeed, the voluntary option was predicted to be preferred to the mandatory version of the white listing policy among members of PD cluster 3, regardless of SC cluster membership, and by those belonging to both PD cluster

[7] Refer to Wolfe and Putler (2002) for a comprehensive evaluation of the assumption of homogeneous priorities within role-based stakeholder groups. The authors conclude that "role-based self-interest frequently is not a sufficient "binding tie" of stakeholder groups" (64).

1 and SC cluster 1. However, respondents belonging to the aforementioned clusters represented less than fifteen percent of the sample.

The main conclusion that can be drawn from the multinomial logit model is that individuals that do not assign high levels of significance to the problem favour voluntary white listing initiatives over the other policy options. Based on the assessment of cluster composition, these individuals are more likely, as compared to the remainder of the sample, to belong to the professional horticulturist group, reside in Ohio, and have higher annual household incomes. The voluntary approach would also be the most popular choice among those who, despite emphasizing the significance of damage to natural areas and irreversible damages, deem cost considerations to be more important than any other when selecting a strategy and do not consider negative externalities resulting from invasions or the failure to assess liability to be main features of the problem.

Although policies rooted in economic instruments were the least popular, regardless of stakeholder perception, these were preferred slightly more under some scenarios than others. Interestingly, the variable tax option received the most support from those who emphasized cost considerations when selecting a strategy while discounting the importance of negative externalities and of not punishing those responsible for causing the problem.

Also of note, the variable tax was preferred to the environmental fee in most circumstances. The preference for the variable tax may be because the tax rate would be determined based on the invasion risk and thus plants not posing an invasion risk would not be taxed. Contrarily, the environmental fee would be applied to the sale of all non-native plant species, including those that have no invasive potential, and thus may be perceived as less appropriate.

Finally, the finding that the status quo policy, black listing, was not preferred by the majority under any of the scenarios modelled is notable. This finding suggests that all stakeholders support the implementation of novel policies to combat the problem of invasions resulting from introductions of plants for ornamental horticulture. However, care must be taken when selecting a policy to replace the status quo since not all plausible policy options will be preferred to black listing.

7.3 Policy Implications and Recommendations

Four main implications emerge from this research with respect to informing policy making in the realm of invasive plant management. First, my findings indicate that the link between stakeholder perceptions and preferences for policies is stronger than that between role-based stakeholder group affiliation and policy preference. As such, discussions surrounding the acceptance of policies to address invasions stemming from horticultural trade should avoid framing the issue in terms of divergence between predefined role-based stakeholder groups. Instead, stakeholder views and opinions of the problem ought to be considered in order to assess acceptance of policies for reducing the invasion risks associated with ornamental horticulture.

Second, the results suggest that a move away from black listing and towards white listing will be supported largely by those confronted by the problem. Other research has shown that voluntary white listing initiatives are, to date, ineffective, and that a mandatory white listing approach would be more appropriate. However, as indicated here, the implementation of mandatory white listing will be challenged most by those individuals who do not perceive any facet of the invasive plant problem to be extremely significant (PD cluster 3). Individuals who do not deem any considerations with respect to selecting a strategy to be very important, while indicating that cost considerations are more important than other considerations (SC cluster 1) are also more likely to advocate for a voluntary approach. As such, education and awareness campaigns to highlight the existence of a problem and its magnitude, may serve to increase acceptance for mandatory white listing policies.

Third, my research suggests that support for policies based on economic instruments is low, regardless of individual perceptions. An explanation for this finding cannot be generated from my research results, but may be due to a lack of familiarity with economic policy instruments in the context of tackling the invasive plant problem outside the academic sphere. Indeed, the applicability of taxes to internalize the externalities associated with the importation of exotic plant species for horticulture has only recently been suggested from a theoretical standpoint. Support for these policies may rise if and when the general public understands the practical feasibility and potential benefits of an economic approach. However, the low support for economic instruments may simply reflect a general dislike for taxes and fees, in which case low awareness levels are not the main issue.

Finally, the research revealed that, although mandatory white listing is generally the most popular option in both Canada and the United States, preference for voluntary white listing is higher in Canada. While this result indicates that a coordinated continental approach to preventing new plant invasions is feasible, the Canadian component of the education and awareness campaigns, discussed above, will be critical.

7.4 Limitations and Areas for Further Research

Although the results of my research have interesting policy implications, some limitations exist that should not be ignored. The most fundamental limitation is the inability to extrapolate my research findings in order to make generalized statements regarding the views and opinions of the entire population of North American stakeholders. Because my sampling methodology did not guarantee a random sample, selection for participation in the study was limited to those stakeholders with access to the Internet and, for the most part, those with email addresses available online. Furthermore, stakeholders from only a few states and provinces were targeted. As such, the conclusions of my research should not be interpreted as a comprehensive assessment of all North American stakeholders. Nonetheless, my research does provide interesting and informative preliminary results that should be considered when conducting further investigation in this field of study.

In addition, my research is fraught with the limitations that are generally associated with a survey-based methodology. Respondent self-selection and biases associated with self-reporting are drawbacks of surveys in general and, as such, may be associated with the current research. Indeed, individuals that would benefit from policies aimed at limiting the introduction of potentially invasive ornamental plant might have been most motivated to participate in the study and thus overrepresented in the data set. In addition, input may be lacking from those that did not think that a solution to the invasive plant problem exists or that that did not deem plant invasions to be an issue worth addressing. Also, individuals that felt the survey unfairly targeted the horticulture industry or that considered control programs to be more important than the prevention of new introduction might have been less willing to participate in the study. Therefore, although care was taken during the survey design phase of the research to avoid these limitations and the sample was large, the absence of bias in the survey data cannot be guaranteed.

Future research stemming from this study should include a more rigorous analysis of the data using the multinomial logit model. My preliminary use of the multinomial logit proved to be fruitful, however the model itself was not developed to its full potential. For instance, the multinomial logit model should be applied to predict the full rankings of the policy options rather than simply the most preferred option. Given results indicating differences between Americans and Canadians, the model could be expanded to include individual traits, such as place of residence, to determine the precise effects of this variable on policy preference. Other socio-demographic variables, such as age, gender, and income, could also be included in the multinomial logit model.

Finally, I suggest that the differences within the stakeholder groups be investigated further. It would be especially interesting to perform the principal components and cluster analyses on the professional horticulturist group. The professional horticulturist group is often portrayed as a homogenous group in opposition to regulation of the industry. However, my research suggests that this is not the case and it would be useful to decipher the diverse perceptions and preferences within the group.

CHAPTER 8: CONCLUSIONS

As explained at the outset, North American policy in place to address the horticultural dimension of the invasive plant problem is ineffective due to fundamental deficiencies. As such, it is important to identify alternative approaches and evaluate their merits and limitations. I identified four novel policy options and reviewed how they had been assessed within the literature. Through the literature review, I discovered that information pertaining to levels of stakeholder acceptance for the various polices was limited. Given the importance of stakeholder acceptance with respect to the successful implementation of policies, I set out to determine, and explain, preferences for the various policy options.

I used a variety of methods to obtain and analyse data such that I could achieve my stated research objectives. Through an online survey, I collected information from a sample of stakeholders residing across North America. Then, using descriptive statistics, one way ANOVA tests, multiple comparisons procedures, and principal components and cluster analyses, I characterized and compared segments of the sample. These tools enabled me to ascertain certain determinants of policy preference. I explored policy preferences further through the preliminary application of a multinomial logit model, resulting in the prediction of policy preferences based on cluster membership.

The main conclusion drawn from my research is that policies based on white listing are always most preferred, regardless of stakeholder group membership and perceptions. Although the majority of respondents prefer a mandatory white listing approach, implemented and enforced by the government, a small but important subset of the sample prefers voluntary industry self-regulation. My analyses characterized the individuals that opted for the voluntary approach and found that, compared to others, they tend to underemphasize the importance of the problem.

Furthermore, my research results suggest that members of pre-defined stakeholder group do not necessarily share the same attitudes and perceptions. Thus, due to the heterogeneity within stakeholder groups, preferences for policies ought to be evaluated based on individual perceptions rather than on group affiliation.

My research thus yields information that can be applied to inform the selection and implementation of policies to address the problem of invasive plants being introduced to North America for horticultural purposes. In addition to identifying and characterizing plausible alternative policy options to address the introduction and sale of invasive plants by the North American horticulture industry, I assessed stakeholder perspectives of the problem and preferences for the defined policy options. I also explored how stakeholder perceptions shape preferences for different policies.

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APPENDICES

Appendix A: The Survey Questionnaire

Section 1: Introductory Questions

1. **How familiar are you with the invasive plant species in your area?**
   - O Very familiar
   - O Somewhat familiar
   - O Not at all familiar
2. **What is your MAIN source of information about which species are invasive in your area?**
   - O Government (any level)
   - O Non-governmental organization
   - O Horticulture industry association, nursery or garden centre, or landscaper
   - O Agricultural publication, fieldman, or extension staff
   - O Weed advisory committee or invasive plant society
   - O Friend or neighbor
   - O Personal observation
   - O Academic publication
   - O Internet
   - O Other
   - O None
3. **I am personally confronted with the invasive plant problem the most as a ...**
   - O Horticultural industry professional (landscaper, professional gardener, nursery owner, nursery staff, botanical garden employee, arborist, horticulture industry representative, etc.) → ***go to Section 1.1***
   - O Hobby gardener (amateur, non-commercial gardening enthusiast) → ***go to Section 1.2***
   - O Agriculturalist (farmer, rancher, industry representative, agricultural weed management specialist, extension agent, fieldman, etc.) → ***go to Section 1.3***
   - O Park manager or staff → ***go to Section 1.4***
   - O Invasive plant expert (governmental policy maker, botanist, researcher, etc.) → ***go to Section 1.5***
   - O Naturalist (member of a conservation-focused NGO or club, weed removal volunteer, etc.) → ***go to Section 1.6***
   - O None of the above → ***go to Section 1.7***

Section 1.1

1. **How long have you been employed in the horticultural sector?**
   - O 0-5 years
   - O 6-10 years
   - O 11-15 years
   - O 16-20 years
   - O 21+ years

2. **Have you ever acted as a horticulture industry representative (i.e., do you sit on the board of directors, participate in the executive committee, etc. of any horticultural associations)?**
   - O Yes
   - O No

3. **Which of the following BEST describes your position as a horticulturist?**
   - O Owner, manager, or employee of a commercial nursery or garden centre → ***go to Section 1.1.1***
   - O Professional gardener, landscaper, or arborist → ***go to Section 1.1.2***
   - O Curator, manager, or employee of a botanical or public garden → ***go to Section 1.1.2***
   - O Other → ***go to Section 1.8***

Section 1.1.1

1. **Which of the following BEST describes your position at the present time?**
   - O Owner of a nursery or garden centre
   - O Manager of a nursery or garden centre
   - O Production employee at a nursery or garden centre
   - O Sales or customer service employee at a nursery or garden centre
   - O Administrative employee at a nursery or garden centre
   - O Other

