University of Alberta

What economic value do Albertans place on containing Chronic Wasting Disease?

by

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This work is dedicated to my parents,
Rod and Trudie Forbes,
and my aunt,
Pat Mullen

Abstract

This study was undertaken to examine the economic value of government sponsored control programs to limit the levels of chronic wasting disease (CWD) in Alberta. Respondents' knowledge, attitudes and preferences concerning aspects of CWD including control methods were also addressed. Employing an attribute based stated preference survey combined with contingent valuation style analysis, the study estimated households' economic value or willingness to pay (WTP) through a 10 year income tax increase for control programs with varying outcomes in terms of disease spread and prevalence levels. The study found that as a whole Albertans are concerned about the disease and willing to commit money to fighting it. That being said, the levels of concern, as well as the economic value vary widely amongst several distinct groups.

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1.0 Introduction

The discovery of chronic wasting disease (CWD) in Alberta heralded a new era in a challenging fight against the prion disease. Chronic wasting disease is a transmissible spongiform encephalopathy which occurs in cervids. Uncertainty surrounds many aspects of CWD, and controversy embroils a chief control measure, culling. Both tracking and containing the disease require government investment, as does research into the many gaps in knowledge associated with CWD. CWD itself imposes a variety of costs on a wide range of populations. Hunter (both aboriginal and recreational) populations face costs in the form of potentially increased health risk[1] and reduced animal availability. Opportunity costs for the time taken to send animal heads for testing and receive results, or to travel to disease free regions are also a consideration. Associated industries are naturally affected as are property owners in infected areas. The owners may face reduced property values due to the disease being present, and inconvenience from research and control efforts. Cervid farm operations face financial repercussions from CWD. While the disease has disparate affects on different individuals and groups, it is expected there will be impacts on the public due to concerns regarding declining wildlife health.

Despite having little or no contact with deer and elk populations, it was hypothesized that on average all Albertans will hold some value towards controlling CWD, or maintaining healthy wildlife populations, within the province. Disease control programs can be reasonably expected to be funded via public tax dollars. Many of those dollars come from people outside of the directly affected groups; as such, this study focuses on the economic impacts of CWD on the general Alberta population. Such values cannot be observed in any marketplace transactions, instead requiring a stated preference approach to ascertain them. Stated preference approaches involve questioning a respondent in order to find values rather than inferring or observing values from respondent

[1] Although there has not been any evidence of CWD affecting humans, there are concerns about the possibility of the disease becoming a risk to human health (WHO fact sheet. 2002).

actions. As such, central to the study was a detailed survey containing qualitative, quantitative and attribute-based stated preference questions administered to 1423 Alberta residents. 1293 respondents were randomly selected from an internet panel representative of the Alberta population, while an additional 130 were recruited to the internet panel via telephone from specific rural areas to respond to the online survey. The survey was developed over 2007 and 2008 with the aid of focus groups and two pilot studies. The full survey was administered between December 11th and December 31st 2008.

Data collected from the survey provided insight into attitudes, activities and knowledge related to the disease as well as wildlife in general. Basic statistical analysis was used for many of the qualitative questions. Econometric analysis, including conditional logit with two alternatives, random parameters logit and latent class models was used to analyze the responses to stated preference valuation questions. This yielded information on who was willing to pay for control programs, and how much they were prepared to bear in tax increases. Tax increases lasting ten years were presented as the payment mechanism for the valuation questions. This, along with the referendum format of the questions, was thought to be credible and logical to respondents, as current CWD control measures were being funded through tax dollars.

The results revealed a high level of concern surrounding the present and potential implications of the disease. The majority of respondents (70.1%) stated that they were aware of CWD, with many aware that it infects deer and elk populations. An even larger majority believed efforts should be undertaken to control it, and found taking no action towards it unacceptable. Many exhibited some level of mistrust towards either the science behind the disease or government and survey statements relating to it, or both. Risk perceptions towards the disease were quite high, with about a third of respondents expressing concern towards consuming deer or elk meat. Support for various control and monitoring measures was mixed. Although most respondents want effort made to control the disease, they seem to disagree on what the effort should entail.

The thesis is laid out in the following manner. The remainder of this chapter gives background information on CWD in Alberta followed by a description of study objectives. Chapter 2 addresses the theory and methods behind the study, apart from that of the survey design. Particular focus is on non-market valuation and attribute based stated preference methods, as well as econometric modeling of the data found through such. Chapter 3 discusses the design and implementation of the survey. Chapter 4 addresses the study results, and Chapter 5 concludes.

1.1 CWD in Alberta

In March 2002, CWD was detected for the first time in the province of Alberta in a farmed elk (ASRD Fact Sheet 2004). CWD is a variant of the transmissible spongiform encephalopathies (TSE) which occurs in cervids (deer, elk, moose and potentially caribou). Despite being of lower profile than several better-known TSEs, (e.g. bovine spongiform encephalopathy (BSE), Scrapie and Creutzfeldt-Jakob disease), CWD has attracted some measure of media and public attention in the last several years. While the disease is not thought to be transmissible to humans, the World Health Organization still states that people should not consume meat from infected animals as a precaution (WHO fact sheet. 2002).

CWD was initially found in a farmed elk in Alberta, but is now thought only to be present in wild deer populations near the eastern border of the province[2]. It is thought to be spreading into Alberta from Saskatchewan. CWD was inadvertently introduced to Saskatchewan through imported elk. In Alberta it is being found in an increasing number of wildlife management units (WMU), at increasing prevalence rates[3]. Wildlife management units are defined as "An area of wildlife managed under Wildlife Act, Alberta Regulation 143/79". Alberta is divided into one hundred and seventy eight WMUs. At the time of the survey, the

[2,3] Alberta Sustainable Resources Development Website: CWD history in Alberta. http://www.srd.alberta.ca/FishWildlife/WildlifeDiseases/ChronicWastingDisease/CWDUpdates/CWDHistoryInAlberta.aspx

disease was thought to be in seven WMUs, at prevalence rates between 0.03 and 0.06[4]. The affected WMUs were rural areas with relatively low human population densities. The largest town in the infected area in Alberta was Lloydminster, with a population of 24,028 with 15,910 on the Alberta side and the remainder in Saskatchewan (2006 census).

Efforts to eradicate or control the disease were hampered on several fronts. Firstly, the disease has no cure or vaccine. Consequently, the only control option after the disease is present is culling the infected animals, and their herd. A primary preventative strategy involved reducing animal concentrations in infected areas, which was expected to slow disease progression (Miskosky, 2007). A second major difficulty is that the disease's transmission vector(s) are largely unknown. Research has established that animal to animal transfer occurs, as does environment to animal (WHO, 2004). Further research has demonstrated that disease causing prions are present and infectious in soil for several years after animals have been removed (Schramm et al., 2006). Unlike bovine spongiform encephalopathy, which is transmitted through the consumption of infected animals, CWD does not require ingestion of infected animal parts. A third challenge is the lack of testing options. A conclusive test for the disease can only be performed once an animal is dead, as it involves examination of the brain and lymph glands.

The outbreak of the disease led the Alberta government to institute a culling program beginning March 2005. This was combined with testing and community education efforts. Recreational hunters were asked to submit animal heads for testing, along with information about where the animal was harvested. This led to the discovery of 18 cases between July 2005 and December 2008. Testing of animals culled through the management program also found 41 cases over that time period. Culling was typically undertaken in response to established occurrences, with efforts focused on reducing herds in infected areas. Based on personal observations at town hall-style meetings, such efforts met with some

[4] Prevalence measures the proportion of animals with CWD in the overall population.

opposition and controversy, particularly in areas where the culling was occurring. The culling program was halted in 2008. Presently, efforts at disease control are limited to education, mandatory or voluntary head testing depending on hunting area, and ongoing disease research (Alberta SRD Town Hall Meeting, Lloydminster, 2008).

1.2 Study Objectives

The intent of this study was to examine the economic impact of CWD on the average Albertan. This intent was broken down into four main objectives: 1) To determine the non market value for Albertans associated with containing CWD. 2) To assess residents' risk perceptions relating to the disease, as well as associated activities and activity changes. 3) To find what levels of knowledge and awareness of CWD exist in the province. 4) To assess attitudes and public perceptions of current and potential control measures.

Non market values consist of passive use, existence and non market use values. Passive use values, for the purposes of this study, are defined as any value a person holds for a good that is not derived from present or immediately anticipated use. Non market use value is comprised of the values associated with behaviors like recreational hunting, and consumption of meat obtained through such. Consideration of such values is required to get a true indication of the efficiency or cost-effectiveness of programs impacting them. As Carson et al. summarize, "overlooking or ignoring the services provided by non-market commodities in cost-benefit analyses and other empirical economic studies severely undermines the accuracy and relevance of the results" (Carson et al. 2001, pg 173). This is certainly the case with CWD, where Albertans' tax dollars fund the control programs. Good policy practice dictates that such values should be taken into consideration.

Understanding residents' risk perceptions is important for four reasons. First, such risk perceptions can reasonably be expected to affect passive use values, with the value of containment increasing in risk perception. Second, risk

perception is a possible gauge of understanding of the disease. Under or over estimation of risk levels indicates a lack of CWD-related knowledge. Third, assessment of risk perception allows one to assess the success of educational efforts and safety and testing programs which have been implemented. Lastly, it allows for actual risk projections in the face of new information. This would be important if disease spread or prevalence levels are found to be higher than expected and people are known to not have taken previous warnings seriously.

The importance of CWD awareness and related knowledge is similar to that of risk perception. The two can be expected to impact WTP values, although the direction that the effect will take is less clear. While risk perception forms an important aspect of CWD knowledge, other factors such as animal populations affected, or areas of the province facing infection are equally so. As with risk perception, awareness is a valuable indicator of whether educational programs are working, and where future efforts should be directed. Assessments of awareness can also provide a gauge for how WTP values may change if CWD becomes a higher profile issue in policy making and the media.

Knowledge of prevailing attitudes towards control measures is critical. For any environmental good "researchers must…recognize the fact that economic value for a good cannot exist in the abstract independent of the terms of its provision" (Carson et al. 2001, pg 180). For CWD this is particularly important because of the limited control options available. Given that the disease is presently untreatable, and can remain interned in soil for years after introduction (Schramm et al., 2006), prevention would seem to be the optimal solution. That being said, the controversy around the primary control measure makes it clear that understanding public attitudes, and conveying appropriate information, is central to developing a viable approach to disease management.

2.0 Theory and Methods

This chapter provides a discussion of the theoretical concepts and methods at the core of this study. It begins with an overview of passive use values, their history, importance, and measurement. A discussion of the contingent valuation method follows, with a focus on past uses and problems contrasted with modern developments. Next an explanation of analysis techniques applied to stated preference data is given. The chapter concludes with a discussion of past uses of stated preference methods and their application to prion disease in wildlife.

2.1 Total Economic Value

A major objective of this study was determining the value Albertans place on controlling CWD in the province. In this context, the value associated with CWD control refers to the monetary willingness to pay for constraining CWD in cervid populations in Alberta to specified levels of spread and prevalence. The WTP value is equivalent to the total economic value (TEV) of controlling the disease. TEV encompasses all values associated with an environmental good; observable and unobservable use values, as well as non-use or passive use values are reflected (Turner, 1999). The nature of an environmental good like CWD control is such that a large portion of related values may be non-market in nature, and consequently not directly observable through market values or behavior.

2.1.1 Passive Use Value

Passive use value encompasses all values a person holds in relation to some good which are not reflected in marketplace exchanges. The term appears frequently in the environmental and economics literature. In 1967, Krutilla noted "that many people valued natural wonders simply for their existence … these people obtain utility through vicarious enjoyment of these areas and, as a result, have a positive WTP for the government to exercise good stewardship of the land" (Krutilla, 1967 in Carson et al., 2001, pg 175). At that time the values remained primarily conceptual, in absence of viable measurement options. With

no opportunities for observation, passive use values were put aside until advances in economic, social and psychological science showed possibilities for measurement through survey design and administration.

Studies of use and passive use values began appearing more regularly in the 1970's, and it was rapidly apparent that measurement of non market values, as well as their inclusion in policy analysis was quite controversial (Carson and Hanemann, 2006). What recognition the studies received was often tempered with caution, perhaps understandably given that it was a new research area. A challenge for the new work to overcome was that one of the cornerstones of scientific practice, verification of results through real world observation, is generally not possible. Verification of results through study replication has been accomplished however, providing the necessary credibility. In spite of this, it was contended as recently as 2001 that there exist three key schools of thought on passive use values: (1) passive use values are irrelevant to decision making, (2) passive use values cannot be monetized, and thus, can only be taken account of as a political matter or by having experts decide, and (3) passive use values can be reliably measured and should be explicitly taken into account (Carson et al. 2001). Clearly each school will have vastly different approaches to decision making, and will frequently come to conflicting conclusions. Consequently, the disputes surrounding the values have not been completely laid to rest, however passive use values have continued to gain widespread recognition and use. Although some such as Murphy and Stevens (2004) in *Contingent Valuation, Hypothetical Bias and Experimental Economics* express concerns about the implementation of stated preference methods, Carson and Hanemann (2006) tested the measurement methods used on observable values and demonstrated them to be reliable when implemented appropriately.

2.1.2 Passive Use Values and CWD

Central to the concept of passive use values is the notion that consumers can derive utility from something without physically using it (Carson 2000). It is

often the case that passive use values arise from public goods, which are non-rival and non-excludable in consumption (Freeman 1993). This is clearly true with CWD containment, as it is not possible for the government to prevent some portion of the population from receiving the benefits of a control program nor does one person's knowledge of "healthy wildlife populations" detract from another person's knowledge of the same.

One common description of a passive use value is existence value, which arises from individuals who receive some utility from knowing a particular species, habitat or ecosystem exists and will continue to exist somewhere on the planet (Turner, 1999). For those that have no present or future contact with the species or affected area, it will be the sole source of value they derive from a program benefiting the species or area. Previous valuation studies dealing with environmental goods have found that in some cases, existence or passive use values surpass use values by a considerable margin (Randall 1997). The high profile and charisma of cervid populations, combined with the minimal contact most residents experience with them, raise the probability of this being the case with CWD control in Alberta.

A range of meanings have been attributed to the term *passive use value* in the literature. The broader definition given by Bateman and Willis (1999) in which passive use value encompasses all unobservable values is adopted for this study. Passive use values are often closely intertwined with other non market values such as existence value; as is the case in this study it is often not possible to distinguish between the two in valuation. For the purposes of valuing CWD control in Alberta, such separation was not required.

Despite the challenges associated with understanding non market values and their measurements, passive use value measurements are being increasingly pursued (Carson and Hanemann 2006). Their importance has come to be recognized by various institutions for a wide variety of contexts. In the case of environmental goods such as CWD-free cervid herds or prevention of species

extinction, the environmental damages due to human action or inaction can be very large. Economic theory demands that, in the case of economic analysis, the full suite of benefits be compared to the full suite of costs. Recognizing this, many governments have policies in place requiring complete accounting. In the United States, Presidential executive orders that required an assessment of the benefits and costs of all major new government regulations and reauthorization of existing ones in the United States greatly increased awareness of non market valuation (Smith 1984). As such, being able to measure complete benefits becomes imperative. At a basic level, "welfare economics, through benefit-cost analysis, seeks to reveal whether the potential change in utility resulting from a change in an economic variable, such as a change in a commodity's price or the level of provision, is positive" (Carson et al. 2001 pg 174). It is an accounting of some good, service or change which when performed reports net human preferences. Without appropriate values a benefit cost analysis will fail to reflect full benefits or costs, possibly leading to the wrong conclusion and an inefficient outcome.

2.2 Stated Preference Methods and Measurement of Passive Use Values

Having established non market values' importance, the question of how to measure such values naturally follows. The non-market nature of the values means that instead of observing the values through revealed preferences, the researchers' only choice is a stated preference (SP) or hypothetical market approach. The highest profile and most-used SP methods are contingent valuation (CV), and choice experiments (or attribute-based stated preference (ABSP) methods). Other options include an actual referendum on whether to provide some public good (Deacon and Shapiro 1975 in Carson et al. (2001)) or a simulated market in which the good is actually provided (Bishop and Heberlein 1979 in Carson et al. (2001)). Carson et al. (2001) note the argument of Borcherding and Deacon (1972) that it may be possible to infer the values of public goods from voting decisions of elected representatives. This implies that people reveal passive use value through the choices made by elected officials, however attempted

measurement in this fashion would be markedly imprecise and no studies, to the best of our knowledge, using this approach for environmental valuation have been performed.

The discussions and controversies surrounding non market value estimation methods are not unprecedented (Kauder 1953). As with any new methodological approach it required time to become established, refined and accepted. SP methods were developed in response to the requirements of benefit cost analyses (BCA). In Canada BCA has become a standard policy making tool, often considered necessary for the justification of government actions, and required by law for certain policy processes (for example the Federal *Cabinet Directive on Streamlining Regulations*). Its appeal as a decision making tool lies in its seeming simplicity: one merely adds up the costs and benefits of an action, and depending on which is greater proceeds accordingly. In absence of a measure of TEV, the approach cannot be used effectively and will likely result in inefficiency and inappropriate policy decisions.

The SP approach originated through the collaboration of a variety of disciplines. First proposed theoretically by Ciriacy-Wantrup in 1947 in the form of contingent valuation, its first practical application came 16 years later when Davis (1963) used it to estimate the value hunters and tourists placed on the Maine Woods. In spite of objections, SP's desirable attributes have led to a clear increase in use since the 1970's, as evidence by the increasing number of studies published. As the technique centers around a survey it is the most flexible of non-market valuation techniques, particularly as it can be used to estimate both use and passive use values (Hailu et al., 1999).

With advances in both economic and survey techniques in the 1980's, SP methods using referendum-style questions became commonplace. It was expected that survey respondents would have an easier time responding yes or no to a proposal with a specified price, in contrast to coming up with a value on the spot as required by open-ended CV. The developments found approval in many

quarters, including social scientists who in the case of referendum CV "appreciated the use of a familiar institution in its appropriate context" (Randall 1997 pg 1490). Economists approved because of the approach's incentive compatibility (Randall 1997). Respondents, when faced with a choice between some government provided amenity which will require them to pay a specified cost versus no cost but also no amenity have little reason to lie and no opportunity to exaggerate their position (Hoehn and Randall 1987).

By the latter half of the 1980's enough research findings supported SP methods, in particular CV, to justify increasing uses of it around the world. Notably, many government organizations began to accept CV as an appropriate method of project evaluation, and CV has found a wide variety of applications, among them valuing endangered species conservation, environmental restoration, and public goods such as health care, education and cultural programs. Between 1965 and 2000 over two thousand papers and studies addressing or using the method have been written or undertaken (Carson 2001). Of particular note is the application of CV to the 1989 Exxon Valdez oil spill. This event spurred the United States National Oceanic and Atmospheric Administration to convene a blue-ribbon panel of economists to determine if CV is appropriate for damage assessment. The panel concluded that "CV studies can produce estimates reliable enough to be the starting point of a judicial process of damage assessment, including lost passive use values" (Arrow et al., 1993 pg 43). Since the publication of the NOAA panel guidelines, appropriately designed CV studies have been accepted by public policy-makers as legitimate decision making tools (Clinch and Murphy, 2001). Boyle makes the point that while some CV critics seem to expect perfection from the method, this is unrealistic as "perfection does not exist even in actual market decisions" (Boyle, 2003 pg 153).

2.2.1 Implementing Valuation Methods

Carson notes that, outside of academic journals, much of the criticism surrounding CV has taken a largely anecdotal form, criticizing the results of

particular CV studies which used techniques known to be problematic. However, a carefully done CV study can provide much useful information to policymakers (Carson, 2004). He describes the steps to both survey and study design central to producing viable stated preference results. Although labeled for use with CV, much of the information and guidance is applicable to most stated preference methods.

The survey development steps will be addressed in the following chapter, however it can be noted here that the survey instrument plays a pivotal role in study credibility. For the study as a whole, the first step is the development work. This generally consists of developing a definition of what the proposed project or program will produce, with the outputs described in terms respondents can relate to. Focus groups and in depth interviews are needed to determine the clarity and credibility of the scenarios. Once these have been completed and the survey instrument is constructed, pretests and pilot studies should be undertaken to assess how well the survey works as a whole.

Secondly, care should be taken to confirm that the population sampled is the relevant one for evaluating the benefits or costs of the proposed project or program. The third step is to ensure an adequate sample size for assessing a continuous variable such as willingness to pay. Fourth, the mode of survey administration should be carefully considered. Lastly, survey instrument and administration aspects particular to the survey administration mode should be examined. For example efforts undertaken to minimize non-responses should be scrutinized. Following the collection of data by survey administration, the next step is analysis and modeling to translate the data into usable information.

2.2.2 Steps undertaken for this study

The development work undertaken for this study was extensive. A great amount of information on the current CWD situation in Alberta and Saskatchewan was provided by scientists at Alberta Sustainable Resources Development. They also provided the science behind outcome projections needed

to develop hypothetical scenarios. Using this information it was possible to develop a survey draft. This was then analyzed in focus groups which were used to ensure survey comprehensibility and believability. The focus group format allowed for group and one-on-one discussions. Two pilot studies were implemented prior to full survey administration.

As the research question was to determine Albertan's willingness to pay to contain CWD, the population of interest consisted of all provincial residents over 18 years of age. The population sampled was a panel recruited by a marketing company to match Alberta socio-demographic characteristics. As discussed further in the Results chapter, the sample deviated slightly from provincial characteristics, notably in income levels. Overall however, the observable characteristics of the sample were quite close to that of the provincial population. Additionally, some rural areas known to be affected by CWD were oversampled, to allow for regional comparisons. The sample size was sufficiently large to produce statistically significant results while balancing cost constraints. An Internet based survey was chosen as the most appropriate mode of survey administration. The reasoning behind this is discussed in the Survey Design chapter, as are the efforts to minimize non-response numbers.

2.2.3 Challenges associated with SP studies

Carson provides a firm grounding for credible SP work. It should be recognized however, that even well designed SP studies face a number of common challenges that have the potential to derail an otherwise solid experiment. Many objections to SP stem from the possibility of bias afflicting the survey and consequently study results. This is due to the lack of opportunity to observe "real world" situations which may alleviate or confirm such concerns. Much of the literature critiquing stated preference studies has focused on the possibility of hypothetical bias (Murphy and Stevens, 2004). Hypothetical bias occurs when respondents answer differently to the choices in the survey scenarios than they would act in reality. Poorly presented information, or ill-framed

questions may increase the likelihood of this type of bias. The first step to preventing it is careful focus group testing. Focus groups can identify whether or not the information pushes them to answer in a certain direction. Following careful testing, additional efforts can be made to avoid hypothetical bias in studies such as the inclusion of "cheap talk scripts" prior to the choice questions, and debriefing questions intended to reveal which respondents may have been exhibiting hypothetical bias (Lusk, 2003). The debriefing question responses are analyzed, and respondents that show evidence of either nay- or yea-saying may be removed from the data set.

Selection bias is a possibility if respondents who chose to answer the survey have some unobservable characteristic that both makes them more likely to answer the survey and affects their responses (Heckman, 1979). Careful comparison of multiple demographic characteristics between the survey sample and the population is one way to attempt to minimize this possibility.

Another type of bias which is identified in many SP studies is known as embedding and is related to scope. It occurs when respondents' values are not affected by changes in the amount or quality of the public good provided (Grafton et al., 2004). Other types of bias which can be largely avoided through careful survey instrument design include anchoring bias, which occurs when respondents are disproportionately affected by a piece of information. Floor or ceiling biases occur if the respondent's actual WTP is higher (ceiling bias) or lower (floor bias), than the values available through the elicitation format. Question order bias can be an issue if the order questions are presented in has an effect on the responses to them.

Nay-saying bias can be a problem if respondents disregard their actual values and vote no out of a desire to send a message, for example against tax increases or the political party proposing the action. Yea-saying is the opposite: respondents vote in support of some action or measure regardless of either payment ability or desire. Blamey et al. (1999) identify two motivations of yea-

saying bias: the first is a social motivation, "where social pressure or desirability considerations motivate respondents to yea-say". The second is an internal motivation, where "respondents simply seek to express their attitudes". Care was taken in this study to choose elicitation methods minimizing bias potential. Greater detail on these efforts can be found in the survey design chapter.

2.2.4 Stated Preference Methods Used in This Study

A number of stated preference approaches have been developed over the past few years. Those central to this study can be loosely grouped into contingent valuation and attribute based stated preference methods. CV is considered the most used SP method in environmental economics. It tends to focus on the monetary factors affecting choices for an environmental good or service (Grafton et al. 2004). Contingent valuation can be considered a collection of methods with varying elicitation formats, including bidding game, open-ended, referendum-style, and the payment card format. The payment card method provides a respondent with a card listing a range of prices, with the respondent asked to place a check next to their maximum WTP (Boyle, 2006).

In its widely used modern format CV creates a hypothetical market for the good in question and presents the change in environmental good or service to survey respondents as a narrative preceding a vote or choice. This allows the economic welfare shift relating to the change in the environmental good or service to be found. In contrast, "attribute based methods divide the situation or valuation context into attributes and elicit responses on choices of different bundles of attributes" (Grafton et al. 2004 pg 229). Attribute based methods can also fit well with the referendum-style approach.

For the purposes of this study, a hybrid of contingent valuation and attribute-based SP methods was employed. The actual choice questions were binary choice attribute based stated preference, conducted referendum style. Analysis was performed along the lines of a CV study, with estimation based on groups of attributes.

2.2.5 The Referendum-Style Method

Referendum-style stated preference questions are often used in valuing public goods or programs. With the NOAA panel report advocating the use of referendum questions, as well as laying detailed ground rules for survey implementation, it can be viewed as an established method. While one must consider the situation when determining the best SP approach to use, the referendum-style format was an excellent fit for the question at the heart of this study regarding WTP for CWD containment. Its appeal lays in its realistic and believable presentation, as well as fully developed data analysis techniques. In a democratic society such as Canada, the idea of voting on a public policy issue is not foreign. Neither are purchasing decisions in which one observes some good and its price, and decides whether or not to buy. The referendum style has been found to be less prone to strategic behavior (Grafton et al. 2004). This is because if the respondent understands that the policy or program will only go ahead if the majority of respondents support it, they have little incentive to behave strategically. Unlike open-ended questions where the respondent may exaggerate or underestimate their WTP to make a point, the discrete choice options curb the opportunity to do so.

2.3 Modeling Discrete Choice Stated Preference Data

2.3.1 The Random Utility Model

At the base of all discrete choice stated preference data modeling techniques is the assumption that individuals make utility maximizing choices within their personal constraints. These constraints may be factors such as time or income, and may or may not be observed by the researcher. This means that each time they are observed deciding between alternatives, the researcher can believe that, from the individual's perspective, the alternative chosen is feasible, and superior to the one(s) not selected. This simple concept yields powerful information. It is the first glimpse into the respondent's utility or preferences. This notion gives rise to Random Utility theory, which reveals the dominance of

certain alternatives while allowing for choice variation through the inclusion of a random element (Adamowicz et al., 1998).

A random utility model of a binary choice can be formulated as such: let the two choices be yes and no. An individual's utility for each choice is then:

$$U_{yes} = x'_{yes}\beta + \varepsilon_{yes} \text{ and } U_{no} = x'_{no}\beta + \varepsilon_{no}$$

Equation 2.1

Where x represents a vector containing a set of factors affecting the decision such as individual characteristics and alternative attributes. A set of parameters reflecting the impacts of changes in x on the choice probability are represented by β. The ε is the included random element, accounting for factors known to the individual but hidden to the researcher.

Then,

$$Prob\ [vote = yes|x] = Prob\ [U_{yes} > U_{no}]$$

$$= Prob\ [(x'_{yes}\beta + \varepsilon_{yes} - x'_{no}\beta - \varepsilon_{no}) > 0|x]$$

$$= Prob[(x'_{yes} - x'_{no})\ \beta + (\varepsilon_{yes} - \varepsilon_{no}) > 0|x]$$

$$= Prob[(x'\beta + \varepsilon) > 0|x]$$

Equation 2.2

The error term is assumed to have a type-1 extreme value distribution. McFadden (1981) in Grafton et al. (2004) shows the conditional choice probability of selecting yes to be:

$$Prob[yes|x] = \frac{e^{\mu\beta x}_{yes}}{e^{\mu\beta x}_{yes} + e^{\mu\beta x}_{no}}$$

Equation 2.3

where μ is a scale parameter. As μ and β cannot be estimated separately, in practice μ is generally set equal to one, allowing the parameters to be estimated using maximum likelihood methods (Grafton et al. 2004, pg 267).

For the contingent valuation case, the utility functions for yes and no votes are as follows:

$$V(yes) = a + b\,(income - bid) \text{ and } V(no) = b(income)$$

Equation 2.4

where a is a measurement of a respondent's utility from the proposed management program, and b is the respondent's marginal utility of income.

From the formulation of the RUM one can see that it is not possible to quantify utility differences between alternatives based on one choice observation; too many factors in the respondent's decision are unobserved by the researcher. Ben-Akiva and Bierlaire (1999) emphasize that due to the incomplete information, it is necessary to account for uncertainty. In his 1977 paper on RUM structure, Manski identifies four possible causes of such uncertainty: unobserved alternative attributes, unobserved individual characteristics, measurement errors and instrumental variables. Thus, although the respondent is assumed to be able to perfectly discriminate between alternatives in a logical fashion, apparent discrepancies in such logic are accounted for. The complicated nature of human decision making processes demand that any decision rules derived from choice observation possess a probabilistic dimension (Ben-Akiva and Bierlaire, 1999) such as that described above.

That being said, with a sufficient number of observed choices, either from the individual or multiple respondents, the researcher can obtain at least ordinal utility information on both the choices and their specific attributes. Depending on what the choices represent, and which choice attributes are observed, multiple choice observations may reveal a great deal more. When the cost of a choice is

one of the attributes observed, it becomes possible to estimate willingness to pay (or accept) values for the choices.