2. **Which of the following BEST describes the type of nursery or garden centre you own, manage, or work for at the present time?**
   - O Retail nursery
   - O Wholesale nursery
   - O Rewholesale nursery (broker)

3. **Which of the following BEST describes the type of business the nursery or garden centre does at the present time?**
   - O Only local sales
   - O Only non-local sales (e.g., mail-order or internet sales)
   - O Mainly local sales
   - O Mainly non-local sales (e.g., mail-order or internet sales)
   - O Other

4. **How are native plants defined by the nursery or garden centre?**
   - O All plants native to North America
   - O Only plants native to the geographic area where the nursery is located
   - O No precise definition has been adopted by the nursery or garden centre
   - O Don't know

5. **What types of plants does the nursery or garden centre sell?**
   - O Only plants native to North America
   - O Only plants native to the geographic area where the nursery is located
   - O Only plants not native to North America
   - O Mainly plants native to North America

- Mainly plants native to the geographic area where the nursery is located
- Mainly plants not native to North America
- All types of plants equally
- Don't know

6. **Does the nursery inform customers as to whether the plants being sold are native to the region where the nursery is located?**
   - Always
   - Never
   - Sometimes
   - Don't know
7. **Does the nursery sell plants for gardening that are considered invasive locally?**
   - Yes
   - No
   - Don't know
8. **Does the nursery sell plants for gardening that are considered invasive elsewhere in North America?**
   - Yes
   - No
   - Don't know
9. **Which of the following types of plants do you PREFER to sell, personally?**
   - Plants that are native to North America but not necessarily to the geographic area where they are being sold
   - Plants that are native to the geographic area where they are being sold
   - Plants that are not native to North America
   - No preference
   - → ***go to Section 1.8***

Section 1.1.2

1. **What types of plants do you use for professional gardening, landscaping, or arboriculture?**
   - Only plants native to North America
   - Only plants native to the geographic area where the nursery is located
   - Only plants not native to North America
   - Mainly plants native to North America
   - Mainly plants native to the geographic area where the nursery is located
   - Mainly plants not native to North America
   - All types of plants equally
   - Don't know

2. **Prior to planting, do you and your customers discuss whether the plants that you will use are native to the local geographic area?**
   - Always
   - Sometimes
   - Never
   - Don't know
3. **When gardening or landscaping commercially, do you use plants that are considered invasive in the area where you work?**

- O Yes
- O No
- O Don't know

4. **Do you use plants when gardening or landscaping commercially that are considered invasive elsewhere in North America?**
   - O Yes
   - O No
   - O Don't know
5. **Which of the following types of plants do you personally PREFER to use for commercial gardening or landscaping?**
   - O Plants that are native to North America but not necessarily to the geographic area where they are being sold
   - O Plants that are native to the geographic area where they are being sold
   - O Plants that are not native to North America
   - O No preference

   → ***go to Section 1.8***

Section 1.1.3

1. **Which of the following BEST describes your position at the present time?**
   - O Director or curator of a botanical or public garden
   - O Manager at a botanical or public garden
   - O Horticultural technician or gardener at a botanical or public garden
   - O Educator at a botanical or public garden
   - O Administrative employee at a botanical or public garden
   - O None of the above
2. **What types of plants does the garden contain at the present time?**
   - O Only plants native to North America
   - O Only plants native to the local geographic area
   - O Only plants not native to North America
   - O Mainly plants native to North America
   - O Mainly plants native to the local geographic area
   - O Mainly plants not native to North America
   - O All types of plants equally
   - O Don't know
3. **Are visitors to the garden informed as to which plants in the garden are native and which plants are non-native?**
   - O Always
   - O Never
   - O Sometimes
   - O Don't know
4. **Does the garden host native plant sales or workshops for gardening with native plants?**
   - O Yes
   - O No
   - O Don't know
5. **Does the garden contain plants that are considered invasive in the region where the garden is located?**
   - O Yes
   - O No
   - O Don't know
6. **Does the garden contain plants that are considered invasive elsewhere in North America?**

O Yes O No O Don't know

7. **Does the garden contain plants considered invasive (locally or elsewhere in North America) that are interpreted for educational purposes?**
   O Yes O No O Don't know

8. **Which of the following types of plants would you personally PREFER be grown in the garden?**
   O Plants that are native to North America but not necessarily to the geographic area where they are being sold
   O Plants that are native to the geographic area where they are being sold
   O Plants that are not native to North America
   O No preference
   → ***go to Section 1.8***

Section 1.2

1. **How many years have you been gardening as a hobby?**
   O 0-5 years
   O 6-10 years
   O 11-15 years
   O 16-20 years
   O 21+ years

2. **Do you purchase non-native plants for ornamental gardening?**
   O Yes O No O Don't know

3. **What types of plants do you use MOST for ornamental gardening?**
   O Native plants
   O Non-native plants
   O Both types equally
   O Don't know

4. **Which of the following types of plants do you PREFER for ornamental gardening?**
   O Native O Non-native O No preference

5. **Do you purchase and grow plants for ornamental gardening that are considered invasive to the area where you live?**
   O Yes O No O Don't know
   → ***go to Section 1.8***

Section 1.3

1. **How long have you been involved in the agricultural sector?**
   O 0-5 years
   O 6-10 years
   O 11-15 years
   O 16-20 years
   O 21+ years

2. **Have you ever acted as an agriculture industry representative (i.e., do you sit on the board of directors, belong to the executive committee, etc. of any agricultural associations)?**
   O Yes O No

3. **Which of the following best describes you?**

- Farmer or rancher → ***go to Section 1.3.1***
- Agricultural advisor/consultant (agricultural fieldman, agricultural extension officer, etc.) → ***go to Section 1.3.2***
- Other → ***go to Section 1.8***

Section 1.3.1

1. **What is the main component of your agricultural activities?**
   - Mixed farming - mainly livestock raising (NOT on a ranch)
   - Mixed farming - mainly crop growing (grain, fruit, vegetables, etc.)
   - Only livestock raising (NOT on a ranch)
   - Only crop growing
   - Ranching
   - Other → ***go to Section 1.8***
2. **Is your agricultural production certified organic?**
   - Yes
   - No
3. **Do you principally derive your livelihood from agricultural activities?**
   - Yes
   - No
4. **In your opinion, have weeds not native to North America invaded your agricultural lands (crop fields, orchard, pastures, range land, etc.)?**
   - Yes
   - No
   - Don't know
5. **In your opinion, have weeds not native to North America reduced the yield or output of your agricultural activities?**
   - Yes
   - No
   - Don't know

   → ***go to Section 1.8***

Section 1.3.2

1. **Which of the following BEST describes your position at the present time?**
   - Agricultural extension agent
   - Agricultural fieldman
   - Agronomist / researcher
   - Private agricultural consultant
   - Weed inspector
   - Weed control specialist
   - Other
2. **In your opinion, have weeds not native to North America invaded agricultural lands (crop fields, orchard, pastures, range land, etc.) in the region where you work?**
   - Yes
   - No
   - Don't know
3. **In your opinion, have weeds not native to North America reduced agricultural yields or output in the region where you work?**
   - Yes
   - No
   - Don't know

→ *go to Section 1.8*

Section 1.4

1. **How long have you been considered an expert in the field of invasive plants?**
   - O 0-5 years
   - O 6-10 years
   - O 11-15 years
   - O 16-20 years
   - O 21+ years
2. **Which of the following types of invasive plant expert BEST describes you at the present time?**
   - O Academic researcher
   - O Policy maker or policy analyst
   - O Professional scientist (e.g., weed management expert, consultant, botanist, etc.)
   - O Other
3. **Where are you currently employed?**
   - O The government (municipal, regional, or federal)
   - O A non-governmental organization (NGO)
   - O A for-profit company or firm
   - O A university or other academic institution
   - O Other
4. **At present, what is the focus of your expertise with respect to invasive plants?**
   - O Agricultural sciences
   - O Economics
   - O Ecology, biology or botany
   - O Horticultural sciences
   - O Policy or law
   - O Weed control
   - O Other
5. **Have you ever contributed to the development of policies specifically aimed at addressing the introduction and/or sale of invasive non-native plants by the horticulture industry?**
   - O Yes
   - O No

   → *go to Section 1.8*

Section 1.5

1. **How long have you been a park employee?**
   - O 0-5 years
   - O 6-10 years
   - O 11-15 years
   - O 16-20 years
   - O 21+ years
2. **What type of park do you work for at present?**
   - O Urban or municipal park
   - O Provincial or state park
   - O National park
   - O Other

3. **Are you currently responsible for managing non-native invasive plants on park lands?**
   - O Yes
   - O No
   - O Don't know
4. **Has the park where you currently work ever been invaded by non-native invasive plants?**
   - O Yes
   - O No
   - O Don't know

   → ***go to Section 1.8***

Section 1.6

1. **What is the PRIMARY focus of your interest in conservation?**
   - O Habitat conservation in general
   - O Biodiversity conservation in general
   - O Native plant diversity conservation specifically
   - O Other
2. **Are you an active member of an NGO or other group that is focused on the conservation of habitat and/or biodiversity?**
   - O Yes
   - O No
3. **Are you an active member of an NGO or other group that organizes the removal of non-native invasive plants from parks and other natural areas?**
   - O Yes
   - O No

   → ***go to Section 1.8***

Section 1.7

1. **Are you confronted with the invasive plant problem in a capacity that was not listed in the previous question?**
   - O Yes, please specify: → ***go to Section 1.8***
   - O No → ***end survey***

Section 1.8

1. **Which of the following statements applies to you personally? Please check all that apply.**
   - ☐ I own property that has a lawn
   - ☐ I own property that has a garden
   - ☐ I own property that has a forest
   - ☐ I own property that has a field
   - ☐ I own property that has a wetland
   - ☐ I own property that does not have any open outdoor green space
   - ☐ I do not own property

To what extent have you:

	Not at all/Not relevant	Somewhat	Very much	Unsure
2. **Experienced a reduction in the enjoyment of your own property due to the occurrence of invasive plants?**	O	O	O	O
3. **Experienced a reduction in the enjoyment of natural areas and/or parks where invasive plants occur?**	O	O	O	O
4. **Devoted time to the removal and/or control of invasive plants on your own property?**	O	O	O	O
5. **Devoted time to the removal and/or control of invasive plants in natural areas and/or parks?**	O	O	O	O
6. **Suffered economic losses due to the occurrence of invasive plants?**	O	O	O	O
7. **Changed your behaviour in an attempt to prevent invasions from occurring?**	O	O	O	O
8. **Been otherwise affected by the invasive plant problem?**	O	O	O	O

9. **Do you consider yourself to be a native plant advocate?**
   - O Yes
   - O No
   - O Unsure / Don't know

10. **How aware are you of existing government regulations and laws that deal with the invasive plant problem?**
    - O Not at all aware
    - O Somewhat aware
    - O Very aware

Section 2: Policies

1. **Policies aimed at addressing the invasive plant problem are applied to specific plant species. In your opinion, which of the following approaches should be used to determine which plant species are considered invasive?**
   - ○ Black List (Creating lists of non-native plant species known to be invasive in a given region. Only species that have already invaded will be listed.)
   - ○ Screen (Assessing the likelihood that newly imported non-native plant species will become invasive. Policies will only target species that have a high likelihood of invasion.)
   - ○ Combination (Listing both non-native species that are known to be invasive in a given region AND non-native plant species that have a high likelihood of invasion.)
   - ○ None of the above
2. **In your opinion, which of the following approaches should be used to limit the introduction and dispersal of invasive plant species?**
   - ○ Ban/Quarantine (Completely prohibiting the import and sale of all plant species that are considered invasive.)
   - ○ Variable Tax (Imposing a variable monetary charge on the sale of all newly imported non-native plant species. The tax rate is dependent on the likelihood of invasion of a species - i.e., the sale of species that are more likely to invade is associated with a greater charge.)
   - ○ Fixed Environmental Fee (Imposing a fixed monetary charge on the sale of all non-native plant species.)
   - ○ None of the above
3. **In your opinion, how should policies aimed at addressing the import and sale of invasive plants for horticulture be implemented and enforced?**
   - ○ Mandatory (Implemented and enforced by the government.)
   - ○ Voluntary Self-Regulation (Implemented and enforced by the horticulture industry - e.g., voluntary codes of conduct.)
   - ○ None of the above

4. **There are several ways to address the horticultural dimension of the invasive plant problem. Five options focused on the introduction and sale of plant species are outlined below. The descriptions are based on the information contained in the previous set of questions.**

   Choose the option that you prefer most.

   Now, choose your second most preferred choice.

   Choose your third choice.

   Choose your fourth choice.

   The remaining option has been automatically selected as the option you prefer least.

	Policy options				
	Option A	Option B	Option C	Option D	Option E
Import & sale	Black list and ban all species listed	Screen and ban species with a high likelihood of invasion	Screen and ban species with a high likelihood of invasion	Screen and variable tax	Fixed environmental fee
Implement & enforce	Mandatory	Mandatory	Voluntary	Mandatory	Mandatory
	O	O	O	O	O

5. **Which of the following considerations influenced your ranking of the five policy options MOST?**
   - O The types of species that are prohibited from being imported and sold (i.e., known invasive species, species with a high likelihood of becoming invasive, or neither)
   - O The types of species that are subject to a monetary charge when sold (i.e., species with a high likelihood of becoming invasive or all non-native species)
   - O The type of monetary charge that is applied (i.e., variable tax or fixed environmental fee)
   - O The implementation and enforcement mechanism (i.e., mandatory or voluntary)
   - O Practicality of implementation
   - O Potential effectiveness
   - O Other
   - O Don't know

Section 3: Attitudes & Perceptions

1. **In your opinion, how important is the invasive plant problem?**
   - O Not at all Important
   - O Somewhat Important
   - O Very Important
   - O No Opinion

In your opinion, how significant are each of the following aspects of the invasive plant problem?

	Not at all significant	Somewhat significant	Very significant	No Opinion
2. **Damage to managed areas (garden, lawn, agricultural lands, etc.)**	O	O	O	O
3. **Damage to natural areas (forests, wetlands, etc.)**	O	O	O	O
4. **Some of the damage caused is irreversible**	O	O	O	O
5. **Invasive plants spread easily across property lines and borders**	O	O	O	O
6. **People who aren't responsible for causing the problem are affected**	O	O	O	O
7. **People who cause the problem aren't penalized or punished**	O	O	O	O
8. **The activities known to cause the problem are allowed to continue**	O	O	O	O

In your opinion, how important are each of the following with respect to causing the invasive plant problem?

	Not at all important	Somewhat important	Very important	No Opinion
9. **People who introduce, buy, or sell any non-native plants for gardening or landscaping purposes**	O	O	O	O
10. **People who introduce, buy, or sell plants known to be invasive for gardening or landscaping purposes**	O	O	O	O

11. **Horticulture industry associations**	O	O	O	O
12. **Government agencies responsible for regulating the horticulture industry**	O	O	O	O
13. **People who don't remove any plants known to be invasive growing on their property**	O	O	O	O

In your opinion, how important are each of the following considerations when choosing a strategy to address the invasive plant problem?

	Not at all important	Somewhat important	Very important	No Opinion
14. **Overall cost of the strategy**	O	O	O	O
15. **Who pays for the strategy**	O	O	O	O
16. **Ability to ensure compliance with the strategy**	O	O	O	O
17. **Potential ability of the strategy to prevent invasions in natural areas**	O	O	O	O
18. **Potential ability of the strategy to control invasions in natural areas**	O	O	O	O
19. **Potential ability of the strategy to prevent invasions on agricultural and other human-modified lands**	O	O	O	O
20. **Potential ability of the strategy to control invasions on agricultural and other human-modified lands**	O	O	O	O

21. **In your opinion, which of the following groups should be MOST responsible for paying to prevent plant invasions?**
    - O People who introduce, buy, or sell any non-native plants for gardening or landscaping purposes
    - O Only people who buy or sell plants known to be invasive for gardening or landscaping purposes
    - O Horticulture industry associations
    - O Government agencies responsible for regulating the horticulture industry

- ○ People who don't remove any plants known to be invasive growing on their property

To what extent do you agree with each of the statements provided below?

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
22. **There is not enough public awareness of the problem**	○	○	○	○	○
23. **It is important to devise policies to address the invasive plant problem**	○	○	○	○	○
24. **I am satisfied with current government efforts to solve the problem**	○	○	○	○	○
25. **My biggest concern with respect to the invasive plant problem is its horticultural dimension**	○	○	○	○	○

Section 4: Demographics

1. **What is your gender?**
   - ○ Male
   - ○ Female
2. **Which of the following age categories describes you?**
   - ○ Under 20
   - ○ 20-30
   - ○ 31-40
   - ○ 41-50
   - ○ 51-60
   - ○ 61-70
   - ○ 71-80
   - ○ Over 80
3. **What is the highest level of education you have completed?**
   - ○ Less than high school
   - ○ Completed high school
   - ○ Some postsecondary education (post secondary not completed)
   - ○ Trades or non-university certificate or diploma
   - ○ Completed university
   - ○ Post graduate degree
4. **What category best describes your annual household income level, before taxes?**
   - ○ Under $50,000
   - ○ $50,000 to $74,999
   - ○ $75,000 to $99,999
   - ○ $100,000 to $149,999
   - ○ $150,000 to $199,999
   - ○ Over $200,000

5. **Which of the following best describes your employment status?**
   - O Full Time Employment
   - O Part Time Employment
   - O Seasonal Employment
   - O Unemployed
   - O Student
   - O Retired
   - O Homemaker

Where do you live?

6. **Country:**
   - O Canada
   - O United States

7. **State/Province:**
   - O Alberta
   - O British Columbia
   - O Manitoba
   - O New Brunswick
   - O Newfoundland and Labrador
   - O Northwest Territories
   - O Nova Scotia
   - O Nunavut
   - O Ontario
   - O Quebec
   - O Prince Edward Island
   - O Saskatchewan
   - O Yukon Territory
   - O Alabama
   - O Alaska
   - O American Samoa
   - O Arizona
   - O Arkansas
   - O California
   - O Colorado
   - O Connecticut
   - O Delaware
   - O District of Columbia
   - O Federated States of Micronesia
   - O Florida
   - O Georgia
   - O Guam
   - O Hawaii
   - O Idaho
   - O Illinois
   - O Indiana
   - O Iowa
   - O Kansas
   - O Kentucky
   - O Louisiana
   - O Maine
   - O Marshall Islands
   - O Maryland
   - O Massachusetts
   - O Michigan
   - O Minnesota
   - O Mississippi
   - O Missouri
   - O Montana
   - O Nebraska
   - O Nevada
   - O New Hampshire
   - O New Jersey
   - O New Mexico
   - O New York
   - O North Carolina
   - O North Dakota
   - O Northern Mariana
   - O Island
   - O Ohio
   - O Oklahoma
   - O Oregon
   - O Palau Island
   - O Pennsylvania
   - O Puerto Rico
   - O Rhode Island
   - O South Carolina
   - O South Dakota
   - O Tennessee
   - O Texas
   - O Utah
   - O Vermont
   - O Virgin Islands
   - O Virginia
   - O Washington
   - O West Virginia
   - O Wisconsin
   - O Wyoming

8. **Town/City: ________________________**

9. **If you would like to make any additional comments about this survey, you may enter them here: ____**

Appendix B: Pilot Test Emails

Initial Email:

Subject: Invasive Plant Survey

My name is Arianne Ransom-Hodges and I am writing to ask for your help in a pilot study being conducted at Simon Fraser University's School of Resource and Environmental Management. The study aims to assess perspectives of the invasive plant problem and preferences for various policy solutions.

We are contacting people who have been affected by the invasive plant problem or stand to be affected by action taken to address the problem. We'd like to know what you think the problem is, how you are confronted by the problem, and how you think the problem should be addressed.

Your participation in the pilot study would be very helpful and involves completing a short (20 minute) online survey. Please feel free to enter comments or suggestions for improving the survey in the boxes located at the bottom of every survey page.

You can begin the survey directly by clicking on this link:

http://www.invasiveplantsurvey.rem.sfu.ca/index.php...

Or, if the link doesn't work, you can login manually by going to:

www.invasiveplantsurvey.rem.sfu.ca

loginID: alb###

password: ####

Should you have any questions or comments, please contact us at invasive_plants@sfu.ca.

Thank you for helping with this important study. Sincerely, Arianne Ransom-Hodges

First Reminder Email:

Subject: Reminder: Invasive Plant Survey

Early last week a survey seeking your perspectives with respect to the invasive plant problem was sent to you. We used a Google search of organizations, firms, and agencies in Alberta to identify people who are or could be affected by the invasive plant problem or stand to be affected by action taken to address the problem. This is how we obtained your email address.

If you have already completed the survey, please accept our sincere thanks. If not, please do so today.

You can begin the survey directly by clicking on this link:

http://www.invasiveplantsurvey.rem.sfu.ca/index.php...

Or, if the link doesn't work, you can login manually by going to:

www.invasiveplantsurvey.rem.sfu.ca

loginID: alb###

password: ####

Should you have any questions or comments, please contact us at invasive_plants@sfu.ca.

We are especially grateful for your help because it is only by asking people like you to share your opinions that we can improve the survey and assess perspectives of the invasive plant problem and preferences for various policy solutions. Thank you for helping with this important pilot study.

Sincerely,

Arianne Ransom-Hodges

Final Reminder Email:

Subject: LAST CHANCE: Invasive Plant Survey

We are now concluding the pilot study of perspectives of the invasive plant problem and preferences for policy solutions. We will stop collecting survey responses at the end of this week.