2.3.2 Calculating Willingness to Pay

The situations presented for the choice questions in a CV survey are designed to vary program attributes including cost, and are administered to a sufficient sample such that WTP values for specified disease control programs can be estimated. Respondents choose between implementing a program with specified attributes including cost, or doing nothing thus incurring no cost and a worst case outcome. A monetary value for respondents' change in utility between the worst case and a control program can be found through an expression of the compensating variation which incorporates a measure of the marginal utility of money, $\beta_{\$}$. $\beta_{\$}$ can be estimated as described by the respondents' utility functions given in equation 2.4. The compensating variation of money is then:

$$CV = \left(\frac{1}{\beta_{\$}}\right)(V_1 - V_0)$$

Equation 2.5

The compensating variation of moving from the worst case state of the world (V_0) to a control program state of the world (V_1) is the WTP for a control program.

If a type I extreme value distribution is assumed for ε in equation 2.2, a logit model results. The logit model was one of the earliest platforms for analyzing discrete choice data (Greene and Hensher 2003). It is derived from the random utility maximization structure as described above, and so assumes a type I extreme value distribution for the ε (Grafton et al. 2004 pg 305). The model takes the form:

$$U_i = V_{in}(X_i) + \varepsilon_{in}$$

Equation 2.6

Where i is the yes/no choice made by individual n, and X captures the deterministic attributes of *i*. The parameters β that the researcher is attempting to estimate are embedded in $V_{in}(X_i)$. Again, ε_{in} catches the elements hidden to the researcher but known to individual *n*. The model was estimated assuming a Gumbel distribution for the error terms, and Grafton et al. 2004 state that the cumulative distribution function of a Gumbel variable is:

$$F(\varepsilon) = \frac{1}{e^{e(\mu(\eta-\varepsilon))}}$$

Equation 2.7

Where η is a location parameter.

2.3.3 Further Analysis

The conditional logit model was a useful starting point for model estimation of the project dataset as it allowed for a general picture of choice attribute and individual characteristic effects on choice probabilities and willingness to pay values. That being said, the model is not without drawbacks, notably the failure to account for taste heterogeneity in either individuals or groups. As such, further modeling was performed with the data set using more advanced models, the Latent Class model and the Random Parameters Logit model.

2.3.4 Latent Class Analysis

A latent class method is an extension of the latent variable approach. The idea of segmenting the population through the use of latent variables to explain choice behavior was put forward by McFadden (1986). Swait (1994) built on the

idea, creating a finite mixture model which allows market segments to be tied to observed behavior in addition to individual consumer characteristics (Boxall and Adamowicz, 2002). The approach has subsequently been used in numerous studies in a variety of fields including environmental valuation. Boxall and Adamowicz applied it to wilderness park choice data, also employing a RPL model for comparison.

Latent class analysis is intended to report otherwise unaccounted for heterogeneity between different groups in a sample. The method allows one to examine divergences in WTP estimates across different segments of the population grouped by various demographic factors. It is a special case of the random parameters model (see below), in which a specified number of support points are hypothesized (Adamowicz et al., 1998). Partitioning responses in this manner allows researchers to observe the different impacts on various groups which are unobservable using the conditional logit model or random parameters logit model without latent classes. Differing impacts due to heterogeneity in preferences at such sub-population levels often have important policy implications. Indeed, it may be the case that impacts of policy options on specific socioeconomic groups is of primary concern. The model allows these groups to be examined, in order to assess consequences and disparities.

It is important to note that while latent class analysis searches for such heterogeneity, it does not definitively assign individuals to specific groups. Rather, membership in different classes associated with specific preference parameters is probabilistic. In the logit model presented in equation (2.4), the latent class model would provide estimates of preferences associated with classes q=1, …Q or:

$$Prob\ (y_n|q) = \frac{exp\ (e'_n\beta_q)}{1 + exp\ (e'_n\beta_q)}$$

Equation 2.8

where individuals are implicitly sorted into Q classes. Several formulations of class membership probability have been used in the literature. Greene and Hensher (2003) propose a multinomial logit form of prior class probability H_{nq} for individual n:

$$H_{nq} = \frac{exp\ (z'_n \Phi_q)}{\sum_{q=1}^{Q}\ exp\ (z'_n \Phi_q)} \qquad q = 1, \ldots Q \qquad \Phi_{q=0}$$

Equation 2.9

Where z_i represents a set of observable characteristics which enter the model for class membership and Φ_q represent the latent class parameter vectors. Then the probability of an individual choosing yes or no is modeled as a function of the probability of choosing, conditional on being in membership class Q, times the probability of being in membership class Q. This probability structure can be used to form a likelihood function.

2.3.4.1 Number of Latent Classes

Often the most difficult aspects of latent class analysis is determining the correct number of classes to use. It is commonly accepted that the best approach is to use multiple information criteria for the selection of the number of classes (Swait, 2007). This is because the number of classes is a discrete parameter, while maximum likelihood estimation demands continuous distributions. However, for any given number of classes it is possible to use maximum likelihood estimation (MLE). Thus one is able to compare the information criteria of various models to determine the optimal number of classes. While there are several measures for choosing the number of classes, the most widely used are the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). AIC is defined as:

$$AIC = -2(logL^{*}_{S} - K_S)$$

Equation 2.10

Where $logL^{*}_{S}$ is the log likelihood at convergence, and K_S is the number of parameters used in the selection of the number of classes.

BIC is defined as:

$$BIC = - logL^{*}_{S} + \frac{[Ks * log\ (M)]}{2}$$

Equation 2.11

Where M is the sample size.

When determining which latent class model to use, both AIC and BIC were examined in this study.

2.3.5 Random Parameters Logit Model

The random parameters logit (RPL) model was developed to allow for unobserved heterogeneity, and differences in covariance of the random components. Alternatively referred to as a mixed logit, the choice probability is a mix of logits with a specified mixing distribution (McFadden and Train, 1997). Each observed variable's coefficient is able to vary randomly across individuals. The approach has proven effective in a variety of disciplines such as marketing, transportation and health in addition to economics and environmental science (Hensher and Jones, 2007). Revelt and Train (1997) employed the model when analyzing data on households' choices of high-efficiency appliances in response to various utility-sponsored programs. They found RPL to be appropriate, as in addition to not showing the restrictive forecasting patterns of the standard logit, the model also provides efficient estimation when individuals have repeated

choices. Increasing the behavioral realism of discrete choice modeling is a desirable trait which RPL accomplishes.

Much like latent class analysis, which allows for differing impacts due to heterogeneity in preferences at the sub-population level, RPL allows for differing impacts at the individual level. Thus it is more flexible than the LCM as it does not require the approximation of the underlying continuous model with a discrete one. It does demand specific assumptions be made about parameter distributions across individuals. Hensher and Jones (2007) identify four key considerations when using RPL: 1) which random parameter distribution assumptions should be made and what impact they will have on the model's performance. 2) How to effectively incorporate prior information in model estimation and prediction. 3) Develop an appropriate sampling methodology for mixed logits. 4) Evaluate RPL model stability and selection of random parameters for inclusion in model estimation. The RPL model is a generalization of the multinomial logit model, of which the logit model presented above is a special case with just two options in the choice set. The unconditional probabilities of RPL models take the form:

$$P_{nq} = \int \frac{e^{x'nt\beta}}{1 + e^{x'nt\beta}} f(\beta|\theta)d\beta$$

Equation 2.12

Where $f(\beta|\theta)$ is the density of β with parameters θ.

The unconditional probability for a sequence of choices for individual n is:

$$P_n(\theta^*) = \int \prod_t \frac{e^{x'nt\beta}}{1 + e^{x'nt\beta}} f(\beta n \mid \theta^*)\,(\beta_n)$$

Equation 2.13

While the log-likelihood function is:

$$LL\ (\theta) = \sum_{n} P_n(\theta)$$

Equation 2.14

Because the integral in equation (2.14) cannot be calculated analytically, it becomes necessary to approximate the probability through simulation, then maximize the simulated log-likelihood function.

2.3.6 A Discussion of the Three Econometric Models

All three models, (logit, latent class and mixed logit) were used for analyzing the data in this study as there is no absolute answer regarding which model is best. Both latent class modeling and the random parameters logit model are considered superior to the conditional logit model as they can provide information on heterogeneous individual or group preferences (Greene, 2004). That being said, the conditional logit model is a good beginning for model estimation. Providing useful information on choice attribute and individual characteristic effects on choice probabilities and willingness to pay values, the logit model can generally be estimated with fewer data points than required for either latent class modeling or a random parameters logit model.

If there is evidence of individual or group heterogeneity in preferences, estimation through one of the more recently developed models may be advantageous. The LCM allows for examination of such effects through a model of discrete parameter variation, assuming individuals are sorted into a specified number of classes. The model can extend to panel data, and assumes the preferences are identical for each person across every choice they make. The insights into the different effects on varying socioeconomic groups that the model provides can be important. In many cases the model manages to balance

heterogeneity amongst individuals and interpretability of impacts on groups of interest.

The random parameters logit model is the most flexible of the three, permitting individual heterogeneity and varying distributions of components in the simulated log-likelihood function The random components are not restricted to normality (Greene and Hensher, 2006). That being said, the benefits of such flexibility are tempered by the requirement to specify the distribution of heterogeneity when constructing the model. Depending on the goal of the research, understanding distributional effects may be paramount.

Previous work comparing these models (see Greene and Hensher, 2006; Adamowicz et al. 1998; Boxall and Adamowicz, 2002) has shown that the best model often depends on the situation, and the study focus. Greene and Hensher, applying the models to a highway preference data set, found it was not possible to state that either LC or RPL was unambiguously preferred to the other. Their data set provided considerable variability which they found to be well accounted for in each, while both models gave a significant statistical improvement over the straight multinomial logit form. Other studies comparing the two have found the LCM to be statistically superior to the RPL model for specific data sets (Shen et al. 2006). This ambiguity, as well as a desire to reinforce the study results spurred the estimation of the two models in addition to the conditional logit in this study. Model discussions specific to the CWD study can be found in the Results chapter.

2.4 Past Uses of the Methods and Their Application to Prion Disease

As discussed throughout this chapter, the methods employed in this study are well established and have been used in numerous contexts ranging from environmental good valuation to transportation research. What is unique to this work is the application to a wildlife disease. An extensive search of the literature failed to find another case in which passive use values were estimated for controlling either prion or other types of disease in wildlife. The closest parallels

to the CWD situation that have been looked at from a passive use perspective are invasive species control and preventing further decline of species at risk.

Both invasive species control and preventing species at risk decline involves wildlife that the general public does not encounter regularly. Both controlling an invasive species, and halting population reduction of a threatened species, involve avoiding negative outcomes. They reflect deteriorating situations, where in absence of action current conditions will not be maintained. This is certainly the case of CWD in Alberta. This distinction is important, as past stated preference work has noted the status quo preference of individuals (Hartman et al., 1991). In these situations, the nature of the problem is such that respondents face a change of the current situation in the absence of action. As such, they may be willing to pay more to avoid such a change than they would after the fact to mitigate it.

McIntosh et al. (2007) conducted a study on the benefits of delaying an invasive species occurrence. Their objective was to determine if it is worthwhile investing in invasive species control even if an invasion ultimately occurs. This is comparable to the CWD situation presented in the survey in which investment in a control program results in varying levels of reduction of the disease ten years in the future (Please see Appendix 2 for choice situations). While they also employed a contingent valuation approach, rather than a referendum-style survey, they used open-ended responses in which respondents were asked to enter their WTP values as either a dollar amount or a range. The results were statistically robust, however they appear to have encountered problems with hypothetical bias. A number of responses had to be excluded due to reported WTP values exceeding household income. That being said, results from WTP as well as preliminary and follow-up questions strongly suggest net benefits of invasion control even if the invasion ultimately occurs.

A study valuing a species at risk with an approach quite similar to that used in this study for CWD control was performed by Jakobsson and Dragun

(2000) looking at the worth of the possum as well as all endangered flora and fauna in Victoria, Australia. They employed a referendum-style contingent valuation survey, but also sent out a second survey version which included both open-ended and payment card questions. The payment mechanism in each version was a tax increase. Analysis of the referendum data was conducted using a conditional logit model with two alternatives. Considerable differences in WTP values between conservation of a single species versus conservation of a vast number suggest that scope effects are present, bolstering the study's credibility.

Another study examining species at risk was performed by Rudd (2009) and measured Canadian's values for conservation programs affecting a variety of at-risk species. Although he employed a choice experiment rather than the contingent valuation method, his use of latent class analysis as well as the focus of program outcomes as the basis for the hypothetical scenarios means the study has several important parallels with this one. In addition to statistically robust WTP estimates, Rudd found significant heterogeneity between various socioeconomic demographics within the Canadian population, reinforcing the importance of recognizing and accounting for such variation.

2.5 Chapter Conclusion

This chapter addressed the theoretical basis and analytical methods of the study. Key concepts including non market, existence and passive use values were discussed. A brief history of the development of stated preference techniques for measurement of such values was included. The three models used for data analysis: conditional logit with two alternatives, random parameters logit and latent class, were provided in general form. Finally a discussion of the methods' past application to similar situations was given. Absent from the chapter was a discussion of the theory behind and development of the survey used. Due to its complex nature and position of central importance, survey design is addressed in the following chapter.

3.0 Survey Design and Implementation

The success of an SP study such as this one depends heavily on the success of the survey at the center of it (Carson, 2000). As such, both the design and implementation of the survey instrument are critical. For the CWD survey this is emphasized by the many aspects of public perception being assessed, each demanding different survey techniques. Great care was taken when building the CWD survey, first in the methods used, and later in the refinement process which involved a focus group and two pilot studies prior to full study administration.

The first step of this process involved building the initial survey instrument. A literature review was undertaken, and research was done on the history of transmissible spongiform encephalopathy. Special focus was paid to the discovery and spread of chronic wasting disease in North America. Discussion with subject area experts from the Fish and Wildlife Division of Alberta Sustainable Resource Development (ASRD) provided data on the progression of the disease in Canada, as well as information on the current situation. Current management measures were described, along with a list of potential management measures under consideration for use. ASRD designed eight possible outcomes in terms of CWD spread and prevalence levels throughout the province using the most up to date data available at the time for use in survey choice questions.

Following the initial construction of the survey, the next step was refining it. First, a focus group went through a paper version of the draft survey. This step allows researchers to identify potentially problematic areas of the survey, as well as gain insight into the respondents' thought processes while they complete the survey. This is necessary to ensure respondents understand and are valuing the correct commodity. Reasonable bid value ranges were also discussed in the group. Some minor adjustments were performed on the survey following the focus group. The survey was then pre-tested through a pilot survey of 134 individuals who completed the first online version of the survey. Due to changes made as a result of the first pilot, a second pilot was administered with what turned into the

final version of the survey (please see Appendix 1). After the second pilot test the survey was deemed ready for full-scale implementation.

3.1 Building the survey

This section describes building the CWD survey by question type. Particular attention is paid to the choice question section.

3.1.1 Basic Demographic and Activity-Related Questions

The CWD survey included standard demographic questions as well as a number of questions inquiring about respondents' activities which may affect or be affected by CWD infection levels in the province. The purpose of the demographic questions was twofold. First, a comparison of the survey responses to those found for Alberta by the Canadian census allows one to determine whether the sample matches the general public in terms of observable characteristics. This, along with response rates, can provide some insights into potential non-response bias. Second, having such demographic information on respondents allows the researcher to assess if certain demographic features such as income or education levels affect responses to other questions such as those related to attitudes and willingness to pay for disease control. Similarly, the questions related to respondent activities such as hunting or participation in conservation groups can be important both in regards to how such activities may impact attitudes and values. These answers are useful in assessing how various groups will be impacted by the disease.

These questions were straightforward; those relating to activities were often yes/no responses. Some, such as whether the respondent has consumed elk or deer meat gave several options including yes (in the past two years), yes (but not in the past two years) and no. The demographic questions were kept as close to those used in the Canadian census as was reasonable, to permit comparison. As some of these questions worked well for framing the issue of CWD in Alberta, they were included in the warm-up section of the survey. Other, more general

questions such as respondent income and education levels were found at the conclusion of the survey.

3.1.2 Warm up and knowledge-assessment questions

A well designed SP survey should contain an introductory section that sets the general context for the decision to be made (Carson, 2000). The survey for this study began with questions on government priorities, opinions and attitudes toward wildlife, the moved into CWD knowledge assessment.

The knowledge assessment question responses allow researchers to determine how high a profile the issue of CWD has in the province. This is relevant to the study, as along with respondent activities it has important implications for attitudes and values related to the disease. The level of baseline knowledge of CWD in Alberta is important, as it has both policy making implications and may impact values associated with CWD.

The knowledge assessment questions came early in the survey prior to much of presentation of background information on the disease. They were quite straightforward with yes/no responses to questions such as, "Prior to completing this survey were you aware CWD is present in Alberta". Although it is possible a higher proportion of respondents said yes to such questions, despite being unaware prior to the survey. This would result in an upward bias however, the length and depth of the survey precluded using more involved test-type questions. These may have irritated respondents and resulted in either poor response rates or less effort put into later questions. These questions, as well as the attitude and opinion questions described in the next section, served to warm respondents up and prepare them for the choice questions that followed.

3.1.3 Attitude and Opinion Questions

The CWD survey sought respondent opinions on a relatively large range of issues. Among these were levels of ecological concern, feelings towards wildlife in general, feelings towards elk and deer populations in particular, beliefs

regarding CWD and the threats associated with it, reasons for the choices made in the CV referendum question and attitudes towards proposed and existing CWD control measures. The fifteen revised New Ecological Paradigm (NEP) questions were also included (See Appendix 3 for full discussion of development and purpose). The NEP questions allowed for an assessment of respondents' levels of ecological concern, and could be incorporated into models of the contingent valuation responses to check for WTP differences between eco-centric and anthropocentric world views. As with most of the attitudinal questions they were presented in Likert-style, with respondents reading a statement then being asked to respond with, "Strongly Agree", "Mildly Agree", "Unsure", "Mildly Disagree", and "Strongly Disagree". Questions relating to attitudes towards wildlife, as well as deer and elk in the province were presented in the same format.

Debriefing questions which followed the contingent valuation section were intended to find the reasons behind respondents' choices. Questions relating to various program attributes had respondents indicate on a range from "Not at all important" to "Extremely Important" how relevant specific factors such as CWD prevalence in infected areas were to their choices.

Of the attitude-related questions, those most relevant to the study's specified objectives cover respondent attitudes towards ten possible disease control actions or approaches ranging from culling elk and deer herds to taking no action against the disease. For each possibility, the survey again used a range, asking respondents to indicate if they found the action "Highly Acceptable", "Somewhat Acceptable", "Neutral", "Somewhat Unacceptable", or "Highly Unacceptable". A "Don't Know" option was also offered. In addition to knowing what actions the general public prefers, these questions may also be useful in determining why respondents chose a certain way in the contingent valuation section.

3.1.4 Information Provision

It is necessary in SP surveys to provide respondents with information such that they are able to consider the issues and answer questions on them meaningfully. It can be a delicate balance however to provide sufficient information without biasing respondents towards or against the issue in question. Administering the survey on CWD required respondents to be provided with sufficient information to answer questions meaningfully. Such information had to be presented to respondents in such a way so as to avoid skewing their responses towards proposed management programs.

3.1.5 Stated Preference Questions

Stated preference, as described in detail in Chapter 2, seeks to determine what value individuals place on some good or service. This is done through observing individuals' choices when they are presented with a hypothetical situation which typically involves some choice between provision of some amount of the good with an associated cost via a realistic payment vehicle versus the status quo or some other provision and cost combination. The choice questions used to estimate Albertans' WTP for CWD containment were carefully constructed, drawing on the NOAA panel recommendations as well as recent developments and technological advances. The bid range was selected and refined through focus group and pilot test results.

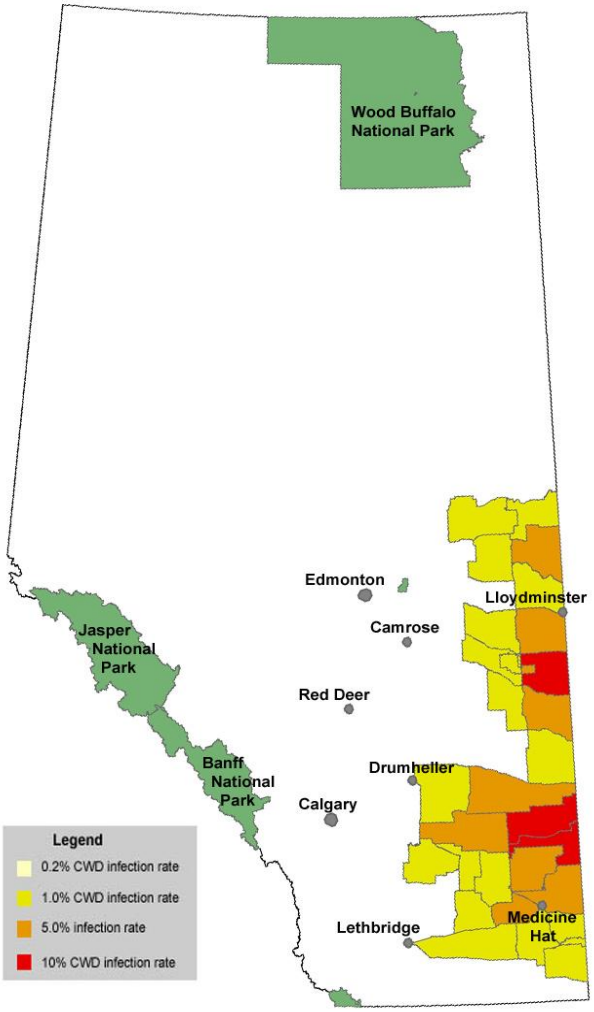
3.1.5.1 Hypothetical Scenarios

As discussed in Chapter 2, a hybrid of referendum attribute based stated preference questions combined with contingent valuation-type analysis was selected for valuing CWD containment. The referendum approach was a good fit for the CWD question, being both believable and familiar for Alberta residents. In a democratic society such as Canada the concept of voting on public provision of a good is not foreign to most respondents.

The referendum style of the choice questions meant that respondents were given two options, one in which nothing is done (the CWD disease levels continue their projected increase trajectories to the worst case outcome) and there is no tax increase and a second in which some disease control program with specified attributes and a certain tax increase is provided. The respondent is asked to vote yes or no for the program. The control programs presented varied in the following attributes: spatial spread of CWD, prevalence level outcome of CWD, and amount of tax increase for a ten year period.

The worst-case scenario, the no program-no cost option, was presented as disease spread and prevalence level outcomes projected ten years in the future. Disease spread level refers to the area of the province in which the disease is present. Given that prion diseases have been found to remain interned in soil for multiple years (Schramm et al. 2006), once the disease has been found in an area it can reasonably be considered infected for the purposes of this study. Prevalence level refers to the proportion of CWD positive animals in an infected area. Both spread and prevalence levels had three possible values: low, medium and high. Low spread had 3 infected wildlife management units, medium spread 12 and high spread 57. Prevalence levels, because of disease spread projections, are not uniform across infected areas for each value. The proportion of animals infected by CWD in areas with the disease ranged from 0.005 to 0.1. The worst case outcome, as well all hypothetical program outcomes, was presented on a map of the province (e.g. Figure 3.1). Color-coding showed spread and prevalence levels. The worst case outcome, in which no control program is implemented, was deemed to exhibit high spread-high prevalence.

Figure 3.1: Worst Case CWD Disease Outcome Presented to Respondents (Projected outcome 10 years in the future in absence of control program)



The map format was thought to be the clearest way of conveying information on the situations, and was well-received by the focus groups.

The outcome projections were developed by scientists with Alberta Sustainable Resources Development. They began with the established locations of CWD-positive deer as of August 2006. They then extrapolated a radiating spread from wildlife management units with infected deer into adjacent units. WMUs were chosen as the base unit as all management decisions, aerial surveys and hunting seasons use the WMU framework. (Dr. Margo Pybus, personal

communication). The hypothetical scenario outcomes were developed with the subject experts' input on reasonable spread rate and prevalence level reductions. Respondents saw proportionate disease levels rather than absolute disease levels. The actual or anticipated numbers of CWD infected deer were not presented.

The outcomes for the hypothetical control programs were presented in the same manner. Once again spread and prevalence levels were identified through color-coding on the map. Please see Appendix 2 for a complete set of the eight possible control program outcomes. As mentioned above, the program attributes presented included the two outcome measures and the cost in the form of a tax increase. Control measures, (such as culling) were not altered across scenarios. This is due to the fact that once the disease is present in an area (as it is in eastern Alberta), reduction of herds is the only existing control option. Each hypothetical control program included a tax increase amount selected randomly from four possibilities. The tax increase was an annual amount that would be paid for ten years. The four possible tax amounts were: $10, $25, $100 and $250. Please see the Bid Value section below for information on how those four were selected. Thus, the eight possible control program outcomes, when combined with the four possible costs, mean that the survey had 36 hypothetical scenarios in which each respondent answered a random selection of three. Please see a copy of the survey in Appendix 1 for choice question examples.

Immediately following the respondents' vote is a certainty level question. It has been found that respondents who vote "yes" but indicate they are uncertain of their actual vote tend to vote "no" in real situations. As such, changing these responses to "no" helps reduce hypothetical bias (Carson et al., 1992; Blumenschein et al. 1998).

3.1.6 NOAA Panel Recommendations, Hypothetical Bias and Survey Design

Uncertainty surrounding possible bias is at the center of most objections to stated preference studies. Consequently, the NOAA panel recommendations focus

on reducing or eliminating such possibilities. General themes include ensuring respondents consider the referendum seriously, adequately informing them of the environmental situation, and reducing the chance of overestimation or underestimation due to social pressures.

Notable effort was undertaken while constructing the choice questions of the CWD survey to control for the presence of the possible bias types which may affect such a survey. The bid range was carefully chosen to ensure that neither floor nor ceiling biases were likely, with proportions of yes votes at the lowest and highest bid levels examined after each pilot study prior to full survey implementation. Each respondent answered three referendum questions. To combat the possibility of question order bias, the order was selected randomly. As the three questions presented to each respondent were drawn at random from 36 possible hypothetical scenarios, the chance of such bias occurring over the survey results as a whole was thought to be negligible.

Bias due to nay-saying, where a respondent voted against some program in a way not reflective of their true values in an effort to make a point, was a possibility considered when designing this study. For CWD in Alberta, the point may stem from a blanket objection to tax increases. It is hard to combat this at the survey design phase, beyond presenting realistic scenarios with non-inflammatory language which was done. Instead, follow-up or debriefing questions seeking (Table 3.1) to identify cases of strategic voting were included, allowing for such instances to be either accounted for or removed at the data modeling stage. If respondents voted no to any of the three programs, the CWD survey asked the following follow up questions:

Table 3.1: A list of the follow-up questions respondents who voted no to a proposed CWD control program were asked.

- I do not believe the program will actually help to limit the spread of CWD in Alberta.
- I think our tax money could be better spent on other issues.
- I do not have enough information to make this decision.
- I felt the proposed management program did not do enough to combat CWD.
- I felt the proposed management program was too extreme.
- I do not agree with increased hunting to eliminate CWD.
- I do not agree with government agencies carrying out culling of elk and deer herds to eliminate CWD.
- The tax increase was too high.
- CWD poses no health risk to humans.
- I am uncertain about levels of CWD management in areas outside Alberta (e.g. Saskatchewan).

The follow up responses made it possible to check for evidence of strategic voting, as well as gain insight into the logic behind the respondents' decisions. This was important, as the problem of naysayers, or protest bids, is commonplace in stated preference studies. Those identified were removed from the data set prior to analysis. Such practice is commonplace in stated preference surveys, and widely accepted as the best way to deal with this source of bias (Jakobson and Dragun, 2001 among many).

Another bias source unique to hypothetical situations is yea-saying, or the "warm-glow" (Nunes and Schokkaert 2003, pg 231) effect. This occurs when respondents overestimate their WTP either to send a message, as in nay-saying, or for the emotional satisfaction of giving the (perceived) right answer. As the bias is likely to be exacerbated or even precipitated by someone observing a respondent's choice, ensuring anonymity is thought to decrease the effect. When NOAA's guidelines were published, in-person interviews were, for a variety of reasons, thought to be the optimal survey mechanism. Consequently, anonymity was probably compromised, and many respondents likely felt socially pressured to seem environmentally concerned. The other aspect, internal motivation, is more

difficult to manage. There is no way to entirely remove the motivation for yea-saying, however including "cheap talk" scripts in CV studies has been shown to reduce hypothetical bias (Cummings et al., 1999). Cheap talk scripts are explanations included in studies before the choice questions. They typically describe hypothetical bias, and remind respondents to treat the hypothetical scenarios as real. The CWD survey included this paragraph prior to the three choice questions:

> *Research has shown that survey respondents do not treat survey questions the same as they would if they were asked to vote in a real referendum. We call this hypothetical bias, and research has found that people typically say that they would pay up to 50% more than they actually would in a real transaction.*
>
> *It is very important that you "vote" as if this were a real referendum being posed by the Alberta government.*

Respondents were also reminded several times about the increase in tax they would bear should the program proceed. As in the case of nay-saying, follow up questions were included. These are shown in Table 3.2.

Table 3.2: A list of the follow-up questions respondents who voted yes to a proposed CWD control program were asked.

- I think the tax increase is a small amount to pay for the benefits received.
- I believe that we should eliminate CWD regardless of the cost.
- I feel it is the 'right' thing to do.
- It is important to invest in maintaining healthy, CWD-free elk and deer herds.
- The program is important but I don't really think that the program will cost me directly.
- I think that elk and/or deer are pests and should be eliminated with or without of CWD infection.
- CWD may become a human health risk.
- I believe that the government should limit the spread of CWD even if the disease cannot be eradicated.