If you'd like to participate in the study by sharing your perspectives and opinions with us, please do so by completing the survey today. If there's a reason that you've chosen not to complete the survey, please send us an email explaining why.

You can begin the survey directly by clicking on this link:

http://www.invasiveplantsurvey.rem.sfu.ca/index.php...

Or, if the link doesn't work, you can login manually by going to:

www.invasiveplantsurvey.rem.sfu.ca

loginID: alb###

password: ####

Should you have any questions or comments, please contact us at invasive_plants@sfu.ca.

Thank you for helping with this important pilot study. Sincerely, Arianne Ransom-Hodges

OR

Subject: please finish the invasive plant survey

We are now concluding the data collection phase for the pilot study of perspectives of the invasive plant problem and preferences for policy solutions. We will stop collecting survey responses at the end of this weekend.

We see that you've logged on to the survey but have not finished completing it. If you'd like to participate in the study by sharing your perspectives and opinions with us, please do so by finishing the survey today. If there's a reason that you've chosen not to finish the survey, please send us an email explaining why.

You can finish the survey directly by clicking on this link:

http://www.invasiveplantsurvey.rem.sfu.ca/index.php...

Or, if the link doesn't work, you can login manually by going to:

www.invasiveplantsurvey.rem.sfu.ca

loginID: alb###

password: ####

Should you have any questions or comments, please contact us at invasive_plants@sfu.ca.

Thank you for helping with this important pilot study.

Sincerely,

Arianne Ransom-Hodges

Thank You Email:

Subject: Thanks!

We are now concluding the pilot study of perspectives of the invasive plant problem and preferences for policy solutions.

Thanks again for taking the time to complete the survey!

Sincerely, Arianne Ransom-Hodges (invasive_plants@sfu.ca)

Appendix C: Emails to Sample

Initial Email:

Subject: Invasive Plant Survey

My name is Arianne Ransom-Hodges and I am writing to ask for your help in a study being conducted at Simon Fraser University's School of Resource and Environmental Management. The study aims to assess perspectives of the horticultural dimension of the invasive plant problem and preferences for various policy solutions.

We are contacting people in Montana who have been affected by the invasive plant problem or stand to be affected by action taken to address the problem. We'd like to know what you think the problem is, how you are confronted by the problem, and how you think the problem should be addressed.

Your participation in the study would be very helpful and involves completing a short (20 minute) online survey.

You can begin the survey directly by clicking on this link:

http://www.invasiveplantsurvey.rem.sfu.ca/index.php...

Or, if the link doesn't work, you can login manually by going to:

www.invasiveplantsurvey.rem.sfu.ca

loginID: xx####

password: ####

If you want other people to complete the survey, please send them this link:

http://www.invasiveplantsurvey.rem.sfu.ca/index.php?SS=y&di=new&pw=new

Should you have any questions or comments, please contact us at invasive_plants@sfu.ca.

Thank you for helping with this important study.

Sincerely, Arianne Ransom-Hodges

First Reminder Email:

Subject: Reminder: Invasive Plant Survey

Early last week a survey was sent to you seeking your input regarding policies to combat the invasive plant problem. This survey focuses on the introduction of invasive species for horticultural purposes and is part of a larger study being conducted at Simon Fraser University in British Columbia, Canada, together with collaborators at the Universities of Wyoming and Washington.

We used a Google search of organizations, firms, and agencies in Ontario to identify people who are or could be affected by the invasive plant problem or stand to be affected by action taken to address the problem. This is how we obtained your email address.

If you have already completed the survey, please accept our sincere thanks. If not, could you please complete the survey within the next day or two?

You can begin or continue the survey directly by clicking on this link:

http://www.invasiveplantsurvey.rem.sfu.ca/index.php...

Or, if the link doesn't work, you can login manually by going to:

www.invasiveplantsurvey.rem.sfu.ca

loginID: xx####

password: ####

Please do NOT send your login information (including the link given above) to others. If you want to send the survey to other people, please provide them with the following link:

http://www.invasiveplantsurvey.rem.sfu.ca/index.php?SS=y&di=new&pw=new

We are especially grateful for your help because it is only by asking people like you to share your opinions that we can get a better idea of how the invasive plant problem is perceived. Your input will also allow us to evaluate preferences for various policy solutions aimed at addressing the import and sale of invasive plants by the horticulture industry.

Should you have any questions or comments, please contact us at invasive_plants@sfu.ca

Thank you for helping with this important study.

Sincerely, Arianne Ransom-Hodges

Final Reminder Email:

Subject: Final Reminder: INVASIVE PLANT SURVEY

We are now concluding the data collection phase of our invasive plant study and we will be accepting survey responses until the end of next week.

If you'd like to participate in the study by sharing your perspectives and opinions regarding the introduction of invasive species for horticultural purposes, please do so by completing the survey today.

You can complete the survey by clicking on this link:

http://www.invasiveplantsurvey.rem.sfu.ca/index.php?...

Or, if the link doesn't work, you can login manually by going to:

www.invasiveplantsurvey.rem.sfu.ca

loginID: xx####

password: ####

Should you have any questions or comments, please contact us at invasive_plants@sfu.ca.

Thank you for helping with this important study.

Sincerely,

Arianne Ransom-Hodge

Thank You Email:

Subject: Thank you for completing the invasive plant survey

We have now concluded the data collection phase of our study regarding the introduction of invasive plants for horticultural purposes.

Thanks for taking the time to complete the survey and participating in our study!

Sincerely, Arianne Ransom-Hodges (invasive_plants@sfu.ca)

Appendix D: Test for Homogeneity of Variance

	Levene Statistic	df1	df2	Sig.[8]
	Stakeholder Groups			
Significance of damage to managed areas	2.873	5	1,656	0.014
Significance of damage to natural areas	82.495	5	1,669	0.000
Significance of irreversible damage	35.631	5	1,626	0.000
Significance of transborder dispersal	39.411	5	1,661	0.000
Significance of affecting those not responsible for causing problem	3.948	5	1,650	0.001
Significance of not punishing those responsible for causing problem	2.287	5	1,620	0.044
Significance of allowing activities that cause problem to continue	46.480	5	1,646	0.000
Importance of cost of strategy	3.635	5	1,651	0.003
Importance of who pays for strategy	10.255	5	1,646	0.000
Importance of ability to ensure compliance with strategy	10.185	5	1,643	0.000
Importance of ability of strategy to prevent invasions in natural areas	54.623	5	1,653	0.000
Importance of ability of strategy to control invasions in natural areas	22.295	5	1,651	0.000
Importance of ability of strategy to prevent invasions in managed areas	23.298	5	1,651	0.000
Importance of ability of strategy to control invasions in managed areas	32.339	5	1,641	0.000
Rank of option A	3.998	5	1,686	0.001
Rank of option B	0.878	5	1,686	0.495
Rank of option C	1.010	5	1,686	0.410
Rank of option D	1.832	5	1,686	0.104
Rank of option E	1.170	5	1,686	0.322

[8] Where the significance level is greater than 0.05, variances are equal

	Levene Statistic	**df1**	**df2**	**Sig.**[8]
	PD Clusters			
Significance of damage to managed areas	9.432	3	1,540	0.000
Significance of damage to natural areas	3,902.458	3	1,540	0.000
Significance of irreversible damage	78.207	3	1,540	0.000
Significance of transborder dispersal	182.780	3	1,540	0.000
Significance of affecting those not responsible for causing problem	24.998	3	1,540	0.000
Significance of not punishing those responsible for causing problem	19.143	3	1,540	0.000
Significance of allowing activities that cause problem to continue	176.322	3	1,540	0.000
Importance of cost of strategy	0.220	3	1,520	0.882
Importance of who pays for strategy	8.924	3	1,517	0.000
Importance of ability to ensure compliance with strategy	80.488	3	1,510	0.000
Importance of ability of strategy to prevent invasions in natural areas	168.639	3	1,517	0.000
Importance of ability of strategy to control invasions in natural areas	118.227	3	1,518	0.000
Importance of ability of strategy to prevent invasions in managed areas	30.124	3	1,519	0.000
Importance of ability of strategy to control invasions in managed areas	32.546	3	1,510	0.000
Rank of option A	3.621	3	1,540	0.013
Rank of option B	0.402	3	1,540	0.751
Rank of option C	7.168	3	1,540	0.000
Rank of option D	1.130	3	1,540	0.336
Rank of option E	0.438	3	1,540	0.726
	SC Clusters			
Significance of damage to managed areas	29.227	3	1,572	0.000
Significance of damage to natural areas	108.004	3	1,580	0.000
Significance of irreversible damage	36.047	3	1,542	0.000
Significance of transborder dispersal	60.443	3	1,576	0.000
Significance of affecting those not responsible for causing problem	35.145	3	1,566	0.000

	Levene Statistic	**df1**	**df2**	**Sig.**[8]
Significance of not punishing those responsible for causing problem	9.477	3	1,548	0.000
Significance of allowing activities that cause problem to continue	51.662	3	1,568	0.000
Importance of cost of strategy	642.589	3	1,591	0.000
Importance of who pays for strategy	710.796	3	1,591	0.000
Importance of ability to ensure compliance with strategy	135.303	3	1,591	0.000
Importance of ability of strategy to prevent invasions in natural areas	133.439	3	1,591	0.000
Importance of ability of strategy to control invasions in natural areas	110.302	3	1,591	0.000
Importance of ability of strategy to prevent invasions in managed areas	206.317	3	1,591	0.000
Importance of ability of strategy to control invasions in managed areas	141.455	3	1,591	0.000
Rank of option A	2.541	3	1,591	0.055
Rank of option B	2.683	3	1,591	0.045
Rank of option C	6.610	3	1,591	0.000
Rank of option D	2.637	3	1,591	0.048
Rank of option E	1.128	3	1,591	0.337

Appendix E: One-Way ANOVA Means and Standard Deviations for Differences Between Groups

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Significance of damage to managed areas	Horticulturist	413	1.25	0.662	0.033	1.19	1.32
	Hobby gardener	329	1.45	0.556	0.031	1.39	1.51
	Agriculturalist	278	1.45	0.615	0.037	1.37	1.52
	Park employee	136	1.34	0.561	0.048	1.24	1.43
	Expert	292	1.39	0.608	0.036	1.32	1.46
	Naturalist	214	1.36	0.546	0.037	1.29	1.44
	Total	1662	1.37	0.606	0.015	1.34	1.4
Significance of damage to natural areas	Horticulturist	416	1.8	0.438	0.021	1.75	1.84
	Hobby gardener	335	1.9	0.294	0.016	1.87	1.94
	Agriculturalist	274	1.84	0.393	0.024	1.8	1.89
	Park employee	136	1.99	0.121	0.01	1.96	2.01
	Expert	295	1.98	0.141	0.008	1.96	2
	Naturalist	219	1.95	0.209	0.014	1.93	1.98
	Total	1675	1.89	0.325	0.008	1.88	1.91
Significance of irreversible damage	Horticulturist	403	1.69	0.57	0.028	1.63	1.74
	Hobby gardener	322	1.84	0.416	0.023	1.79	1.88
	Agriculturalist	265	1.66	0.533	0.033	1.6	1.73
	Park employee	133	1.83	0.38	0.033	1.76	1.89
	Expert	291	1.85	0.374	0.022	1.81	1.9
	Naturalist	218	1.85	0.396	0.027	1.8	1.9
	Total	1632	1.78	0.474	0.012	1.75	1.8
Significance of transborder dispersal	Horticulturist	413	1.67	0.548	0.027	1.62	1.72
	Hobby gardener	332	1.78	0.445	0.024	1.73	1.83
	Agriculturalist	276	1.81	0.436	0.026	1.76	1.86
	Park employee	136	1.9	0.328	0.028	1.84	1.95
	Expert	293	1.86	0.376	0.022	1.82	1.9
	Naturalist	217	1.88	0.358	0.024	1.83	1.92
	Total	1667	1.79	0.449	0.011	1.77	1.81

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Significance of affecting those not responsible for causing problem	Horticulturist	408	1.57	0.561	0.028	1.51	1.62
	Hobby gardener	330	1.59	0.567	0.031	1.53	1.65
	Agriculturalist	275	1.6	0.572	0.035	1.54	1.67
	Park employee	136	1.69	0.479	0.041	1.61	1.77
	Expert	291	1.58	0.553	0.032	1.52	1.65
	Naturalist	216	1.56	0.568	0.039	1.48	1.63
	Total	1656	1.59	0.558	0.014	1.56	1.62
Significance of not punishing those responsible for causing problem	Horticulturist	396	1.43	0.651	0.033	1.37	1.5
	Hobby gardener	323	1.46	0.631	0.035	1.4	1.53
	Agriculturalist	270	1.55	0.594	0.036	1.48	1.62
	Park employee	135	1.59	0.59	0.051	1.49	1.69
	Expert	291	1.5	0.607	0.036	1.43	1.57
	Naturalist	211	1.53	0.604	0.042	1.45	1.61
	Total	1626	1.5	0.62	0.015	1.47	1.53
Significance of allowing activities that cause problem to continue	Horticulturist	404	1.69	0.546	0.027	1.64	1.75
	Hobby gardener	330	1.76	0.463	0.026	1.71	1.81
	Agriculturalist	273	1.73	0.477	0.029	1.67	1.79
	Park employee	136	1.9	0.319	0.027	1.85	1.96
	Expert	292	1.84	0.374	0.022	1.8	1.89
	Naturalist	217	1.9	0.303	0.021	1.86	1.94
	Total	1652	1.78	0.452	0.011	1.76	1.8
Importance of cost of strategy	Horticulturist	408	1.51	0.556	0.028	1.46	1.57
	Hobby gardener	328	1.47	0.569	0.031	1.41	1.53
	Agriculturalist	278	1.56	0.518	0.031	1.5	1.63
	Park employee	137	1.63	0.5	0.043	1.54	1.71
	Expert	290	1.56	0.556	0.033	1.5	1.63
	Naturalist	216	1.44	0.542	0.037	1.37	1.51
	Total	1657	1.52	0.548	0.013	1.5	1.55
Importance of who pays for strategy	Horticulturist	406	1.66	0.514	0.026	1.61	1.71
	Hobby gardener	325	1.57	0.544	0.03	1.51	1.63
	Agriculturalist	278	1.68	0.483	0.029	1.62	1.74
	Park employee	137	1.62	0.502	0.043	1.54	1.71
	Expert	290	1.53	0.565	0.033	1.46	1.59
	Naturalist	216	1.46	0.535	0.036	1.39	1.53
	Total	1652	1.59	0.531	0.013	1.57	1.62

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Importance of ability to ensure compliance with strategy	Horticulturist	408	1.79	0.436	0.022	1.75	1.83
	Hobby gardener	328	1.81	0.405	0.022	1.77	1.86
	Agriculturalist	276	1.84	0.38	0.023	1.79	1.88
	Park employee	134	1.83	0.378	0.033	1.76	1.89
	Expert	289	1.83	0.394	0.023	1.78	1.88
	Naturalist	214	1.9	0.314	0.021	1.86	1.94
	Total	1649	1.83	0.395	0.01	1.81	1.85
Importance of ability of strategy to prevent invasions in natural areas	Horticulturist	409	1.79	0.434	0.021	1.75	1.84
	Hobby gardener	332	1.9	0.3	0.016	1.87	1.93
	Agriculturalist	275	1.86	0.356	0.021	1.82	1.9
	Park employee	136	1.9	0.295	0.025	1.85	1.95
	Expert	290	1.96	0.2	0.012	1.94	1.98
	Naturalist	217	1.96	0.189	0.013	1.94	1.99
	Total	1659	1.89	0.328	0.008	1.87	1.9
Importance of ability of strategy to control invasions in natural areas	Horticulturist	408	1.82	0.422	0.021	1.78	1.86
	Hobby gardener	331	1.91	0.288	0.016	1.88	1.94
	Agriculturalist	275	1.82	0.393	0.024	1.78	1.87
	Park employee	136	1.91	0.31	0.027	1.86	1.96
	Expert	289	1.87	0.345	0.02	1.83	1.91
	Naturalist	218	1.93	0.254	0.017	1.9	1.97
	Total	1657	1.87	0.353	0.009	1.85	1.89
Importance of ability of strategy to prevent invasions in managed areas	Horticulturist	409	1.58	0.555	0.027	1.52	1.63
	Hobby gardener	331	1.7	0.486	0.027	1.65	1.75
	Agriculturalist	276	1.75	0.474	0.029	1.69	1.81
	Park employee	137	1.39	0.534	0.046	1.3	1.48
	Expert	288	1.49	0.572	0.034	1.42	1.56
	Naturalist	216	1.54	0.527	0.036	1.47	1.61
	Total	1657	1.6	0.537	0.013	1.57	1.62
Importance of ability of strategy to control invasions in managed areas	Horticulturist	405	1.58	0.551	0.027	1.52	1.63
	Hobby gardener	326	1.71	0.459	0.025	1.66	1.76
	Agriculturalist	276	1.75	0.456	0.027	1.7	1.81
	Park employee	135	1.44	0.528	0.045	1.35	1.53
	Expert	287	1.47	0.572	0.034	1.4	1.53
	Naturalist	218	1.53	0.518	0.035	1.46	1.6
	Total	1647	1.6	0.527	0.013	1.57	1.62

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Rank of option A	Horticulturist	420	2.89	1.318	0.064	2.76	3.01
	Hobby gardener	337	2.69	1.32	0.072	2.55	2.84
	Agriculturalist	281	2.66	1.327	0.079	2.5	2.81
	Park employee	137	2.53	1.329	0.114	2.3	2.75
	Expert	295	2.42	1.142	0.067	2.29	2.55
	Naturalist	222	2.4	1.152	0.077	2.25	2.55
	Total	1692	2.64	1.282	0.031	2.57	2.7
Rank of option B	Horticulturist	420	1.87	0.871	0.042	1.79	1.95
	Hobby gardener	337	1.84	0.842	0.046	1.75	1.93
	Agriculturalist	281	1.83	0.938	0.056	1.72	1.94
	Park employee	137	1.67	0.778	0.066	1.54	1.8
	Expert	295	1.58	0.812	0.047	1.48	1.67
	Naturalist	222	1.61	0.82	0.055	1.5	1.72
	Total	1692	1.75	0.86	0.021	1.71	1.8
Rank of option C	Horticulturist	420	2.33	1.441	0.07	2.19	2.46
	Hobby gardener	337	2.61	1.482	0.081	2.46	2.77
	Agriculturalist	281	2.72	1.402	0.084	2.56	2.89
	Park employee	137	3.43	1.469	0.126	3.18	3.68
	Expert	295	3.25	1.465	0.085	3.08	3.42
	Naturalist	222	3.28	1.419	0.095	3.1	3.47
	Total	1692	2.83	1.499	0.036	2.75	2.9
Rank of option D	Horticulturist	420	3.76	0.968	0.047	3.67	3.85
	Hobby gardener	337	3.68	1.02	0.056	3.57	3.79
	Agriculturalist	281	3.65	1.056	0.063	3.52	3.77
	Park employee	137	3.5	1.072	0.092	3.32	3.68
	Expert	295	3.69	0.932	0.054	3.58	3.79
	Naturalist	222	3.66	1.038	0.07	3.52	3.79
	Total	1692	3.68	1.006	0.024	3.63	3.73
Rank of option E	Horticulturist	420	4.16	0.919	0.045	4.07	4.25
	Hobby gardener	337	4.18	0.944	0.051	4.08	4.28
	Agriculturalist	281	4.15	0.998	0.06	4.03	4.26
	Park employee	137	3.87	1.09	0.093	3.68	4.05
	Expert	295	4.07	0.996	0.058	3.96	4.19
	Naturalist	222	4.05	1.024	0.069	3.91	4.18
	Total	1692	4.11	0.981	0.024	4.06	4.15

Appendix F: Total Variance Explained

Total Variance Explained: PD Variables

Comp.	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var.	Cum. %	Total	% of Var.	Cum. %	Total	% of Var.	Cum. %
1	2.75	39.33	39.33	2.75	39.33	39.33	2.03	29.00	29.00
2	1.08	15.36	54.68	1.08	15.35	54.68	1.80	25.69	54.68
3	.90	12.80	67.48						
4	.72	10.27	77.75						
5	.61	8.66	86.41						
6	.51	7.35	93.75						
7	.44	6.25	100.00						

Extraction Method: Principal Component Analysis.