Several of these follow-up questions allow one to check for evidence of yae-saying, and note or remove instances of it. Citing "I believe that we should eliminate CWD regardless of the cost" as a reason for voting yes suggests the respondent did not contemplate their own financial situation when voting, while giving the reason "The program is important but I don't really think that the program will cost me directly" implies the respondent is not voting as if it were an actual referendum. The measures undertaken while designing the CWD survey to counter potential sources of bias contribute to the robustness of the final results and study conclusions.

3.1.7 Bid Range Selection

An important aspect of CV involves the selection of appropriate bid values. As mentioned, an inadequate range may cause either floor or ceiling bias. The other extreme is also undesirable as Alberini and Carson (1993) demonstrate: an unnecessarily large range or overly large number of bid values result in inefficiency and the need for larger sample sizes. Clearly, careful balancing is required. As such, consultation and pre-testing are considered standard and important practices when constructing CV surveys (Arrow et al. 1993). Construction of this survey involved both focus groups and pilot tests. One of the central objectives of these was to establish an appropriate bid range. The focus groups provided comments on the bid range, while the pilot test results established what proportion of respondents said "no" at the lowest bid level and "yes" at the highest bid level. This reveals whether the values cover the complete WTP range.

3.2 Focus Group

Once a draft version of the survey was constructed, a focus group of 16 subjects was assembled to review the survey. Key objectives of this exercise were to ensure clarity of the survey, to check for information bias, and to establish that the bid range was appropriate. The survey was generally well received, with no

major problems identified. Several options for displaying CWD spread and prevalence levels were shown, and the maps used were selected as the clearest option. This was important, as one of the challenges when building this survey was the volume of information that needed to be conveyed to recipients.

In addition to the hypothetical situations themselves, the relatively low profile of the disease meant substantial background information needed to be included. While this was necessary to allow respondents to give meaningful and informed answers, care had to be taken not to bias such answers through the tone of information given. The focus group was asked about the issue, and confirmed the information given was seen as neutral. Participants were also quizzed on the bid range proposed ($10, $25, $75, $150). They felt it adequately captured their WTP values.

3.3 Pilot Tests

The two pilot tests were administered under contract by Leger Marketing, which maintains a Canada-wide panel of respondents. The company converted the CWD survey into an online version, and sent invitations for completion to randomly selected Alberta residents on the panel. 140 respondents completed the initial pilot survey between October 14th and October 20th 2008. No major flaws were detected in the survey with exception of the bid range. The highest value was found to be too low (Please see Chapter 4: Results for voting numbers at each bid level). As such, the range was adjusted to ($10, $25, $100, $250) before a second pilot test was run. The purpose of the second pilot was mainly to ensure the revised bid values were appropriate prior to the full scale survey being conducted. The second pilot was administered to 120 respondents between November 17th, 2008 and November 19th, 2008. The bid values were found to be reasonable, and the survey proceeded to full-scale implementation without alteration.

3.4 Survey Administration

The full survey was administered between December 1st, 2008 and December 28th, 2008. As with the two pilot surveys, it was performed by Leger Marketing with invitations sent randomly to Alberta residents on the company's internet panel. The demographic questions allowed for checking how representative the sample was of the Alberta population, as some concern regarding this existed due to the fact participation in the panel is voluntary. 1293 respondents from the internet panel completed the survey. An additional 130 respondents were recruited via telephone, and joined the internet panel to complete the survey. These respondents were rural residents residing in areas either currently infected by CWD, or thought to be at high risk of becoming so. Population densities are relatively low in those areas in contrast to other regions of the province, and this recruitment ensured sufficient representation.

One final issue should be noted. The NOAA panel strongly endorsed in-person interviews as the best option for survey administration. At the time the guidelines were written, the three chief survey options were in-person, by mail and by telephone. Technological advances and proliferation in the sixteen years since that time have meant other options now exist, most notably web-based surveys. Surveys administered through the internet have a number of downsides. A response bias towards computer literate individuals and technology owners is a concern. The potential for this bias has likely been decreasing as computer access and ownership become commonplace. A lack of consequentiality is an issue in any hypothetical survey, however the ease with which respondents can click through an internet based one may heighten the problem. That being said, the majority of advantages given by an in-person survey such as information and question order control, and incomplete notifications can be programmed into the internet survey. The possibility of interviewer bias is removed, as is one major yea-saying motivation. The flexibility and comparatively low cost of graphic presentations is another major benefit. These reasons, along with the fact that a

considerable majority of Canadian households have internet access (Canadian Internet Use Survey) made this the best option for the study survey.

3.5 Chapter Conclusion

This concludes the description of the CWD survey design. Screen captures of a full survey can be found in Appendix 1. Due to the random selection nature of the choice questions, 96 survey versions were possible. Maps showing the eight possible management scenario outcomes can be found in Appendix 2. The following chapter discusses results of the pilot tests and full survey, before moving into a discussion of data modeling and findings.

4.0 Results

The preceding two chapters provided background on the study issues, theoretical and methodological support for the approaches used, and a description of the design and implementation of the survey instrument. This chapter presents the findings of the survey and analysis. It begins with a discussion of sample representativeness and response rates, followed by results from the CWD attitude, knowledge and activity-related questions. Results from the referendum questions, including those found in pilots 1 and 2, follow. Finally, welfare changes in the form of willingness to pay values for CWD management programs calculated through econometric analysis of the referendum results are given. A summary of results concludes the chapter.

4.1 Sample Characteristics and Response Bias

4.1.1 Survey Sample and Population of Interest

A key quality of all survey-based studies is that the sample be representative of the population of interest. For this study's purposes the sample was intended to be representative of the Alberta population. Failure to meet this objective could result in sample bias, and potentially erroneous results and conclusions. Policies and actions such as those associated with CWD management will have varying effects on population groups. Under- or over-representation of a group may have consequences for a study's results and conclusions. The representative objective may fail for several reasons, among them non-random sampling and non-responses. In the case of this study, a lack of appropriate representation may result in skewed attitude and perception results and incorrect welfare measures. As such, efforts were taken to ensure appropriate sampling techniques, and data collection was designed to allow for later comparison of the sample and the general Alberta population.

Demographic question responses for respondents from the regular sample were compared to those reported for Alberta in the 2006 Canada Census. The

responses of those recruited via telephone for oversampling of the affected areas were not included. Response rates, as well as responses to four questions administered to many of those who declined to respond to the full survey, were used to check for evidence of non-response bias. Two populations formed the focus of this study: the first was the general Alberta population, the second those living in the rural, CWD-affected areas. A comparison of the survey sample demographics and Alberta population demographics can be seen in Appendix 6. Survey respondents tended to fall within the 45-54 and 55-64 age categories more frequently than Alberta residents. 5% fewer fell in the 64+ category, and nearly 7% fewer fell in the youngest category. Survey respondents were slightly more likely to be female, and more likely to have some form of post-secondary education. Alberta residents were 11% more likely to have children than survey respondents. Responses to household income enquiries suggest survey respondents tended to have higher incomes, and that the lower income brackets are underrepresented. 16.7% did not provide income information, preventing a full comparison.

4.1.2 Response Rates

As discussed in Chapter 3, the survey was administered by the market research company Leger Marketing. Leger maintains a panel of Alberta respondents who have previously indicated their willingness to participate in research studies. For the two pilot studies as well as the full survey, the company e-mailed invitations to randomly selected members of their Alberta panel inviting them to complete the survey. Due to our specific interest in the affected rural areas, Leger recruited additional respondents from those areas into the panel which allowed them to be oversampled. Respondents recruited in this manner are labeled Regional Sub Sample for the purposes of this study. For the full survey the response rate of 56.96% to the e-mail invitations was comparable to those of

the pilot studies[5]. Of those recruited into the panel by telephone, 9.9%[6] completed the survey. It should be noted that respondents recruited via telephone for oversampling were not included in the sample analysed for general population results to ensure that the sample was representative of Albertans as a whole. The sample recruited through the internet panel representative of the Alberta population is referred to as Full Survey. The responses of those recruited via telephone were combined with responses from those in the Full Survey residing in the affected areas. This combined sample is referred to as Affected Area.

In order to check for self-selection or non-response bias, individuals contacted by telephone who declined to complete the survey were asked to answer four short questions. A large number agreed to do so. Respondents recruited by internet saw the same four questions initially, prior to an introduction to the survey. Again the intent was to reveal any differences between those who chose to complete the survey and those who declined, however very few individuals who responded to the e-mail invitation by clicking on the survey link chose to answer just the first four questions. Results from the telephone recruitment questions show few major difference between respondents and non-respondents (see Appendix 6). Those who answered the survey from the targeted area were slightly more likely to belong to a wildlife or conservation related organization, be or have a family member who is a hunter, and to have eaten elk or deer meat. Comparable proportions had eaten elk or deer meat within the past year. None of the

[5] For each of the pilot studies, 100 completed surveys were requested. Respondents were randomly invited and recruited via e-mail. 200 e-mail invitations were sent out for each pilot study. 140 surveys were completed for a response rate of 70% for Pilot 1. 120 of the Pilot 2 surveys were completed for a response rate of 60%.

[6] There are several likely reasons for this. Firstly, respondents contacted directly via e-mail had previously indicated their interest in participating in surveys. Secondly, the telephone recruitment was more complicated than the e-mail recruitment. After indicating their agreement to complete the survey, individuals recruited by telephone had to provide their e-mail address and were then sent an e-mail with the survey link. The additional steps provided a greater number of chances for respondents to drop out of the process. As well, the online nature of the survey required individuals to have access to an e-mail address and computer with internet access. While not unreasonable given 73.2% of Canadians have internet access, (Statistics Canada Cansim Database Table 358-0126 (2007)), those in rural areas are the least likely to have such access which may have been a factor.

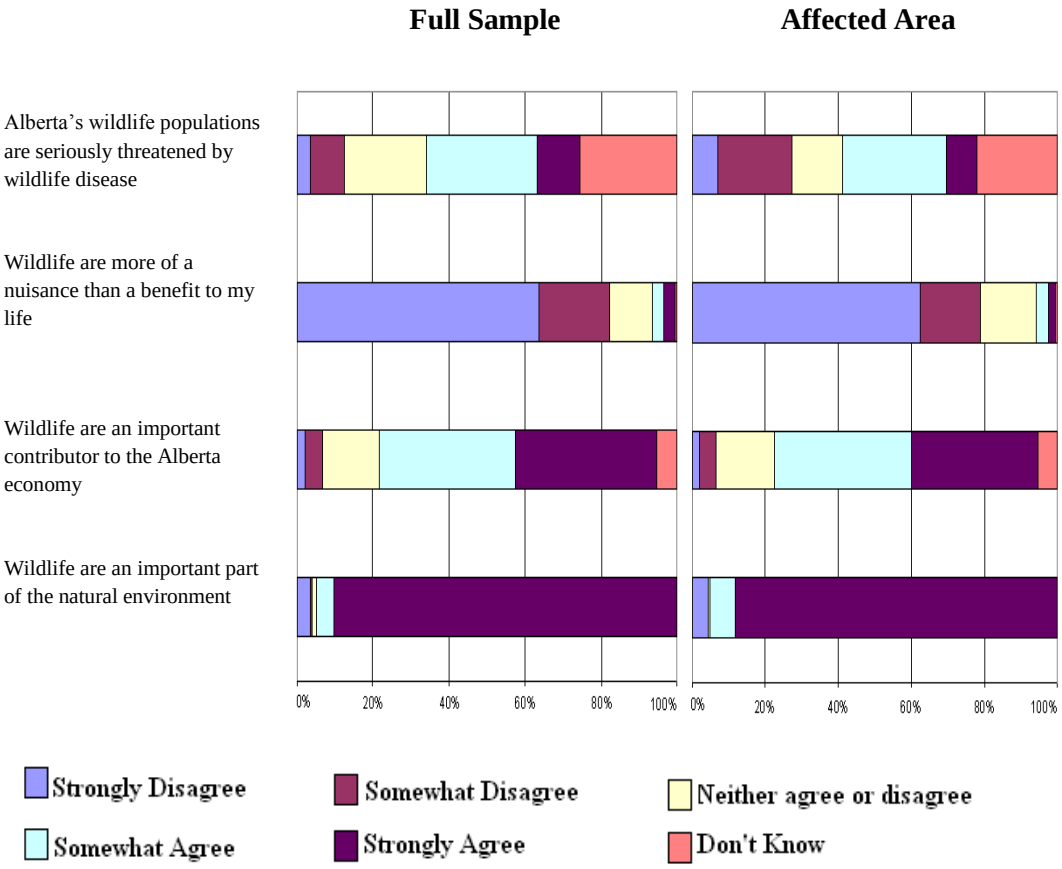
differences were large enough to suggest systematic response bias based on these observable factors. It is possible, of course, that other unobserved factors generated forms of response bias that we cannot account for.

4.2 Perceptions of wildlife, elk and deer in Alberta

One of the central research topics of this study was to identify the level of public concern associated with CWD. Closely related to these levels are public perceptions of wildlife in general, and cervid populations in particular. The survey included general questions regarding wildlife and its role in Alberta and the natural environment. The data collected from these questions were analysed using descriptive statistics in SPSS.

The responses to the questions revealed that most Albertans have a strong affinity for wildlife, and view its role in the environment as highly important. Many also view wildlife as having an important role in the province's economy, while mixed perceptions exist around the level of threat the disease poses to wildlife populations. Statistical testing found responses from rural residents were not significantly different to those of the provincial sample (Figure 4.1).

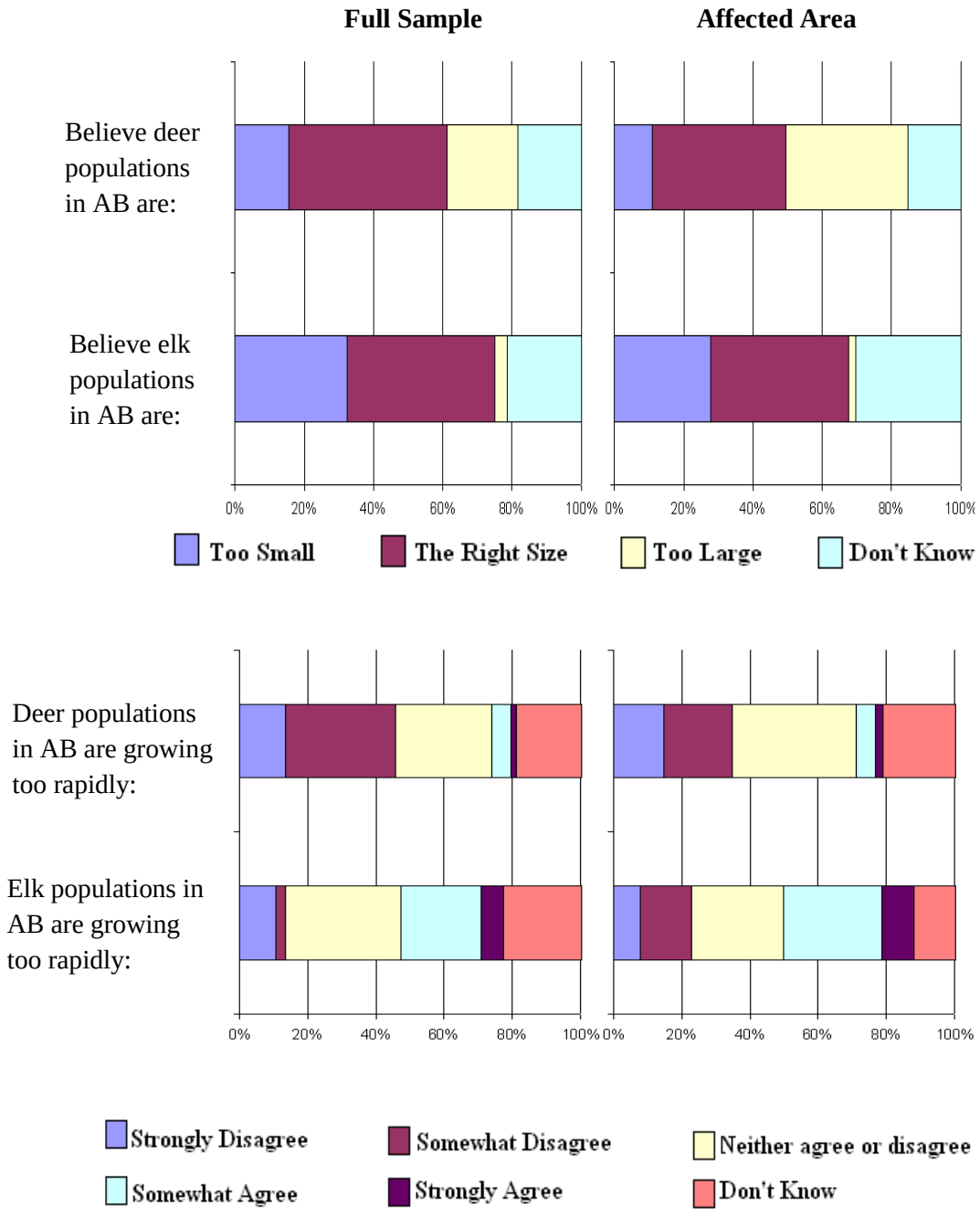
Figure 4.1: Respondent Perceptions of Wildlife in Alberta



The mixed beliefs of threat levels are likely indicative of a lack of common knowledge surrounding wildlife disease. Of the four general wildlife questions the question "How strongly do you agree with the statement Alberta's wildlife populations are seriously threatened by wildlife disease" received the largest proportion of "Don't Know" responses - over a quarter of respondents selected that option. As wildlife disease is rarely a high profile topic, media coverage is not extensive (with the notable exception of some coverage of CWD). Thus, the lack of knowledge indicated is not surprising. The strong positive support for wildlife in the province is directly relevant to risk perceptions and importance of CWD issues in Alberta. The levels of public support for wildlife and the environment reflected in these questions suggest high values for the removal of threats to them.

The survey sought respondents' opinions on the size of existing deer and elk populations, as well as the growth rates of those populations in the province. These opinions could be expected to have an effect on both the support of CWD management and the valuation of control programs involving culling. Few respondents indicated that elk populations were too large (Figure 4.2), while opinions on the size of deer populations were more mixed.

Figure 4.2: Respondent Perceptions of Elk and Deer Populations in Alberta



CWD-affected residents were slightly less likely than the full Alberta population to call elk populations too large, but nearly 15% more said that of deer

populations. High proportions of "Don't Know" responses were recorded for the two questions amongst both the affected respondents and the full sample.

Results from the wildlife, elk and deer questions indicate that Albertans are concerned about wildlife populations and the environment, but unsure of how large a role elk or deer play in them. Nearly all respondents believed elk populations to be too small or the right size, while a segment thought deer populations to be too large. The eight questions were posed prior to the provision of much of the CWD and cervid background information given in the survey, so that the findings were not influenced by this information.

A large proportion of Albertans were uncertain if either elk or deer populations are growing too rapidly, while those that expressed opinions do not offer a clear consensus (Figure 4.2). One cannot tell from the responses why individuals answered the way they did. A multitude of possible reasons exist, among them personal preference for or against either species, concerns about ecological balance and concern regarding possible impacts of overly large or small cervid populations. Large cervid populations have both benefits and costs which respondents were reminded of in the survey. Perhaps tellingly, respondents in rural areas from both the full and recruited sub samples, who could be expected to bear the brunt of any negative consequences of large populations were more inclined to indicate that deer populations were too large, and growing too rapidly. Rural respondents' collective opinion on elk population growth was more aligned with the province as a whole. Visible in Figure 4.2 are variable perceptions regarding the growth of elk and deer populations in Alberta.

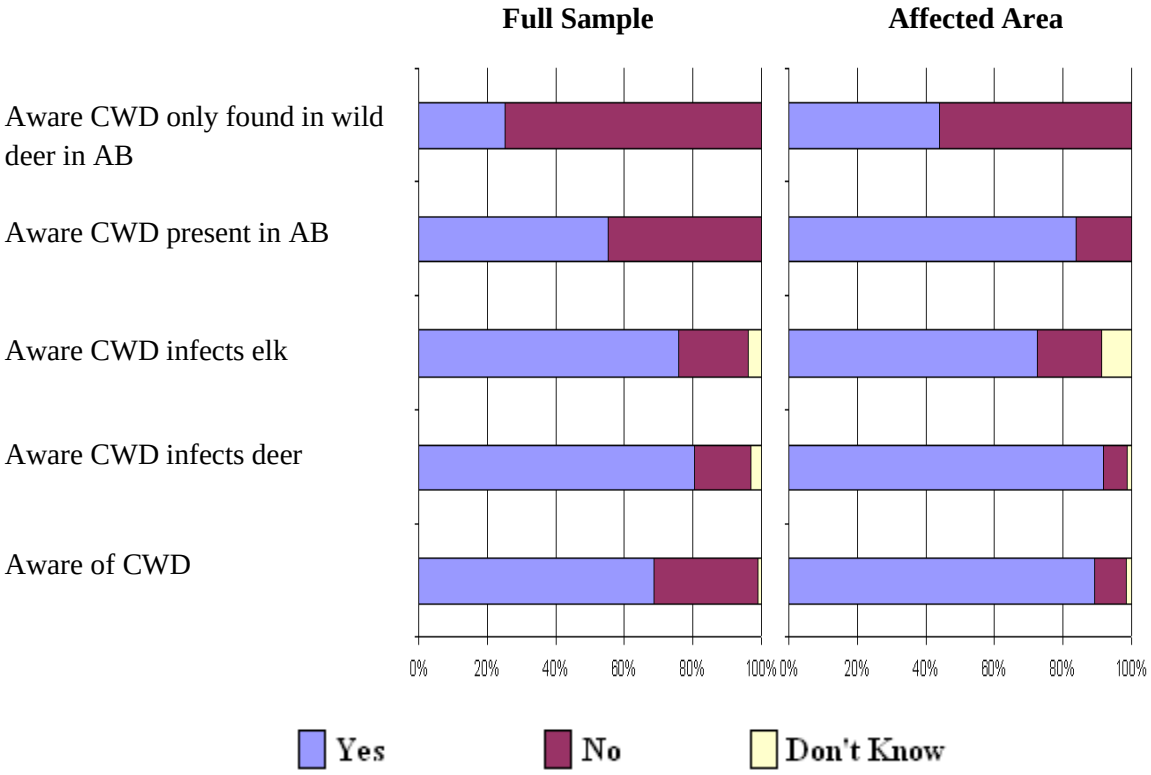
4.3 CWD Awareness and Perceptions

4.3.1 Prior Knowledge

CWD appears to have received a notable amount of media coverage in Alberta for a wildlife disease. Its unexpected appearance in the Canadian prairies, coupled with a relatively quick spread and controversy around control measures

fueled this coverage. 70.4% of respondents stated that they were aware of CWD, while of those 81.7% and 75.4% knew it infects deer and elk respectively (Figure 4.3). For the affected area respondents, those percentages were 89.2%, 91.8% and 72.5%. Given their proximity to the disease and infected deer populations, as well as the control effort controversy, a divergence in affected and full population knowledge is not unexpected.

Figure 4.3: Respondent Knowledge of Chronic Wasting Disease



The gap was even greater in regards to Alberta-specific information. While 83.8% of affected area respondents knew CWD was found in the province, and 44.1% were aware it is found only in wild deer presently, those percentages were lower for the full population sample at 57.8% and 26.5%.

Both populations recorded high proportions of respondents stating they had heard of CWD. It is clear the majority of respondents had been previously

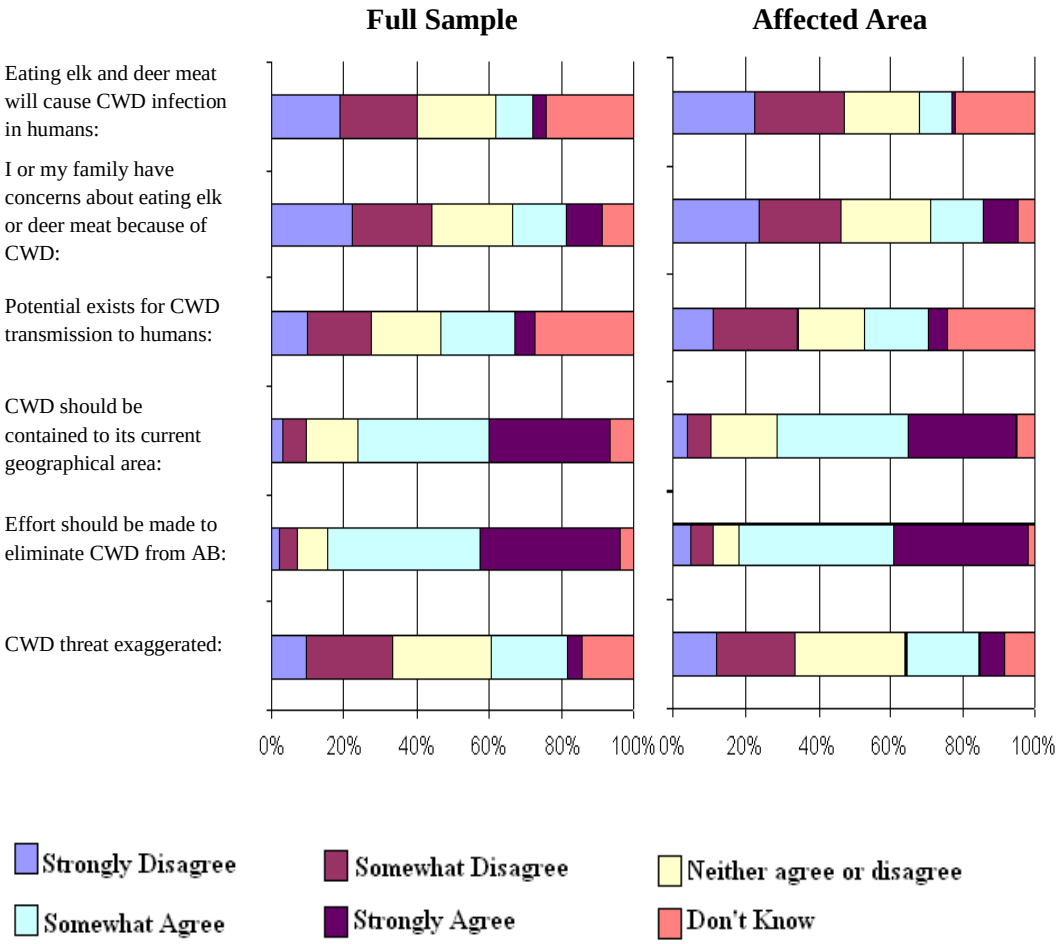
exposed to information on the disease previously. Those who self reported awareness of it may have had preconceived opinions prior to reading background material included in the survey to provide context for the referendum choice questions. In spite of this, knowledge on the specifics of the CWD situation in Alberta is not high. Just 26% of respondents knew that CWD was only present in wild deer in Alberta. This suggests that the majority of Albertans have limited pre-existing knowledge of CWD and its effects on cervids.

4.3.2 Perceptions of CWD Risks

The findings from this study indicate Albertans' risk perceptions of CWD are quite varied. Respondents were asked to rank their agreement on six statements pertaining to CWD risk on a 5 point Likert scale ranging from "Strongly Agree" to "Strongly Disagree". "Don't Know" was also an option.

There is no clear consensus on whether the threat of CWD has been exaggerated, however the largest proportion of responses were "Neither agree nor disagree" to a statement on that point (Figure 4.4). 72.1% of respondents fell within the "Somewhat Agree" to "Somewhat Disagree" range. This suggests residents believe that government and/or scientists' position and statements on the issues are mostly credible. The pattern of responses was comparable to those of respondents in the affected areas.

Figure 4.4: Respondent Perceptions of CWD Risk



Uncertainty similarly exists on the direct threat CWD poses to humans, and the potential of CWD to transfer to humans. The majority (57.4%) of respondents responded "Somewhat Agree" to "Somewhat Disagree", with nearly 30% indicating the "Don't Know" response. This uncertainty on the transfer potential could be a reaction to the mixed messages being received or a reflection of the depth of knowledge. While Health Canada states there have been no cases of prion disease in humans caused by CWD, the World Health Organization strongly recommends against consuming the meat of any animals suspected to be suffering from a prion disease. Once again, the pattern of affected area responses closely matched the full provincial sample (Figure 4.4).

In order to account for existing misperceptions surrounding the disease, respondents were asked if they thought consuming elk or deer would cause CWD in humans. While less than 15% agreed with the statement, 45.9% neither agreed nor disagreed or didn't know. Those numbers were slightly lower for respondents living in affected areas (Figure 4.4). These responses may indicate a lack of CWD information, or a mistrust of the information being disseminated by government and scientific organizations. It is possible Albertans were recalling the early confusion around BSE in the United Kingdom, when consumers were widely assured it was not a human health risk[7].

Despite their uncertainty around transfer potential, most Albertans (urban and rural) do not have concerns about themselves or their families consuming elk or deer meat (Figure 4.4), suggesting they do not expect to be at risk due to consuming infected animals. It is unclear whether this is due to utilization of and confidence in the government's testing program, or belief that the probability of coming in contact with an infected animal is trivial. 85% of Albertans have eaten elk or deer meat previously, with nearly 30% having consumed it in the past year. In rural areas about 95% of respondents have eaten at least one of the two, and nearly 50% have done so within the past year.

Regardless of their beliefs around transmission potential, a considerable majority of Albertans feel that government action is in order to deal with the disease (Figure 4.4). 69% of respondents indicated CWD should be contained to its current geographic area, while 80.6% think that effort should be undertaken to eliminate it from Alberta. A question posed after respondents had been given more background information on the disease as well as possible control measures found barely 10% of respondents thought taking no action to control CWD to be acceptable. This suggests Albertans are averse to either or both the known risks the disease poses to cervid populations and the environment, or the unknown risk it may pose to human health. Desire for government action was slightly lower in

[7] BBC News, 26 October, 2000. "Ministers 'misled' public on BSE".

the regional sub-sample, suggesting that for some Albertans the benefits of controlling the disease do not surpass the negative impacts of existing control efforts.