Total Variance Explained: SC Variables

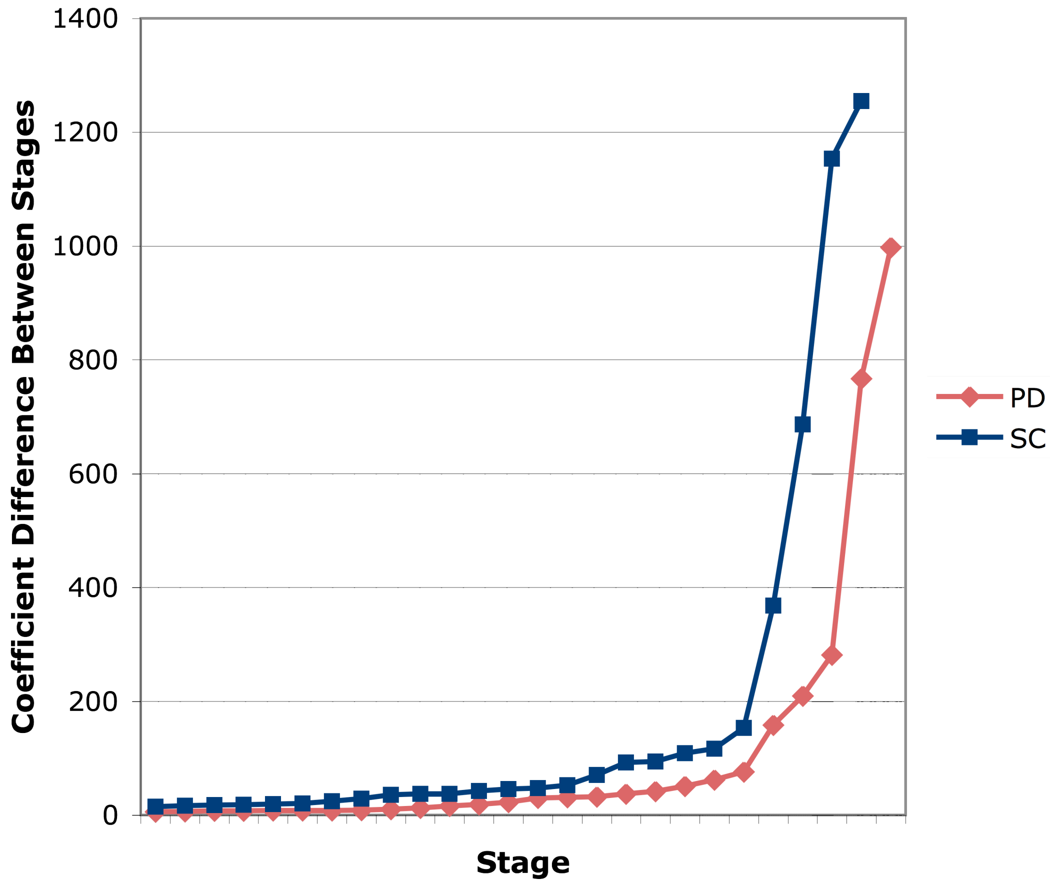
Comp.	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var.	Cum. %	Total	% of Var.	Cum. %	Total	% of Var.	Cum. %
1	2.36	33.74	33.74	2.36	33.74	33.74	1.79	25.56	25.56
2	1.59	22.67	56.41	1.59	22.67	56.41	1.69	24.15	49.71
3	1.18	16.83	73.24	1.18	16.83	73.24	1.65	23.53	73.24
4	.81	11.55	84.79						
5	.49	7.04	91.83						
6	.40	5.67	97.50						
7	.18	2.50	100.00						

Extraction Method: Principal Component Analysis.

Appendix G: Determination of Cluster Numbers

Four PD clusters and four SC clusters were defined from the hierarchical cluster analyses. These four clusters were identified based on the coefficient differences between the stages, contained within the agglomeration schedules produced by SPSS. The number of clusters is based on the number of stages where large coefficient differences are observed (see graph below). The number of stages beyond the point where the coefficients differences between stages becomes large (not a small increment from the one before) helps to determine the number of clusters.

In addition to the information provided by the graph below, means were plotted for the PD variables for 3, 4, and 5 PD clusters and means were plotted for 3, 4, and 5 SC variables. These plots were used to identify the maximum number of visibly unique clusters, four in this case.



Appendix H: One-Way ANOVA Means and Standard Deviations for Differences Between Clusters

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
PD CLUSTERS							
Significance of damage to managed areas	1	301	1.14	.613	.035	1.07	1.21
	2	951	1.52	.540	.018	1.48	1.55
	3	184	.94	.620	.046	.85	1.03
	4	108	1.54	.519	.050	1.44	1.64
	Total	1544	1.38	.604	.015	1.35	1.41
Significance of damage to natural areas	1	301	2.00	.000	.000	2.00	2.00
	2	951	2.00	.000	.000	2.00	2.00
	3	184	1.42	.576	.042	1.33	1.50
	4	108	1.58	.495	.048	1.49	1.68
	Total	1544	1.90	.315	.008	1.89	1.92
Significance of irreversible damage	1	301	1.97	.180	.010	1.95	1.99
	2	951	1.94	.232	.008	1.93	1.96
	3	184	1.01	.577	.043	.92	1.09
	4	108	1.19	.477	.046	1.09	1.28
	Total	1544	1.78	.463	.012	1.76	1.81
Significance of transborder dispersal	1	301	1.71	.517	.030	1.65	1.77
	2	951	1.94	.242	.008	1.92	1.96
	3	184	1.20	.570	.042	1.12	1.28
	4	108	1.89	.316	.030	1.83	1.95
	Total	1544	1.80	.437	.011	1.78	1.82
Significance of affecting those not responsible for causing problem	1	301	.96	.463	.027	.90	1.01
	2	951	1.84	.373	.012	1.81	1.86
	3	184	1.16	.535	.039	1.08	1.24
	4	108	1.95	.211	.020	1.91	1.99
	Total	1544	1.59	.558	.014	1.56	1.62

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Significance of not punishing those responsible for causing problem	1	301	.81	.468	.027	.76	.87
	2	951	1.78	.412	.013	1.76	1.81
	3	184	1.00	.618	.046	.91	1.09
	4	108	1.93	.263	.025	1.88	1.98
	Total	1544	1.51	.617	.016	1.48	1.54
Significance of allowing activities that cause problem to continue	1	301	1.69	.505	.029	1.63	1.75
	2	951	1.93	.262	.009	1.91	1.95
	3	184	1.18	.599	.044	1.10	1.27
	4	108	1.90	.304	.029	1.84	1.96
	Total	1544	1.79	.447	.011	1.77	1.81
Importance of cost of strategy	1	297	1.44	.549	.032	1.38	1.50
	2	940	1.53	.546	.018	1.50	1.57
	3	179	1.54	.532	.040	1.46	1.62
	4	108	1.53	.555	.053	1.42	1.63
	Total	1524	1.52	.546	.014	1.49	1.54
Importance of who pays for strategy	1	296	1.44	.579	.034	1.37	1.51
	2	940	1.62	.511	.017	1.59	1.65
	3	180	1.63	.517	.039	1.56	1.71
	4	105	1.62	.526	.051	1.52	1.72
	Total	1521	1.59	.531	.014	1.56	1.61
Importance of ability to ensure compliance with strategy	1	294	1.78	.426	.025	1.73	1.82
	2	934	1.89	.322	.011	1.87	1.91
	3	180	1.64	.526	.039	1.56	1.72
	4	106	1.83	.402	.039	1.75	1.91
	Total	1514	1.84	.388	.010	1.82	1.86
Importance of ability of strategy to prevent invasions in natural areas	1	297	1.90	.297	.017	1.87	1.94
	2	939	1.95	.227	.007	1.93	1.96
	3	180	1.63	.527	.039	1.56	1.71
	4	105	1.82	.387	.038	1.74	1.89
	Total	1521	1.89	.319	.008	1.88	1.91

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Importance of ability of strategy to control invasions in natural areas	1	298	1.86	.367	.021	1.82	1.90
	2	938	1.93	.262	.009	1.91	1.95
	3	180	1.63	.517	.039	1.56	1.71
	4	106	1.82	.385	.037	1.75	1.89
	Total	1522	1.87	.345	.009	1.86	1.89
Importance of ability of strategy to prevent invasions in managed areas	1	296	1.42	.577	.034	1.35	1.48
	2	939	1.67	.498	.016	1.63	1.70
	3	181	1.41	.614	.046	1.32	1.50
	4	107	1.75	.436	.042	1.66	1.83
	Total	1523	1.59	.538	.014	1.57	1.62
Importance of ability of strategy to control invasions in managed areas	1	293	1.40	.562	.033	1.33	1.46
	2	937	1.67	.492	.016	1.64	1.70
	3	176	1.43	.581	.044	1.34	1.51
	4	108	1.79	.411	.040	1.71	1.87
	Total	1514	1.60	.528	.014	1.57	1.62
Rank of option A	1	301	2.82	1.337	.077	2.67	2.97
	2	951	2.46	1.211	.039	2.38	2.54
	3	184	3.19	1.344	.099	2.99	3.39
	4	108	2.35	1.138	.110	2.13	2.57
	Total	1544	2.61	1.274	.032	2.55	2.67
Rank of option B	1	301	1.83	.912	.053	1.73	1.94
	2	951	1.66	.809	.026	1.61	1.71
	3	184	2.11	.946	.070	1.97	2.25
	4	108	1.74	.911	.088	1.57	1.91
	Total	1544	1.75	.866	.022	1.71	1.80
Rank of option C	1	301	2.57	1.423	.082	2.41	2.74
	2	951	3.14	1.494	.048	3.05	3.24
	3	184	1.87	1.212	.089	1.69	2.05
	4	108	3.05	1.449	.139	2.77	3.32
	Total	1544	2.87	1.507	.038	2.80	2.95

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Rank of option D	1	301	3.65	1.071	.062	3.53	3.78
	2	951	3.66	.980	.032	3.60	3.72
	3	184	3.67	1.021	.075	3.52	3.82
	4	108	3.71	.986	.095	3.52	3.90
	Total	1544	3.67	1.003	.026	3.62	3.72
Rank of option E	1	301	4.12	.992	.057	4.00	4.23
	2	951	4.08	.991	.032	4.01	4.14
	3	184	4.16	.956	.070	4.02	4.30
	4	108	4.15	1.012	.097	3.96	4.34
	Total	1544	4.10	.988	.025	4.05	4.15
SC CLUSTERS							
Significance of damage to managed areas	1	166	1.17	.651	.051	1.07	1.27
	2	503	1.09	.547	.024	1.04	1.14
	3	513	1.60	.558	.025	1.55	1.64
	4	394	1.54	.539	.027	1.48	1.59
	Total	1576	1.37	.605	.015	1.34	1.40
Significance of damage to natural areas	1	167	1.65	.502	.039	1.58	1.73
	2	507	1.95	.222	.010	1.93	1.97
	3	512	1.90	.327	.014	1.87	1.93
	4	398	1.92	.278	.014	1.89	1.95
	Total	1584	1.90	.322	.008	1.88	1.91
Significance of irreversible damage	1	160	1.51	.624	.049	1.41	1.60
	2	496	1.82	.426	.019	1.79	1.86
	3	494	1.80	.448	.020	1.76	1.84
	4	396	1.81	.431	.022	1.77	1.85
	Total	1546	1.78	.468	.012	1.76	1.80

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Significance of transborder dispersal	1	164	1.55	.630	.049	1.45	1.65
	2	507	1.78	.452	.020	1.74	1.82
	3	512	1.85	.403	.018	1.81	1.88
	4	397	1.86	.343	.017	1.83	1.90
	Total	1580	1.80	.444	.011	1.78	1.82
Significance of affecting those not responsible for causing problem	1	165	1.33	.636	.050	1.23	1.43
	2	501	1.50	.564	.025	1.45	1.55
	3	509	1.73	.477	.021	1.69	1.77
	4	395	1.64	.535	.027	1.59	1.69
	Total	1570	1.59	.554	.014	1.57	1.62
Significance of not punishing those responsible for causing problem	1	162	1.17	.724	.057	1.05	1.28
	2	496	1.42	.625	.028	1.37	1.48
	3	498	1.61	.546	.024	1.57	1.66
	4	396	1.60	.590	.030	1.54	1.65
	Total	1552	1.50	.619	.016	1.47	1.53
Significance of allowing activities that cause problem to continue	1	162	1.48	.623	.049	1.38	1.58
	2	507	1.81	.409	.018	1.78	1.85
	3	507	1.81	.424	.019	1.77	1.84
	4	396	1.85	.380	.019	1.81	1.89
	Total	1572	1.79	.446	.011	1.76	1.81
Importance of cost of strategy	1	168	1.40	.612	.047	1.31	1.50
	2	511	1.46	.558	.025	1.41	1.51
	3	515	1.98	.124	.005	1.97	2.00
	4	401	1.05	.342	.017	1.02	1.09
	Total	1595	1.52	.548	.014	1.49	1.55
Importance of who pays for strategy	1	168	1.52	.558	.043	1.43	1.60
	2	511	1.50	.542	.024	1.46	1.55
	3	515	1.98	.124	.005	1.97	2.00
	4	401	1.24	.506	.025	1.19	1.29
	Total	1595	1.59	.529	.013	1.57	1.62

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Importance of ability to ensure compliance with strategy	1	168	1.36	.572	.044	1.27	1.44
	2	511	1.85	.358	.016	1.82	1.88
	3	515	1.95	.232	.010	1.93	1.97
	4	401	1.85	.371	.019	1.81	1.89
	Total	1595	1.83	.394	.010	1.81	1.85
Importance of ability of strategy to prevent invasions in natural areas	1	168	1.17	.460	.035	1.10	1.24
	2	511	1.97	.174	.008	1.95	1.98
	3	515	1.95	.211	.009	1.94	1.97
	4	401	1.99	.086	.004	1.98	2.00
	Total	1595	1.89	.330	.008	1.87	1.90
Importance of ability of strategy to control invasions in natural areas	1	168	1.15	.485	.037	1.07	1.22
	2	511	1.94	.232	.010	1.92	1.96
	3	515	1.93	.255	.011	1.91	1.95
	4	401	2.00	.050	.002	1.99	2.00
	Total	1595	1.87	.354	.009	1.85	1.89
Importance of ability of strategy to prevent invasions in managed areas	1	168	1.29	.581	.045	1.20	1.37
	2	511	1.01	.337	.015	.98	1.04
	3	515	1.96	.193	.009	1.94	1.98
	4	401	2.00	.000	.000	2.00	2.00
	Total	1595	1.60	.536	.013	1.57	1.62
Importance of ability of strategy to control invasions in managed areas	1	168	1.23	.525	.040	1.15	1.31
	2	511	1.05	.365	.016	1.02	1.08
	3	515	1.95	.223	.010	1.93	1.97
	4	401	2.00	.000	.000	2.00	2.00
	Total	1595	1.60	.528	.013	1.57	1.62
Rank of option A	1	168	3.04	1.407	.109	2.83	3.26
	2	511	2.63	1.280	.057	2.51	2.74
	3	515	2.63	1.205	.053	2.52	2.73
	4	401	2.46	1.264	.063	2.33	2.58
	Total	1595	2.63	1.275	.032	2.56	2.69

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Rank of option B	1	168	2.13	1.012	.078	1.98	2.29
	2	511	1.72	.832	.037	1.65	1.79
	3	515	1.72	.823	.036	1.65	1.79
	4	401	1.65	.807	.040	1.57	1.73
	Total	1595	1.75	.854	.021	1.70	1.79
Rank of option C	1	168	2.17	1.361	.105	1.96	2.37
	2	511	2.92	1.492	.066	2.79	3.05
	3	515	2.83	1.558	.069	2.70	2.97
	4	401	3.04	1.415	.071	2.91	3.18
	Total	1595	2.84	1.501	.038	2.77	2.92
Rank of option D	1	168	3.55	1.066	.082	3.39	3.71
	2	511	3.59	1.032	.046	3.50	3.68
	3	515	3.76	.975	.043	3.67	3.84
	4	401	3.71	.975	.049	3.62	3.81
	Total	1595	3.67	1.006	.025	3.62	3.72
Rank of option E	1	168	4.11	1.029	.079	3.96	4.27
	2	511	4.14	.975	.043	4.06	4.23
	3	515	4.07	.989	.044	3.98	4.15
	4	401	4.13	.954	.048	4.04	4.23
	Total	1595	4.11	.980	.025	4.06	4.16

Appendix I: One-Way ANOVA Results for Differences Between Clusters

		Sum of Squares	df	Mean Square	F	Sig.
Significance of damage to managed areas	Between PD Clusters	73.104	3	24.368	76.661	.000
	Within PD Clusters	489.515	1540	.318		
	Total	562.619	1543			
Significance of damage to natural areas	Between PD Clusters	66.009	3	22.003	389.357	.000
	Within PD Clusters	87.027	1540	.057		
	Total	153.036	1543			
Significance of irreversible damage	Between PD Clusters	184.423	3	61.474	648.906	.000
	Within PD Clusters	145.892	1540	.095		
	Total	330.315	1543			
Significance of transborder dispersal	Between PD Clusters	88.063	3	29.354	219.356	.000
	Within PD Clusters	206.082	1540	.134		
	Total	294.145	1543			
Significance of affecting those not responsible for causing problem	Between PD Clusters	226.894	3	75.631	458.468	.000
	Within PD Clusters	254.046	1540	.165		
	Total	480.940	1543			
Significance of not punishing those responsible for causing problem	Between PD Clusters	283.447	3	94.482	478.051	.000
	Within PD Clusters	304.366	1540	.198		
	Total	587.813	1543			
Significance of allowing activities that cause problem to continue	Between PD Clusters	90.603	3	30.201	213.678	.000
	Within PD Clusters	217.661	1540	.141		
	Total	308.264	1543			
Importance of cost of strategy	Between SC Clusters	201.931	3	67.310	387.908	.000
	Within SC Clusters	276.073	1591	.174		
	Total	478.004	1594			
Importance of who pays for strategy	Between SC Clusters	134.684	3	44.895	228.894	.000
	Within SC Clusters	312.054	1591	.196		
	Total	446.737	1594			

		Sum of Squares	df	Mean Square	F	Sig.
Importance of ability to ensure compliance with strategy	Between SC Clusters	45.039	3	15.013	117.911	.000
	Within SC Clusters	202.576	1591	.127		
	Total	247.615	1594			
Importance of ability of strategy to prevent invasions in natural areas	Between SC Clusters	97.312	3	32.437	672.930	.000
	Within SC Clusters	76.691	1591	.048		
	Total	174.004	1594			
Importance of ability of strategy to control invasions in natural areas	Between SC Clusters	98.499	3	32.833	516.612	.000
	Within SC Clusters	101.115	1591	.064		
	Total	199.614	1594			
Importance of ability of strategy to prevent invasions in managed areas	Between SC Clusters	324.731	3	108.244	1290.598	.000
	Within SC Clusters	133.439	1591	.084		
	Total	458.169	1594			
Importance of ability of strategy to control invasions in managed areas	Between SC Clusters	304.282	3	101.427	1158.377	.000
	Within SC Clusters	139.308	1591	.088		
	Total	443.590	1594			

Appendix J: One-Way ANOVA Means and Standard Deviations for Differences Between Countries

			N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
							Lower Bound	Upper Bound
PD 1	Rank of option A	Canada	140	2.95	1.375	.116	2.72	3.18
		United States	161	2.71	1.297	.102	2.51	2.91
		Total	301	2.82	1.337	.077	2.67	2.97
	Rank of option B	Canada	140	1.86	.910	.077	1.71	2.01
		United States	161	1.81	.917	.072	1.67	1.96
		Total	301	1.83	.912	.053	1.73	1.94
	Rank of option C	Canada	140	2.34	1.334	.113	2.11	2.56
		United States	161	2.78	1.469	.116	2.55	3.01
		Total	301	2.57	1.423	.082	2.41	2.74
	Rank of option D	Canada	140	3.73	1.002	.085	3.56	3.90
		United States	161	3.59	1.126	.089	3.41	3.77
		Total	301	3.65	1.071	.062	3.53	3.78
	Rank of option E	Canada	140	4.13	.995	.084	3.96	4.29
		United States	161	4.11	.991	.078	3.95	4.26
		Total	301	4.12	.992	.057	4.00	4.23
PD 2	Rank of option A	Canada	368	2.55	1.223	.064	2.43	2.68
		United States	583	2.40	1.201	.050	2.30	2.50
		Total	951	2.46	1.211	.039	2.38	2.54
	Rank of option B	Canada	368	1.64	.705	.037	1.57	1.71
		United States	583	1.67	.869	.036	1.60	1.74
		Total	951	1.66	.809	.026	1.61	1.71
	Rank of option C	Canada	368	2.91	1.472	.077	2.76	3.06
		United States	583	3.29	1.490	.062	3.17	3.41
		Total	951	3.14	1.494	.048	3.05	3.24
	Rank of option D	Canada	368	3.73	.970	.051	3.63	3.82
		United States	583	3.62	.985	.041	3.54	3.70
		Total	951	3.66	.980	.032	3.60	3.72

			N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
							Lower Bound	Upper Bound
	Rank of option E	Canada	368	4.17	.982	.051	4.07	4.27
		United States	583	4.02	.993	.041	3.94	4.10
		Total	951	4.08	.991	.032	4.01	4.14
PD 3	Rank of option A	Canada	71	3.34	1.330	.158	3.02	3.65
		United States	113	3.10	1.349	.127	2.85	3.35
		Total	184	3.19	1.344	.099	2.99	3.39
	Rank of option B	Canada	71	2.13	.985	.117	1.89	2.36
		United States	113	2.10	.925	.087	1.92	2.27
		Total	184	2.11	.946	.070	1.97	2.25
	Rank of option C	Canada	71	1.99	1.336	.159	1.67	2.30
		United States	113	1.80	1.127	.106	1.59	2.01
		Total	184	1.87	1.212	.089	1.69	2.05
	Rank of option D	Canada	71	3.41	1.077	.128	3.15	3.66
		United States	113	3.83	.953	.090	3.65	4.01
		Total	184	3.67	1.021	.075	3.52	3.82
	Rank of option E	Canada	71	4.14	1.018	.121	3.90	4.38
		United States	113	4.18	.918	.086	4.01	4.35
		Total	184	4.16	.956	.070	4.02	4.30
PD 4	Rank of option A	Canada	50	2.54	1.182	.167	2.20	2.88
		United States	58	2.19	1.083	.142	1.90	2.47
		Total	108	2.35	1.138	.110	2.13	2.57
	Rank of option B	Canada	50	1.88	.961	.136	1.61	2.15
		United States	58	1.62	.855	.112	1.40	1.85
		Total	108	1.74	.911	.088	1.57	1.91
	Rank of option C	Canada	50	2.66	1.465	.207	2.24	3.08
		United States	58	3.38	1.361	.179	3.02	3.74
		Total	108	3.05	1.449	.139	2.77	3.32
	Rank of option D	Canada	50	3.74	.986	.139	3.46	4.02
		United States	58	3.69	.995	.131	3.43	3.95
		Total	108	3.71	.986	.095	3.52	3.90