Albertans are unsure about what the presence of CWD in the province means for them. This same uncertainty surrounds scientific efforts to manage the disease. In the face of such uncertainty a considerable majority believes that the government should err on the side of caution, and undertake efforts to reduce the risk posed by the disease by controlling and/or eliminating it in the province. Although elimination of CWD from Alberta received stronger support than containing it to its current geographic area, respondents had not been informed at that point of the survey that total elimination may not be possible as the disease is already present in herds and the soil (Schramm et al. 2006). More respondents, particularly those in uninfected areas, may have supported containment had this been known. Responses to the referendum questions discussed below revisit this possibility.

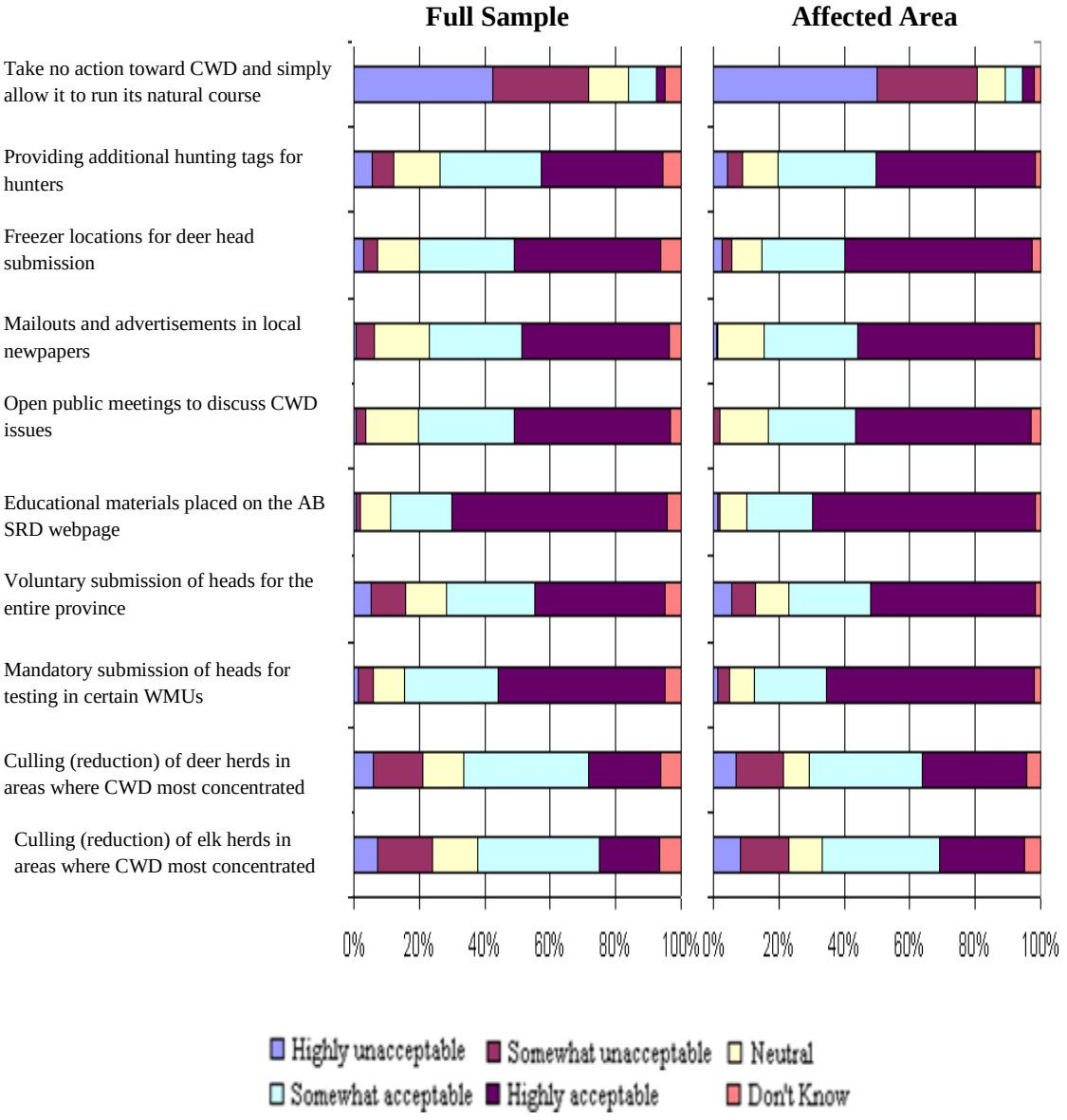
4.3.3 Support for CWD Management Actions

Much of the controversy surrounding CWD in Alberta has centered on the management actions undertaken. As discussed in Chapter 1, options for controlling and containing the disease are extremely limited. There is no cure or vaccine for it, and the principal control option is herd reduction in infected areas. Understanding which management efforts Albertans find acceptable is important both for assessing the viability of future management efforts as well as the valuation of potential programs. The NOAA panel emphasized the importance of accurate program descriptions, as the valuation of an environmental program can reasonably be expected to be impacted by the types of actions undertaken (Arrow et al., 1993).

Proposed management actions received largely positive responses (Figure 4.5). Even for the two most arguably controversial control measures, the culling of elk and deer herds in infected areas, just 24% and 21.4% of respondents

respectively indicated they found the measures to be unacceptable. The proportions of regional sub sample responses indicating unacceptability were very close at 23% and 21.6%.

Figure 4.5: Acceptability of Present or Proposed CWD Control Measures to Respondents



Of the seven other management activities respondents were presented with, only two were found unacceptable by more than 10% of respondents (Figure 4.5). 12.1% of respondents did not think hunters who voluntarily submit their

animal heads for testing should be given additional tags in affected WMUs. Based on comments made on the survey, in many cases this was likely due to philosophical objections regarding hunting and hunting practices (see Appendix 4 for full comments list). 15.6% of respondents thought it unacceptable for there to be voluntary submissions of animal heads throughout the province. It is unclear if some found this objectionable due to the voluntary nature or concerns over costs of such a program. 7.5% of respondents found freezer locations for deer head submission unacceptable suggesting a cost concern amongst at least some of the objectors. Mandatory submissions of animal heads in certain WMUs received near unanimous support, with just 5.8% of respondents indicating objection to the measure.

The remaining CWD control measures presented were educational in nature, including placing information on the Alberta Sustainable Resource Development website, holding open public meetings to discuss CWD and conducting mail-outs and placing advertisements in local newspapers. Support for these three was strong. The proportions of respondents finding the measures unacceptable were 2%, 3.5% and 6% respectively. This suggests Albertans want to be informed on CWD, as well as on issues and developments associated with it.

Not only was support for the population reduction measures slightly higher amongst the rural respondents, all management measures presented received larger support with fewer unacceptable and “Don’t Know” responses (Figure 4.5). This indicates that despite bearing most of the impacts of management measures, the majority of regional sub-sample respondents are concerned and want CWD controlled.

The strong levels of support for the management measures suggest that the majority of Albertans will support a well planned and communicated management program. Barely 10% find taking no action and allowing CWD to run its natural course acceptable, indicating Albertans expect their government to act. These findings contradict the impression portrayed in the media of widespread public

opposition to disease control efforts (i.e. Miskosky, 2007). They also are in opposition with the Alberta government's decision to halt the culling side of control efforts in December 2008, and limit management efforts to surveillance and education. The results show that when Albertans are presented with a clear background description of CWD and an overview of related issues more than half will support even unpalatable measures in order to contain the disease.

Both qualitative and quantitative survey responses revealed widespread concern about CWD, and widespread support of control programs directed at it. This suggests many may not support the government's decision to halt culling, which is arguably the core of the control effort. A strong sentiment of erring on the side of caution emerged.

4.4 Referendum Question Results

4.4.1 Scenario Frequency

Combining the usable surveys from Pilot 2 and the provincial sample yielded a sample size of 1391. Each respondent answered 3 randomly selected referendum CV questions, in which they voted on whether to support a management program that resulted in one of 8 possible outcomes but required a tax increase in the amount of one of the four bid values. The tax increase would be in place for 10 years. If they opted not to support the management program no tax increase occurred, but disease levels in the province were projected to be high spread - high prevalence 10 years hence.

Both program outcome and tax increase were selected at random for each of the three questions respondents answered, giving 36 possible scenarios. The sole deviation from complete randomness was that the survey was programmed such that respondents would not see the same program outcome more than once. The nature of the design meant there was some discrepancy in the number of times each scenario was presented; the range was 94 to 209. This was a

surprisingly large range, however 75% of the scenarios were presented between 113 and 180 times.

4.4.2 Referendum Results

The responses to the referendum questions revealed strong support for a CWD management program in the province. One can see from the probability of yes votes presented in Table 4.1 the majority of respondents were willing to bear tax increases to achieve the better disease outcomes presented.

Table 4.1: CWD control program referendum results by scenario, with yes vote probabilities

Low Spread - Low Prevalence					**Medium Spread - Medium Prevalence**				
	$10	**$25**	**$100**	**$250**		**$10**	**$25**	**$100**	**$250**
Yes	107	87	81	38	**Yes**	92	70	51	39
No	26	30	56	66	**No**	34	43	70	95
Total:	133	117	137	104	**Total**	126	113	121	134
P(Yes)	0.805	0.744	0.591	0.365	**P(Yes)**	0.73	0.619	0.421	0.291
Low Spread - Medium Prevalence					**Medium Spread - High Prevalence**				
	$10	**$25**	**$100**	**$250**		**$10**	**$25**	**$100**	**$250**
Yes	95	103	40	41	**Yes**	98	64	39	32
No	23	29	58	79	**No**	19	49	76	90
Total	118	132	98	120	**Total**	117	113	115	122
P(Yes)	0.805	0.78	0.408	0.342	**P(Yes)**	0.838	0.566	0.339	0.262

Low Spread - High Prevalence					High Spread - Low Prevalence				
	$10	**$25**	**$100**	**$250**		**$10**	**$25**	**$100**	**$250**
Yes	99	81	52	40	**Yes**	127	112	77	65
No	13	34	42	94	**No**	38	38	90	118
Total	122	115	94	134	**Total**	165	150	167	183
P(Yes)	0.811	0.704	0.553	0.299	**P(Yes)**	0.77	0.747	0.461	0.355
Medium Spread - Low Prevalence					**High Spread - Medium Prevalence**				
	$10	**$25**	**$100**	**$250**		**$10**	**$25**	**$100**	**$250**
Yes	102	72	53	34	**Yes**	133	109	79	47
No	17	45	65	75	**No**	49	71	109	162
Total	119	117	118	109	**Total**	182	180	188	209
P(Yes)	0.857	0.615	0.449	0.312	**P(Yes)**	0.731	0.606	0.42	0.225

All referendum questions were followed immediately by a certainty question, asking if respondents were: 'Very Certain', 'Somewhat Certain', 'Somewhat Uncertain' or 'Very Uncertain' that they would make the same decision in an actual referendum. In addition to revealing potential cases of hypothetical bias, the uncertainty scores may give a wider view of how seriously respondents took the referendum questions. The uncertainty responses were given a scale of 1 through 4, with 1 being the least certain and 4 the most. The mean certainty score for all referendum CV questions was 3.342, while mean scores for the 36 scenarios ranged from 3.288 to 3.609. These mean scores are quite high, suggesting most respondents were confident in their decisions. Some individual scores suggest a number of respondents cannot guarantee that they would give the same answers in a real life situation. The referendum results reported and used for WTP estimation reflect those of the Full Sample, and not those recruited via telephone for oversampling of the affected areas.

4.4.3 Reasons for Respondent Choices

After completing the referendum questions, respondents were asked for their reasoning behind the choices they made. As one would expect, most respondents identified CWD spread and prevalence levels, as well as annual tax changes as important factors in their decisions. Many also indicated that uncertainty about what is being done for CWD in other provinces was at least somewhat of a factor.

For those respondents who voted "no" to at least one of their three referendum questions, more than a quarter reported their most important reason for voting this way was that CWD poses no health threat to humans. Another 24% reported their most important reason to be insufficient information. Just 1% voted "no" because they thought the management program too extreme, while less than 4% chose opposition to hunting as their most important reason. 42% of respondents voting "no" indicated that the tax increase played at least some part in their negative decision.

Of the respondents who voted "yes" to at least one of the referendum questions, nearly a third indicated the most important reason behind their vote was the importance of investing in CWD-free herds. More than 22% cited belief that the tax increase was small for the benefits received as the strongest reason. Of all yes-voting respondents, 35% felt the possibility of CWD becoming a human health risk played some role in their decision, while nearly 50% indicated their belief that government should limit the spread of CWD played a part in their choice of vote.

4.5 Welfare Changes: Willingness to Pay Values

Three model types were applied to the problem of estimating the welfare changes associated with the proposed CWD management programs: a conditional logit model with two alternatives, a latent class model and a random parameters logit model. A detailed reasoning behind their selection is given in Chapter 2.

4.5.1 Model 1: Conditional Logit Model

The conditional logit model (CL) with two alternatives uses a logistic regression to estimate the probability of any given respondent voting yes for a program based on program attributes and respondent characteristics. The model assumes a logistic cumulative distribution function. A model with only CWD management program attributes as the explanatory variables would provide coefficient estimates of those attributes and by extension WTP estimates for the general Alberta population. While mean WTP values for the province are not unimportant, differences in WTP values amongst varying socio-demographic groups within the province are also of interest to this study.

4.5.1.1 Model Specification

In an attempt to account for heterogeneity in voting choices, numerous demographic factors were incorporated into the model as interaction terms. The interaction term attempts included: age, New Ecological Paradigm score[8], years of schooling, number of children, household income, if the person had hunted in the past two years, if the person was previously aware of CWD, if the person lived in an urban or rural setting, and if he or she lived in an area affected by CWD under high spread conditions, but unaffected under the alternative outcome presented. All were interacted with an alternative-specific constant, equal to 1 if no management program was implemented, resulting in a high spread-high prevalence outcome. The intent of this was to reveal if belonging to a given demographic group was a significant predictor of choice: for example if a higher education was correlated with an increased probability of a yes vote. Most of the interaction terms were found to be statistically insignificant, while others did not have a sufficient number of instances to permit model estimation.

[8] See Appendix 3 for explanation

The exceptions to this were gender, age and scaled income. Each of these interaction terms were found to be highly statistically significant (Table 4.2). An alternative-specific constant was created when the choice question data was put into panel form. It is equal to one for the worst-case projected outcome (high spread-high prevalence), the choice with no management program but also no cost, and equal to zero for the alternative outcome presented with some management program but also a positive cost. The alternative-specific constant was found to be highly significant. Parameter estimates on all significant program outcomes were negative as they were compared to the low prevalence – low spread case. The interaction terms age*constant and income*constant parameter estimates were negative indicating respondents' probability of voting yes increased in age and income. The interaction term male*constant was positive, indicating respondents' probability of voting yes decreased if they were male. Income was divided by 1000 to provide for ease of interpretation of parameter estimates. The final conditional logit model with two alternatives included all management program attributes in the form of outcomes, as well as age, scaled income and gender-constant interaction terms. Outcome parameters found to be significant were low spread – medium prevalence, medium spread – high prevalence and high spread – high prevalence. The outcome low spread – low prevalence was left out and so the model parameters for all other outcomes reflect the respondents' probability of voting yes to the other outcome as opposed to the low-spread – low prevalence outcome. All significant program outcome parameters were negative as expected, as one would expect the probability of voting yes to a program to decline as the outcome gets worse.

Table 4.2: Conditional logit model of CWD control program referendum results	
Dependent Variable: Probability of a Yes vote	
Constant	-0.6770***
	(-0.1793)
Cost	-0.008***
	(-0.0004)
Low Spread - Med Prevalence	-0.4565***
	(-0.1422)
Low Spread - High Prevalence	0.0743
	(-0.145)
Med Spread - Low Prevalence	-0.0639
	(-0.1241)
Med Spread - Med Prevalence	-0.1179
	(-0.1182)
Med Spread - High Prevalence	-0.4891***
	(-0.1433)
High Spread - Low Prevalence	0.0042
	(-0.1211)
High Spread - Med Prevalence	-0.3657***
	(-0.1144)
Age*Constant	-0.0093***
	(-0.0028)
Income*Constant	-0.0018**
	(-0.0008251)
Male*Constant	0.2459***
	(0.0754)
Rho-squared	0.1041
Log-Likelihood	-2148.8
AIC	1.2429
BIC	1.2641
*Statistically significant at the 90% level	
**Statistically significant at the 95% level	
***Statistically significant at the 99% level	

4.5.1.2 Conditional Logit WTP Estimates

The calculations described in equation 2.3 were performed on the data and yielded the WTP estimates presented in Table 4.3. A value of $121.35 to avoid a high spread – high prevalence outcome and instead achieve a low spread – low prevalence outcome (for a 47 year old male with an income of $57,000) reflects Albertans' economic value associated with the control of the disease. Of concern is the fact that WTP values were significantly different for just 3 other outcome

levels (Table 4.3). There could be several reasons for this, including the possibility that respondents did not strongly differentiate between the shift from the worst case scenario to the best, and the shift from the other less than maximum reduction levels to low spread and prevalence. The lack of significance may also reflect variation in the number of times scenarios appeared in the survey, as shown in Table 4.1. The coefficient on the male interaction term indicates that the mean WTP to achieve any outcome other than high spread-high prevalence is $30.76 less for males. This is consistent with results often reported in the literature that males tend to be less risk averse than females (Jacobsen et al., 2007, Borghans et al., 2009) Mean WTP increases in both age and income. For each additional year of age, WTP rises.

Table 4.3: CWD Control Program Outcome[**] and Individual Characteristic WTP estimates with standard errors[***]

	WTP	Std errors from Wald tests[†]:
Low Spread - Low Prevalence	$121.35*	21.74
Low Spread - Med Prevalence	$64.29*	17.17
Med Spread - High Prevalence	$60.21*	17.86
High Spread - Med Prevalence	$63.14*	14.32

* Significant at the 1% level

[**] Program outcomes found to be significantly different from Low Spread - Low Prevalence outcome included

[***] Program outcome WTP estimates calculated with average sample age (47) and average sample income ($57,000)

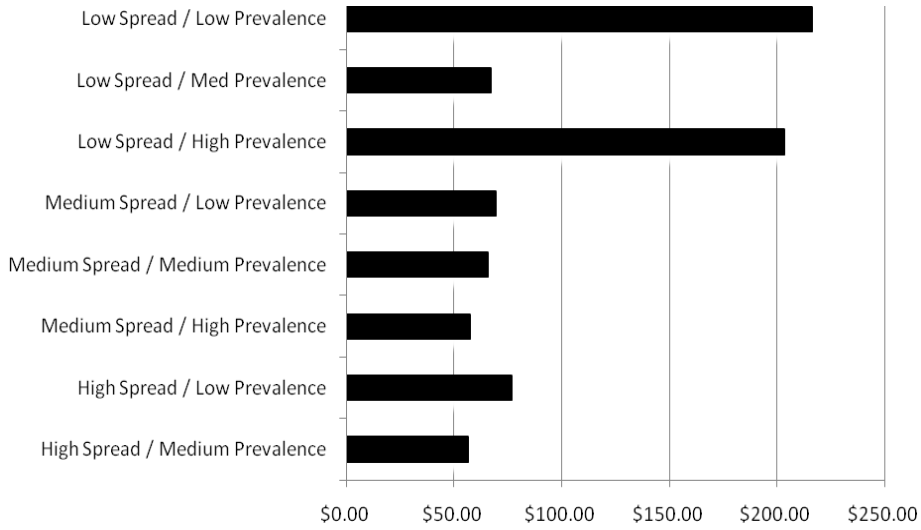
[†] Krinsky-Robb method produced comparable results

To try to understand the partially disjointed pattern reflected in the WTP values and significance levels of outcomes in the first model, and to allow for an examination of scope effects, separate binary logit models were estimated for each of the eight outcome scenarios on the first choice responses. This was done by splitting the sample by choice order and outcome scenario. Program cost was left as the sole explanatory variable. By limiting the data set to the initial choice question the possibility that respondents were influenced by previous questions, and consciously or unconsciously failed to consider the choice scenarios

separately, is removed. WTP for each outcome relative to a high spread – high prevalence outcome can then be calculated in a similar fashion as for the conditional logit model.

Results from this approach revealed greater variation in WTP values for the differing program outcomes (Figure 4.6). Low spread – low prevalence is clearly preferred with the greatest WTP value, while as expected high spread – medium prevalence has the lowest. With a few exceptions, values decrease with increasing spread and prevalence levels. A notable exception to this is the value found for a low spread – medium prevalence outcome, which is markedly lower than both the low spread – low prevalence and low spread – high prevalence values. While the reason for this is not certain, it is likely related to the random nature of the choice questions. It appears that overall the respondents who saw the outcome simply happened to be less supportive of CWD control efforts than those who saw alternative outcomes. Specifically, the lower value stems from a higher proportion of no votes at the $100 bid level than the outcome low spread – high prevalence received. While low spread – medium prevalence received a slightly higher proportion of yes votes at the highest bid level, it was insufficient to increase the WTP value largely. These results indicate that, overall, respondents were sensitive to scope. As discussed in Chapter 2, the scope test is considered an important indicator of whether respondents appropriately consider the public good to be provided, in this study CWD containment. The increasing WTP in increasing disease control suggest this to be the case. Detailed model results are given in Appendix 7.

Figure 4.6: Household annual WTP values by CWD control program outcome estimated from respondents' first choice question to check for scope effects



In spite of the mild aberrations, results from the individual contingent valuation regressions show respondents' support for a CWD management program. The positive WTP value at even the worst alternative to high spread – high prevalence suggests, as did results from the first model show that respondents want something done and are willing to pay for it. The relatively high values for 2 of the 3 low spread outcomes may reflect a deep disutility from one's own area being afflicted, and a belief that once CWD is interned in the soil it cannot be eradicated.

The conditional and binary logit regressions provided important valuation information, but limited insight into how individuals and subsets in the Alberta population are affected. To further examine heterogeneity observed in the choices, a latent class model was next applied to the data.

4.5.2 Latent Class Results

It was expected that in a diverse population such as that of Alberta, socio-demographic groups with similar voting preferences would emerge. Should this be the case, defining the groups as well as separate welfare measures lends

credibility to the estimates and allows for assessing impacts on each group separately. The latent class model is well suited for such analysis as it specifies that the data distribution observed is made up of a finite number of underlying preference classes (please see Chapter 2 for full discussion).

4.5.2.1 Model Specification

Model specification with latent class analysis required a number of additional steps not necessary with the conditional logit regression. In addition to determining the behavioral model to use, it was necessary to ascertain which individual-specific variables should be included for the purposes of latent class formulation, as well as the appropriate number of classes. The number of classes determines the number of underlying distributions to be estimated, while the individual-specific variables specified are intended to account for heterogeneity of choices.

Several choice probability models were considered, including the initial conditional logit model. A conditional logit model with two alternatives with choice as the dependent variable and with constant and cost as parameters was ultimately selected as the base behavioral model. It can be interpreted as the probability of voting yes for any management program which results in an outcome other than high spread – high prevalence. WTP estimates represent the value placed on such a management program. The latent class model presented was chosen due to a combination of factors, including AIC and BIC values, the significance of the model parameters and the significance of the individual-specific variables within the class probabilities.

Two classes with the chosen logit regression were found to be most appropriate. AIC and BIC values were found to be 1.09851 and 1.11066 respectively, while for the one class model they were 1.25182 and 1.25486. A three class model was rejected due to the log likelihood being flat, illustrating that the data would not support three separate preference classes. Numerous individual characteristics sourced from the demographic, attitudinal and activity questions

were tested as predictors of class membership. Most were rejected due to a lack of significance within the class membership probabilities, or model failure due to a lack of variation within the data set. In the end, a person's gender, income (scaled), and whether or not they had hunted in the past two year were selected for inclusion. Results from the model including coefficient estimates for each classes' conditional logit regression and class membership probabilities, along with WTP estimates for each of the three classes, is shown in Table 4.4.

Table 4.4: Latent Class Model Results of CWD Control Program Referendum Questions With Class WTP Estimates

Number of Observations		4173	
Log likelihood at convergence		-2284.048	
Rho Squared		0.12319	
Class 1 (0.478 membership)		**Class 2 (base) (0.522 membership)**	
Constant	-0.668***	Constant	-2.67***
	(0.127)		(.0844)
Cost	-0.0406***	Cost	-0.00976***
	(.00602)		(0.000424)
Classification Function			
Constant	-0.222**	Constant	-
	(0.108)		-
Male	0.276**	Male	-
	(0.120)		-
Hunter	-0.472**	Hunter	-
	(0.203)		-
Scaled Income	-0.000356	Scaled Income	-
	(0.000174)		-
WTP:	$16.45	WTP:	$273.48

* Statistically significant at the 90% level

**Statistically significant at the 95% level

***Statistically significant at the 99% level

4.5.2.2 Latent Class Model Results

Latent class analysis revealed two groups of Albertans with distinctly different welfare measures for containing CWD. *Class 1*, with 48.4% of respondents, had a WTP of $16.45. *Class 2*, the base class with 51.6% of respondents, had a WTP of $268.01.

Class 1 class members were more likely to be male, and to have lower incomes. They were less likely to be hunters. These results support those found in Model 1, with gender affecting mean WTP. Although too few respondents identified as hunters to allow for the inclusion of the variable's interaction term in the conditional logit, the indication of its importance found through latent class analysis is not unexpected. A comparatively high use value must be assumed to be included with hunters' WTP. Lower income resulting in lower WTP is a natural result, and has been found in numerous stated and revealed preference studies. The finding supports the study's validity as it suggests respondents took their own economic conditions into consideration when voting. They were requested to do this in the cheap talk script. In spite of the comparatively low WTP value for *Class 1*, it was still positive. In aggregate the value is not negligible. In contrast, the *Class 2* base class wants a control program implemented, regardless of expected outcome as long as high spread – high prevalence is avoided. They are willing to bear a heavy tax increase for this to come about.

The latent class results demonstrate the difficulty of implementing a controversial environmental program. Support levels diverge dramatically; the population is split nearly in half with mean WTP for the two groups at opposing ends of the spectrum. The class predictor variables included explain some of the heterogeneity within the model, but not all. That fact, along with the findings of insignificance for the numerous other individual-specific variables, speaks to the complexity of the question. The situation of CWD in Alberta is such that individual characteristics or beliefs may have opposing effects. For example, concerned conservationists may be motivated to halt disease progression, but

opposed to the culling necessary to bring it about. Whether or not such an individual supports a management program will be person-specific and will differ amongst conservationists. Such nuances may not be picked up in either a survey or econometric model. Model 3, with the random parameters logit framework, further explores the heterogeneity.

4.5.3 Random Parameter Logit Model Results

Where the LCM approximated the underlying continuous distribution with two discrete ones, the RPL framework allowed the model parameters to vary across individuals. As with the LCM, choice probabilities were estimated by contrasting no management program and a high spread – high prevalence outcome, with management programs resulting in one of the other eight outcomes and a tax increase.

4.5.3.1 Model Specification

The constant parameter was assumed to have a normal distribution, and was allowed to vary randomly. Numerous variables thought to be possible sources of heterogeneity in the random parameter were tested, including NEP score, education level, number of children, if a person was previously aware of CWD, if a person lived in an urban or rural setting, and if he or she lived in a CWD affected area. A person's gender, age and whether he or she had hunted within the past two years were the only significant sources of heterogeneity found for the constant parameter.

4.5.3.2 RPL Welfare Measure Results

Model results are presented in Table 4.5. Whether a person has hunted in the past two years, and his or her age are found to be significant sources of heterogeneity in constant at a 10% level, while a person's gender is significant at the 5% level. WTP estimates are more complicated than those for models 1 and 2, due to the individual specific nature of the estimates, they are most easily

calculated and clearly presented using the means of continuous variables, and alternatives for the dummy variables (please see Chapter 2 for a full description).

Table 4.5: RPL Model Results of CWD Control Program Referendum Questions With WTP Estimates

Number of Observations	4173
Log likelihood at convergence	-2609.931
Rho Squared	0.09379
Random Parameters in utility functions:	
Constant	-1.41058***
	(0.319548)
Non-random Parameters in utility functions:	
Scaled Cost	-1.61857***
	(0.081505)
Heterogeneity in mean, Parameter: Variable	
Constant:Hunter	-0.47446*
	(0.272402)
Constant:Male	0.342269**
	(0.17243)
Constant:Age	-0.01103*
	(0.006336)
Derived Std Deviations of Parameter Distributions	
NsConstant	2.549086***
	(0.134608)
WTP Estimates for the Alberta population	
Estimates calculated with age=47.23	
Individual Traits	**WTP estimate**
Male-Nonhunter	$98.20

Male-Hunter	$127.51
Female-Nonhunter	$119.35
Female-Hunter	$148.66
*Statistically significant at the 90% level	
**Statistically significant at the 95% level	
***Statistically significant at the 99% level	

The constant parameter coefficient for a management program that results in any outcome other than the worst, is decreasing in a person's age. This implies that the WTP value is increasing. The constant parameter coefficient also decreases if a person is a hunter, implying that hunters have a higher WTP value. As with models 1 and 2, it decreases if a person is male. The large and highly significant derived standard deviation of the constant parameter confirms it to be a large source of heterogeneity in the data.

WTP estimates for all alternatives, calculated at a mean age of 47.23, can be seen in Table 4.5. The values range from $98.20 for a 47.23 year old male who does not hunt to $148.66 for a female hunter of the same age. While the differences between the individual-specific WTP estimates are not trivial, particularly when age variation is acknowledged, the much greater ranges found though models 1 and 2 indicate unobserved sources of heterogeneity. The RPL model results are still valuable for the precise picture they provide of differing effects on various individuals.