			N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
							Lower Bound	Upper Bound
	Rank of option E	Canada	50	4.18	1.082	.153	3.87	4.49
		United States	58	4.12	.957	.126	3.87	4.37
		Total	108	4.15	1.012	.097	3.96	4.34
SC 1	Rank of option A	Canada	73	3.27	1.436	.168	2.94	3.61
		United States	95	2.86	1.365	.140	2.59	3.14
		Total	168	3.04	1.407	.109	2.83	3.26
	Rank of option B	Canada	73	2.11	.951	.111	1.89	2.33
		United States	95	2.15	1.062	.109	1.93	2.36
		Total	168	2.13	1.012	.078	1.98	2.29
	Rank of option C	Canada	73	2.07	1.262	.148	1.77	2.36
		United States	95	2.24	1.434	.147	1.95	2.53
		Total	168	2.17	1.361	.105	1.96	2.37
	Rank of option D	Canada	73	3.45	1.093	.128	3.20	3.71
		United States	95	3.62	1.044	.107	3.41	3.83
		Total	168	3.55	1.066	.082	3.39	3.71
	Rank of option E	Canada	73	4.10	1.095	.128	3.84	4.35
		United States	95	4.13	.981	.101	3.93	4.33
		Total	168	4.11	1.029	.079	3.96	4.27
SC 2	Rank of option A	Canada	174	2.74	1.271	.096	2.55	2.93
		United States	337	2.57	1.283	.070	2.43	2.70
		Total	511	2.63	1.280	.057	2.51	2.74
	Rank of option B	Canada	174	1.73	.791	.060	1.61	1.85
		United States	337	1.72	.853	.046	1.62	1.81
		Total	511	1.72	.832	.037	1.65	1.79
	Rank of option C	Canada	174	2.68	1.418	.108	2.47	2.89
		United States	337	3.04	1.515	.083	2.88	3.20
		Total	511	2.92	1.492	.066	2.79	3.05
	Rank of option D	Canada	174	3.61	1.057	.080	3.46	3.77
		United States	337	3.58	1.021	.056	3.47	3.69
		Total	511	3.59	1.032	.046	3.50	3.68

			N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
							Lower Bound	Upper Bound
	Rank of option E	Canada	174	4.24	.989	.075	4.09	4.38
		United States	337	4.09	.965	.053	3.99	4.20
		Total	511	4.14	.975	.043	4.06	4.23
SC 3	Rank of option A	Canada	199	2.66	1.169	.083	2.50	2.83
		United States	316	2.60	1.229	.069	2.47	2.74
		Total	515	2.63	1.205	.053	2.52	2.73
	Rank of option B	Canada	199	1.71	.787	.056	1.60	1.82
		United States	316	1.72	.846	.048	1.63	1.82
		Total	515	1.72	.823	.036	1.65	1.79
	Rank of option C	Canada	199	2.59	1.534	.109	2.38	2.81
		United States	316	2.98	1.557	.088	2.81	3.15
		Total	515	2.83	1.558	.069	2.70	2.97
	Rank of option D	Canada	199	3.86	.888	.063	3.74	3.98
		United States	316	3.69	1.022	.058	3.58	3.81
		Total	515	3.76	.975	.043	3.67	3.84
	Rank of option E	Canada	199	4.17	.927	.066	4.04	4.30
		United States	316	4.00	1.022	.057	3.89	4.12
		Total	515	4.07	.989	.044	3.98	4.15
SC 4	Rank of option A	Canada	203	2.63	1.319	.093	2.45	2.81
		United States	198	2.28	1.183	.084	2.11	2.44
		Total	401	2.46	1.264	.063	2.33	2.58
	Rank of option B	Canada	203	1.67	.772	.054	1.57	1.78
		United States	198	1.63	.843	.060	1.51	1.75
		Total	401	1.65	.807	.040	1.57	1.73
	Rank of option C	Canada	203	2.83	1.401	.098	2.64	3.03
		United States	198	3.26	1.400	.100	3.07	3.46
		Total	401	3.04	1.415	.071	2.91	3.18
	Rank of option D	Canada	203	3.73	1.004	.070	3.60	3.87
		United States	198	3.69	.946	.067	3.56	3.82
		Total	401	3.71	.975	.049	3.62	3.81

			N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
							Lower Bound	Upper Bound
	Rank of option E	Canada	203	4.13	.997	.070	3.99	4.27
		United States	198	4.14	.911	.065	4.01	4.26
		Total	401	4.13	.954	.048	4.04	4.23

Appendix K: One-Way ANOVA Results for Differences Between Countries

			Sum of Squares	df	Mean Square	F	Sig.
PD 1	Rank of option A	Between Countries	4.383	1	4.383	2.464	.118
		Within Countries	531.930	299	1.779		
		Total	536.312	300			
	Rank of option B	Between Countries	.142	1	.142	.170	.681
		Within Countries	249.553	299	.835		
		Total	249.694	300			
	Rank of option C	Between Countries	14.955	1	14.955	7.546	.006
		Within Countries	592.613	299	1.982		
		Total	607.568	300			
	Rank of option D	Between Countries	1.437	1	1.437	1.254	.264
		Within Countries	342.630	299	1.146		
		Total	344.066	300			
	Rank of option E	Between Countries	.040	1	.040	.040	.841
		Within Countries	294.891	299	.986		
		Total	294.930	300			
PD 2	Rank of option A	Between Countries	5.279	1	5.279	3.607	.058
		Within Countries	1388.992	949	1.464		
		Total	1394.271	950			
	Rank of option B	Between Countries	.172	1	.172	.263	.608
		Within Countries	621.760	949	.655		
		Total	621.933	950			
	Rank of option C	Between Countries	32.967	1	32.967	14.992	.000
		Within Countries	2086.869	949	2.199		
		Total	2119.836	950			
	Rank of option D	Between Countries	2.389	1	2.389	2.490	.115
		Within Countries	910.261	949	.959		
		Total	912.650	950			

			Sum of Squares	df	Mean Square	F	Sig.
	Rank of option E	Between Countries	5.353	1	5.353	5.474	.020
		Within Countries	928.043	949	.978		
		Total	933.396	950			
PD 3	Rank of option A	Between Countries	2.526	1	2.526	1.402	.238
		Within Countries	327.817	182	1.801		
		Total	330.342	183			
	Rank of option B	Between Countries	.038	1	.038	.042	.838
		Within Countries	163.788	182	.900		
		Total	163.826	183			
	Rank of option C	Between Countries	1.565	1	1.565	1.066	.303
		Within Countries	267.304	182	1.469		
		Total	268.870	183			
	Rank of option D	Between Countries	7.817	1	7.817	7.776	.006
		Within Countries	182.960	182	1.005		
		Total	190.777	183			
	Rank of option E	Between Countries	.057	1	.057	.062	.804
		Within Countries	167.052	182	.918		
		Total	167.109	183			
PD 4	Rank of option A	Between Countries	3.296	1	3.296	2.581	.111
		Within Countries	135.334	106	1.277		
		Total	138.630	107			
	Rank of option B	Between Countries	1.806	1	1.806	2.202	.141
		Within Countries	86.935	106	.820		
		Total	88.741	107			
	Rank of option C	Between Countries	13.893	1	13.893	6.984	.009
		Within Countries	210.875	106	1.989		
		Total	224.769	107			
	Rank of option D	Between Countries	.068	1	.068	.069	.793
		Within Countries	104.034	106	.981		
		Total	104.102	107			
	Rank of option E	Between Countries	.094	1	.094	.091	.763
		Within Countries	109.535	106	1.033		
		Total	109.630	107			

			Sum of Squares	df	Mean Square	F	Sig.
SC 1	Rank of option A	Between Countries	6.967	1	6.967	3.572	.060
		Within Countries	323.742	166	1.950		
		Total	330.708	167			
	Rank of option B	Between Countries	.059	1	.059	.057	.811
		Within Countries	171.060	166	1.030		
		Total	171.119	167			
	Rank of option C	Between Countries	1.244	1	1.244	.670	.414
		Within Countries	308.089	166	1.856		
		Total	309.333	167			
	Rank of option D	Between Countries	1.179	1	1.179	1.039	.310
		Within Countries	188.440	166	1.135		
		Total	189.619	167			
	Rank of option E	Between Countries	.038	1	.038	.036	.850
		Within Countries	176.813	166	1.065		
		Total	176.851	167			
SC 2	Rank of option A	Between Countries	3.499	1	3.499	2.140	.144
		Within Countries	832.110	509	1.635		
		Total	835.609	510			
	Rank of option B	Between Countries	.025	1	.025	.036	.850
		Within Countries	352.957	509	.693		
		Total	352.982	510			
	Rank of option C	Between Countries	15.153	1	15.153	6.890	.009
		Within Countries	1119.395	509	2.199		
		Total	1134.548	510			
	Rank of option D	Between Countries	.128	1	.128	.120	.730
		Within Countries	543.207	509	1.067		
		Total	543.335	510			
	Rank of option E	Between Countries	2.271	1	2.271	2.397	.122
		Within Countries	482.301	509	.948		
		Total	484.571	510			
SC 3	Rank of option A	Between Countries	.470	1	.470	.323	.570
		Within Countries	746.202	513	1.455		
		Total	746.672	514			

			Sum of Squares	df	Mean Square	F	Sig.
	Rank of option B	Between Countries	.008	1	.008	.011	.915
		Within Countries	348.167	513	.679		
		Total	348.175	514			
	Rank of option C	Between Countries	18.387	1	18.387	7.669	.006
		Within Countries	1229.916	513	2.397		
		Total	1248.303	514			
	Rank of option D	Between Countries	3.375	1	3.375	3.568	.059
		Within Countries	485.285	513	.946		
		Total	488.660	514			
	Rank of option E	Between Countries	3.434	1	3.434	3.529	.061
		Within Countries	499.188	513	.973		
		Total	502.621	514			
SC 4	Rank of option A	Between Countries	12.473	1	12.473	7.937	.005
		Within Countries	627.013	399	1.571		
		Total	639.486	400			
	Rank of option B	Between Countries	.190	1	.190	.291	.590
		Within Countries	260.628	399	.653		
		Total	260.818	400			
	Rank of option C	Between Countries	18.543	1	18.543	9.453	.002
		Within Countries	782.649	399	1.962		
		Total	801.192	400			
	Rank of option D	Between Countries	.177	1	.177	.186	.666
		Within Countries	379.843	399	.952		
		Total	380.020	400			
	Rank of option E	Between Countries	.007	1	.007	.008	.931
		Within Countries	363.988	399	.912		
		Total	363.995	400			