4.6 Chapter Conclusion.

This chapter presented the findings from the CWD survey administered to Alberta residents in December, 2008. Initially sample validity was assessed, followed by survey results and discussion. The results can be broadly sectioned into two categories: CWD-related attitudes, activities and knowledge, and results from the referendum contingent valuation which yielded the WTP estimates.

To assess sample representativeness, key demographics of survey respondents were compared to those of Alberta residents found in the 2006 census. A number of demographic factors were found to diverge between the sample and Alberta populations. The divergences were not unduly large, and as the study was undertaken in 2008 while the census data was from 2006 it is hoped that the actual divergences from the Alberta population are even smaller. The response rate for those recruited through e-mail was reasonably high. The response rate for those recruited via telephone was considerably lower. This is likely due to the facts that those contacted by phone had not previously expressed an interest in participating, and telephone recruitment required additional steps giving more opportunities for respondents to drop out. Despite the poor response rate, differences between respondent and non-respondent populations were minimal.

Responses concerning individual's feelings on wildlife, the environment and CWD-related issues found high regard for Alberta wildlife and the natural environment, but uncertainty over whether they are facing threats. Greater concern was expressed over small elk populations than small deer populations, while fewer people thought elk populations to be growing too rapidly.

The majority of respondents had heard of CWD prior to beginning the survey, but responses to disease trait questions reflected shallow knowledge on it. Awareness of CWD in Alberta was comparatively poor. Risk perceptions relating to CWD were mixed, possibly due to a lack of knowledge on the problem, or a perceived lack of government credibility. Opinion questions indicated a strong belief in government responsibility for dealing with the disease.

Albertans exhibited a strong aversion to the uncertainties surrounding CWD, its characteristics and effects. The majority supported the government erring on the side of caution by taking decisive steps to halt disease level increases. All current and potential CWD management actions received majority support, including the culling of elk and deer herds in infected areas. As mentioned in the survey design chapter, respondents were presented with

proportionate disease level estimates and projections not absolute infection numbers. It is not possible to tell from this study if presenting the absolute numbers of CWD infected deer would have influenced the results.

The general public, when faced with a clear outline of the CWD situation in Alberta, indicated that they want the situation addressed. While some may dislike the main control method of culling, respondents largely supported the use of most mechanisms to contain the disease. Due to space constraints the study did not ask respondents' opinions on management measures prior to presenting the background information on the situation. As such it is not possible to say definitively whether the educational component affected respondent attitudes. Regardless, the study results suggest that either the general opinion was poorly portrayed in the media and majority support for the government control program was there; or majority support would have been there with stronger communication and education efforts in place. While a proportion of respondents expressed disagreement with the more unpalatable control measure of culling, more than half indicated support of it. A summary table of WTP results from the models can be found below. As can be seen from the table, even the Class 1 class has a positive WTP of $16.45, and is aggregated across all Alberta households[9] one finds a value of $20,664,490 per year for 10 years. Government spending on the provincial CWD control program in 2007, the year prior to this survey, was $1,080,000 (Pybus, 2007). The study results indicate that even the most conservative benefit estimates exceed the government spending amounts. It should be noted, however, that respondents' WTP was measured for successful control programs.

[9] Using the 2006 Canada census population counts of households in Alberta.

Table 4.6: Summary of WTP estimates and Variances found Through a Conditional Logit Model, a Latent Class Model, and a Random Parameters Logit Model

WTP by program for a 47 year old male with an income of $57,000 (Estimated with a Conditional Logit Model with two alternatives)		**Std errors from Wald tests**:**
Low Spread - Low Prevalence	$121.35*	21.74
Low Spread - Med Prevalence	$64.29*	17.17
Med Spread - High Prevalence	$60.21*	17.86
High Spread - Med Prevalence	$63.14*	14.32

* Significant at the 1% level

**Krinsky-Robb method produced comparable results

WTP for a program with one of the 8 possible outcomes versus the worst case projected outcome, by class membership:	
Class 1: Class 1 class	$16.45
Class 2: Class 2 class	$273.48
WTP for a program with one of the 8 possible outcomes versus the worst case, by individual characteristics:	
Male-Nonhunter	$98.20
Male-Hunter	$127.51
Female-Nonhunter	$119.35
Female-Hunter	$148.66

5.0 Conclusion

This study estimated the WTP values, and ascertained knowledge and attitudes related to CWD control in the province of Alberta. In doing so, it made it possible to assess current and potential socio-economic impacts of CWD spread on the general Alberta resident population in terms of passive use value or total economic value as the disease migrates across the border from Saskatchewan. The findings have policy implications for government, while the methods used had not been applied to a contagious wildlife disease before.

5.1 Policy Implications

This study began with the impetus to inform provincial policy on CWD control efforts. Given that the disease could potentially spread province wide, understanding the general populations' associated values and levels of concern is highly relevant. The situation is complicated by the information gaps which surround the prion disease, such as transmission vectors, time it can remain interned in soil, human health risks, and efficacy of control measures.

The positive economic values for CWD control programs that result in reduced spread and prevalence of the disease found in this study provide an indication of the program's benefits. They speak to Albertans' desires to limit CWD, and may be useful in future cost benefit analyses of possible control programs. It is not possible to conduct such a cost benefit analysis at this time, as a successful control program does not presently exist and therefore neither does cost information. The changes in WTP values associated with higher disease level outcomes may also be useful for cost benefit analysis. If cost information for programs that have a limiting effect on disease spread and prevalence levels but do not keep them at the lowest levels becomes available, these values would be applicable. Although negative media coverage accompanied control efforts in the past, the survey demonstrated that when given an overview of the situation presented in as neutral tones as possible, Albertans prefer the government to err on the side of caution. That being said, the responses reported in the media

combined with the 21.4% and 24% of respondents who strongly object to deer or elk culling respectively suggest that the distribution of preferences and values across Albertans should also be considered.

Failure to develop and invest in a management program to reduce CWD spread and prevalence, according to projections provided by the Alberta Sustainable Resources Development, will result in higher spread – higher prevalence outcomes (personal correspondence with Margo Pybus). Ongoing inaction will likely allow spread and prevalence levels to continue increasing. While a full analysis of the impacts of such continued spread was outside the focus of this study, it is worth noting that results indicate clearly that this is an undesirable outcome in the minds of Albertans. Further study could delve into the long term costs of such an outcome, aided by scientific projections of spread and prevalence rates into the future. In addition, it is possible that with additional information the preferences of the public regarding the value of control programs and the desirability of different mechanisms could change. Future survey work could help reveal such information.

5.2 Contributions to Research

This study used stated preference valuation methods to assess the values the general public held for controlling a prion disease in wildlife populations. An extensive literature search turned up no other studies examining the non market value of similar disease control efforts. By employing the attribute based stated preference questions combined with a contingent valuation type of analysis, it was possible to find the values Albertans place on control programs with specified outcomes. Both the strong expressions of concern found from the opinion questions, and the statistically significant valuation estimates demonstrate the importance of conducting this type of analysis for such problems. Without WTP values for such management programs, a complete cost benefit analysis cannot be conducted. This study demonstrates that it is possible to get WTP values to avoid less attractive future outcomes.

An environmental problem which shares many characteristics with the CWD spread in Alberta is the issue of invasive species. As with CWD in deer herds, invasive species represent a situation in which in absence of human intervention the situation will deteriorate. The situation becomes worse than it was in absence of intervention or action. Unlike prion disease in wildlife, there has been some non-market work done on invasive species. It is still quite limited however, and the literature review done for this study revealed that many gaps exist. Almost no non-market valuation of invasive species prevention or mitigation has been undertaken in Canada. An approach comparable to that used for valuing CWD control in Alberta would work well in the case of an invasive species.

5.3 Present and Future Conditions and Socioeconomic Impacts

Although previously found in farmed elk in Alberta, CWD is now present in wild mule deer populations in the province. The possibility of long term implications from the disease's spread is heightened by the ability of prion diseases to remain interned in soil for long periods of time. Eradicating CWD is also notoriously difficult as treatments frequently used to eradicate more traditional diseases are ineffective against prions (Schramm et al., 2006). Uncertainty still exists as to potential health risks in humans. The study did ask respondents if their answers would change if CWD was definitively found to be a human health threat. A majority of the respondents who voted no against the management programs indicated they would change their vote to yes if CWD was found to be transmissible to humans. Due to the large proportion of respondents who voted no that indicated their votes would change to yes if prion disease in humans as a result of CWD exposure was found to occur, one would expect an increase in the value of controlling the disease in such a situation. At present, the majority of hunters who submitted animal heads for testing consumed or gave away meat from the animals prior to receiving the test results back (Zimmer, 2009). This suggests that such hunters either do not take the recommendations of

the World Health Organization (WHO) to avoid consuming any prion-infected animal seriously, are unaware of the WHO report, or believe the risk to be negligible. If such risks were ultimately found to be higher than anticipated, one can reasonably expect that the values associated with disease control would change as well. Should this come to pass, additional study would be required to reassess the actual values. As is generally the case with stated preference studies, the values found can only be termed estimates due to the possibility of one or more types of bias. Despite all efforts to prevent it, the possibility of hypothetical bias cannot be eliminated. Selection bias may also be present, if those who completed the survey did so because of an attraction to the survey topic.

In the future, further research may focus on formal cost benefit analysis of one or more control programs. To do so would require greater information on management costs and control program efficacy than is available presently. Should it become available such research would be a valuable policy exercise.

This study found that Albertans have strong concerns about CWD in their province. Household WTP value estimates per annum for ten years were found to be statistically significant. Some variation according to group affiliation including age range, income, gender and whether or not a person hunted was found. In spite of the variation, the aggregate values are a large counterbalance to the potential costs of CWD containment. The majority support for all management actions presented indicates the public wants action undertaken to halt or even just slow disease spread and to contain prevalence levels.

Overall, aggregate WTP for CWD containment appears to be substantial. However, in the latent class analysis, 48.4% respondents were willing to pay very little ($16.45). As well, from an equity standpoint it is clear that some Albertans were affected more than others by CWD control measures simply due to their location within the province. Despite this even the majority of those living in or bordering on infected areas supported the control measures presented. Albertans do not want the CWD situation in their province to progress. They are willing to

pay for, and bear the inconvenience of, control programs designed to prevent that from happening.

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Appendix 1: Full Survey

Edited slightly to allow for page fit, text as appeared in survey

Thank you for agreeing to participate in our survey. This survey should take approximately 20 to 30 minutes to complete.

It will ask you questions regarding elk and deer herds in Alberta and government policies for managing those herds.

You will also be provided with some information about elk and deer in Alberta and then be asked to answer some questions based on that information.

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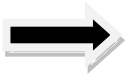

1. **Please indicate how strongly you agree or disagree with the following statements about wildlife:**

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Wildlife are an important part of the natural environment	○	○	○	○	○
Wildlife are an important contributor to the Alberta economy	○	○	○	○	○
Wildlife are more of a nuisance than a benefit to my life	○	○	○	○	○
Alberta's wildlife populations are seriously threatened by wildlife disease	○	○	○	○	○

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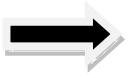

Elk and deer in Alberta

White-tailed deer are Alberta's most abundant ungulate (hoofed animals including deer, moose and elk) and are typically found in wooded river flats and coulees in the prairie region, and in aspen groves in the parkland and southern boreal zones. The range of white-tailed deer is expanding westward into the foothills and mountains, and northward into the boreal zone.

Mule deer are slightly larger and less abundant than white-tailed deer. Mule deer are found throughout Alberta, but are most abundant in southern and western Alberta. They typically inhabit mixed-wood forests, hilly areas and edges of coniferous forests.

Elk (also called Wapiti) are much larger than mule deer and white-tailed deer, and are the only members of the deer family in Alberta that collects a harem. Elk prefer woodland mixed with open grassland and are mainly found in the foothills and mountains, and in Elk Island National Park and Cypress Hills Provincial Park.

Alberta Fish and Wildlife Division estimates the provincial populations of elk and deer to be about 230,000 white-tailed deer, 133,000 mule deer, and 26,000 elk.

Source: Alberta Sustainable Resource Development, Fish and Wildlife Divisionhttp://www.srd.gov.ab.ca/fishwildlife/livingwith/huntingalberta/gamespecies.aspx

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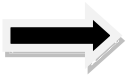


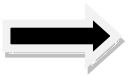
Increasing elk and deer populations are considered by some people to be **beneficial** for several reasons, including:

- Elk and deer are valuable big game animals that provide recreation, food and clothing
- Elk and deer are fun to watch
- Elk and deer are an important food source for predatory animals such as mountain lions
- Elk and deer benefit their habitat, and our wild areas by "mowing" "pruning" and "fertilizing" vegetation and aerating soil

Increasing elk and deer populations are considered by some people to be **problematic** for several reasons, including:

- Auto collisions involving deer and elk cause can cause damage and loss of lives
- Elk and deer like to eat many plants humans use for landscaping and can harm some endangered plant species by eating them
- Elk and deer can cause damage to crops such as alfalfa and wheat
- Elk and deer can be a safety hazard at airports
- Elk and deer carry ticks that carry Lyme disease (note: to date, Lyme disease has not been found in Alberta)

Source: US Department of Agriculture. Animal and Plant Health Inspection Service. National Wildlife Research Center. "Living with wildilife – Deer": http://www.aphis.usda.gov/ws/nwrc/is/living/deer.pdf

Based on this information, please answer the next question by clicking on the arrow. 

	Too small	The right size	Too large
I believe that elk populations in Alberta are…	○	○	○
I believe that deer populations in Alberta are…	○	○	○

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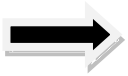
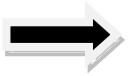


Please indicate how strongly you agree or disagree with the following statements:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Deer populations in Alberta are growing too rapidly	○	○	○	○	○
Elk populations in Alberta are growing too rapidly	○	○	○	○	○

Please click the arrow to continue



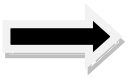
Chronic Wasting Disease

- Chronic wasting disease (CWD) is a progressive, fatal, degenerative disease of the brain belonging to a group of diseases called Transmissible Spongiform Encephalopathies (TSEs).
- Other examples of TSEs are Scrapie, BSE (mad cow disease) and CJD (the most common TSE found in humans, CJD is ultimately fatal).
- CWD affects elk, mule deer and white-tailed deer, has no current treatment or vaccine and is the only TSE to occur in free-ranging species.
- There is currently no scientific evidence that CWD can be transmitted to humans. However, hunters are advised not to eat meat from infected animals.
- There is currently no evidence that CWD can be contracted by livestock such as cattle, sheep, goats, horses or bison.

Before responding to this survey, had you heard of chronic wasting disease (CWD)?

- ○ **Yes**
- ○ **No**
- ○ **Don't know**

Please click the arrow to continue



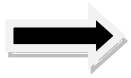
Did you know that CWD can infect deer?

- ○ **Yes**
- ○ **No**
- ○ **Don't know**

Did you know that CWD can infect elk?

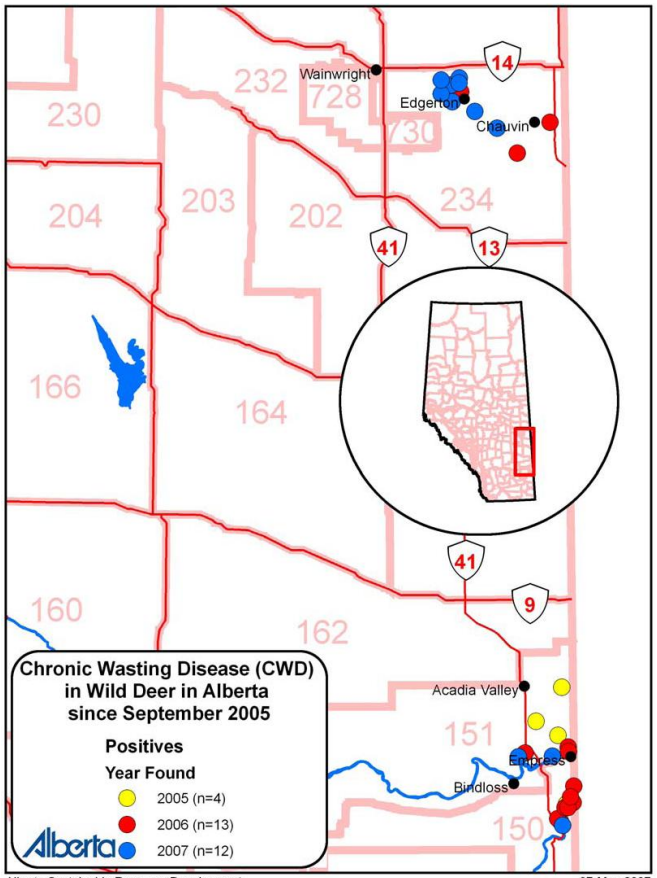
- ○ **Yes**
- ○ **No**
- ○ **Don't know**

Please click the arrow to continue



The map to the right shows the areas in Alberta where CWD has been found in wild deer.

- A total of 16 cases of CWD have been found in wild Alberta deer out of 8,792 wild animals tested.
- The first confirmed case of CWD in a wild Alberta cervid occurred in September, 2005, almost 3 years after the last Alberta case of CWD in farmed elk and deer.
- All known cases of CWD in wild deer and elk have occurred near the Alberta-Saskatchewan border.
- Rates of CWD infection in those two areas are estimated to be 1.2% (i.e. 12 out of every 1000 tested animals were found to be infected) to 1.3% for white-tailed deer and 0.1% to 0.4% for mule deer.
- To date, no cases of CWD have been found in wild elk in Alberta.
- CWD has also been present for some time in Saskatchewan and the United States, including Colorado, Wisconsin and many other states.
- In Colorado where CWD has been present since the 1960s, CWD infection rates are as high as 15% (150 out of every 1000 animals are infected), with overall infection rates of roughly 5% in all infected areas of the state.



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CWD on Alberta elk and deer farms

- Alberta began conducting voluntary testing for CWD in farmed and wild elk and deer in the fall of 1996.
- In August, 2002 Alberta initiated a mandatory surveillance program for all farmed elk and deer.
- To date, only 3 farmed elk or deer have tested positive for CWD in Alberta; all in 2002. These 3 cases occurred on two farms with both farms having their herds subsequently depopulated (destroyed).
- Since 2002, more than 32,000 farmed deer or elk have been tested for CWD with no new cases found. Alberta's elk and deer farms are currently CWD free.

Before responding to this survey, did you know that although CWD has been present in farmed elk and deer in Alberta *in the past*, it is *currently* only present in Alberta in wild deer?

- ○ **Yes**
- ○ **No**
- ○ **Don't know**

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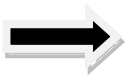

Please indicate your level of agreement with the following statements on a scale from strongly disagree to strongly agree:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Don't know
The threat of CWD has been exaggerated.	○	○	○	○	○	○
Effort should be taken to eliminate CWD from the province.	○	○	○	○	○	○
CWD should be contained to its current geographical area.	○	○	○	○	○	○
I think there is a potential for CWD to be transferred to humans	○	○	○	○	○	○
I or my family have concerns about eating elk and deer meat because of CWD.	○	○	○	○	○	○
I believe that eating elk and deer meat will cause CWD infections in humans.	○	○	○	○	○	○

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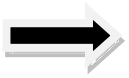

Currently the government is conducting a variety of programs to address CWD in the province of Alberta. Please rate how acceptable the management program would be to you on a scale from highly unacceptable to highly acceptable.

	Highly Unacceptable	Somewhat Unacceptable	Neutral	Somewhat acceptable	Highly Acceptable	Don't know
Culling (eradication) of elk and deer herds in the areas where CWD is most concentrated.	○	○	○	○	○	○
Mandatory submission of heads for testing in certain Wildlife Management Units	○	○	○	○	○	○
Voluntary submission of heads for the entire province.	○	○	○	○	○	○
Educational Materials placed on the webpage of Alberta Sustainable Resource Development's.	○	○	○	○	○	○
Open public meetings to discuss CWD issues.	○	○	○	○	○	○
Mailouts and advertisements in local newspapers.	○	○	○	○	○	○
Freezer locations for deer head submission.	○	○	○	○	○	○
Providing additional hunting tags for to hunters who submit the heads of their killed animals in certain Wildlife Management Units	○	○	○	○	○	○
Take no action towards controlling CWD and simply allow it to run its natural course	○	○	○	○	○	○

Please click the arrow to continue

The province of Alberta has been investing in programs to reduce CWD in Alberta. These programs require funding for surveillance, testing and wildlife management. On the next page we will provide you with some potential scenarios for CWD distribution and infection rates and ask you whether or not you would vote for a program that achieves a certain reduction in expected spread and infection rates but results in a certain increase in your annual taxes.

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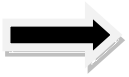
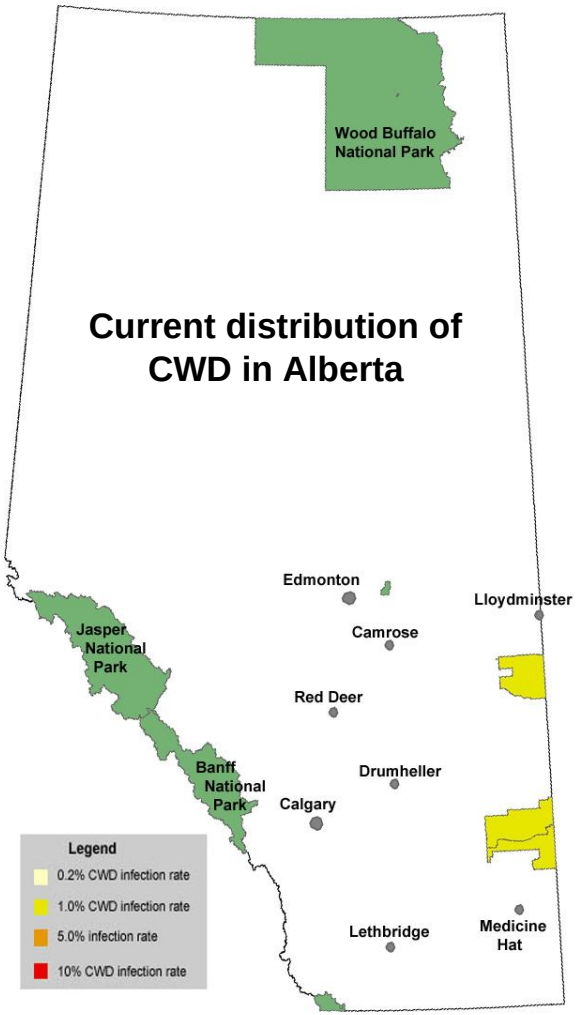




The map to the left shows the current distribution of CWD in Alberta and infection rates of CWD in Alberta.

The outlined areas on the map that are colored coded with the colors in the legend are wildlife management units (WMUs).

WMUs are geographic areas set out in legislation for wildlife and conservation management.

Recall that a 0.2% infection rate means that 2 out of 1000 tested elk and deer were found to be infected with CWD.

1.0% - 10 out of 1000 tested animals were infected

5.0% - 50 out of 1000 tested animals were infected

10% - 100 out of 1000 tested animals were infected

Please click the arrow to continue

HOW WOULD YOU VOTE?

There are many management programs that the Alberta government could adopt to deal with CWD in the province, however their outcomes are often uncertain.

In the following screens, we will provide you with some potential scenarios for CWD distribution in the province, and ask you whether or not you would vote for a program that achieves a certain reduction in expected spread and prevalence levels, but also requires an increase in your annual taxes.

Please bear in mind that in each scenario that you will see:

- The map on the left side of the screen will be a possible estimate of the expected distribution of CWD in 10 years if **no management action** is taken. **This map does not change in any of the scenarios.**
- The map on the right will be the expected distribution and infection rates if **a new management program is adopted.** The new program would require additional funding that would mean an increase in annual tax rates for the next 10 years.

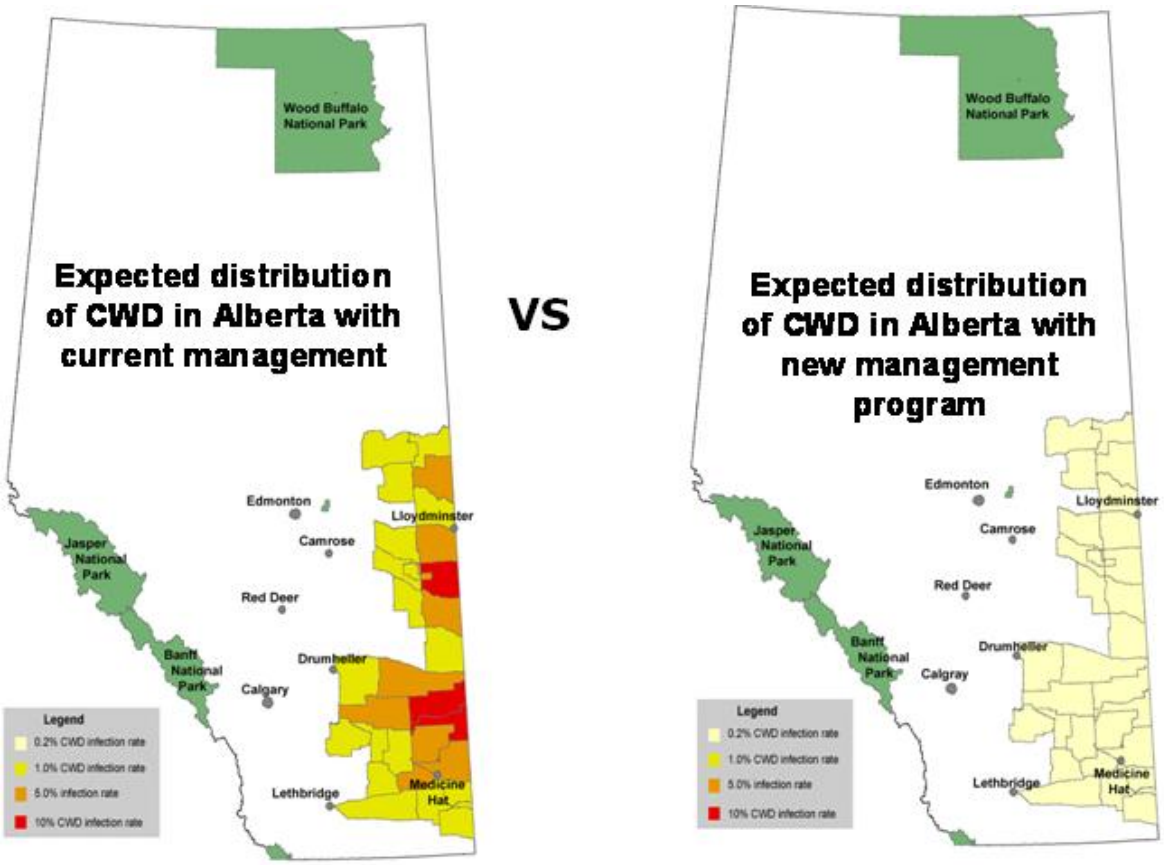
Research has shown that survey respondents do not treat survey questions the same as they would an actual referendum. We call this hypothetical bias, and research has found that people typically say they will pay more than they actually would in a real transaction.

It is very important that you vote as if this were **a real referendum** being posed by the Alberta government.

Please click the arrow to continue

Please place your vote for the following proposed CWD management program:

How would you vote in a referendum on the proposed CWD management program that reduced infection rates to from the levels of the map on the left to the infection rates in the map on the right but resulted in a *$25* increase in annual taxes for the next 10 years?

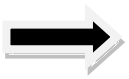


- ○ I vote YES for the proposed CWD management program with a $25 tax increase
- ○ I vote NO for the proposed CWD management program

How certain are you that this is the choice you would make if it were an actual referendum?

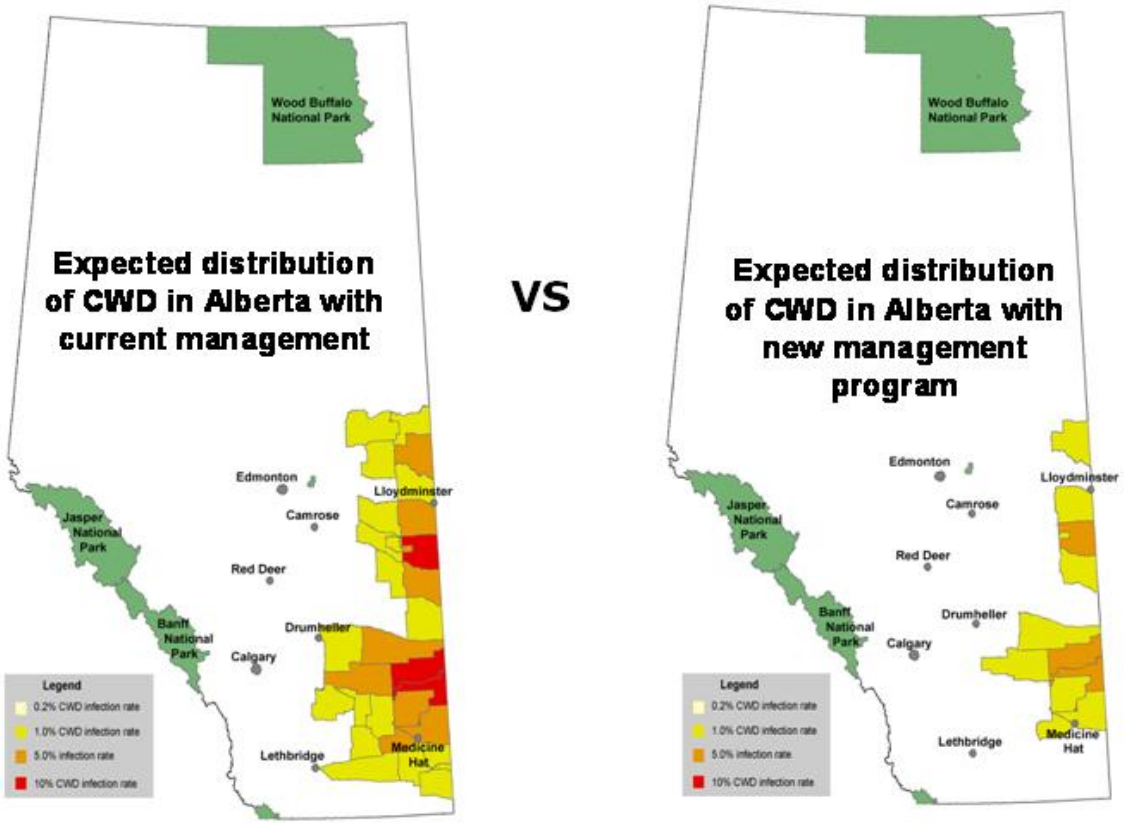
- ○ Very certain
- ○ Somewhat certain
- ○ Somewhat uncertain
- ○ Very uncertain

Please click the arrow to continue



Please place your vote for the following proposed CWD management program:

How would you vote in a referendum on the proposed CWD management program that reduced infection rates to from the levels of the map on the left to the infection rates in the map on the right but resulted in a *$25* increase in annual taxes for the next 10 years?

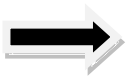


- ○ I vote YES for the proposed CWD management program with a $25 tax increase
- ○ I vote NO for the proposed CWD management program

How certain are you that this is the choice you would make if it were an actual referendum?

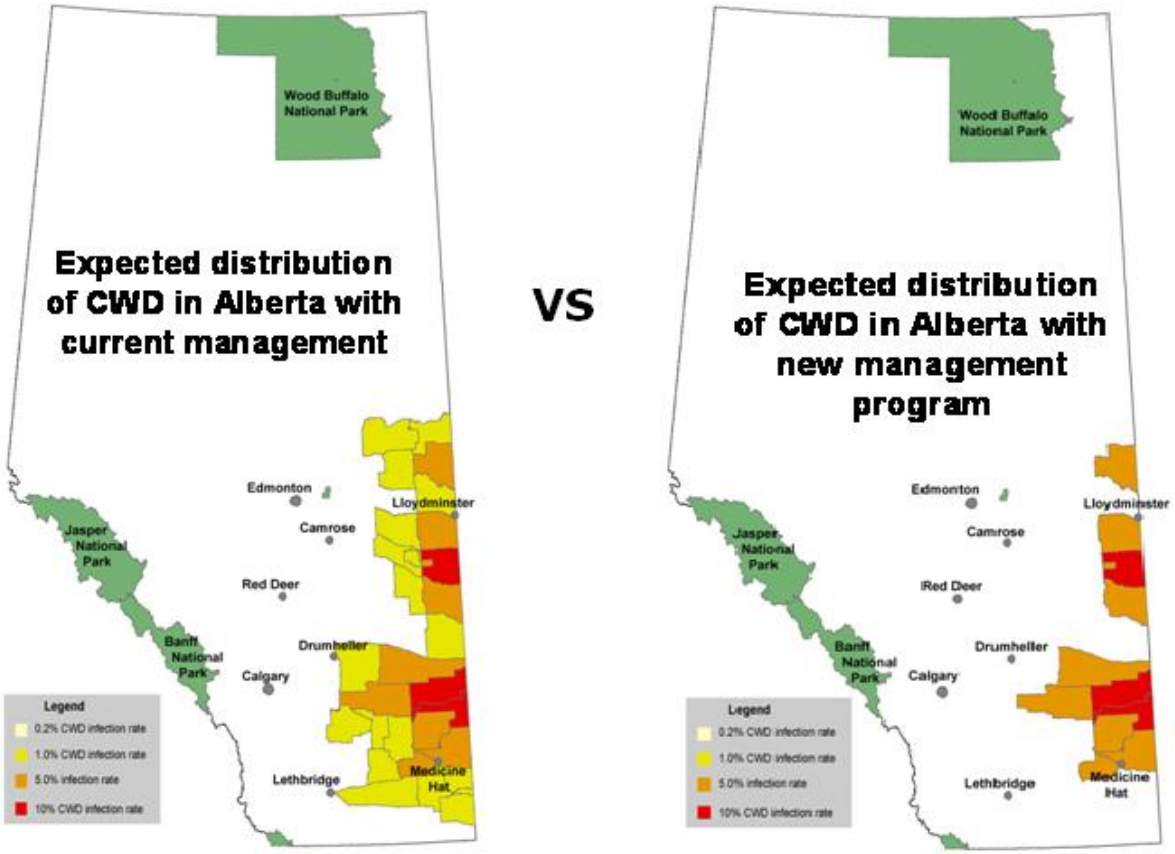
- ○ Very certain
- ○ Somewhat certain
- ○ Somewhat uncertain
- ○ Very uncertain

Please click the arrow to continue



Please place your vote for the following proposed CWD management program:

How would you vote in a referendum on the proposed CWD management program that reduced infection rates to from the levels of the map on the left to the infection rates in the map on the right but resulted in a *$25* increase in annual taxes for the next 10 years?

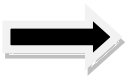


- ○ I vote YES for the proposed CWD management program with a $25 tax increase
- ○ I vote NO for the proposed CWD management program

How certain are you that this is the choice you would make if it were an actual referendum?

- ○ Very certain
- ○ Somewhat certain
- ○ Somewhat uncertain
- ○ Very uncertain

Please click the arrow to continue



When placing your votes, how important was each of the following to you:

	Not important at all	Slightly important	Very important	Extremely important
CWD prevalence rate in infected areas	○	○	○	○
Degree to which CWD has spread across the province	○	○	○	○
Change in annual taxes because of CWD management program	○	○	○	○
Uncertainty about what is being done about CWD in other provinces	○	○	○	○

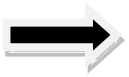
Please click the arrow to continue

If you voted No to any of the proposed programs, it was because:

Please select all that apply.

- ☐ I do not believe the program will actually help to limit the spread of CWD in Alberta.
- ☐ I think our tax money could be better spent on other issues.
- ☐ I do not have enough information to make this decision.
- ☐ I felt the proposed management program did not do enough to combat CWD.
- ☐ I felt the proposed management program was too extreme.
- ☐ I do not agree with increased hunting to eliminate CWD.
- ☐ I do not agree with government agencies carrying out culling of elk and deer herds to eliminate CWD.
- ☐ The tax increase was too high.
- ☐ CWD poses no health risk to humans.
- ☐ I am uncertain about levels of CWD management in areas outside Alberta (e.g. Saskatchewan).

Please click the arrow to continue

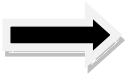


Following are the reasons you mentioned for voting NO to any of the proposed programs.

Of these, please check the MOST IMPORTANT REASON by marking on the left.

- ☐ I do not believe the program will actually help to limit the spread of CWD in Alberta.
- ☐ I think our tax money could be better spent on other issues.
- ☐ I do not have enough information to make this decision.
- ☐ I felt the proposed management program did not do enough to combat CWD.
- ☐ I felt the proposed management program was too extreme.
- ☐ I do not agree with increased hunting to eliminate CWD.
- ☐ I do not agree with government agencies carrying out culling of elk and deer herds to eliminate CWD.
- ☐ The tax increase was too high.
- ☐ CWD poses no health risk to humans.
- ☐ I am uncertain about levels of CWD management in areas outside Alberta (e.g. Saskatchewan).

Please click the arrow to continue



If you voted YES to any of the proposed programs, it was because:

Please select all that apply.

- ☐ I think the tax increase is a small amount to pay for the benefits received.
- ☐ I believe that we should eliminate CWD regardless of the cost.
- ☐ I feel it is the 'right' thing to do.
- ☐ It is important to invest in maintaining healthy, CWD-free elk and deer herds.
- ☐ The program is important but I don't really think that the program will cost me directly.
- ☐ I think that elk and/or deer are pests and should be eliminated with or without of CWD infection.
- ☐ CWD may become a human health risk.
- ☐ I believe that the government should limit the spread of CWD even if the disease cannot be eradicated.

Please click the arrow to continue

Following are the reasons you mentioned for voting YES to any of the proposed programs.

Of these, please check the MOST IMPORTANT REASON by marking on the left.

☐ I think the tax increase is a small amount to pay for the benefits received.

☐ I believe that we should eliminate CWD regardless of the cost.

☐ I feel it is the 'right' thing to do.

☐ It is important to invest in maintaining healthy, CWD-free elk and deer herds.

☐ The program is important but I don't really think that the program will cost me directly.

☐ I think that elk and/or deer are pests and should be eliminated with or without of CWD infection.

☐ CWD may become a human health risk.

☐ I believe that the government should limit the spread of CWD even if the disease cannot be eradicated.

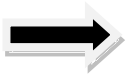
Please click the arrow to continue

Now we would like to ask you a few questions about you so that we can categorize responses.

For each of the following activities, please indicate whether or not you participated in the following activities in the past2 years:

	Yes	**No**
Hunting	○	○
Fishing	○	○
Wildlife watching	○	○
Feeding wildlife with table scraps or special food (including bird seed) for wildlife	○	○
Photographing, studying or recording wildlife	○	○
Observing, collecting or creating wildlife related art or literature	○	○
Being a member of any wildlife related organization	○	○
Contributing to an organization that protects endangered wildlife	○	○
Contributing to an organization that promotes wildlife conservation	○	○
Other general outdoor recreation (e.g. camping, hiking, backpacking, biking, cross country skiing, canoeing, rafting)	○	○
Motorized outdoor recreation (e.g. all terrain vehicle driving (ATVing), snowmobiling, boating)	○	○

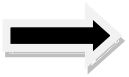
Please click the arrow to continue



Has a member of your immediate family hunted in the past 2 years?

- ○ **Yes**
- ○ **No**
- ○ **I don't know**

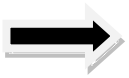
Please click the arrow to continue



Have you ever eaten elk or deer meat?

- ○ I have never eaten elk or deer meat
- ○ I have eaten elk or deer meat in the last year
- ○ I have eaten elk or deer meat, but not in the last year

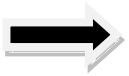
Please click the arrow to continue



Do you own and/or operate a game farm?

- **Yes**
- **No**

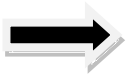
Please click the arrow to continue



Do you own and/or operate a cattle ranch?

- **Yes**
- **No**

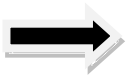
Please click the arrow to continue



Are you:

- **Male**
- **Female**

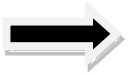
Please click the arrow to continue



How old are you?

Please insert your, in years (e.g. 26, 35, 47 etc.) in the box below

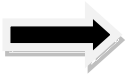
Please click the arrow to continue



Are you a member of any wildlife or conservation related organizations (e.g. CPAWS, Sierra Club, World Wildlife Fund)?

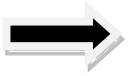
- ○ **Yes**
- ○ **No**

Please click the arrow to continue



Please specify the wildlife or conservation related organization of which you are a member:

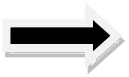
Please click the arrow to continue



What is the highest level of schooling you have completed?

- ○ Some high school or less
- ○ High school diploma
- ○ Some university, college, or technical school
- ○ Technical school graduate
- ○ University/College graduate
- ○ Some graduate school
- ○ Graduate degree

Please click the arrow to continue



Please indicate your household income before taxes in 2007.

We ask for you household income so that we can compare our data with Alberta statistics to ensure that our sample reflects the general Alberta population.

- ○ Less than $10 000
- ○ $10 000 to $14 999
- ○ $15 000 to $19 999
- ○ $20 000 to $24 999
- ○ $25 000 to $29 999
- ○ $30 000 to $34 999
- ○ $35 000 to $39 999
- ○ $40 000 to $44 999
- ○ $45 000 to $49 999
- ○ $50 000 to $54 999
- ○ $55 000 to $59 999
- ○ $60 000 to $69 999
- ○ $70 000 to $79 999
- ○ $80 000 to $99 999
- ○ $100 000 to $119 999
- ○ $120 000 to $149 000
- ○ Greater than $149 000
- ○ I prefer not to answer

Please click the arrow to continue

How many people contribute to your household income?

Please enter the number in the space provided.

Please click the arrow to continue

Please indicate, by checking the most appropriate choice, where you currently live.

- ○ Large urban setting (100 000 people or more)
- ○ Small urban setting (20 000 to 99 999 people)
- ○ Town or village (1 000 to 19 999 people)
- ○ Rural setting (999 people or less)

Please click the arrow to continue

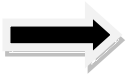
Are there any children in your household under 18 years of age?

- ○ Yes
- ○ No
- ○ I prefer not to say

How many people are there in your household under 18 years of age?

Please enter your answer in the box below:

Please click the arrow to continue



What are the first 3 digits of your postal code?

Please click the arrow to continue

Finally, listed below are statements about the relationship between humans and the environment.

For each one, please indicate whether you STRONGLY AGREE, MILDLY AGREE, are UNSURE, MILDLY DISAGREE, or STRONGLY DISAGREE with it.

	STRONGLY AGREE	MILDY AGREE	UNSURE	MILDLY DISAGREE	STRONGLY DISAGREE
We are approaching the limit of the number of people the earth can support	○	○	○	○	○
Humans have the right to modify the natural environment to suit their needs	○	○	○	○	○
When humans interfere with nature it often produces disastrous consequences.	○	○	○	○	○
Human ingenuity will insure that we do NOT make the earth unlivable	○	○	○	○	○
Humans are severely abusing the environment	○	○	○	○	○
The earth has plenty of natural resources if we just learn how to develop them	○	○	○	○	○
Plants and animals have as much right as humans to exist	○	○	○	○	○

The balance of nature is strong enough to cope with the impacts of modern industrial nations	○	○	○	○	○
Despite our special abilities humans are still subject to the laws of nature	○	○	○	○	○
The so-called “ecological crisis” facing humankind has been greatly exaggerated	○	○	○	○	○
The earth is like a spaceship with very limited room and resources	○	○	○	○	○
Humans were meant to rule over the rest of nature	○	○	○	○	○
The balance of nature is very delicate and easily upset	○	○	○	○	○
Humans will eventually learn enough about how nature works to be able to control it	○	○	○	○	○
If things continue on their present course, we will soon experience a major ecological catastrophe	○	○	○	○	○

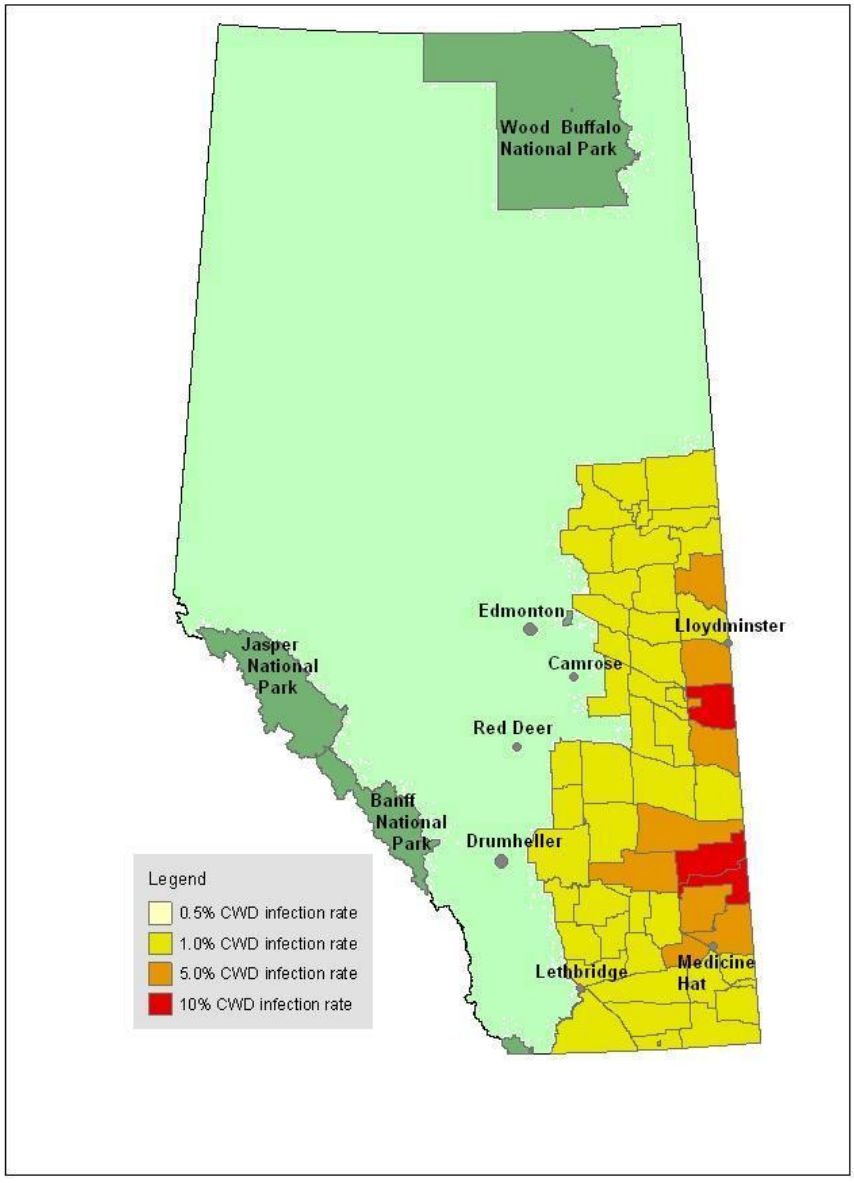
If you have any comments on this survey or the CWD issue, please feel free to add them here:

Please click the arrow to continue

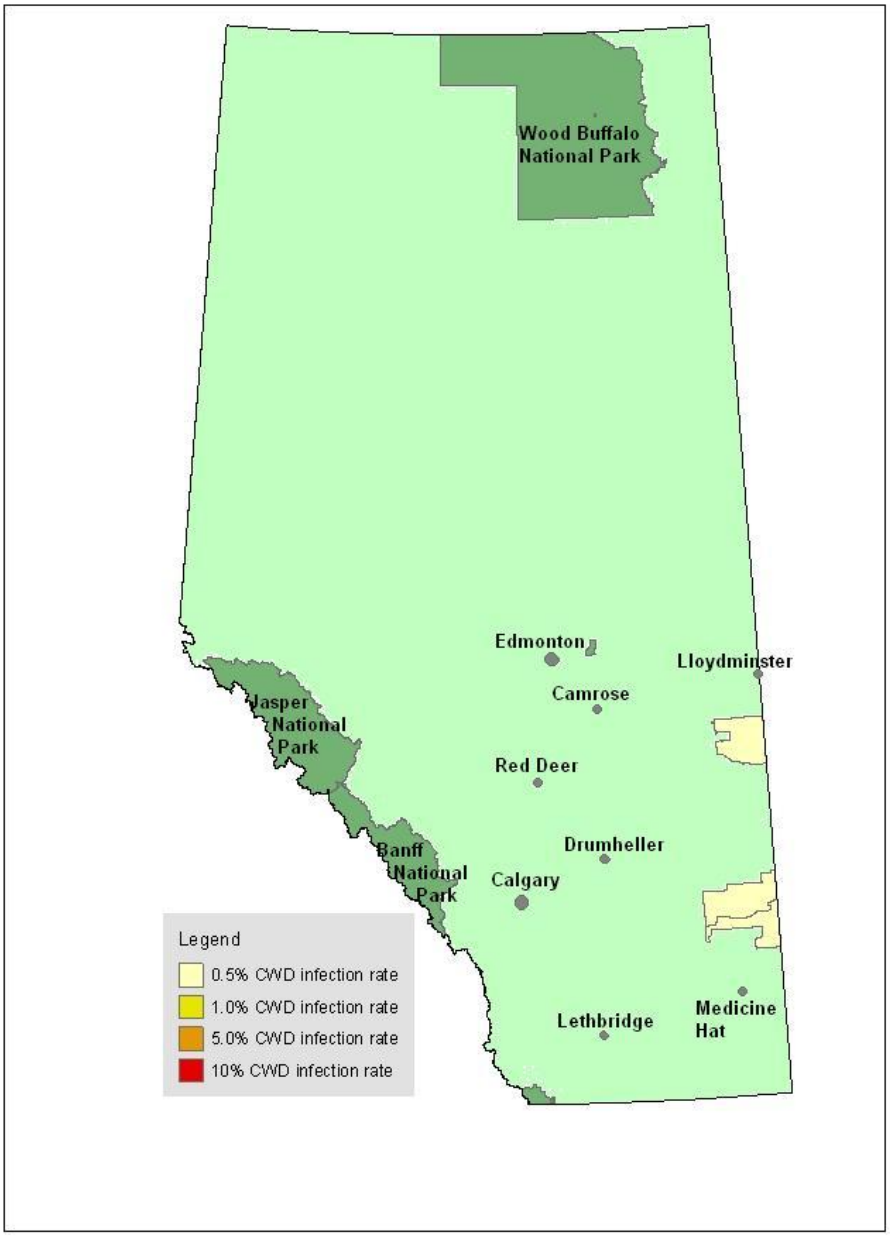
Appendix 2: Control Program Outcomes

High Spread – High Prevalence

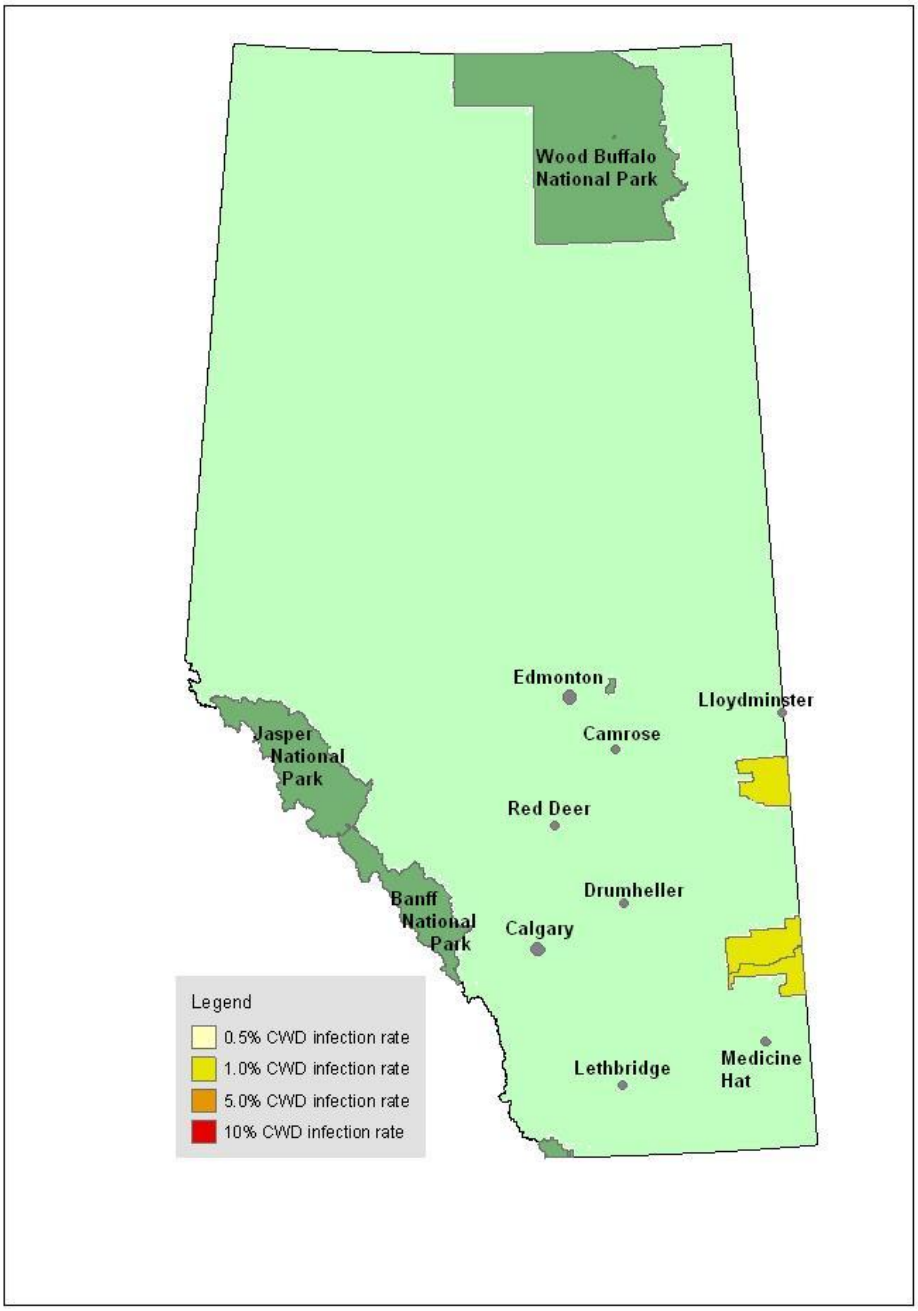
(Worst Case, outcome will occur if no management plan implemented)



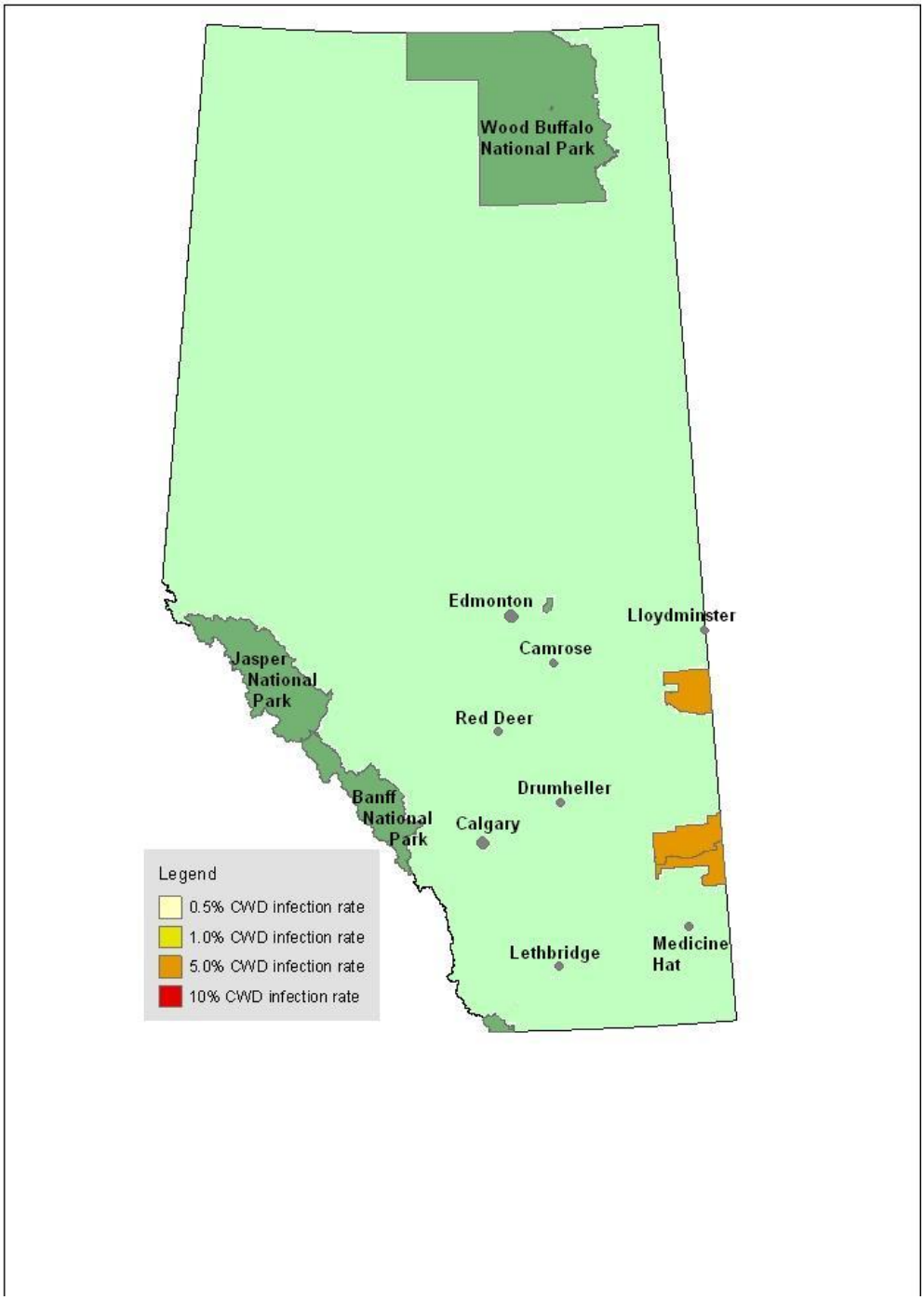
Low Spread – Low Prevalence Outcome



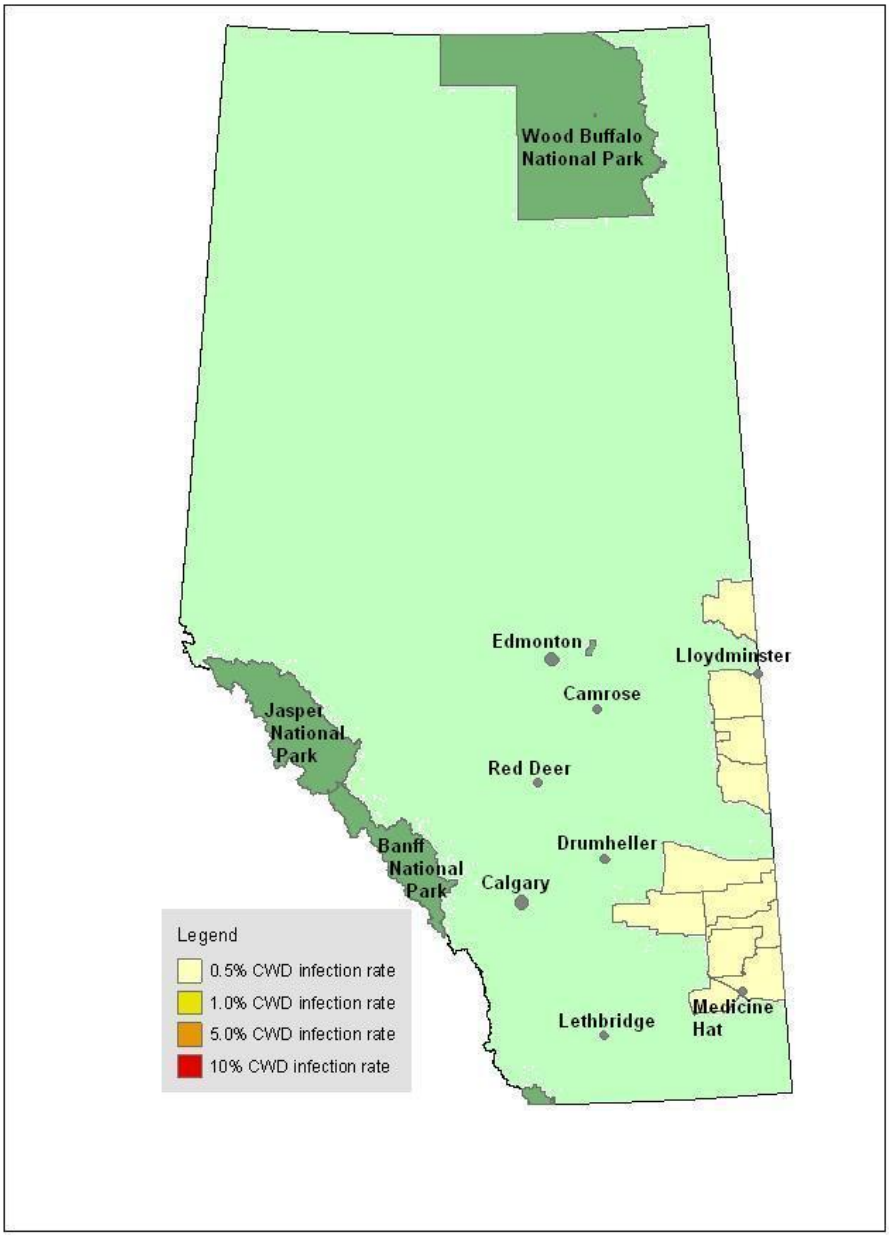
Low Spread – Medium Prevalence Outcome



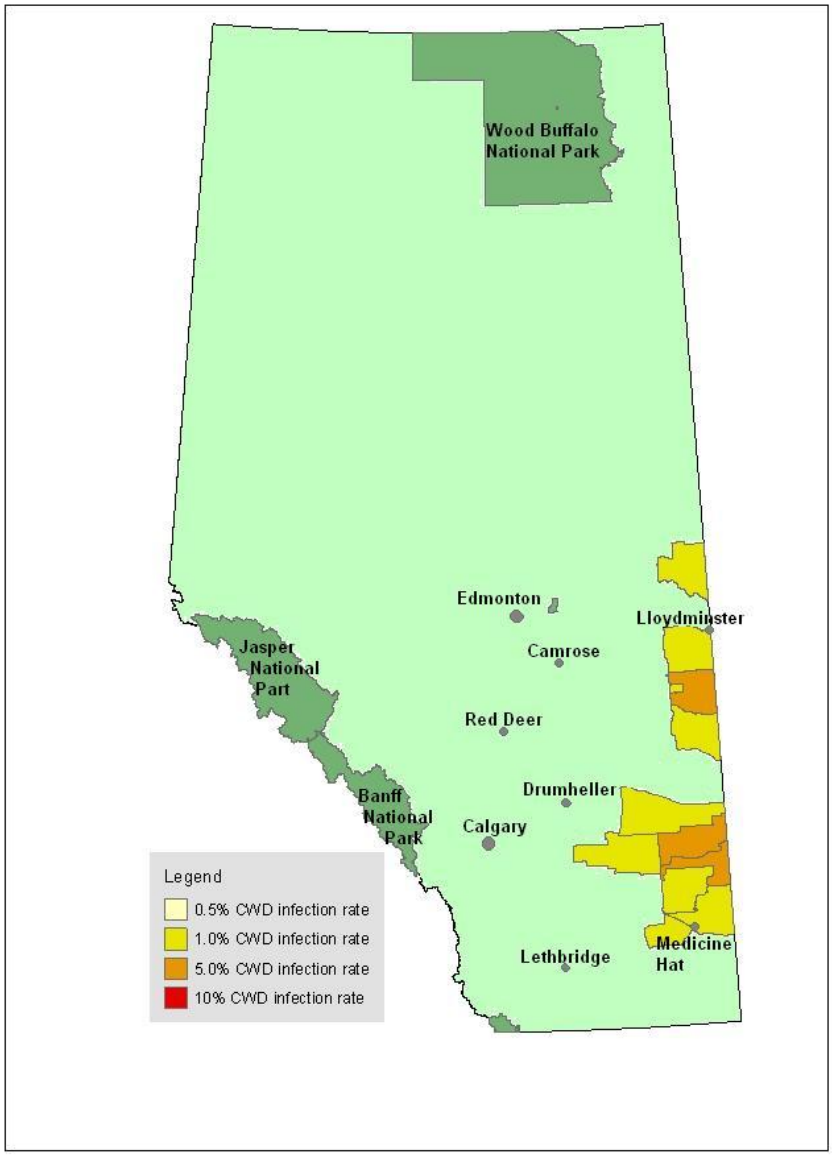
Low Spread – High Prevalence Outcome



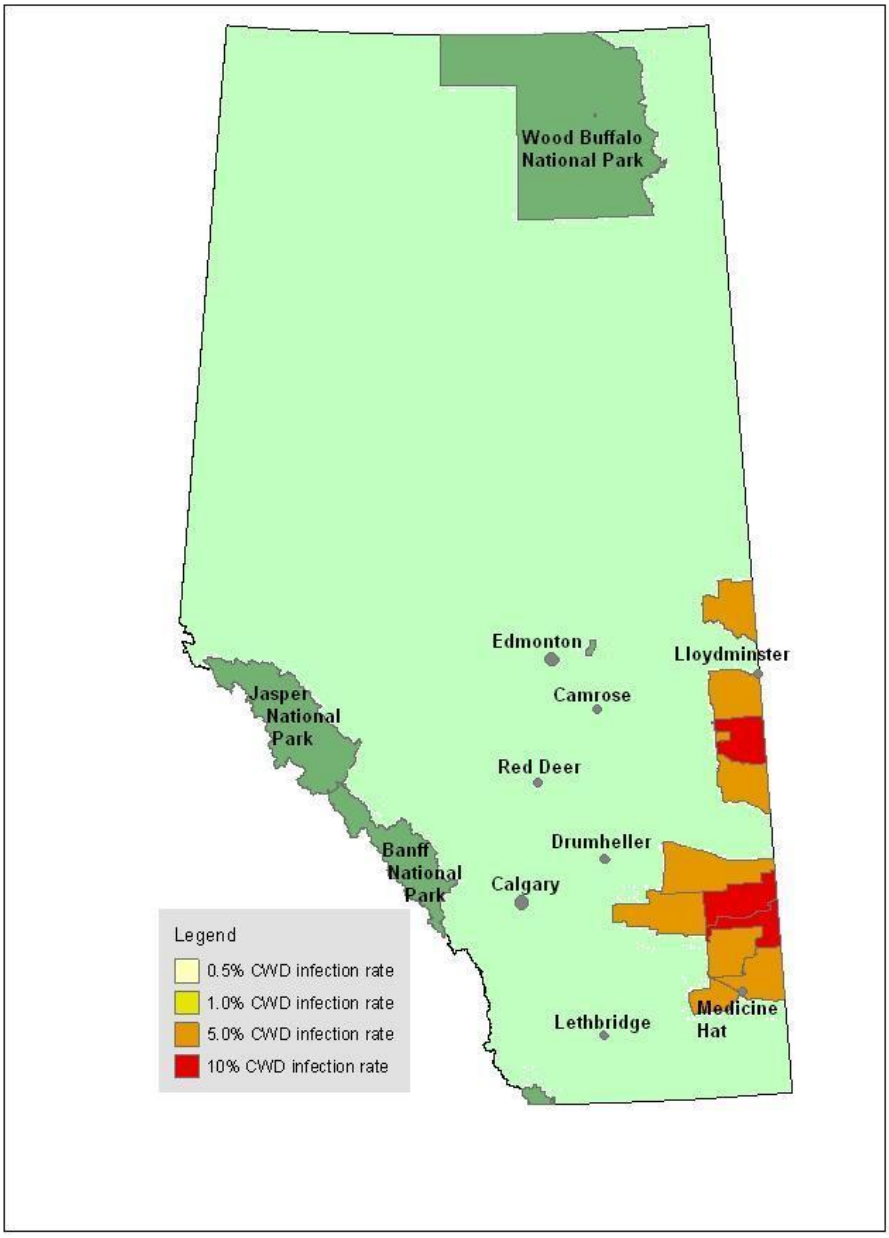
Medium Spread – Low Prevalence Outcome



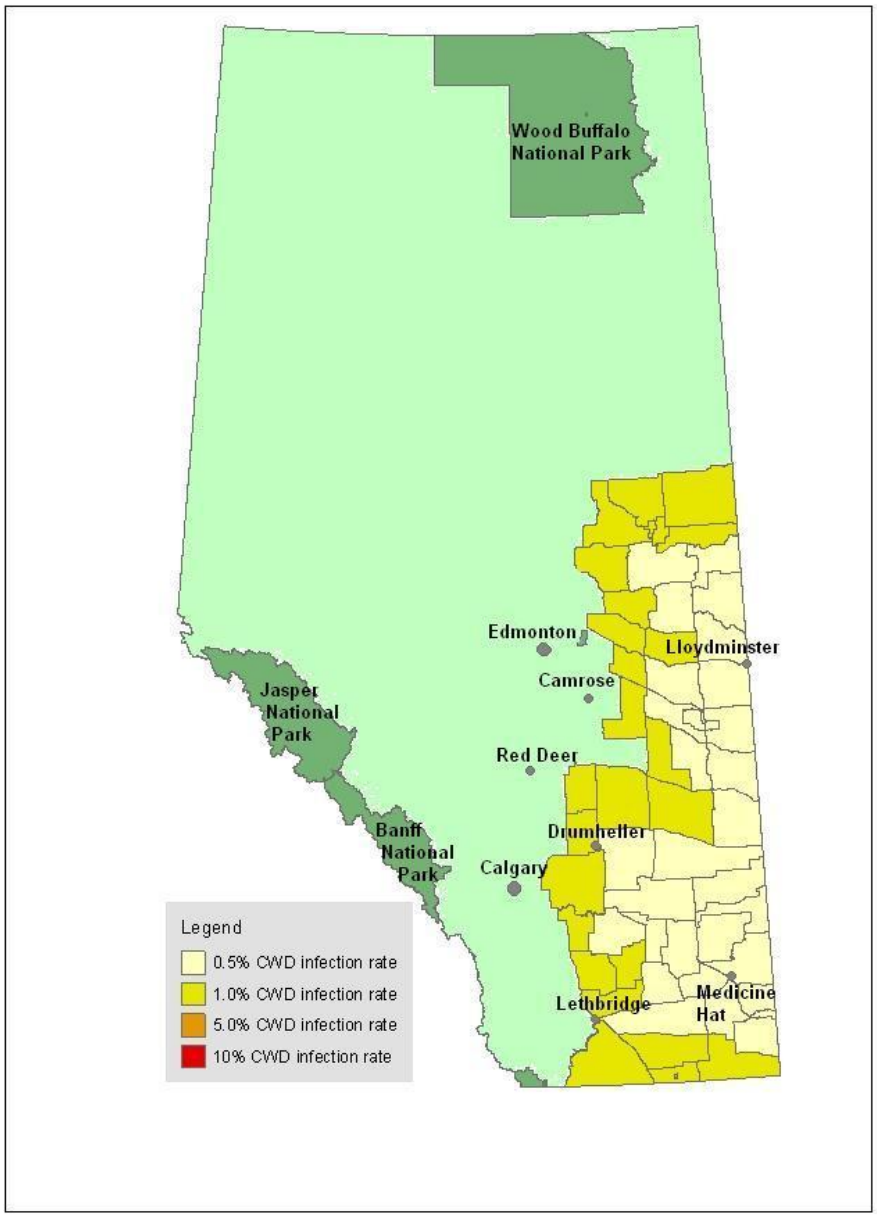
Medium Spread – Medium Prevalence Outcome



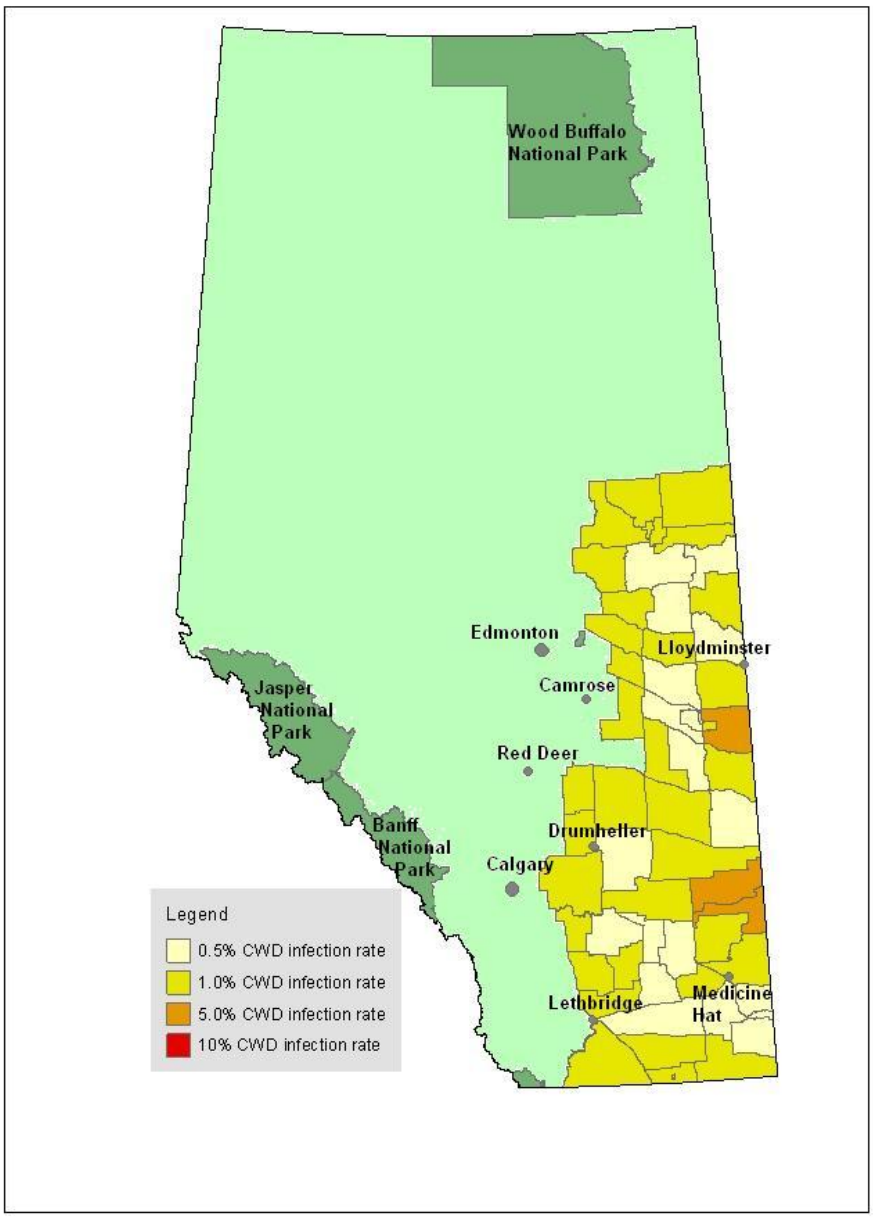
Medium Spread – High Prevalence Outcome



High Spread – Low Prevalence Outcome



High Spread – Medium Prevalence Outcome


Wood Buffalo National Park
Edmonton
Lloydminster
Camrose
Jasper National Park
Red Deer
Drumheller
Banff National Park
Calgary
Lethbridge
Medicine Hat
Legend
0.5% CWD infection rate
1.0% CWD infection rate
5.0% CWD infection rate
10% CWD infection rate

Appendix 3: New Ecological Paradigm Information and Results

New Environmental Paradigm

The concept of the new environmental paradigm surfaced in the 1970's, and refers to a collection of ideas or mindsets perhaps best described as anti-anthropocentric. It contrasted with the accepted views of the day, which tended to center around the notion of human profits and progress at the expense of the environment. Despite a predominant "anti-ecological dominant social paradigm" (Dunlap and Van Liere 1978), concepts such as the possibility of limited resources, and the necessity of environmental stewardship were beginning to take hold. Even then, when such idea holders were in a minority, the importance of knowing how prevalent such views are was recognized.

In 1978, Dunlap and Van Liere published an article proposing a NEP Scale, which would give an indication of individual and public acceptance of the NEP. They developed the scale through a large survey administered to two separate samples of Washington state residents. One was drawn from the general population, while the second was drawn from members of a state-wide environmental organization. The survey asked questions on a wide range of environmental and lifestyle factors, then interspersed 12 items intended to measure the NEP in a collection of 35 Likert-style questions (please see table below). These 35 questions gave a statement, then asked respondents to indicate whether they: "Strongly Agree," "Mildly Agree", "Mildly Disagree" or "Strongly Disagree". 8 of the 12 NEP questions could be considered pro-NEP, and scores of 4 for "Strongly Agree", 3 for "Mildly Agree", 2 for "Mildly Disagree" and 1 for "Strongly Disagree" were assigned. The remaining 4 of the 12 could be considered opposed to NEP, and as such the scoring was reversed. From the score means and frequencies one can infer the level of support for the NEP. Significant differences between the values found from the environmental organization members and the general public suggest known-group validity for the scale (Dunlap et al. 2000). Work by Kempton et al. (1995) found three comparable beliefs to those central to the NEP Scale, supporting the scale's content validity.

The third important validity measure, construct validity is harder to measure, however Dunlap et al. (2000) found indications that as more studies use, test and confirm the NEP it should increase. In the same paper, the authors updated the NEP to a fifteen item list, and include an unsure option. These 15 items were included in the CWD survey. From the survey responses, it was possible to calculate a NEP scale score for Albertans, however NEP scale score was not found to have a significant impact on respondents' WTP when the data was modeled. Response results by percentage can be seen in Table A3.1.

Table A3.1: New Ecological Paradigm Question Results

	Strongly Agree	Mildly Agree	Uncertain	Mildly Disagree	Strongly Disagree	Don't Know
1) We are approaching the limit of the number of people the earth can support	24.4%	26.5%	22.1%	14.0%	9.4%	3.6%
2) Humans have the right to modify the natural environment to suit their needs	3.4%	20.3%	11.0%	31.1%	33.1%	1.1%
3) When humans interfere with nature it often produces disastrous consequences	37.6%	39.0%	8.4%	10.1%	4.3%	0.6%
4) Human ingenuity will insure that we do NOT make the earth unlivable	9.1%	23.7%	23.6%	23.2%	18.8%	1.6%
5) Humans are severely abusing the environment	49.4%	32.7%	4.9%	6.6%	5.8%	0.6%
6)The earth has plenty of natural resources if we just learn how to develop them	20.8%	38.3%	12.6%	14.2%	12.9%	1.3%
7) Plants and animals have as much right as humans to exist	54.4%	25.8%	5.1%	8.6%	5.1%	0.8%
8) The balance of nature is strong enough to cope with the impacts of modern industrial nations	4.1%	13.7%	15.4%	28.0%	37.1%	1.6%
9) Despite our special abilities humans are still subject to the laws of nature	60.3%	29.4%	4.7%	2.7%	2.0%	1.0%

10) The so-called ecological crisis facing humankind has been greatly exaggerated	10.3%	20.9%	15.7%	21.1%	30.2%	1.9%
11) The earth is like a spaceship with very limited room and resources	30.6%	33.8%	11.2%	14.4%	8.7%	1.3%
12) Humans were meant to rule over the rest of nature	9.6%	15.3%	9.9%	21.0%	41.9%	2.3%
13) The balance of nature is very delicate and easily upset	41.2%	36.6%	7.0%	10.1%	3.7%	1.1%
14) Humans will eventually learn enough about how nature works to be able to control it	4.1%	16.9%	22.7%	26.7%	27.5%	1.8%
15) If things continue on their present course, we will soon experience a major ecological catastrophe	28.7%	32.0%	18.0%	10.5%	8.8%	1.6%

Appendix 4: Respondent Comment List

Table A5.1: Optional Respondent Comments to Survey

Asking for 100 or 25 dollars a year, I`ll throw in a box of unused .303 shells for the conservation officers to shoot the poor deer, or do they do something else to fight this problem??
Very informative survey, but it was very difficult to vote without knowing what the plan was that I was voting for. Results are lovely, but at what cost? As for the fear of CWD transmission from animals to humans, well, we can avoid that if we just stop
This is one of the better surveys that I have done lately. It covers a subject very important to me. Thank you very much.
It is to bad that you could not identify CWD before you kill or cull the animals
We have hunters in our family, so I am glad I learned about CWD and hope something is done to help.
humans have some capacity to understand and help natural systems rejuvenate from human interference Too often human interference causes unforseen consequences and humans are slow to see the effects and loath to change we need to understand the natural sys
I am very opposed to the government culling herds by flying over them and shooting them out of a helicopter.
I do not like the way the Gov. is trying to control the CWD. There is way too much waste of the deer meat..and it is inhumane the way the killing is being done...shooting them from helicopters.
I believe that the way the Alberta Government is dealing with CWD is wrong.
Let the hunters cull the herds if needed and monitor deer killed. Mass culling by Government is unnessary and expensive.
Requiring dear heads to be tested will not be effective because most people will not comply. Incentives are a good idea, but will probably only serve as a reward to those who would already comply. Controlling the spread of disease is invaluble. What if th
I sometimes feel that diseases need to run their (natural selection) courses. I think that : 1.Maintaining aproprait deer/elk populations through increased hunting levels is good stewardship. 2. Indescriminate killing by use of helicopters or any other ma
ITS VERY WELL KNOW THAT JUST BECUASE THERES TAX INCREASES DOES NOT MEAN THAT THE MONEY GOES INTO THE PROGRAM. THERE IS ALREADY BILLIONS THERE TO WORK WITH. I WOULD ALSO LIKE TO KNOW EXACTLY WHAT THE CAUSE OF THIS PROBLEM IS AND IF IT HAS BEEN CAUSED BY HU

IF WE CAN NOT LEARN HOW TO GIVE BACK TO NATURE, IT WILL JUST TAKE FROM US IN ONE WAY OR ANOTHER. WHAT WE PUT OUT IS WHAT WE WILL RECEIVE IN THE LONG RUN.
VERY INFORMATIVE. THANKS.
BAN GAME FARMS AND PRESSURE SASKATCHEWAN TO DO THE SAME AS WELL AS THE PRACTICE OF BAITING ANIMALS FOR HUNTING (SASK).
WOULD LIKE TO HAVE THE AFFECTED PROVINCES WORK TOGETHER TO MAKE A PLAN TO FIX THE PROBLEM , ALSO IF ANY US STATES ARE AFFECTED THAT BORDER US WE NEED TO SEE IF THEY ARE DOING ANYTHING ABOUT IT. IF THEIR IS NO COOPERATION FOR BOTH REASONS I STILL WE SHOU
THE ONLY PART THAT'S DIFFICULT IS THE FINANCIAL PART OF OUR TAXES. WE ALREADY PAY A HIGH TAX RATE NOW WITHOUT ADDING ANY ADDITIONAL PRESSURE. THERE HAS TO BE A BETTER WAY TO RAISE THE MONEY. WITH COST OF LIVING INCREASING ALL THE TIME, PEOPLE WILL BECO
Bottom line.... too much immigration in Alberta. Too many people. Different cultures and those from different areas of the world who come here to Alberta look upon our resources differently, I believe, for example, you will find that Asian immigration cor
I think the public needs a lot more info and education on our wonderful god"s land it"s a privlage to have it and not to destroy it.
this is the most relevant survey i have seen, thank you for getting opinions on important issues like this
Elk meat is delicious. I wish it were more available to us city slickers.
I think that there is no way humanly possible for this earth to sustain humans and animals indefinitely. That's why I'm looking forward to the day when we can live on a new earth - one without boundaries or sickness and one that will never wear out. Jesu
My husband hunts every year. If I were not a vegetarian I would have no problem eating the meat.
I think that Canada it,s self is well monitured compared to the rest of the world. Maybe we should be looking at what might be causing the CWD in southeast alberta instead of trying to control it, and let them pay for it. I live in a area that is not affe
Does this include National & Provincial Parks such as Banff, where protected animals have not been culled and natural selection is interfered with by humans?
Healthy wildlife populations are part of a healthy ecosystem. We should do what we can to minimize the spread of CWD. History teaches us that the Alberta government has a poor track

record for wildlife protection and wildlife management.
monies from the hunting fees should help,pay for the cwd expense. user fee or tax
We need to control the spread of the disease in deer and elk, or we will be faced with the same disastrous spread of the Pine Beetle in British Columbia. If we do nothing now, in 10 years time, we will be faced with a disaster of uncontrollable proportio
I will support wildlife and ecological programs when we give unborn babies the same protection that we give unborn wildlife such as whales and eagles.
it is a natural dissease the the government is being a bunch of idiots and blowing it all out of proportion. the government killing hundreds of animals at one time is criminal. instead of hiring sharp shoots to kill the animals from helicopters is crimi
I do not agree with hunting. Nature will find a balance if not interfered with by humans.
I was interested by the survey, but was sorry that there was not more attention paid to language. Too many reponses were not mutually exclusive, and some were not choices - an example, we are always approaching the limits of sustainability.
not at this time
Nature was fine until a few years ago when industry started polluting the environment. I think some of these diseases are the result of sour gas, drilling of oil etc.
This survey although interesting doesn't give enough details on good changes,
NO TAX INCREASES, PERIOD. ALSO, I DON'T GIVE HUMANS TOO MUCH CREDIT IN MANAGING THIS EARTH, I SUSPECT ONLY TIME WILL TELL.
I felt when answering some of these questions that there wasn't enough information provided, or I was not familiar enough with the topic and for me to make an informed decision or answer I think i would have to read more on the topic.
IT SEEMS THAT THE LAST QUESTION IS A POORLY VEILED GLOBAL WARMING QUESTION. BUNK!!
WHY NOT ELIMINATE RECREATIONAL HUNTING OF ALTOGETHER?? IT IS A STUPID PASTIME IN THIS DAY AND AGE.
These people are just sucking money out of the government. Get a real job!
The maps in the latter portion of the survey were wpvery small to read on my PDA. It would have helped to have the text seperate from the map.
government interference has often not been effective in many areas. push for education and accurate information to the masses. society pressure can often produce results
I found the spelling mistake (miatake) amusing. I felt that a "go-back" feature would have

made the survey easier to complete.
I expect the decision on how to act to be taken by educated government wokers. Surveys like this are pointless as I am incapable of making a truly informed decision about an issue like this as it is completely out of my area of expertise. This survey has
very interesting indeed let's conserve & protect wildlife
Many more animals are dying from gov't culls than ever would die naturally from CWD.
I believe the disease needs to be taken care of, but am over taxed already. How many jobs does a person have to take just to afford more taxes to cover more programs.
too long
Perhaps there should also be a survey on the decline of predator populations and transformation of habitat which is a factor in the rising deer and elk population
I think conservation of the environment and nature in Alberta is a joke, and a sad one. Alberta Conservation proudly advertises hunting on billboards; how does this conserve nature in any way? If the hunters hadn't killed all the deer, or farmers the pred
This feels like a survey whose results will be manipulated to give whatever results the government of Alberta desires to hear.
What we are doing to our enviroment, is disastrous on a global scale and there has to be action immediately if we are to avoid a total ecological breakdown
Quite fascinating. I learned something from your survey. It was intelligent and well thought out.
Stop the killing programs re: wolves
All things have to be treated as necessary.
LET THOSE WHO WANT TO HUNT, HUNT ! LOWER THE COST OF PERMITS AND GIVE THEM FREE PERMITS IF THEY BRING IN HEADS. IF THERE HEAD IS POSITIVE FOR CWD GIVE THE 2 FREE PERMITS!
was a very informative survey enjoyed this one
I don't hunt and I don't believe in hunting. I think nature would take it's course if mankind would stop interferring and trying to control everything in their environment. If we stopped trying to farm wild animals, abusing animals, and shooting wild an
the final ?'s seemed geared to the greens
A meaninful survey
It's an issue becuase it's there and if not addressed, what else will be left by the wayside. Time

to get things back in control
These programs should be paid for by the taxes the Alberta government already collects or through hunting licenses or park usage fees.
I support it
East Central Alberta has had a huge deer population increase since I lived there in the late 1960's - there should be culls over and above the CWD issue, unsure of Elk population.. As well there is Moose in the Battle River valley system as far east as Wa
Very timely and important issue
The Hunting Tag Fees are very high. I feel some of this money should be used to eradicate CWD. Now that we have computerized Hunting Regulations, Licences and Tags, the money saved for this system could be ear-marked for CWD eradication.
WE must do all we can to prevent CWD
I found the questions very leading to enviromentalist only way of thinking
Why has this not had any attention until now?
There are a surplus of deer and elk
Very informative
A lot of good information on CWD which is not common knowledge.
I disagreed with the $25/year special tax. It is not the $25 that is a problem. The cost of this program should just be included in the Provincial budget and we will pay for it that pay. I just do not approve a extra levies, for special purposes. If w
less taxes, work within our means people can't afford too many increases and will be opposed to it if they are charged too much
I beleive that humans will be able to eliminate the CWD in affected areas eventually and allow nature to repopulate these areas in time. It would have been benificial in this survey to have more information as to the actions being used now and what the Sa
Very informative and interesting. Good luck in your research
I don't think that CWD is a naturally occuring illness in animals.... I think they got it from livestock feed, just like the cattle contracting BSE. It is just one more example of man's greed and lack of respect for other living things, that allows him t
Because of the technical nature of this issue, I think it's better that experts decide what to do. Asking the general populace what's important is fraught with difficulties as we don't know all the facts, nor will we nor can we take the time to research

My understanding of the BSE is that it often comes from food. I would suspect that the infected deer somehow came accross some of the discarded feed for cattle. I believe this is also the same area of Alberta where Rats came accross the border as well. Pe
I feel that there should be more surveys like this, as it is important to know how people feel. Thank you for doing this survey
I've no problem with hunting to keep a balance, although we don't hunt or eat wild meat ourselves. However, at times man's 'keeping a balance' has negative repercussions. The elimination of natural predators such as wolves is an example. And Austrailia's
An important survey
The survey almost exclusively ignored the problems of ranched Deer and Elk. CWD and related diseases such as BSE are much more of a danger in ranched animals. But this is typical of the approach our government takes to "Sustainable Resource Development."
I think that the general public should be better informed on this issue.
curious how else this survey is being conducted? i know others who would have wonderful valuable input - farming, hunting, etc...
I believe CWD may spell the demise of our natural deer population if left unchecked, however, I do not support increased personal taxes to fund the research into this...the gov't can give away millions of dollars to large corporations so I believe they ca
Animal disease whether CWD, Anthrax or Tularemia to name a few, will almost certainly rise up from time to time. The cyclical nature of disease works as a natural population control and while humans may have some control, we will likely never achieve tot
I do not feel that Killing animals based on what some people speculate will happen, is an acceptable form of action. Imagin killing an entire family of healthy people because one of them was sick. It would be absolutly unacceptable, and no one in this cou
Man's abuse is wearing on earth's resources
Family members are avid hunters, and in the areas colored on your map. They have each year shot a diseased deer, which they reported to Fish and Wildlife.
In the question about charging $100 a year to control the spread of CWD, my reason for not agreeing was not given as an option. The reason I disagreed was because I believe the cost
Although I have had 3 car accidents involving wildlife in a 3-year time period (2 deer and 1 moose) I still strongly believe that humans and wildlife can co-exist. I just wish that there were ways to limit vehicle accidents involving wildlife. I hate to
Why must we have to pay for others mistakes all the time.
more quota hunts and longer game seasons would help to see that the harvests actually happen.

to many hunters do not fill their tags becuse of short seasons . Also many old time hunters still purchase tags with no intention of going out to hunt because th
I just feel that those who do not know anything about our wildlife should keep their mouths shut. Roads and hiking trails are a privilage not a right and we need to be more kinder to our animal families and not be so ready to kill them for doing what come
I would be willing to pay more than a $10 increase in taxes - but certainly not as much as $250/yr. The government should do as much as possible to protect the deer and elk - esp. research into what caused the CWD problem in the first place (probably som
Interesting survey -- do some Albertans still think we can blithely develop every energy resource and sacrifice every ecosystem and species for the sake of immediate profit?
I do Not trut he government on this issue or in fact any wildlife management issue
While CWD maybe a problem I dont feel that the survey looked at all the alternatives to the problem. Since I nor any member of my family is a hunter the risk to us is minimal, why should I as a tax payer support a program to reduce CDW when my exposure w
Managment of the natural environment has never been all that successful in my opinion however I think it's improving. Thinking humans control the natural environmentis absurd. People can definitley abuse the Earth and the the thing we can do - lessen t
I feel this was a very good survey , and am glad to see that this type of issue is being looked at
We need a strategy that will include more hunting and other ways to reduce numbers using the existing budgets. We have a lot of knowledge available withing this group of hunters and wildlife specialists. The use of different tactics in the several most in
It is important to educate; however humans are complacent in there true commitment to coexisting with nature. It is the governments responsibility to legislate strong policies that force all people to change there habits, even if this mean job losses, and
Question 28: some parts seemed intentionally was polarizing and were not specific enough to be answerable with the given choices. What does "If things continue along the present course" mean? Which "things", and what is the "course" they are on? Was th
I feel the culling of deer and elk opens up habitat for neighboring deer to move into and populate. It increases the possibility of CWD infected animals to move in from Sask.
I commend you for requesting the opinions of the Alberta populace.
It will be interesting to see the results.
As our greed for continued expansions; second homes; vacation properties; it is apparent that more than just the deer and elk populations are suffering and experiencing these and even newer diseases. Humans are actually suffering as well with the increas

taxes need more value for dollars spent a lot ofdollars are spent to only benefit the rich hoping they will trickle down and boost the welfare of all WRONG
You have opened up my eyes to this CWD issue,and I thank you for this information.
good survey with excellent questions
I do believe God made us "rulers" over the earth - but to take care of it as stewards, not to be "powerful, do what we want rulers"
With the surplus' being enjoyed by the Government of Alberta it is my opinion that they already have enough money to fund this project and so any tax increases should be kept to a minimum
CWD is likely to behave in the same manor as BSE and Kreutzvelds Jacobs disease (sp?) A program guiding game ranchers and hunters on how to protect themselves from consuming the brain and other neural matter should be considered to prevent the passing of
Excellent Survey. You have provided critical information to help people make choices.
hunting is part of our provincial heritage and even among non hunters such as ourselves we recognize the right to hunt and to maintain healthy wildlife populations.
There should be an expanded 'management program' to deal with CWD than what exists today.
There is no global warming, the arctic grew 30% last year. You want a carbon tax, we exhale carbon dioxide, soon you'll charge us to breathe out. Plants thrive on carbon dioxide, you put that in a greenhouse and the plants grow bigger. Carbon dioxide i
I learned something today. Thank You.
In regards to the idea of raising taxes to combat CWD, maybe the areas of direct interest should be taxed first as in hunters, elk farms, etc. rather than all tax payers.
I hope there is a livable world for my great- grandchildren; we are using up the Earth so quickly that I am concerned about our survival!
Any program Alberta enacts needs to be in conjunction with neighboring provinces and states otherwise it will have no lasting impact. Programs the rely on culling, should only be done by licensed hunters and not by government staff or contractors. Money
i think that it should be publicized more so that more people know about it, it can turn into a mad cow like disease we need to have a prevention plan instead of trying to deal with it if there is a big problem
I think there are other ways eg. vacines, and drugs I think the alberta government now that it is controled by some red neck farmer is trigger happy. I love seeing the animals in my yard.
Why were groups like AFGA, Pheasants Forever, Ducks Unlimited not part of the question if one belonged to a wildlife or conservation group? It is very prejudicial to include only the

"soft" conservation groups. I almost answered the question as a NO, and
It is good for humans to be reminded that we must take better care of and respect our wildlife.
our eco system is already a disaster because of usbecause we dont have the time everyone thinks we do
I am so please to be able to comment on a subject like this that I think is so important to all of us.
I am saddened when I see Canada and other Countries turn their back on what is happening to our earth when its right in front of their nose. Take for example the melting of the ice in the artic which is happening faster and faster. This never happened unt
I am uncertain if the plan would work because it would not totally wipe out the disease. I feel that there would be reinfection.
As i gaze out my window right at this moment I face an undisturbed field in the middle of a bustling city and am able to enjoy a mother deer and her offspring enjoying the field the way it was meant to be. Hunting and culling of these wonderful beasts by
I am happy to see that the Province is exploring these important issues.
so glad someone is concerned! Alberta has no laws made or enforced to protect our wilb animal resources only $ matters to our alta gov"t.. CAROL
The information could perhaps have been presented in a more concise and clear fashion
I have heard of this before(CWD) but not to the extent that I think I should have. I learned more in this survey than by any other means. I think that's sad
I worry about the health of my horses.
Survey is quite detailed for this format. CWD issue is somewhat similar to Alberta's "rat" policy. We should at least try to protect our borders.
I enjoyed your survey, more than most of the surveys I take.
I really like your surveys, which is why I agreed to do them. They're so intelligent.
The government of AB is a bunch of conservative "cowboys" who ride roughshod over anything or body that doesn't conform to its standards. I don't support government in culling any species.
Get a grip on it before it lands in domestic animal farms
I strongly believe that Elk and Deer domesticated farming is unacceptable. It appears that CWD is much more prevalent on these farms than when the animals are left in the wild.
It is important from my standpoint that wildlife in our province be preserved, as much as

possible, for future generations. If taxes are to be imposed to reduce or eliminate wildlife diseases, then they should be added to the licenses to hunters rather t
Many in my extended family hunt & it is an important issue
Would seem the info that was present here, tells that the C.W.D. is coming from the other province and States due to migratory habits of the animals. What are the othr officials doing about it?
CWD is a very high concer especially to prevent any spread and we need to at least contain it, if not erraticate it. As a side note, I feel the domestic "Ranching" or farming of wild species is wrong and we are just asking for troublr. By this I mean deer
I'm not sure the issue of CWD and radical environmentalism are to be equated as inclusion of the previous question intimates. As to the latter, there are natural forces at work that we are only marginally willing to admit but we humans are so arrogant as
Would like more information available (or to know where to get it) regarding why CWD is of concern to humans - are there health issues? Economic issues?
I'd like to know what the $250 would be used for...seems like quite a bit of money from every person in the province, what other options are there other than more money...how is what is available already being spent????
Some of the questions were obscure. An animal has to be infected for humans to get sick. Eating uninfected meat poses no problem. Also, with CJD, you have to eat the brains or spinal column. I assume it is the same with CWD.
Hunting in Alberta is unnecessary should be banned outside of game farms. It's economic (ie. hunting tourism) effect is negligible. Thus CWD in the wild would not effect the human population.
Mad Cow was/is a huge issue and CWD will become one if we do not 'nip it in the bud', as it were.
I'm glad to see that U of A is looking at this problem
Humans try to play God, we just need to let things be!
CWD is new to me - I lived in an area where we hunted in deer each year, but had I known about this I would have been less likely to consume the meat and would have begged my father not to hunt.
I feel it is important to reduce CWD or even eliminate it if possible. The cost now would be less than if we wait until this problem becomes uncontrollable.
It is time that our government offers incentives for tax payers to want to improve our environment and hold manufactures accountable for making sure they product ecological

friendly products from clothing to household goods to vehicles.
instead of tax money why not tap into the surplus created by oil revenue....which has had a great impact on wildlife & the environment...ie - the birds killed at the oilsands.
If the first case appeared in the USA then why not back track it to the source of the infection and search for a cure there, was it toxic waste, radiation, pesticides or genetic altering of species.
Humans take over areas previously inhabited by wildlife. If it were not inhaitble to wildlife it would not be inhabitable to humans. Humans must take responsible steps when inhabiting new areas to leave space for wildlife.
enjoyed the survey.
I think a better method of culling deer and elk populations is to stop eradicating carnivores such as coyotes, wolves, cougars, and bears.
Information and public education are important to increasing the understanding of this issue. I was not aware that CWD was as much of an issue in the wild.
I FEEL THAT THE GOVT. IN ALBERTA HAS ENOUGH MONEY/SURPLUS TO PUT INTO CWD RESEARCH WITHOUT HAVING TO RAISE TAXES TO PAY FOR IT.
Culling is something done by those who feel an anthropocentric sense of lordship over mother nature and our fellow creatures: our environmental toxins and wastes are the root cause of many many of these problems. Instead of shooting herbivores, how about
There is not enough data about neighboring provinces
crossbow hunting should be allowed in farm areas to control deerpopulations.
I am willing to pay more taxes to control CWD providing the program is sure to have a fairly high success rate. I however do not want my tax dollars wasted on a program that will do very lit to help.
I feel the population of the planet, as well as Canada, is over reaching what nature can provide within our current political, and economic cultures. The current way of thinking in Canada is wrong concerning immigration, we don't need to keep growing our
I don't think that everything can be completely controlled by humans, but I do believe that we should take precautions to protect ourselves (if it is ever found that CWD is transmittable to humans) as well as our environment (which includes wildlife) as w
On long lists(i.e. more than 15 items) put the headings for the choices, in the middle and or the end.
Some of the questions are a little misleading. In a sense, I felt like I was being led to suggest I was a "tree hugger" but the reality is, I consider myself more of a realist. We are highly

dependent upon this planet for our very survival, and the forc
living in alberta can be a frustrating and difficult task if you care about the environment at all. it seems that all anyone cares about here is the profits they can make, and if anything, ANYTHING, comes between them and their money then it is considere
If we are going to be unsuccessful at controlling CWD in the long term because of its spread in other jurisdictions and this is going to be an war without end then it should be allowed to take its course. Let the hunters and their guides and the Elk Ranch
I voted no to the referndum because i feel that the the various direct and indirect taxes that we pay in Aberta ranges between 30% to 40 % of our paycheck.
Although I live in Edmonton, I own farmland which according to your maps may be in a CWD area (range 7 in the MD of Provost) so I am more affected than my residence suggests. I do not want CWD to become active in the ungulate population near my farm. Al
Understanding of nature is an ongoing process and ideological politics should be left out.
Alta. gov't. should implement a longer hunting season, to help curb the CWD spread, also in these economic times the price of hunting tags and certificates should be lowered, to encourage more people to hunt
I have noticed CWD information regarding voluntary and mandatory head salvaging for hunters. I am not a hunter, but I appreciate that the information is so easily available for the public. I believe we need to do a lot more research on the effects of CWD
people need to lurn to recycle as a way of life and survival not as statement of their place in society.Learn to live in harmony with nature instead of always fighting to try to control it. There is a need and a place for every living thing eradicate one
go green
Heard someone from Alberta gov. talk about the CWD issue 4 years ago and have followed the issue since then.
Nature has a way of controlling its own over population. But when diseases cross over they could be disasterous for species that cannot develop a resistance in time. Controlling is more desireable. Good hard questions for me to mull over. Thanks.
The referendum questions were totally idiotic. They assume that your experts could predict what will happen to the levels of CWD 10 years into the future. This is as bad as the Grizzly "experts" predicting the demise of the grizzly in Albert by looking fo
what do you expect when man is constantly pushing the wildlife out of there habitat. Maybe if we reduced the prisons, and eliminate the prisoners, we could have lots more available for sustainable life. eg people,plants and animals can all co-exist.

If there was way to study and cure CWD without harming the animals then I agree with it.
I liked it I learned somthing thanks.
More proactive educational influence on the young to ensure a future of ecological balance between nature and humans
I believe those who hunt shoud ensure meat is utilized to the utmost including the hides etc.
I don't like the wording of "Humans were meant to control nature." I prefer the idea of stewardship.
I am extremly concerned about our environment and I strongly believe that animals are an important part of our environment. I donate $30.00 a month to Nature Conservacy, to help by lands for wildlife. I know that $30.00 a month is not a very big amount, b
I strongly oppose hunting and strongly question how accurate the populations of any wildlife species really is. There is alot of illegal hunting, and poaching that takes place south of Calgary. It sickens me.
I believe that "unsure" and "dont know" are close enough to the same thing that they make that part of the survey a little confusing
We need make sure there is a balance between develoment, human inhabitants and nature
If CWD becomes a major problem, then direct intervention is necessary to erradicate CWD, no matter the cost. Human lives is a top priority.
I primarily object to a tax levy to deal with CWD because I don't trust Government to use it properly, efficiently and as intended. Tire tax and electronic tax are there so the government can fraudulently claim they are doing something meaningful but they
After waching programs on how our animals are treated and fed I choose to eat very little meat.
This survey was very long.
Inreference to last set of questions; 'rule over' does not not or should be allowed to mean or equate to 'rape pillage, or abuse'!! rather to cultivate, manage, enhance, reclaim,recycle, utilize most effeciently. Inteligence and responsable approach woul
It is important that we find the cause of CWD so that we may be certain that it will not pose further risk to humans, wildlife and other vegetation.
this reminds me of Alberta's war on rats, in that the source is from Sask. Obviously exterminating the deer population is not feasable but this area has very few natural predators, wolves are out of the question but mountain lions might work in the South
I feel the last culling of the deer was inhumain,cruel wastefull putting carcasses in the pits hanging deer from the helicopter still alive et6c alot of rules were broken and some one needs

to answer for it .
I dont think mass culls are necessary! I think responsible hunting is the best way to maintain healthy populations and prevent mass culls! If population is regulated, it would prevent spread of disease caused by overpopulation and the environment would be
I would like to see more information provided on CWD to the public. My limited knowledge on the subject made it difficult to make an informed decision on best control practices and potential risks.
Wildlife populations vary geographically and our impact on them is proportional to their abundance and range. elk and deer are expanding their numbers in response to mild winters but are susceptible to changes in the carrying capacity of their home range
The phone solicitor said it would only take a few minutes, but i wish they were more accurate in there initial presentation. Terry
I would support culling but Alberta wastes plenty on other areas - so a reallocation of existing funds should be possible rather than a tax increase
due to gun regulations the wildlife populations have exploded,,, with milder winters and later frosts the ruts have been later as well,,, by increaing hunting seasons and allowing those that have been avid outdoors people through out thier lives (as myse
too long. better to have a simple question - would you support a tax increase to ameliorate cwd?
With only 53 cases of CWD out of 20000 cases of culled deer, the government needs to wake up and realize that culling is destroying deer and elk populations unnessicarily. They need to wake up and think outside the box.
I feel that this problem is not as complicated as it seems Goernments should spend some time doing research on the food quality that these animals are eating and they will find that many places are very low in copper and thus affecting the situation. Se
I am in favor of a slight tax increase to combat CWD, but I feel the hunters should carry the majority of the cost.
I think that if all animals are not tested in all places this is a waste of time this has been in deer for many years and did not just show up over night there has to be more done to under stand cwd before any more calls are done
I am glad you asking the opinion of people like myself and felt the survey was well planned.
i disagree with mass slaughter of deer. hunters should be able to get extra tags and send heads in. Less hunters due higher price of licence, and gun registersy, that what lessened hunters and alot quit, because of this bs.
I would be absolutely delighted to learn that the Alberta government is taking the

environmental concerns around the oil industry and the tar sands as seriously as it appears to be taking concerns about the spread of CWD.
Stop game farms DO NOT contain our wildlife. In the wild mother nature takes care of it self being disease or sickness.
Interesting questions that everyone should contemplate. Its definetly time for a world government or order that has the entire planets well being as a priority. I really don't think that people have the ability to work together and organize the world, st
Did you mix up the potential tax increases and resulting disease spread? Apparently increasing taxes $100 per year to fund the program is less effective than $10 increases!
I think a study like this is LONG over due, however I would like more information about what you plan to achieve with this study.
i think we have an excess in tax money that the gov't is exploiting and wasting that there is no need for me to pay more taxes for other causes (no matter how important) that is why i said no
what is sask. doing about the spread of cwd
There has been a drastic reduction in the number of hunters in recent years because of the introduction of asinine gun control regulation of hunting firearms and the exhorbitant increase in hunting license fees. Cutting license fees would increase the nu
I thought that CWD was actually more widespread than you indicate.
You seem to be looking for opinions that are not necessarily informed. There was a great degree of subjectivity in the survey.
The very first confirmed case of CWD was discovered less than a mile from my farm at Acadia Valley. This is a very sensitive issue for all. The control measures and culling programs undertaken , I hope, will contain this disease from spreading. I think we
Interesting survey, and I appreciate the knowledge I have learned from this survey. I really hope many "humans" will answer this survey, so this is beneficial to those collecting data, so this can become information for us as a society to use. Happy New
Some questions require a more detailed answer than the choices given in the survey. For these questions, the best fit answer chosen does not fully answer the question.
What is going on environmentally in the areas where these diseases are found most often?
The, funding for the program should come from other sources rather than general taxation. People who hunt, farm and otherwise gain from the deer & elk population should have user fees increased and other less necessary funding by the prov. gov't dept res
Ask ATCO or some other billing company to advertise your e-mail survey address, and make sure the public and government gets the results

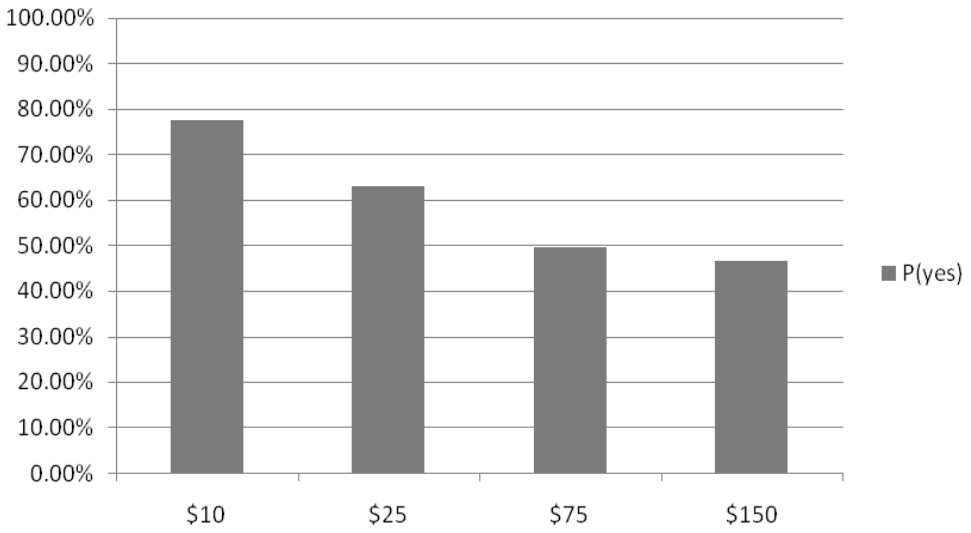
Appendix 5: Pilot Test Results and Discussion

A5.1 Pilot 1

A critical component of referendum contingent valuation experiments is an appropriate bid range. The ideal bid range will capture all respondents' maximum willingness to pay values while maintaining efficiency by not using an unnecessarily wide range (Alberini and Carson, 1993). Achieving this balance was difficult for this study; due to the absence of prior valuation studies on the containment of disease in wildlife, very little was known in advance regarding Albertans' willingness to pay (WTP) to control CWD. Given the importance of using suitable bid levels, it was deemed appropriate to conduct a pilot experiment prior to the full scale survey. The principal objective of the pilot was assessing if the bid range was reasonable.

The 140 respondents in pilot 1 faced bid values in the form of annual tax increases of $10, $25, $75 and $150. Focus group discussions suggested this range to be appropriate. The goal was to have nearly all respondents vote yes to a management program with one of the eight possible outcomes at the lowest value, and nearly all vote no at the highest. A frequency analysis of respondent votes performed in SPSS revealed the highest bid value to be inadequate, as a large proportion of respondents voted yes to management programs with the maximum cost of $150. Out of all eight possible outcome scenarios, 42% of respondents who randomly saw the $150 bid level supported the program. The high percentage of yes votes was not exclusive to the best outcomes; a number of relatively poor outcomes including medium spread-medium prevalence and high spread-low prevalence had notably high percentages. The frequency analysis was performed after yea-sayers were removed, and those respondents who voted yes but indicated substantial uncertainty and had their votes recorded as no. The wide acceptance at the highest level indicated a strong potential for ceiling bias. Vote frequency can be seen in figure A5.1.

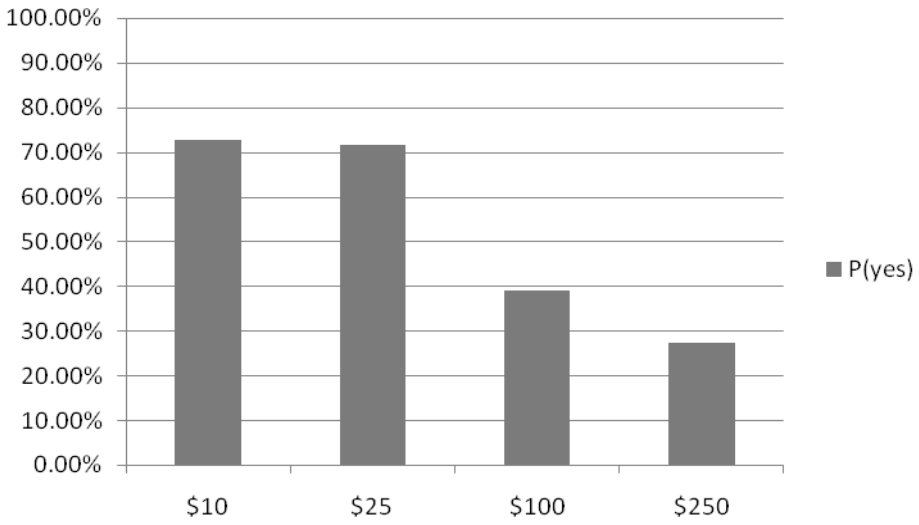
Figure A5.1: Probability of yes vote in Pilot 1 for all scenarios by bid level



A5.2 Pilot 2 Results

Due to the high proportion of yes votes at the maximum bid level in Pilot 1, new bid levels of $10, $25, $100 and $250 were adopted. To ensure they were appropriate, a second pilot experiment was run. A frequency analysis of the referendum votes showed the new bid range to be far better suited than that used in Pilot 1. Including all 8 possible program outcomes, the probability of respondents who saw a $250 bid value voting yes was 27%. The probability dropped to near zero for the worst outcomes in terms of CWD impact. Please see figure 4.8 for vote frequency for all outcomes at the four bid levels.

Figure 4.8: Probability of yes vote in Pilot 2 for all scenarios by bid level



As the new bid range was found to be more appropriate, and no other issues were found with the survey, the experiment proceeded with no changes made to the survey instrument. This meant that results from Pilot 2 could be combined with and used in the full survey analysis. To confirm this, a homogeneity test was run to check if it was acceptable to pool the two groups. The results of a chi-squared test did not reject a homogeneity restriction and results from Pilot 2 were combined with the full survey for all further analysis.

Appendix 6: Comparison of Provincial Survey Sample and Alberta Demographic Characteristics

Table A6.1 Comparison of Sample and Alberta demographic characteristics

	Alberta Population	Provincial Survey Sample
Age:		
20-24 / 18-24	5.62%	3.70%
25-44	21.93%	37.40%
45-54	11.46%	27.40%
55-64	7.23%	21.80%
65+	7.90%	9.60%
%Male / %Female	50.5% / 49.5%	46.1% / 53.9%
Education:		
High school diploma or less	49.63%	43.90%
Technical school graduate	10.89%	13.00%
University/college graduate	34.22%	31.40%
Some graduate school	n/a	2.20%
Graduate degree	5.26%	9.10%
Children in household < 18 years:		
0	55.94%	66.50%
1	18.59%	13.90%
2	17.20%	13.40%
3+	8.28%	6.30%
Household Income:		
< $10000	5.06%	1.20%
$10000-$14999	4.36%	1.80%
$15000-$19999	5.85%	1.70%

$20000-$24999	5.06%	2.00%
$25000-$29999	5.40%	2.30%
$30000-$34999	5.56%	3.60%
$35000-$39999	5.42%	3.90%
$40000-$44999	5.13%	3.10%
$45000-$49999	4.79%	3.70%
$50000-$54999	8.80%	4.00%
$55000-$59999	7.90%	3.80%
$60000-$69999	6.82%	6.80%
$70000-$79999	5.75%	6.70%
$80000-$99999	4.73%	12.30%
$100000-$119999	8.25%	9.60%
$120000-$149999	4.52%	9.10%
>$149999	6.59%	7.70%
Decline to Answer	-	16.70%

Table A6.2: Comparison of non-respondent and affected area respondent demographic characteristics.

	Non-respondents	Affected Area
Do you live in a:		
Rural Setting (<= 999)	40.2%	40.2%
Town or Village (1000-19,999)	29.6%	34.8%
Small Urban Setting (20,000-99,999)	22.0%	25.0%
Large Urban Setting (>=100,000)	6.4%	n/a
Don't know	1.8%	n/a
Are you a member of any wildlife or conservation related organizations		
Yes	9.2%	14.7%
No	90.4%	85.3%
Don't know	0.3%	0.0%
Have you ever eaten elk or deer meat		
Yes	78.1%	93.1%
No	21.6%	6.9%
Don't know	0.3%	0.0%
Have you eaten elk or deer meat in the last year		
Yes	48.3%	48.0 %
No	51.2%	52.0%

Don't know	0.5%	0.0%
Have you or a member of your immediate family hunted in the past two years		
Yes	35.7%	42.2%
No	63.2%	57.4%
Don't know	1.1%	0.5%

Appendix 7: Results of Binary Logit Regressions Done by Individual Outcomes Using First Choice Data.

Table A7.1: Results and WTP estimates of CWD control program outcomes found through binary logit models estimated separately by outcome on the first choice events with cost as the sole explanatory variable. N = 1384.

Low Spread / Low Prevalence			**Medium Spread / Medium Prevalence**		
Constant***	1.3346	**WTP:**	Constant***	1.0524	**WTP:**
	(0.1847)	$216.36		(0.2342)	$66.01
COST***	-0.0062		COST**	-0.0159	
	(0.0021)			(0.0069)	
Low Spread / Med Prevalence			**Medium Spread / High Prevalence**		
Constant***	1.3026	**WTP:**	Constant***	1.4910	**WTP:**
	(0.1357)	$67.24		(0.2759)	$57.36
COST***	-0.0194		COST***	-0.0260	
	(0.0011)			(0.0075)	
Low Spread / High Prevalence			**High Spread / Low Prevalence**		
Constant***	1.1613	**WTP:**	Constant***	1.5869	**WTP:**
	(0.0470)	$203.18		(0.5049)	$76.76
COST**	-0.0057		COST***	-0.0207	
	(0.0012)			(0.0078)	
Medium Spread / Low Prevalence			**High Spread / Medium Prevalence**		
Constant***	1.2625	**WTP:**	Constant***	1.3213	**WTP:**
	(0.2785)	$69.51		(0.5029)	$56.41
COST***	-0.0182		COST***	-0.0234	
	(0.0075)			(0.0111)	

Full Sample:			*Statistically significant at the 90% level
Constant***	1.1704	**WTP:**	**Statistically significant at the 95% level
	(0.0738)	$117.41	***Statistically significant at the 99% level
COST***	-0.00997		
	(0.0013)		